**DEPARTMENT OF LABOR**

**Occupational Safety and Health Administration**

**29 CFR Parts 1910 and 1926**

**[Docket No. S–215]**

**RIN 1218–AB67**

## Electric Power Generation, Transmission, and Distribution; Electrical Protective Equipment

**AGENCY:** Occupational Safety and Health Administration (OSHA), Labor.

**ACTION:** Proposed rule.

**SUMMARY:** OSHA is proposing to update the existing standard for the construction of electric power transmission and distribution installations and make it consistent with the more recently promulgated general industry standard addressing the maintenance and repair of electric power generation, transmission, and distribution lines and equipment. The proposal also makes some miscellaneous changes to both standards, including adding provisions related to host employers and contractors, flame resistant clothing, and training, and updates the construction standard for electrical protective equipment, makes it consistent with the corresponding general industry standard, and makes it applicable to construction generally.

The existing rules for this type of work were issued in 1971. They are out of date and are not consistent with the more recent, corresponding rules for the operation and maintenance of electric power transmission and distribution systems. The revised standard would include requirements relating to enclosed spaces, working near energized parts, grounding for employee protection, work on underground and overhead installations, work in substations, and other special conditions and equipment unique to the transmission and distribution of electric energy.

OSHA is also proposing a new standard on electrical protective equipment for the construction industry. The current standards for the design of electrical protective equipment, which apply only to electric power transmission and distribution work, adopt several national consensus standards by reference. The new standard would replace the incorporation of these out-of-date consensus standards with a set of performance-oriented requirements that is consistent with the latest revisions of these consensus standards and with the corresponding standard for general industry. Additionally, OSHA is proposing new requirements for the safe use and care of electrical protective equipment to complement the equipment design provisions.

In addition, OSHA is proposing changes to the two corresponding general industry standards. These changes address: Class 00 rubber insulating gloves, electrical protective equipment made from materials other than rubber, training for electric power generation, transmission, and distribution workers, host-contractor responsibilities, job briefings, fall protection (including a requirement that employees in aerial lifts use harnesses), insulation and working position of employees working on or near live parts, protective clothing, minimum approach distances, deenergizing transmission and distribution lines and equipment, protective grounding, operating mechanical equipment near overhead power lines, and working in manholes and vaults. These changes would ensure that employers, where appropriate, face consistent requirements for work performed under the construction and general industry standards and would further protect employees performing electrical work covered under the general industry standards. The proposal would also update references to consensus standards in §§ 1910.137 and 1910.269 and would add new appendices to help employers comply with provisions on protective clothing and the inspection of work positioning equipment.

OSHA is also proposing to revise the general industry standard for foot protection. This standard has substantial application to employers performing work on electric power transmission and distribution installations, but that applies to employers in other industries as well. The proposal would remove the requirement for employees to wear protective footwear as protection against electric shock.

**DATES:** *Informal public hearing.* OSHA will hold an informal public hearing in Washington, DC, beginning December 6, 2005. The hearing will commence at 10 a.m. on the first day, and at 9 a.m. on the second and subsequent days, which will be scheduled, if necessary.

*Comments.* Comments must be submitted (postmarked or sent) by October 13, 2005.

*Notices of intention to appear.* Parties who intend to present testimony at the informal public hearing must notify OSHA in writing of their intention to do so no later than August 15, 2005.

*Hearing testimony and documentary evidence.* Parties who request more than 10 minutes for their presentations at the informal public hearing and parties who will submit documentary evidence at the hearing must submit the full text of their testimony and all documentary evidence postmarked no later than November 3, 2005.

**ADDRESSES:** You may submit written comments, notices of intention to appear, hearing testimony, and documentary evidence—identified by docket number (S–215) or RIN number (1218–AB67)—by any of the following methods:

- Federal eRulemaking Portal: *http://www.regulations.gov.* Follow the instructions for submitting comments.
- OSHA Web site: *http://dockets.osha.gov/.* Follow the instructions for submitting comments on OSHA's Web page.
- Fax: If your written comments are 10 pages or fewer, you may fax them to the OSHA Docket Office at (202) 693–1648.
- Regular mail, express delivery, hand delivery and courier service: Submit three copies to the OSHA Docket Office, Docket No. S–215, U.S. Department of Labor, 200 Constitution Avenue, NW., Room N2625, Washington, DC 20210; telephone (202) 693–2350. (OSHA's TTY number is (877) 889–5627.) OSHA Docket Office hours of operation are 8:15 a.m. to 4:45 p.m., E.S.T.

*Instructions:* All submissions received must include the agency name and docket number or Regulatory Information Number (RIN) for this rulemaking. All comments received will be posted without change to *http://dockets.osha.gov/*, including any personal information provided. For detailed instructions on submitting comments and additional information on the rulemaking process, see the ''Public Participation'' heading of the **SUPPLEMENTARY INFORMATION** section of this document.

*Docket:* For access to the docket to read comments and background documents that can be posted go to *http://dockets.osha.gov/.* Written comments received, notices of intention to appear, and all other material related to the development of this proposed standard will be available for inspection and copying in the public record in the Docket Office, Room N2439, at the address listed previously.

*Hearing.* The hearing will be held in the auditorium of the U.S. Department of Labor, 200 Constitution Avenue, NW., Washington, DC.

**FOR FURTHER INFORMATION CONTACT:** *General information and press inquiries:*

Mr. Kevin Ropp, Director, Office of Communications, Room N3647, OSHA, U.S. Department of Labor, 200 Constitution Avenue, NW., Washington, DC 20210; telephone (202) 693–1999.

*Technical information:* Mr. David Wallis, Director, Office of Engineering Safety, Room N3609, OSHA, U.S. Department of Labor, 200 Constitution Avenue, NW., Washington, DC 20210; telephone (202) 693–2277 or fax (202) 693–1663.

*Hearings:* Ms. Veneta Chatmon, OSHA Office of Communications, Occupational Safety and Health Administration, Room N3647; 200 Constitution Avenue, NW., Washington, DC 20210, telephone: (202) 693–1999.

For additional copies of this **Federal Register** notice, contact OSHA, Office of Publications, U.S. Department of Labor, Room N3101, 200 Constitution Avenue, NW., Washington, DC, 20210; telephone (202) 693–1888. Electronic copies of this **Federal Register** notice, as well as news releases and other relevant documents, are available at OSHA's Web page on the Internet at *http://www.osha.gov.*

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## I. Background

*A. Acronyms*

The following acronyms have been used throughout this document:

AED Automated external defibrillator
ALJ Administrative law judge
ANSI American National Standards Institute
ASTM American Society for Testing and Materials
BLS Bureau of Labor Statistics
CFOI Census of Fatal Occupational Injuries
CPR Cardiopulmonary resuscitation
EEI Edison Electric Institute
EPRI Electric Power Research Institute
FRA Flame-resistant apparel
FTE Full-Time Equivalent [Employee]
IBEW International Brotherhood of Electrical Workers
IEEE Institute of Electrical and Electronic Engineers
IMIS OSHA's Integrated Management Information System
IRFA Initial Regulatory Flexibility Analysis
NAICS North American Industry Classification System
NEPA National Environmental Policy Act of 1969
NESC National Electrical Safety Code
NFPA National Fire Protection Association
NIOSH National Institute for Occupational Safety and Health
OIRA Office of Information and Regulatory Affairs
OMB Office of Management and Budget
OSH Act (or simply "the Act") Occupational Safety and Health Act of 1970
OSHA Occupational Safety and Health Administration
OSHRC Occupational Safety and Health Review Commission
PRIA Preliminary Regulatory Impact Analysis
RIN Regulatory information number
SBA Small Business Administration
SBAR Small Business Advocacy Review Panel
SBREFA Small Business Regulatory Enforcement Fairness Act
SER small entity representative
SIC Standard Industrial Classification
WCRI Worker Compensation Research Institute

*B. Need for Rule*

Employees maintaining or constructing electric power transmission or distribution installations are not adequately protected by current OSHA standards, though these employees face far greater electrical hazards than those faced by other workers. The voltages involved are generally much higher than voltages encountered in other types of work, and a large part of electric power transmission and distribution work exposes employees to energized parts of the power system.

Employees performing work involving electric power generation, transmission, and distribution are exposed to a variety of significant hazards, such as fall, electric shock, and burn hazards, that can and do cause serious injury and death. As detailed below, OSHA estimates that, on average, 444 serious injuries and 74 fatalities occur annually among these workers.

Although some of these incidents may have been prevented with better compliance with existing safety standards, research and analyses conducted by OSHA have found that many preventable injuries and fatalities would continue to occur even if full compliance with the existing standards were achieved. Without counting incidents that would potentially have been prevented with compliance with existing standards, an estimated additional 116 injuries and 19 fatalities would be prevented through full compliance with the proposed standards.

Additional benefits associated with this rulemaking involve providing updated, clear, and consistent safety standards regarding electric power generation, transmission, and distribution work. The existing standard for the construction of electric power transmission and distribution lines and equipment is contained in Subpart V of OSHA's construction standards (29 CFR part 1926). This standard was promulgated on November 23, 1972, over 30 years ago (37 FR 24880). Some of the technology involved in electric power transmission and distribution work has changed since then, and the current standard does not reflect those changes. For example, the method of determining minimum approach distances has become more exact since 1972, and the minimum approach distances given in existing § 1926.950(c)(1) are not based on the latest methodology. The minimum approach distances in this proposal are more protective as well as more technologically sound. Additionally, parts of Subpart V need clarification. For example, in existing Subpart V, there are three different requirements relating to the use of mechanical equipment near overhead lines: §§ 1926.952(c)(2) [1] and 1926.955(a)(5) [2] and (a)(6).[3] These provisions apply

[1] This requirement reads as follows:

(2) With the exception of equipment certified for work on the proper voltage, mechanical equipment shall not be operator closer to any energized line or equipment than the clearances set forth in § 1926.950(c) unless:

(i) An insulated barrier is installed between the energized part and the mechanical equipment, or

(ii) The mechanical equipment is grounded, or

(iii) The mechanical equipment is insulated, or

(iv) The mechanical equipment is considered as energized.

[2] This requirement reads as follows:

(5)(i) When setting, moving, or removing poles using cranes, derricks, gin poles, A-frames, or other mechanized equipment near energized lines or equipment, precautions shall be taken to avoid contact with energized lines or equipment, except in bare-hand live-line work, or where barriers or protective devices are used.

(ii) Equipment and machinery operating adjacent to energized lines or equipment shall comply with § 1926.952(c)(2).

[3] This requirement reads as follows:

(6)(i) Unless using suitable protective equipment for the voltage involved, employees standing on the

Continued

different requirements to these operations depending on whether or not the mechanical equipment involved is lifting equipment and on whether or not work is being performed on overhead lines. Two different United States Courts of Appeals found these regulations to be confusing even though they accepted OSHA's interpretation regarding their application (*Wisconsin Electric Power Co.* v. *OSHRC,* 567 F.2d 735 (7th Cir. 1977); *Pennsylvania Power & Light Co.* v. *OSHRC,* 737 F.2d 350 (3d Cir. 1984)). In fact, the majority in the Wisconsin Electric decision noted that ''[r]evision of the regulations by any competent draftsman would greatly improve their clarity'' (*Wisconsin Electric,* 567 F.2d at 738).

Even the newer general industry standards on the operation and maintenance of electric power generation, transmission, and distribution installations (29 CFR 1910.269) and electrical protective equipment (29 CFR 1910.137) are not completely consistent with the latest advances in technology represented by updated consensus standards covering this type of work and equipment.

OSHA has different standards covering construction work on electric power transmission and distribution systems and general industry work on the same systems. In most instances, the work practices used by employees to perform construction or general industry work on these systems are the same. The application of OSHA's construction or general industry standards to a particular job depends upon whether the employer is altering the system (construction work) or maintaining the system (general industry work). For example, employers changing a cutout (disconnect switch) on a transmission and distribution system would be performing construction work if they were upgrading the cutout, but general industry work if they were simply replacing the cutout with the same model.

Since the work practices used by the employees would most likely be identical, the applicable OSHA standards should be identical. OSHA's existing requirements are not, however. Conceivably, for work involving two or more cutouts, different and conflicting OSHA standards might apply. The inconsistencies between the two standards create difficulties for employers attempting to develop appropriate work practices for their employees. For this reason, employers and employees have told OSHA that it should make the two standards identical. This proposal does so.

ground shall avoid contacting equipment or machinery working adjacent to energized lines or equipment.

(ii) Lifting equipment shall be bonded to an effective ground or it shall be considered energized and barricaded when utilized near energized equipment or lines.

### *C. Accident Data*

OSHA has looked to several sources for information on accidents in the electric utility industry in preparing this proposed rule. Besides OSHA's own accident investigation files, statistics on injuries are compiled by the Edison Electric Institute (EEI) and by the International Brotherhood of Electrical Workers (IBEW). Additionally, the Bureau of Labor Statistics (BLS) publishes such accident data as incidence rates for total cases, lost workday cases, and lost workdays. The National Institute for Occupational Safety and Health (NIOSH) publishes accident data as part of its Fatality Assessment and Control Evaluation Program.

Analyses of accident data for electric power transmission and distribution workers can be found in the following documents, which (like all exhibits) are available for inspection and copying in Docket S–215 in the Docket Office:

(1) ''Preparation of an Economic Impact Study for the Proposed OSHA Regulation Covering Electric Power Generation, Transmission, and Distribution,'' June 1986, Eastern Research Group, Section 4.

(2) ''Assessment of the Benefits of the Proposed Standard on Electric Power Generation, Transmission, and Distribution Coding Results and Analysis,'' October 5, 1990, Eastern Research Group.

(3) ''Analytical Support and Data Gathering for a Preliminary Economic Analysis for Proposed Standards for Work on Electric Power Generation, Transmission, and Distribution Lines and Equipment (29 CFR 1910.269 and 29 CFR 1926—Subpart V),'' 2005, CONSAD Research Corp., Chapter 4.

To develop estimates of the potential benefits associated with this proposal, CONSAD Corp., under contract to OSHA, researched and reviewed potential sources of useful data. CONSAD, in consultation with the Agency, determined that the most reliable data sources for this purpose included OSHA's Integrated Management Information System, and the Census of Fatal Occupational Injuries developed by the BLS.

From these sources, CONSAD identified and analyzed injuries and fatalities that would be addressed by this proposal. A description of the methodological approach used for analyzing these data is included in the final report submitted to OSHA from CONSAD. CONSAD's analysis found that an average of 74 fatalities and 25 injuries involving circumstances directly addressed by the existing or proposed standards are recorded annually in the relevant databases. These accidents include cases involving electric shock, burns from electric arcs, and falls, which are the predominant types of accidents occurring in electric power generation, transmission, and distribution work.

### *D. Significant Risk*

OSHA must show that the hazards the Agency addresses in a safety regulation present significant risks to employees. OSHA has generally considered an excess risk of 1 death per 1000 employees over a 45-year working lifetime as clearly representing a significant risk. *Industrial Union Dept.* v. *American Petroleum Institute (Benzene),* 448 U.S. 607, 655 (1980); *International Union* v. *Pendergrass (Formaldehyde),* 878 F.2d 389, 392–93 (D.C. Cir. 1989); *Building and Construction Trades Dept., AFL–CIO* v. *Brock (Asbestos),* 838 F.2d 1258, 1264–65 (D.C. Cir. 1988). As part of the regulatory analyses for this standard, OSHA has determined the population at risk, the occupations presenting major risks, and the incidence and severity of injuries attributable to the failure to follow the rules established in the proposed standard. In keeping with the purpose of safety standards to prevent accidental injury and death, OSHA has estimated the number of accidents that would be prevented by the new rule.

Electricity has long been recognized as a serious workplace hazard exposing employees to dangers such as electric shock, electrocution, electric arcs, fires, and explosions. The other hazards this rule addresses, namely, falls and being struck by, struck against, or caught between objects, are also widely recognized. The 227,683 employees performing work covered by the proposed standards experience an average of 444 injuries and 74 fatalities each year.[4] Over a 45-year working lifetime, more than 14 of every 1000 of these employees [5] will die from hazards

[4] For a detailed explanation of the number of employees covered by the proposal and the number of injuries and fatalities experienced by these workers, see Section V, Preliminary Regulatory Impact Analysis and Initial Regulatory Flexibility Analysis, later in this preamble.

[5] The number of fatalities expected to occur in 45 years is 74 fatalities × 45, or 3330. Thus, 14.6 employees in 1000 covered by the proposal ((3330 fatalities/227,683 employees) × 1000) will die from job-related hazards.

posed by their work. As detailed in Section V, Preliminary Regulatory Impact Analysis and Initial Regulatory Flexibility Analysis, later in this preamble, the Agency estimates that the proposed rule will prevent 116 injuries and 19 deaths each year. Accordingly, OSHA has preliminarily determined that hazards faced by employees performing construction or maintenance work on electric power generation, transmission, and distribution installations pose a significant risk of injury or death to those employees, and that this proposed rule would substantially reduce that risk and would be reasonably necessary to provide protection from these hazards.

**II. Development of Proposal**

*A. Present OSHA Standards*

OSHA adopted standards applying to the construction of power transmission and distribution lines and equipment in 1972 (Subpart V of Part 1926). OSHA defines the term ''construction work'' in § 1910.12 as ''work for construction, alteration, and/or repair, including painting and decorating.'' The term ''construction'' is broadly defined in § 1910.12(d) and § 1926.950(a)(1) to include alteration, conversion, and improvement of electric power transmission lines and equipment, as well as the original installation of the lines and equipment. However, Subpart V does not apply to the operation or maintenance of transmission or distribution installations.

On January 31, 1994, OSHA adopted rules for the operation and maintenance of electric power generation, transmission, and distribution lines and equipment, § 1910.269. This standard was intended as a companion standard to Subpart V of the construction standards to address areas where Subpart V did not apply. The new standard was also based on the latest technology and national consensus standards.

OSHA revised its electrical protective equipment standard in § 1910.137 at the same time § 1910.269 was issued. The revision of § 1910.137 eliminated the incorporation by reference of national consensus standards relating to rubber insulating equipment and replaced it with performance-oriented rules for the design, manufacture, and safe care and use of electrical protective equipment.

Other OSHA standards also relate to electric power generation, transmission, and distribution work. The permit-required confined space standard in § 1910.146 applies to entry into certain confined spaces found in this type of work. Section 1910.147 is OSHA's generic lockout and tagging standard. Although this standard does not apply to electric power generation, transmission, or distribution installations, it formed the basis of § 1910.269(d), which does apply to the lockout and tagging of these installations. Subpart S of the General Industry Standards and Subpart K of the construction standards set requirements for unqualified [6] workers who are working near electric power generation, transmission, and distribution lines and equipment.

*B. Relevant consensus standards*

The National Electrical Safety Code (American National Standards Institute Standard ANSI C2, also known as the NESC) was also taken into consideration in the development this proposal. This national consensus standard contains requirements specifically addressing electric power generation, transmission, and distribution work. The latest version of ANSI C2 [7] is much more up-to-date than Subpart V. However, ANSI C2 is primarily directed to the prevention of electric shock, although it does contain a few requirements for the prevention of falls.

The American Society for Testing and Materials (ASTM) has adopted standards related to electric power generation, transmission, and distribution work. ASTM Committee F18 on Electrical Protective Equipment for Workers has developed standards on rubber insulating equipment, climbing equipment, protective grounding equipment, fiberglass rod and tube used in live-line tools, and clothing for workers exposed to electric arcs.

The National Fire Protection Association (NFPA) has adopted a standard on electrical safety for employees, NFPA 70E–2004, Electrical Safety Requirements for Employee Workplaces. Although it does not apply to electric power generation, transmission, or distribution installations, this standard contains requirements for unqualified employees working near such installations.

The Institute of Electrical and Electronic Engineers (IEEE) is also responsible for writing standards for electric power generation, transmission, and distribution installations and for work on those installations. Many of these standards have been adopted by ANSI. Among these IEEE standards are: IEEE Std. 516, IEEE Guide for Maintenance Methods on Energized Power-Lines, and IEEE Std. 1048, IEEE Guide for Protective Grounding of Power Lines.

A list of consensus standards relating to electric power generation, transmission, and distribution work can be found in existing Appendix E to § 1910.269. OSHA considered the latest editions of all the standards listed in this section of the preamble or the Appendix in the development of the proposal.

*C. Advisory Committee on Construction Safety and Health*

Section 107 of the Contract Work Hours and Safety Standards Act and the Agency's own rulemaking regulations in 29 CFR Part 1911 require OSHA to consult with the Advisory Committee on Construction Safety and Health (ACCSH or the Committee) in setting standards for construction work. Specifically, § 1911.10(a) requires the Assistant Secretary to (1) provide ACCSH with the draft proposed rule along with pertinent factual information, (2) and to prescribe a period within which the Committee must submit its recommendations on the proposal.

OSHA has a 10-year history of consulting with ACCSH on the proposed construction standards for electrical protective equipment and electric transmission and distribution work. The Agency has provided several drafts of the proposed construction rules and updates on the status of the proposal.

On May 25, 1995, OSHA first took a draft of the proposed construction standards to ACCSH, providing the Committee with a draft of the proposal and with a statement on the need for and background behind the proposal. The Committee formed a workgroup to review the document and report back to ACCSH. The workgroup provided comments to OSHA. Although the Agency gave a status report on the proposal to the Committee on August 8, 1995, ACCSH did not make any formal recommendations to OSHA at that time.

The Agency provided a later draft of the proposal to ACCSH on December 10, 1999. This time, the Committee made no comments. On February 13, 2003, OSHA gave ACCSH a status report on the proposal and summarized the major revisions in the draft.

On May 22, 2003, OSHA provided the Committee with the same copy of the draft proposal that had been provided to the small entity representatives who

[6] In this preamble, ''unqualified worker'' (or ''unqualified employee'') means an employee who does not have the requisite training to work on or near electric power generation, transmission, or distribution installations. For more information, see the discussion of proposed § 1926.950(b) in Section IV, Summary and Explanation of Proposed Rule, later in this preamble.

[7] ANSI/IEEE C2–2002.

were participating in the Small Business Regulatory Enforcement and Fairness Act (SBREFA) proceedings, which were being conducted at that time. OSHA also explained the major issues being raised by the small entity representatives on the draft proposal.

On May 18, 2004, ACCSH gave formal recommendations on OSHA's proposal. OSHA sought ACCSH's recommendations on the proposal generally, as well as on issues specifically related to host employer-contractor communications and flame-resistant clothing. ACCSH voted unanimously that: (1) The construction standards for electric power transmission and distribution work should be the same as the general industry standards for the same type of work; (2) requiring some safety-related communications between host employers and contractors was necessary; and (3) employees need to be protected from hazards posed by electric arcs through the use of flame-resistant clothing. ACCSH also recommended unanimously that OSHA issue its proposal, consistent with these specific votes.

**III. Legal Authority**

The purpose of the Occupational Safety and Health Act of 1970 (OSH Act or the Act), 29 U.S.C. 651 *et seq.*, is ''to assure so far as possible every working man and woman in the Nation safe and healthful working conditions and to preserve our human resources.'' 29 U.S.C. 651(b). To achieve this goal, Congress authorized the Secretary of Labor to promulgate and enforce occupational safety and health standards. 29 U.S.C. 655(b) and 658.

A safety or health standard ''requires conditions, or the adoption or use of one or more practices, means, methods, operations, or processes, reasonably necessary or appropriate to provide safe or healthful employment and places of employment.'' 29 U.S.C. 652(8). A standard is reasonably necessary or appropriate within the meaning of Section 652(8) if:

• A significant risk of material harm exists in the workplace and the proposed standard would substantially reduce or eliminate that workplace risk;

• It is technologically and economically feasible;

• It employs the most cost effective protective measures;

• It is consistent with prior Agency action or supported by a reasoned justification for departing from prior Agency action;

• It is supported by substantial evidence; and

• In the event the standard is preceded by a consensus standard, it is better able to effectuate the purposes of the OSH Act than the standard it supersedes.

*International Union, UAW* v. *OSHA (LOTO II),* 37 F.3d 665, 668 (D.C. Cir. 1994).

OSHA has generally considered an excess risk of 1 death per 1000 employees over a 45-year working lifetime as clearly representing a significant risk *(see Industrial Union Dept.* v. *American Petroleum Institute (Benzene),* 448 U.S. 607, 655 (1980); International Union v. Pendergrass (Formaldehyde), 878 F.2d 389, 392–93 (D.C. Cir. 1989); *Building and Construction Trades Dept., AFL-CIO* v. *Brock (Asbestos),* 838 F.2d 1258, 1264–65 (D.C. Cir. 1988)).

A standard is considered technologically feasible if the protective measures it requires already exist, can be brought into existence with available technology, or can be created with technology that can reasonably be expected to be developed *(see American Iron and Steel Institute* v. *OSHA (Lead II),* 939 F.2d 975, 980 (D.C. Cir. 1991)). A standard is economically feasible when industry can absorb or pass on the costs of compliance without threatening the industry's long-term profitability or competitive structure *(see American Textile Mfrs. Institute* v. *OSHA (Cotton Dust),* 452 U.S. 490, 530 n. 55 (1981); Lead II, 939 F.2d at 980). A standard is cost effective if the protective measures it requires are the least costly of the available alternatives that achieve the same level of protection (*see LOTO II,* 37 F.3d at 668).

All OSHA standards must be highly protective (*LOTO II,* 37 F.3d at 669) and, where practical, ''expressed in terms of objective criteria and of the performance desired.'' 29 U.S.C. 655(b)(5). Finally, the OSH Act requires that when promulgating a rule that differs substantially from a national consensus standard, OSHA must explain why the promulgated rule is a better method for effectuating the purpose of the Act. 29 U.S.C. 655(b)(8). As discussed elsewhere in this preamble, OSHA is using several consensus standards as the basis for its proposed rule. The deviations from these consensus standards are explained in Section IV, Summary and Explanation of Proposed Rule, later in this preamble.

**IV. Summary and Explanation of Proposed Rule**

This section discusses the important elements of the proposed standard, explains the purpose of the individual requirements, and explains any differences between the proposed rule and existing standards. References in parentheses are to exhibits in the rulemaking record. References prefixed by ''269'' are to exhibits and transcripts in the rulemaking record from OSHA's earlier rulemaking on § 1910.137 and § 1910.269. These documents are available for inspection and copying in the Docket Office under Docket S–015. (The transcripts are listed in the docket as ''exhibits'' 100–X through 208–X.)

OSHA is proposing a new construction standard on electrical protective equipment, 29 CFR 1926.97, and a revision of the standard on the construction of electric power transmission and distribution lines and equipment, 29 CFR Part 1926, Subpart V. The Agency is also proposing changes to the general industry counterparts to these two construction standards, 29 CFR 1910.137 and 1910.269, respectively. The proposed construction standards may contain some nonsubstantive differences from their existing counterpart general industry requirements that are not separately included in the proposed revision of the general industry standards. However, the Agency intends for the corresponding construction and general industry requirements to be the same in the final rule except to the extent that separate requirements are supported by the rulemaking record. For example, the definition of ''designated employee'' in existing § 1910.269(x) reads as follows:

> An employee (or person) who is designated by the employer to perform specific duties under the terms of this section and who is knowledgeable in the construction and operation of the equipment and the hazards involved.

OSHA is proposing a slightly revised version of this definition in § 1926.968, as follows:

> An employee (or person) who is assigned by the employer to perform specific duties under the terms of this section and who has sufficient knowledge of the construction and operation of the equipment and the hazards involved to perform his or her duties safely.

The Agency does not believe that the proposed definition for Subpart V is substantially different from the existing definition in § 1910.269(x). Therefore, OSHA is not specifically including the proposed change to the definition of ''designated employee'' in the proposed changes to § 1910.269. The language in the final standards (that is, §§ 1910.269(x) and 1926.968) will be the same, however, unless the record warrants a separate definition for construction work.

In addition, the proposal references national consensus standards in notes following various requirements. These references are intended to provide employers and employees with additional useful sources of information that can assist them in complying with the standards. OSHA intends to review the latest editions of these consensus standards and reference those editions when promulgating the final rule provided they still provide suitable guidance.

*A. Electrical Protective Equipment, Section 1926.97*

Electrical protective equipment is in constant use during electric power transmission and distribution work; and, appropriately, existing Subpart V contains provisions related to this equipment. The existing OSHA standards for electrical protective equipment in construction work are contained in § 1926.951(a)(1), which only applies during construction of electric power transmission and distribution lines and equipment. Electrical protective equipment, however, is used throughout the construction industry. OSHA therefore believes that updated personal protective equipment provisions should apply throughout the construction industry, wherever such equipment is necessary for employee safety, and that electrical protective equipment provisions should not be limited to the use of this equipment in electric power transmission and distribution work. Therefore, OSHA is proposing new § 1926.97, Electrical protective equipment, to replace § 1926.951(a)(1), which incorporates by reference the following six American National Standards Institute (ANSI) standards:

| Item | ANSI Standard |
|---|---|
| Rubber insulating gloves | J6.6–1971 |
| Rubber matting for use around electric apparatus. | J6.7–1935 (R1971) |
| Rubber insulating blankets | J6.4–1971 |
| Rubber insulating hoods | J6.2–1950 (R1971) |
| Rubber insulating line hose | J6.1–1950 (R1971) |
| Rubber insulating sleeves | J6.5–1971 |

These ANSI standards were originally developed and adopted as American Society for Testing and Materials (ASTM) standards. (In fact, the latest revisions of these standards use the ASTM designations, rather than using separate designations for both standards-writing organizations.) As is typical of national consensus standards, the ASTM standards are filled with detailed specifications for the manufacture, testing, and design of electrical protective equipment. Additionally, these standards are revised frequently, making existing § 1926.951(a)(1) over a quarter century out of date. For example, the most recent ANSI standard listed in the former OSHA requirement is dated 1971. The most recent ASTM version available is a 2002 edition of specifications on rubber insulating gloves. The complete list of current ASTM standards corresponding to the ANSI standards is as follows:

ASTM D120–02a, Specification for Rubber Insulating Gloves.

ASTM D178–01$^{e1}$, Specification for Rubber Insulating Matting.

ASTM D1048–99, Specification for Rubber Insulating Blankets.

ASTM D1049–98$^{e1}$ (Reapproved 2002), Specification for Rubber Insulating Covers.

ASTM D1050–90 (Reapproved 1999), Specification for Rubber Insulating Line Hose.

ASTM D1051–02, Specification for Rubber Insulating Sleeves.

Additionally, ASTM has adopted standards on the in-service care of insulating line hose and covers (ASTM F478–92 (Reapproved 1999)), insulating blankets (ASTM F479–95 (Reapproved 2001)), and insulating gloves and sleeves (ASTM F496–02a), which have no current counterparts in existing § 1926.951(a)(1).

In an attempt to retain the quality of protection afforded by the ASTM standards, OSHA has developed proposed new § 1926.97 which has been derived from the ASTM documents but which has been written in performance terms. OSHA recognizes the importance of the ASTM standards in defining basic requirements for the safe design and manufacture of electrical protective equipment for employees. Proposed § 1926.97 would increase the protection presently afforded to power transmission and distribution employees by the outdated ANSI/ASTM standards incorporated by reference in the existing standard. The proposal carries forward ASTM provisions that are performance oriented and necessary for employee safety, but does not contain many of the detailed specifications in those consensus standards. The proposal will thus provide greater flexibility for compliance with these provisions to the extent that worker safety warrants.

There are several reasons why adopting the ASTM standards in toto would be inappropriate in this rulemaking. First, ASTM has revised each of the currently referenced standards several times since they were adopted in the former OSHA regulation. Because of the continual process by which ASTM periodically revises its standards, any specific editions that OSHA might adopt would likely be outdated within a few years. Additionally, since the rulemaking process is lengthy, a complete revision of OSHA's electrical protective equipment requirements every three years or so to keep pace with the changes in the consensus standards is not practical. (In fact, some of the ASTM standards will likely be revised again during the rulemaking period.) To remedy this problem, OSHA is proposing new § 1926.97 to make the standards flexible enough to accommodate changes in technology, obviating the need for constant revision. Where possible, the proposed standard has been written in performance terms in order to allow alternative methods of compliance if they provide comparable safety to the employee.

Another difficulty with incorporation of the ASTM standards by reference is that they contain details that go beyond the purposes of the OSHA standard or that are not directly related to employee safety. In proposed § 1926.97, OSHA has tried to carry forward only provisions that are relevant to employee safety in the workplace. Furthermore, OSHA has attempted to simplify those provisions to make the requirements easier for employers and employees to use and understand. Because the revision places all relevant requirements in the text of the regulations, employers would no longer have to refer to the ASTM documents to determine their obligations under OSHA.

In striving for this degree of simplification, the Agency has tried to use an approach that will accept new methods of protection that may appear in future editions of the ASTM standards. OSHA recognizes that such future editions of these standards might contain technological advances providing significant improvement in employee safety, which might not be permitted under proposed § 1926.97. However, due to the performance-oriented nature of the OSHA standard as compared to the ASTM standards, conflicts between the two standards in areas affecting employee safety are expected to be infrequent.

Furthermore, an employer who follows future versions of ASTM standards would likely be covered by OSHA's *de minimis* policy as set forth in OSHA Instruction CPL 02–00–103 (Field Inspection Reference Manual). Under that policy, a *de minimis* condition[8] exists: (1) Where an employer's workplace has been updated in accordance with new technology or equipment as a result of revisions to the latest consensus publications from which OSHA standards were derived, (2) where the updated versions result in a ''state of the art'' workplace, technically advanced beyond the requirements of the applicable OSHA standard, and (3) where equal or greater safety and health protection is provided.

*Paragraph (a).* Paragraph (a) of § 1926.97 addresses the design and manufacture of insulating blankets, matting, covers, line hose, gloves, and sleeves made of rubber (either natural or synthetic). See the summary and explanation of proposed § 1926.97(b) for general requirements on other types of insulating equipment.

Under proposed paragraph (a)(1)(i), blankets, gloves, and sleeves would have to be manufactured without seams. This method of making the protective equipment minimizes the chance that the material will split. Because they are used when workers handle energized lines, gloves and sleeves are the only defense an employee has against electric shock. Additionally, blankets, gloves, and sleeves need to be seamless because the stresses placed on the equipment by the flexing of the rubber during normal use could cause a seam to separate. The other three types of electrical protective equipment (covers, line hose, and matting) generally provide a more indirect form of protection—they insulate the live parts from accidental, rather than intended, contact—and they are not usually subject to similar amounts or types of flexing.

Proposed paragraph (a)(1)(ii) would require electrical protective equipment to be marked to indicate its class and type. The class marking indicates the voltage with which the equipment can be used; the type marking indicates whether or not the equipment is ozone resistant. This will enable employees to know the uses and voltages for which the equipment is suited. Proposed paragraph (a)(1)(ii) would also permit equipment to contain other relevant markings, such as one indicating the manufacturer's name or compliance with ASTM standards.

Paragraph (a)(1)(iii) would require all markings to be nonconductive and to be applied so that the properties of the equipment are not impaired. This would ensure that no marking interferes with the protection to be provided by the equipment.

Paragraph (a)(1)(iv) would require markings on gloves to be provided only in the cuff area. Markings in other areas could possibly wear off. Moreover, having the markings in one place will allow the employee to determine the class and type of glove quickly. Furthermore, OSHA would require in paragraph (c)(2)(vii) that rubber gloves normally be worn under protector gloves. Because a protector glove is almost always shorter than the corresponding rubber glove with which it is worn and because the cuff of the protector glove can easily be pulled back without removal, it is easy to see markings on the cuff portion of the rubber glove beneath. Any marking provided on the rubber glove in an area outside of the cuff could not be seen with the protector glove in place.

Under the national consensus standards, electrical protective equipment must be capable of passing certain electrical tests. In proposed § 1926.97(a)(2), OSHA incorporates these requirements. The tests specified in the ASTM standards are very detailed. This is not the case in the OSHA standard. Through the use of performance language, the proposed rule would establish the same level of protection without a lengthy discussion of test procedures.

Paragraph (a)(2)(i) would require electrical protective equipment to be capable of withstanding the a-c proof-test voltages in Table E–1 or the d-c proof-test voltages in Table E–2 of the standard (depending, of course, on whether an a-c proof test or an equivalent d-c proof test is performed). The proof-test voltages listed in these tables have been taken from the current ASTM standards, which also contain details of the test procedures used to determine whether electrical protective equipment is capable of withstanding these voltages. These details have not been included in the proposed rule. Paragraph (a)(2)(i)(A) replaces them with a performance-oriented requirement that whatever test is used must reliably indicate that the equipment can withstand the proof-test voltage involved. To meet the requirements of the OSHA performance standard, employers would normally get the assurance of the manufacturer that the equipment is capable of withstanding the appropriate proof-test voltage.[9] Manufacturers typically look to the ASTM standards for guidance in determining the testing procedure.

Proposed paragraph (a)(2)(i)(B) would require the proof-test voltage to be applied for 1 minute for insulating matting and for 3 minutes for other insulating equipment. These times are based on the proof-test times given in the ASTM design standards and are appropriate for testing the design capabilities of electrical protective equipment.

Proposed paragraph (a)(2)(i)(C) would require rubber insulating gloves to be capable of withstanding the a-c proof-test voltage indicated in Table E–1 of the standard after a 16-hour water soak. If rubber insulating gloves absorb water, a reduction in insulating properties will result. Water absorption is thus a critical property because exposure to perspiration or rain is quite common while line worker's gloves are in use. Electrical work is sometimes performed in the rain, and an employee's perspiration is often present while the gloves are in use. The soak test is needed to ensure that electrical protective equipment can withstand the voltage involved under these conditions.

When an a-c proof test is used on gloves, the resulting proof-test current gives an indication of the validity of the gloves' make-up, the dielectric constant of the type of material used, its thickness, and the total area under test. Paragraph (a)(2)(ii) prohibits the a-c proof-test current from exceeding the current allowed in Table E–1. The currents listed in the table have been taken from ASTM D120–02a.

Under paragraph (a)(2)(ii)(A), the maximum current for a-c voltages at frequencies other than 60 hertz would be computed from the direct ratio of the frequencies.

Gloves are filled with and immersed in water during the a-c proof test, and the water inside and outside the glove forms the electrodes. The a-c proof-test current is dependent on the length of the portion of the glove that is out of water. Because the proof-test current is a function of immersion depth, it is important to specify the depth in the rule. Otherwise, employee safety could be compromised. Therefore, paragraph (a)(2)(ii)(B) in the proposed standard specifies that gloves to be tested must be filled with and immersed in water to the depth given in Table E–3 in the standard. This table was taken directly

[8] OSHA considers a *de minimis* condition to be a technical violation of a standard only. However, because the employer is considered to be in substantial compliance with the standard, the Agency issues no citations or penalties, nor is the employer required to bring his or her workplace into compliance with the older standard.

[9] As explained in the note at the end of paragraph (a), OSHA deems equipment meeting the ASTM standards as being compliant with the OSHA standard. Thus, an employer could simply look for equipment labeled as meeting these standards. Manufacturers attest, through this label, that their equipment is capable of passing all the required tests, including the a-c or d-c proof tests.

from ASTM D120 and is valid for the proof-test currents listed in Table E–1.

The allowable proof-test current must be increased for proof-tests on gloves after a 16-hour water soak because the gloves absorb a small amount of water, which results in slightly increased current during the test. ASTM D120 allows an increase in the proof-test current of 2 milliamperes. If the proof-test current increases more than that, it would indicate that the gloves absorbed too much water. OSHA has proposed to allow a similar increase in proof-test current in paragraph (a)(2)(ii)(C).

Since the relatively high voltages used in testing electrical protective equipment for minimum breakdown voltage can actually damage the insulating material under test (even if it passes), proposed paragraph (a)(2)(iii) would prohibit protective equipment that has been subjected to such a test from being used to protect employees from electrical hazards. The intent of the proposal is to prohibit the use of equipment that has been tested under conditions equivalent to those in the ASTM standards for minimum breakdown voltage tests.

A note at the end of proposed § 1926.97(a) indicates that all the tests given in the paragraph are described in the listed ASTM standards, as follows:

> These [ASTM] standards contain specifications for conducting the various tests required in paragraph (a) of this section. For example, the a-c and d-c proof tests, the breakdown test, the water soak procedure, and the ozone test mentioned in this paragraph are described in detail in the ASTM standards.

This does not mean that OSHA is adopting the ASTM standards by reference. In enforcing proposed § 1926.97, the Agency would accept any test that meets the requirements of the OSHA standard. However, the proposal states explicitly that the ASTM tests listed in the note are acceptable; and, if the ASTM specifications are met, an employer has assurance that he or she is complying with proposed § 1926.97. If an employer uses other test methods, the Agency would determine, on a case-by-case basis, whether or not they meet the OSHA standard.

Around high-voltage lines and equipment, a luminous discharge, called electric corona, can occur due to ionization of the surrounding air caused by a voltage gradient which exceeds a certain critical value. The blue corona discharge is accompanied by a hissing noise and by ozone, which can cause damage to certain types of rubber insulating materials. Therefore, when there is a chance that ozone may be produced at a work location, electrical protective equipment made of ozone-resistant material is frequently used. To ensure that ozone-resistant material will, in fact, be resistant to the damaging effects of the gas, paragraph (a)(2)(iv) requires this type of material (Type II) to be capable of withstanding an ozone test that can reliably indicate that the material will resist ozone exposure in actual use. As noted earlier, standardized ozone tests are given in the ASTM specifications. The proposed rule also lists signs of failure of the test, such as checking,[10] cracking, breaks, and pitting.

Paragraph (a)(3) applies to the workmanship and finish of electrical protective equipment. Because physical irregularities can interfere with the insulating properties of the equipment, paragraph (a)(3)(i) prohibits the presence of harmful defects that can be detected by the tests or inspections required under § 1926.97. However, some minor irregularities are nearly unavoidable in the manufacture of rubber goods, and these imperfections may be present in the insulating materials without significantly affecting the insulation. Paragraph (a)(3)(ii) lists the types of imperfections that are permitted. Even with these imperfections, electrical protective equipment is still required to be capable of passing the electrical tests specified in paragraph (a)(2).

Since paragraph (a) of § 1926.97 is written in performance-oriented language, OSHA believes that it is important for employees, employers, and manufacturers to have some guidance in terms of what is acceptable under the proposed standard. OSHA also realizes that the current ASTM specifications on electrical protective equipment are accepted by employers and employees in the industry as providing safety to employees and that existing electrical protective equipment is normally made to these specifications. Furthermore, the proposal is based on the provisions of these national consensus standards, although the requirements are stated in performance terms. OSHA has therefore included a footnote at the end of paragraph (a) stating that rubber insulating equipment meeting the requirements of the listed ASTM standards for this equipment are considered as conforming to the requirements contained in § 1926.97(a). The lists of ASTM standards in the proposed rule (in the notes following paragraphs (a)(3)(ii)(B) and (c)(2)(ix)) contain the latest revisions of these standards. The Agency has reviewed these documents and has found them to provide suitable guidance for compliance with § 1926.97(a).[11] It should be noted that the listed consensus standards are the only ones with official recognition within the body of the standard. Future consensus standards are not automatically given the same recognition but will have to be reviewed by OSHA to determine whether they provide sufficient protection.

*Paragraph (b).* Paragraph (b) of the proposed § 1926.97 addresses electrical protective equipment other than the rubber insulating equipment addressed in paragraph (a). Equipment falling under this paragraph includes plastic guard equipment, insulating barriers, and other protective equipment intended to provide electrical protection to employees. Some of the equipment addressed in paragraph (b) is covered under a national consensus standard. For example, insulating plastic guard equipment is covered by ASTM F968, Specification for Electrically Insulating Plastic Guard Equipment for Protection of Workers. Other types of protective equipment are not covered by consensus specification.

Paragraph (b)(1) would require electrical protective equipment to be capable of withstanding any voltage that might be imposed on it. The voltage includes transient overvoltages as well as the nominal voltage that is present on an energized part of an electric circuit. Equipment withstands a voltage if it maintains its integrity without flashover or arc through. This paragraph would protect employees from failure of electrical protective equipment. Equipment conforming to a national consensus standard for that type of equipment will generally be considered as complying with this rule if that standard contains proof testing requirements for the voltage involved. For types of equipment not addressed by any consensus standard, OSHA is considering accepting electrical protective equipment that is capable of passing a test equivalent to that described in ASTM F712, Standard Test Methods for Electrically Insulating Plastic Guard Equipment for Protection

[10] ASTM F819–00 e1, Standard Terminology Relating to Electrical Protective Equipment for Workers, defines ''ozone cutting and checking'' as: ''cracks produced by ozone in a material under mechanical stress.''

[11] OSHA has also reviewed earlier versions of these ASTM standards and found them to afford protection equal to that of the OSHA standard. Thus, the Agency will accept electrical protective equipment meeting earlier versions of the consensus standards provided the equipment meets the edition of the standard that was in effect at the time of manufacture and provided the employer has followed the use and care provisions set out in proposed § 1926.97(c).

of Workers. Guidance for performing dielectric tests of electrical protective equipment is also given in IEEE Std. 516, IEEE Guide for Maintenance Methods on Energized Power-Lines. OSHA invites comments on whether these standards contain suitable test methods and whether equipment passing those tests should be acceptable under the OSHA standard.

The electrical test criteria set in ASTM F968 are summarized in Table IV–1 and Table IV–2. The Agency believes that the performance criteria proposed in paragraph (b)(1) minimize the necessity of setting or specifically including similar criteria in the OSHA standard. However, comments are invited on the need to set specific electrical performance values in the OSHA rule and on whether Table IV–1 and Table IV–2 could be applied to all types of electrical protective equipment that would be covered by proposed § 1926.97(b).

TABLE IV–1.—WITHSTAND VOLTAGE PROOF TEST

| Class | Rating kV φ-φ | Maximum use kV φ-g (60 Hz) | Proof test withstand voltage (in service testing) | | | |
|---|---|---|---|---|---|---|
| | | | kV φ-g | | Duration min. | Criteria |
| | | | 60 Hz | D–C | | |
| 2 | 14.6 | 8.4 | 13 | 18 | 1.00 | No flashover other than momentary as a result of too-close spacing of electrode. |
| 3 | 26.4 | 15.3 | 24 | 34 | 1.00 | |
| 4 | 36.6 | 21.1 | 32 | 45 | 1.00 | |
| 5 | 48.3 | 27.0 | 42 | 60 | 0.50 | |
| 6 | 72.5 | 41.8 | 64 | 91 | 0.25 | |

TABLE IV–2.—MINIMUM FLASHOVER TEST

| Class | Rating kV φ-φ | Maximum use kV φ-g (60 Hz) | Minimum flashover test kV φ-g | | Criteria |
|---|---|---|---|---|---|
| | | | 60 Hz | D–C | |
| 2 | 14.6 | 8.4 | 14 | 20 | No flashover other than momentary as a result of too-close spacing of electrode. |
| 3 | 26.4 | 15.3 | 25 | 35 | |
| 4 | 36.6 | 21.1 | 34 | 48 | |
| 5 | 48.3 | 27.0 | 43 | 61 | |
| 6 | 72.5 | 41.8 | 67 | 95 | |

Proposed paragraph (b)(2) addresses the properties of insulating equipment that limit the amount of current seen by an employee. Paragraph (b)(2)(i) would require electrical protective equipment used as the primary insulation of employees from energized parts to be capable of passing a test for current (that is, a proof test) when subjected to the highest nominal voltage on which the equipment is to be used. Paragraph (b)(2)(ii) would limit the current encountered during the test to 1 microampere per kilovolt of applied voltage. This requirement is intended to prevent the use of poor insulating materials or good insulating materials that are contaminated with conductive substances (for example, fiberglass-reinforced plastic coated with a conductive finish), which could lead to electric shocks to employees using the equipment. The limit for current has been taken from IEEE Std. 516, and OSHA believes such a limit is reasonable and appropriate. The Agency invites comments, however, on whether another value would better protect employees.

When equipment is tested with ac voltage, the current measured during the test consists of three components: (1) Capacitive current caused by the dielectric properties of the equipment being tested, (2) conduction current through the equipment, and (3) leakage current passing along the surface of the equipment. The conduction current is negligible for materials typically used in insulating equipment, and the leakage current should be small for clean, dry insulating equipment. The capacitive component usually predominates when insulating equipment in good condition is tested. The second note to paragraph (b)(2) summarizes this information.

The tests required under proposed paragraphs (b)(1) and (b)(2) would normally be performed by the manufacturer initially during the design process and periodically during the manufacturing process. However, some employers might want to use equipment that is made of insulating materials but that is not intended by the manufacturer to be used as insulation. For example, a barrier made of rigid plastic may be intended for use as a general purpose barrier. An employer could test the barrier under proposed paragraphs (b)(1) and (b)(2). If the equipment passed the tests, it would be acceptable for use as insulating electrical protective equipment. Note 1 to paragraph (b)(2) makes clear that paragraph (b)(2) applies to equipment for primary insulation; it is not intended to apply to equipment used for secondary insulation or used for brush contact only.

*Paragraph (c).* Although existing § 1926.951(a)(1) does not contain provisions for the care and use of insulating equipment, OSHA believes provisions of this type can contribute greatly to employee safety. Electrical protective equipment is, in large part, manufactured in accordance with the latest ASTM standards. This would probably be the case even in the absence of OSHA regulation. However, improper use and care of this equipment can easily reduce, or even eliminate, the protection afforded by this equipment. Therefore, OSHA is proposing new requirements on the in-service care and use of electrical protective equipment to the design standards already contained in existing § 1926.951(a)(1). These new provisions will help ensure that these safety products retain their insulating properties.

Proposed paragraph (c)(1) would require electrical protective equipment to be maintained in a safe and reliable condition. This general, performance-oriented requirement, which would apply to all equipment addressed by new § 1926.97, helps ensure that employees are fully protected from electric shock.

Detailed criteria for the use and care of specific types of electrical protective equipment are contained in the following ASTM standards:

ASTM F 478–92, Specification for In-Service Care of Insulating Line Hose and Covers.

ASTM F 479–95, Specification for In-Service Care of Insulating Blankets.

ASTM F 496–02a, Specification for In-Service Care of Insulating Gloves and Sleeves.

OSHA based the requirements proposed in paragraph (c)(2) on these standards.

Paragraph (c)(2) applies only to rubber insulating blankets, covers, line hose, gloves, and sleeves. These are the only types of electrical protective equipment addressed by consensus standards on the care and use of such equipment. Rubber insulating matting, which is addressed by the material design specifications in paragraph (a), is not covered by any ASTM standard on its in-service care or by § 1910.137(c)(2). This type of equipment is generally permanently installed to provide supplementary protection against electric shock. Employees stand on the matting, and they are insulated from ground, which protects them from phase-to-ground electric shock. However, because this type of equipment is normally left in place after it is installed and because it is not relied on for primary protection from electric shock (the primary protection is provided by other insulating equipment or by insulating tools), it is not tested on a periodic basis and is not subject to the careful inspection before use that other insulating equipment is required to receive. It should be noted, however, that rubber insulating matting is required to be maintained in a safe, reliable condition under paragraph (c)(1).

Although the rubber insulating equipment addressed in § 1926.97(a) is currently designed to be capable of withstanding voltages of up to 40 kilovolts, such equipment is actually intended to be used at lower voltages (see, for example, ASTM F 496 on the care and use of rubber insulating gloves and sleeves). The use of insulating equipment at voltages less than its actual breakdown voltage provides a margin of safety for the employee. In paragraph (c)(2)(i) and Table E–4, the proposal has adopted the margins of safety recognized in the ASTM standards, restricting the use of insulating equipment to voltages lower than the proof-test voltages given in Table E–1 and Table E–2.

Table E–4 contains the following note:

> The maximum use voltage is the a-c voltage (rms) classification of the protective equipment that designates the maximum nominal design voltage of the energized system that may be safely worked. The nominal design voltage is equal to the phase-to-phase voltage on multiphase circuits. However, the phase-to-ground potential is considered to be the nominal design voltage:
>
> (1) If there is no multiphase exposure in a system area and if the voltage exposure is limited to the phase-to-ground potential, or
>
> (2) If the electrical equipment and devices are insulated or isolated or both so that the multiphase exposure on a grounded wye circuit is removed.

In the general case, electrical protective equipment must be rated for the full phase-to-phase voltage of the lines or equipment on which work is being performed. This ensures that employees are protected against the most severe possible exposure, that is, contact between one phase conductor and another. However, if the employee is only exposed to phase-to-ground voltage, then the electrical protective equipment selected can be based on this lower voltage level (nominally, the phase-to-phase voltage divided by $\sqrt{3}$ ). For example, a three-phase, solidly grounded, Y-connected overhead distribution system could be run as three phase conductors with a neutral or as three single-phase circuits with one phase conductor and a neutral each. If only one phase conductor is present on a pole, there is no multiphase exposure. If all three phase conductors are present, the multiphase exposure can be removed by insulating two of the phases or by isolating [12] two of the phases. After the insulation is in place or while the employee is isolated from the other two phase conductors, there is no multiphase exposure, and electrical protective equipment rated for the phase-to-ground voltage could be used. (It should be noted that, until the multiphase exposure has actually been removed, the phase-to-phase voltage remains the maximum use voltage. Thus, the maximum use voltage of any insulation used to ''remove phase-to-phase exposure'' must be greater than or equal to the phase-to-phase voltage on the system.) OSHA requests comments on how employees can be insulated or isolated from multiphase exposure to ensure the safe use of electrical protective equipment.

Proposed paragraph (c)(2)(ii) would require insulating equipment to be visually inspected before use each day and immediately after any incident which might be suspected of causing damage. In this way, obvious defects can be detected before an accident occurs. Possible damage-causing incidents would include exposure to corona and exposure to possible direct physical damage. Additionally, rubber gloves would be required to be subjected to an air test along with the inspection. In the field, this test usually consists of rolling the cuff towards the palm so that air is entrapped within the glove. In a testing facility, a mechanical inflater may be used. In either case, punctures and cuts can easily be detected. The note following paragraph (c)(2)(ii) indicates that ASTM F 1236–96, *Standard Guide for Visual Inspection of Electrical Protective Rubber Products*, contains (1) information on how to inspect rubber insulating equipment and (2) descriptions and photographs of potential irregularities in the equipment.

During use, electrical protective equipment may become damaged and lose some of its insulating value. Paragraph (c)(2)(iii) of proposed § 1926.97 lists types of damage that would cause the insulating value to drop. The equipment may not be used if any of these defects are present.

Defects other than those listed in paragraph (c)(2)(iii) may develop during use of the equipment and could also affect the insulating and mechanical properties of the equipment. If such defects are found, proposed paragraph (c)(2)(iv) would require the equipment to be removed from service and tested in accordance with other requirements in paragraph (c)(2). The results of the tests determine if it is safe to return the items to service.

Foreign substances on the surface of rubber insulating equipment can degrade the material and lead to damage to the insulation. Paragraph (c)(2)(v) would require the equipment to be cleaned as needed to remove any foreign substances.

Over time, certain environmental conditions can also cause deterioration of rubber insulating equipment. Proposed paragraph (c)(2)(vi) would require insulating equipment to be stored so that it is protected from injurious conditions and substances, such as light, temperature extremes, excessive humidity, and ozone. This requirement helps the equipment retain its insulating properties as it ages.

[12] Depending on the configuration of the system, an employee could be isolated from two of the phases on the pole by approaching one of the outside phase conductors and working on it from a position where there is no possibility of coming too close to the other two phase conductors. Isolation of the employee may be impossible for some line configurations.

OSHA does not consider carrying the equipment on trucks for the use of employees during the course of work to be storage. However, the Agency does not believe that it is safe to store the equipment on trucks for extended periods between use if such storage would expose the equipment to extremes of temperature or humidity. It may be necessary, under some circumstances, to store equipment indoors during prolonged periods when employees would not be using it. Workers are dependent upon electrical protective equipment for their safety, and all reasonable means of protecting it from unnecessary damage must be employed.

Rubber insulating gloves are particularly sensitive to physical damage during use. Through handling conductors and other electrical equipment, an employee can damage the gloves and lose the protection they provide. For example, a sharp point on the end of a conductor could puncture the rubber. To protect against damage, protector gloves (made of leather) are worn over the rubber gloves. Proposed paragraph (c)(2)(vii) recognizes the extra protection afforded by leather gloves and would require their use over rubber gloves, except under limited conditions.

Protector gloves would not be required with Class 0 or Class 00 gloves if high finger dexterity is needed for small parts manipulation. The maximum voltage on which Class 0 and Class 00 gloves can be used is 1,000 volts and 500 volts, respectively. At these voltages, an employee is protected against electric shock as long as a live part does not puncture the rubber and contact the employee's hand. The type of small parts encountered in work on energized circuits, such as small nuts and washers, are not likely to do this. While the exception is necessary to allow work to be performed on small energized parts, extra care is needed in the visual examination of the glove and in the avoidance of handling sharp objects. (A note to this effect is included in the proposal.)

The other exception to the requirement for protector gloves is granted if the employer can demonstrate that the possibility for damage is low and if gloves at least one class higher than required for the voltage are used. For example, if a Class 2 glove is used at 7500 volts or less (the maximum use voltage for Class 1 equipment), if high dexterity is needed, and if the possibility of damage is low, then protector gloves need not be used. In this case, the additional thickness of insulation provides a measure of additional physical protection. This exception does not apply when the possibility of damage is significant, such as when an employee is using a knife to trim insulation from a conductor or when an employee has to handle moving parts, such as conductors being pulled into place. To ensure that no loss of insulation has occurred, paragraph (c)(2)(vii)(C) would require any gloves used under this exception to be tested before being used again.

Paragraph (c)(2)(viii), Table E–4, and Table E–5 would require insulating equipment to be tested periodically to verify that electrical protective equipment retains its insulating properties over time. Table E–4 lists the retest voltages that are required for the various classes of protective equipment, and Table E–5 presents the testing intervals for the different types of equipment. These test voltages and intervals were taken from the relevant ASTM standards.

Paragraph (c)(2)(ix) proposes a performance-oriented requirement that the method used for the periodic tests give a reliable indication of whether or not the electrical protective equipment can withstand the voltages involved. As this is a performance-oriented standard, OSHA does not spell out detailed procedures for the required tests, which vary depending on the type of equipment being tested. On the other hand, OSHA believes that it is important for employees, employers, and testing laboratories to have some guidance in terms of what is acceptable under the proposed standard. Therefore, following paragraph (c)(2)(ix), OSHA has included a note stating that electrical test methods given in the various ASTM standards on rubber insulating equipment meet the proposed performance requirement. The Agency believes that referencing acceptable test methods within the standard will benefit employees, employers, and testing laboratories. As noted earlier, this does not mean that OSHA is adopting the ASTM standards by reference. In enforcing § 1926.97(c)(2)(ix), the Agency would accept any test that meets the requirements of the OSHA standard. However, the proposal states explicitly that the listed ASTM tests would be acceptable; and, if the ASTM specifications are met, an employer has assurance that he or she would be complying with § 1926.97(c)(2)(ix). If an employer uses other test methods, the Agency will determine, on a case-by-case basis, whether or not they meet the Federal standard.

Once the equipment has undergone the in-service inspections and tests, it is important to ensure that any failed equipment is not returned to service. Paragraph (c)(2)(x) would prohibit electrical protective equipment that failed the required inspections and tests from being used by employees, unless the defects can be safely eliminated. Proposed paragraph (c)(2)(x) also lists acceptable means of eliminating defects and rendering the equipment fit for use. Sometimes defective portions of rubber line hose and blankets can be removed. The result would be a smaller blanket or a shorter length of line hose. Under the proposal, rubber insulating blankets may only be salvaged by severing the defective portions of the blanket if the resulting undamaged area is at least 560 mm by 560 mm (22 inches by 22 inches) for Class 1, 2, 3, and 4 blankets. (Smaller sizes cannot be reliably tested using standard test methods.) Obviously, gloves and sleeves cannot be repaired in this manner; however, there are methods of patching them if the defects are minor. Rubber blankets can also be patched. The patched area must have electrical and physical properties equal to those of the material being repaired. To minimize the possibility that a patch will loosen or fail, the proposal would not permit repairs to gloves outside the gauntlet area (the area between the wrist and the reinforced edge of the opening). OSHA stresses that the proposal would not permit repairs in the working area of the glove, where the constant flexing of the rubber during the course of work could loosen an ill-formed patch.

Once the insulating equipment has been repaired, it must be retested to ensure that any patches are effective and that there are no other defects present. Such retests would be required under paragraph (c)(2)(xi).

Employers, employees, and OSHA compliance staff must have a method of determining whether or not the tests required under proposed paragraphs (c)(2)(viii) and (c)(2)(xi) have been performed. Paragraph (c)(2)(xii) would require this to be accomplished by means of certification by the employer that equipment has been tested in accordance with the standard. The certification is required to identify the equipment that passed the test and the date it was tested. Typical means of meeting this requirement include logs and stamping test dates on the equipment. A note following paragraph (c)(2)(xii) explains that these means of certification are acceptable.

*B. Electric Power Transmission and Distribution, Subpart V*

OSHA is proposing to revise Subpart V of its construction standards. This subpart contains requirements for the prevention of injuries to employees performing construction work on electric power transmission and distribution installations.

The proposed revision of Subpart V is based primarily on the general industry standard § 1910.269, Electric power generation, transmission, and distribution, which was promulgated in January 1994, rather than on existing Subpart V, which was promulgated in 1972. As noted earlier in this preamble, the existing Subpart V is technologically out of date and contains provisions that are poorly written. OSHA believes that basing the revision of Subpart V on the more recently promulgated § 1910.269 will produce a standard that will be easier for employees and employers to understand and will better protect employees than a revision based on the existing construction standard.

Section 1926.950, General

Section 1926.950, General, proposes the scope of revised Subpart V and proposes general requirements for training and the determination of existing conditions.

Paragraph (a)(1) of proposed § 1926.950 sets the scope of revised Subpart V. OSHA intends the revision of Subpart V to apply to the same types of work covered under the existing standard. Therefore, paragraph (a)(1) has been taken directly from existing § 1926.950(a) and (a)(1). As proposed, Subpart V would apply to the construction of electric power transmission and distribution installations. For the purposes of the proposal and the existing standard, ''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.

Paragraph (a)(2) of proposed § 1926.950 explains the application of the subpart with respect to the rest of Part 1926. The proposed provision reads as follows: ''This subpart applies in addition to all other applicable standards contained in this Part 1926. Employers covered under this subpart are not exempt from complying with other applicable provisions in Part 1926 by the operation of § 1910.5(c) of this chapter. Specific references in this subpart to other sections of Part 1926 are provided for emphasis only.'' All other construction industry standards would continue to apply to installations covered by the revised standard unless an exception is given in Subpart V. For example, § 1926.959(a)(2) would require the critical components of mechanical elevating and rotating equipment to be inspected before each shift. This provision would not supersede existing §§ 1926.500(a)(5) and (a)(6), which detail specific requirements for the inspection of cranes. Also, in a change that OSHA considers nonsubstantive, § 1910.269(a)(1)(iii) will be amended to include language equivalent to that of the new provision at § 1926.950(a)(2).[13]

In contrast to § 1910.269, Subpart V does not apply to work on electric power generation installations or to the installations themselves. The construction of an electric power generation station normally poses hazards more akin to those of general construction rather than those found in the operation and maintenance of the generation plant. The only exceptions would be during the final phase of construction of a generating station, when electrical and other acceptance testing of the installation is being performed, and during ''reconstruction'' phases, when other portions of the generating station would still be in operation. During these two operations, the work being performed resembles general industry work, and the appropriate work practices to follow are contained in the general industry standard § 1910.269. Therefore, rather than repeat the relevant portions of § 1910.269 in Subpart V, OSHA has simply stated in § 1926.950(a)(3) that such work shall comply with § 1910.269. The Agency requests comments on whether § 1910.269 should apply to all work involving electric power generation installations, as proposed, or whether the relevant requirements from § 1910.269 should be contained in Subpart V.

Similarly, line-clearance tree trimming is not normally performed as part of the construction of electric power transmission or distribution installations. One exception occurs when trees are trimmed along an existing overhead power line to provide clearance for a new transmission or distribution line being constructed. Even here, however, this work is not construction-like in nature. Therefore, OSHA is also applying § 1910.269 to line-clearance tree-trimming operations, regardless of whether the work is considered to be construction work. The Agency also requests comments on whether § 1910.269 should apply to all work involving line-clearance tree trimming, as proposed, or whether the relevant requirements from § 1910.269 should be contained in Subpart V.

[13] Paragraph (a)(1)(iii) of § 1910.269 presently states: ''This section applies in addition to all other applicable standards contained in this part 1910. Specific references in this section to other sections of part 1910 are provided for emphasis only.''

Paragraph (b) of § 1926.950 addresses training for employees. Subpart V currently contains no general provisions related to training employees in the safety precautions necessary to perform electric power transmission and distribution work. It is widely recognized that electric-utility-type work requires special knowledge and skills. Additionally, both existing Subpart V and the proposed revision of Subpart V contain many safety-related work practice requirements that are necessary for the protection of employees. In order to gain the requisite knowledge and skills to employ these work practices, employees must be adequately trained. Therefore, in the proposed revision of Subpart V, OSHA has included training requirements based on those in § 1910.269.

Paragraph (b)(1) contains training requirements applying to all employees performing work covered by Subpart V. Paragraph (b)(1)(i) would require employees to be trained in the safety-related work practices, safety procedures, and other personnel safety requirements in the standard that pertain to their respective job assignments. This training is necessary to ensure that employees use the safety-related work practices outlined in proposed Subpart V.

Under paragraph (b)(1)(ii), employees would also be required to be trained in and familiar with any other safety practices necessary for their safety, including applicable emergency procedures. The proposed rule would require employees to be trained in safe work techniques that relate to his or her job. Additionally, if more than one set of work practices could be used to accomplish a task safely, the employee would need to be trained in only those work methods he or she is to use. For example, an insulator on a power line could be replaced through the use of live-line tools, through the use of rubber insulating equipment, or by deenergizing the line. The employee would only have to be trained in the method actually used to replace that insulator.

The proposal cannot specify requirements for every hazard the employee faces in performing electric power transmission or distribution work. Employers must fill in this gap by training their employees in hazards that are anticipated during the course of jobs they are expected to perform. The language of proposed § 1926.950(b)(1)(ii) imparts OSHA's intent that safety training be provided in areas that are not directly addressed by the standard but that are related to the employee's job.

Under paragraph (b)(1)(iii), the training provided to an employee would have to be commensurate with the risk he or she faces. This provision is not contained in either existing Subpart V or § 1910.269. This proposed requirement, which has been taken from § 1910.332(c), is intended to ensure that an appropriate level of training is provided. Employees who face little risk in their job tasks need less training than those whose jobs expose them to the most danger. OSHA believes that this provision will ensure that employers direct their training resources where they will provide the greatest benefit. At the same time, all employees will receive adequate training to protect them against the hazards they face in their jobs. OSHA notes, however, for employees who are currently provided the training required by existing § 1910.269, this training will be considered sufficient for compliance with proposed paragraph (b)(1)(iii). Proposed paragraph (b)(1)(iii) does not require employers to make changes to their training programs; rather it provides employers with options to tailor their training programs and resources to employees with particularly high-risk jobs.

Paragraph (b)(2) of proposed § 1926.950 contains additional requirements for the training of qualified employees. Because qualified employees are allowed to work very close to electric power lines and equipment and because they face a high risk of electrocution, it is important that they be specially trained. OSHA believes that qualified employees need to be extensively trained for them to perform their work safely. Towards this end, the proposal would require that these employees be trained in distinguishing live parts from other parts of electric equipment, in determining nominal voltages of lines and equipment, in the minimum approach distances set forth in the proposal, in the techniques involved in working on or near live parts, and in the knowledge necessary to recognize electrical hazards and the techniques to avoid these hazards.

OSHA believes that there is a need for all employees to be trained on a continuing basis. Initial instruction in safe techniques for performing specific job tasks is not sufficient to ensure that employees will use safe work practices all of the time. At OSHA's hearing on § 1910.269, Dr. Heinz Ahlers of NIOSH spoke about the effect of training on accidents, as follows:

> * * * I think in a majority of those instances, the fatality involved the worker who had been appropriately trained for the exposure that he subsequently came in contact with and just was not following what the training and the company policy had involved. [269–DC Tr. 47–48]

Continual reinforcement of this initial guidance must be provided to ensure that the employee actually uses the procedures he or she has been taught. This reinforcement can take the form of supervision, safety meetings, pre-job briefings or conferences, and retraining. Typically, adequate supervision can detect unsafe work practices with respect to tasks that are routine and are performed on a daily or regular basis. However, if an employee has to use a technique that is applied infrequently or that is based on new technology, some follow-up is needed to ensure that the employee is actually aware of the correct procedure for accomplishing the task. A detailed job briefing, as required under proposed § 1926.952(d)(2), may be adequate if the employee has previously received some instruction, but training would be necessary if the employee has never been schooled in the techniques to be used.

For these reasons, OSHA has supplemented the basic training requirements proposed in § 1926.950(b)(1) and (b)(2) with two additional requirements: (1) a requirement for regular supervision (that is, supervision that takes place on a periodic basis throughout the year) and an annual inspection by the employer to determine whether or not each employee is complying with the safety-related work practices required by Subpart V and (2) a requirement for additional training whenever

- The regular supervision or annual inspection indicates that the employee is not following the safety-related work practices required by the standard,
- New technology, new types of equipment, or changes in procedures necessitate the use of safety-related work practices that are different from those that the employee would normally use, or
- The employee must use safety-related work practices that are not normally used during his or her regular job duties.

These two provisions are contained in paragraphs (b)(3) and (b)(4).

The proposal includes a note indicating that the Agency considers tasks performed less often than once per year to require retraining before the task is actually performed. Instruction provided in pre-job briefings is acceptable if it is detailed enough to fully inform the employee of the procedures involved in the job and to ensure that he or she can accomplish them in a safe manner. OSHA believes that this requirement will significantly improve safety for electric power transmission and distribution workers.

Under paragraph (b)(5), the proposal would require classroom or on-the-job training or a combination of both. This allows employers to continue the types of training programs that are currently in existence. (See the discussion of Note 2 to paragraph (b)(7) for an explanation of how employers may treat previous training.)

An employee who has attended a single training class on a procedure that is as complex as the lockout and tagging procedure used in an electric generating plant has generally not been fully trained in that procedure. Unless a training program establishes an employee's proficiency in safe work practices and unless that employee then demonstrates his or her ability to perform those work practices, there will be no assurance that safe work practices will result. To address this problem, the Agency is proposing paragraph (b)(6), which reads as follows:

> 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.

The inclusion of paragraph (b)(6) and the demonstration of proficiency requirement contained in paragraph (b)(7), discussed later in this preamble, are intended to ensure that employers do not try to comply with § 1926.950(b) by simply handing training manuals to their employees. These provisions will require employers to take steps to assure that employees comprehend what they have been taught and that they are capable of performing the work practices mandated by the standard. OSHA believes that these two paragraphs will maximize the benefits of the training required under the standard.

The employer would be required, by paragraph (b)(7), to determine that each employee has demonstrated proficiency in the work practices involved. Until the employer makes this determination, the employee would not be considered as being trained. Employers relying on training provided by others are expected to take steps to verify that the employee has indeed received it. For example, an employer could call a previous employer or training facility or could check a union employee's journeyman lineman credentials. Alternatively, an employer could test the employee's knowledge of safe work practices. After these steps have been taken, the employer could then, based on visual observation of the employee, determine that that employee has been trained in accordance with the standard and has demonstrated proficiency in the work practices involved. A note following this paragraph explains that employee training records, which are maintained by many employers but which are not required by the standard, are one way of tracking when an employee has demonstrated proficiency. OSHA requests comments on whether the standard should require employers to record employee training.

Note 2 to paragraph (b)(7) describes how an employer may treat training that the employee has received previously (for example, through previous employment). If an employer can demonstrate that an employee has already been trained, the employer does not have to duplicate previous instruction provided that the employer: (1) Confirms that the employee has the job experience appropriate to the work to be performed, (2) through an examination or interview, makes an initial determination that the employee is proficient in the relevant safety-related work practices before he or she performs any work covered by this subpart, and (3) supervises the employee closely until that employee has demonstrated proficiency in all the work practices he or she will employ. OSHA believes that it is unnecessary to require employers to duplicate training the employee has received in the past. However, the Agency believes that it is important for the employer to take steps to ensure that the previous training was adequate for the work practices the employee will be performing. It is possible, for example, that an employee who has received training through an apprenticeship program was not trained in the specific grounding practices used by his or her current employer. The employer must determine where the gaps in the employee's training are and provide supplemental training to cover them. Otherwise, employees may follow different practices that endanger not only themselves but their coworkers as well. For example, a previously trained employee may have been instructed to wear rubber gloves and sleeves, but his or her current employer's practices require only rubber gloves but with the extra insulation on conductors as required by proposed § 1926.960(c)(2). This employee will be unlikely to install all the necessary insulation, increasing the risk to the employee and his or her coworkers.

Existing § 1910.269(a)(2)(vii) requires employers to certify that employees have received the training required under that section. The certification must be made when the employee demonstrates proficiency in the work practices involved. To reduce unnecessary paperwork burdens placed on employers, OSHA is proposing to eliminate the requirement to certify training. The Agency believes that compliance with the training requirements can be determined through employee interviews; thus, the certification requirement is unnecessary. OSHA does believe, however, that it is essential for the employee to demonstrate proficiency in the work practices involved before he or she is considered as having been trained satisfactorily. Therefore, as described earlier, the proposal includes this as a requirement. Comments are requested on whether or not the existing certification requirement in existing § 1910.269(a)(2)(vii) is necessary and on whether or not the proposed alternative will better protect employees.

The work covered by Subpart V is frequently done by an employer working under contract to an electric utility. Traditionally, electric utilities [14] have had a workforce that was sufficient for the day-to-day maintenance of the electric power generation, transmission, and distribution system. Electric utilities would hire contractors when the work to be performed went beyond routine maintenance. Thus, contractors typically would perform the following types of work: new transmission and distribution line construction, extensive transmission and distribution line renovation (such as the replacement of a large number of utility poles or the upgrading of the line to a higher voltage), line-clearance tree trimming, generation plant overhauls, and repair of extensive storm damage.

Contractors performing electric power generation, transmission, and distribution work experience a disproportionate share of fatal accidents in comparison to electric utilities. Table IV–3 presents the number of fatalities experienced by electric utilities and their major electrical contractors.

TABLE IV–3.—FATALITIES BY SIC

| SIC | Industry | Year | Number |
|---|---|---|---|
| 783 | Line-clearance tree-trimming contractors | 1991 | 4 |
| | | 1992 | 7 |
| | | 1993 | 9 |
| | | 1994 | 4 |
| | | 1995 | 2 |
| | | 1996 | 6 |
| | | 1997 | 4 |
| | | 1998 | 5 |
| Total | | | 41 |
| 1623 | Power Line Contractors | 1991 | 15 |
| | | 1992 | 12 |
| | | 1993 | 20 |
| | | 1994 | 21 |
| | | 1995 | 15 |
| | | 1996 | 11 |
| | | 1997 | 11 |
| | | 1998 | 12 |
| Total | | | 117 |
| 1731 | Electrical Contractors | 1991 | 5 |

[14] For the purposes of the discussion of § 1926.950(c), OSHA is using the term "electric utility" to include any employer who hires a contractor to work on that employer's electric power generation, transmission, or distribution facility.

TABLE IV–3.—FATALITIES BY SIC—Continued

| SIC | Industry | Year | Number |
|---|---|---|---|
| | | 1992 | 6 |
| | | 1993 | 13 |
| | | 1994 | 9 |
| | | 1995 | 9 |
| | | 1996 | 6 |
| | | 1997 | 8 |
| | | 1998 | 9 |
| Total | | | 65 |
| 4911 | Electric Utilities | 1991 | 33 |
| | | 1992 | 34 |
| | | 1993 | 28 |
| | | 1994 | 23 |
| | | 1995 | 36 |
| | | 1996 | 23 |
| | | 1997 | 20 |
| | | 1998 | 27 |
| Total | | | 224 |
| 4931 | Combination Utilities (e.g., Electric and Gas Utilities) | 1991 | 2 |
| | | 1992 | 7 |
| | | 1993 | 1 |
| | | 1994 | 1 |
| | | 1995 | 1 |
| | | 1996 | 2 |
| | | 1997 | 2 |
| | | 1998 | 1 |
| Total | | | 17 |
| Grand total | | | 464 |

Source: OSHA accident inspection data for the years 1991 through 1998.

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**Figure 1—Percent Fatalities by Industry Type**

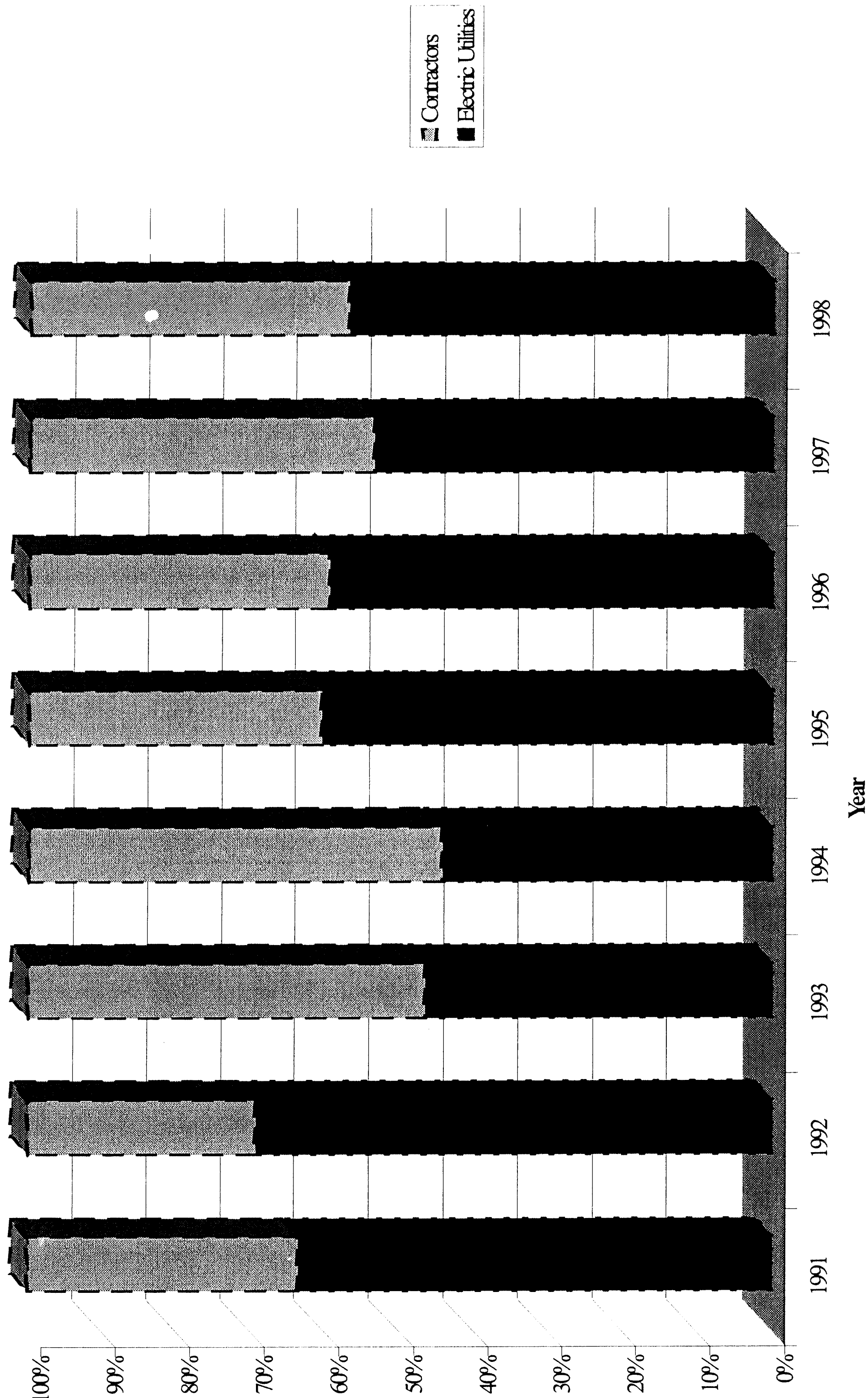


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Figure 1 shows the percentages of fatalities for the two groups. These figures demonstrate that, while the overall number of fatalities has not changed significantly, the proportion of fatal accidents has shifted from electric utilities to their contractors, with nearly half of the fatalities involving contractors.

The number of fatalities for the two industry groups does not tell the full story. To determine the relative risk faced by employees, OSHA must look at fatality rates, which represent the number of deaths per 1000 employees. Using employment data for 1997 from Section V, Preliminary Regulatory Impact Analysis and Initial Regulatory Flexibility Analysis, later in this preamble, the Agency has calculated fatality rates for electric utilities and their major contractors, as shown in Table IV–4.

TABLE IV–4.—FATALITY RATE BY INDUSTRY

| Year | Electric utilities | | Electrical contractors | | Line-clearance tree trimmers | |
|---|---|---|---|---|---|---|
| | 124408 Employees [1] | | 43472 Employees [2] | | 35020 Employees [3] | |
| | Number of fatalities | Fatality rate | Number of fatalities | Fatality rate | Number of fatalities | Fatality rate |
| 1991 | 35 | 0.28 | 20 | 0.46 | 4 | 0.11 |
| 1992 | 41 | 0.33 | 18 | 0.41 | 7 | 0.20 |
| 1993 | 29 | 0.23 | 33 | 0.76 | 9 | 0.26 |
| 1994 | 24 | 0.19 | 30 | 0.69 | 4 | 0.11 |
| 1995 | 37 | 0.30 | 24 | 0.55 | 2 | 0.06 |
| 1996 | 25 | 0.20 | 17 | 0.39 | 6 | 0.17 |
| 1997 | 22 | 0.18 | 19 | 0.44 | 4 | 0.11 |
| 1998 | 28 | 0.23 | 21 | 0.48 | 5 | 0.14 |
| Total | 241 | 0.24 | 182 | 0.52 | 41 | 0.15 |

[1] Source: "Analytical Support and Data Gathering for a Preliminary Economic Analysis for Proposed Standards for Work on Electric Power Generation, Transmission, and Distribution Lines and Equipment (29 CFR 1910.269 and 29 CFR 1926—Subpart V)," 2005, CONSAD Research Corp. (CONSAD), full-time equivalent employment for NAICS 221110, electric power generation, NAICS 221120, electric power transmission, control, and distribution, and NAICS 2211, publicly owned utilities, combined.
[2] Source: CONSAD, full-time equivalent employment for NAICS 234910, water, sewer, and pipeline construction, NAICS 234920, power and communication transmission line construction, and NAICS 235310, electrical contractors, combined.
[3] Source: CONSAD, full-time equivalent employment for SIC 0783, ornamental shrub and tree services.

As can be seen from this table, the fatality rates for contractors are more than double the comparable rate for electric utilities.

OSHA believes that, for the protection of all employees performing electric power generation,[15] transmission, and distribution work, it is essential that electric utilities hire contractors who have employees with the skills, knowledge, training, tools, and protective equipment necessary to perform this work safely. The safety of electric utility employees as well as the safety of contractor employees depends on this.

It is clear that the safety of contract employees is dependent on their skills, knowledge, training, tools, and protective equipment. The requirements of § 1926.950(b) generally ensure that all employees have the requisite skills and training. Other requirements in the standard, including §§ 1926.954, 1926.957, and 1926.960, address tools and protective equipment. However, these other provisions do not adequately address the employees' knowledge of the actual equipment they will be working on. For example, an employee might be trained in the climbing of concrete poles. Climbing these structures typically involves the attachment of temporary ladders into fittings on the concrete poles. An employee with the general type of training in climbing electric power transmission structures that contract employees typically receive might not be aware of the specific attachment and locking means used by the concrete poles and structures owned by the electric utility that hires the contractor. Without this knowledge, the employee could attach the temporary ladder incorrectly or fail to lock it in place properly with possibly fatal results.

In addition, several provisions in the standard would require the employer to assess certain hazards covered by the standard. For example, § 1926.960(g) would require employers to assess hazards associated with electric arcs. Contract employers need to have sufficient information about the electrical system so that they can perform these hazard assessments.

The facilities owned by an electric utility pose hazards to employees of contractors working on those facilities. For example, overhead electric power transmission and distribution lines and equipment owned by electric utilities pose serious fall, electrocution, and electric shock hazards. Employees exposed to such hazards need to be highly trained and skilled. If an electric utility hires a contractor who uses unqualified employees on those lines and equipment, the hazards posed by the utility's facilities will almost certainly lead to injuries. If the contract employees are working on a power line with the understanding that it is deenergized and if the contract employees do not fully understand the electric utility's procedures for deenergizing lines and equipment, then those employees could mistakenly believe that a line is deenergized when it is not, with possibly fatal results. Inadequate maintenance of an electric utility's facilities can also lead to unexpected hazards for contract employees.

The safety of electric utility employees is also affected by the contract employer's work. For example, a contractor's work could cause an overhead energized line to fall on a deenergized line on which an electric utility employee is working, creating hazards for the electric utility employee. Additionally, a contract employee who is not familiar with the utility's procedures for reenergizing lines and equipment might inadvertently remove a tag protecting an electric utility employee.

[15] Although Subpart V applies only to the construction of transmission and distribution installations, the same requirements on the duties of host and contract employers are being proposed in § 1910.269, which applies to the maintenance and operation of electric power generation installations in addition to transmission and distribution installations.

Although electric utility employees do not typically work with contract employees, sometimes they do work together. For example, it is common practice for contract employees and electric utility employees to work side-by-side during emergency restoration operations, such as those that follow a big storm. Additionally, contractors in electric power generation plants will be working near employees working full time in the plant.

It is clear from these examples that electric utility employers and contract employers must cooperate and communicate if all employees maintaining or constructing electric power generation, transmission, or distribution facilities are to be adequately protected. Thus, OSHA is proposing requirements in § 1926.950 for each type of employer to ensure the necessary exchange of information between electric utility and contract employers. The proposed requirements have been taken from similar provisions in the Agency's standard for Process Safety Management, § 1910.119(h).

Paragraph (c)(1) of proposed § 1926.950 would impose duties on host employers that hire contractors to perform work on the host employer's installations covered by Subpart V. Host employer is defined as ''[a]n employer who operates and maintains an electric power transmission or distribution installation covered by Subpart V of this Part and who hires a contract employer to perform work on that installation.'' This definition includes electric utilities and other employers who operate and maintain an electric power transmission or distribution installation. However, it does not include an employer who owns but does not operate and maintain such installations. The Agency believes that host employers who operate and maintain their electric power transmission and distribution installations have expertise in working safely on such installations. On the other hand, some entities may own but not operate or maintain these installations. These entities generally do not have the expertise necessary to work safely on transmission or distribution lines and equipment and would have little hazard-related knowledge to pass on to contractors. In addition, the employees of such entities would have little if any exposure to hazards created by a contract employer. Therefore, OSHA is proposing to exclude such entities from having to comply with proposed § 1926.950(c)(1). The Agency invites comments on whether excluding such employers from the host-contract employer provisions proposed in § 1926.950(c)(1) unduly jeopardizes employee safety and whether any of the provisions in that paragraph could reasonably be applied to such employers.

OSHA is also not proposing to extend the host-contract employer provisions to line-clearance tree-trimming contractors for work performed by line-clearance tree trimmers who are not qualified employees. Existing § 1910.269(a)(1)(i)(E) lists the paragraphs that apply to line-clearance tree-trimming, and OSHA is not proposing to add the host-contract employer provisions to that list. As noted earlier, the fatality rate for line-clearance tree-trimming contractors is lower than the rate for utilities. Thus, it appears that though line-clearance tree-trimming operations are relatively hazardous, they are still safer than power line construction, repair, and maintenance. On the other hand, if a line-clearance tree-trimming operation is performed by a qualified employee, then the host-contract employer provisions would apply. (*See* existing § 1910.269(a)(1)(i)(E)(1).) As long as they are using electrical protective equipment, these employees are permitted to come much closer to energized parts than unqualified employees, and the Agency believes that these employees face hazards similar to contract power line workers.[16] OSHA requests comments on whether excluding line-clearance tree-trimming contractors from the host-contract employer provisions proposed in § 1926.950(c)(1) unduly jeopardizes employee safety and whether any of the provisions in that paragraph could reasonably be applied to such employers.

Contract employer is defined as ''[a]n employer who performs work covered by Subpart V of this Part for a host employer.'' This includes painting contractors, line construction contractors, electrical contractors, and any other contractors working on the construction of electric power transmission and distribution lines.[17] It does not include contractors who might be present at a jobsite where some work performed is covered by Subpart V, but who are not performing any covered work.

Sometimes the host employer is aware of hazards that are present at its facilities of which the contractor might not be aware. For example, what appeared to be a static line on one electric utility's transmission system was energized at 4,000 volts. Static lines are typically grounded. An employee of a contractor, perhaps not understanding that the line was energized, contacted the static line and was electrocuted. Paragraph (c)(1)(i) of proposed § 1926.950 would address this problem by requiring the host employer to inform contract employers of any known hazards that the contractor or its employees might fail to recognize. This provision should ensure that the contractor will be able to take measures to protect its employees from hazards posed by the host employer's workplace. Although this provision would not require the host employer to inform the contract employer of hazards the contract employees should be expected to recognize, such as hazards posed by an overhead power line, the proposal would require the host employer to inform the contract employer of known hazards the contractor might not be aware of. For example, if a host employer knows that a particular manhole on its system is subject to periodic contamination from a nearby fuel tank, that information must be relayed to the contractor.

Proposed paragraph (c)(1)(i) also covers information that a contract employer would need to make any hazard assessments called for under the proposed standard. For example, proposed § 1926.950(d) would require employers to determine existing conditions related to the safety of the work being performed before work is started. Under paragraph (c)(1)(ii), the host employer would have to provide any system parameters that the contract employer would need to satisfy paragraph (d). These parameters could include such things as the nominal circuit voltage, maximum switching transient voltages, and the presence of any utility poles known by the host employer to have defects that could affect employee safety. This is the type of information that could affect the contractor's choice of work practices or could otherwise affect the safety of the contractor's employees. In addition, the contract employer would otherwise have difficulty obtaining much of this information, if it could be obtained at all.

Proposed paragraph (c)(1)(i) would not require the host employer to survey the contract work areas for hazards. For

[16] For a full discussion of why existing § 1910.269 applies different requirements to line-clearance tree-trimming operations depending on whether or not the operation is performed by a qualified employee, see the preamble to the final rule on electric power generation, transmission, and distribution work (January 31, 1994, 59 FR 4336).

[17] For § 1910.269, this definition also includes contractors working on an electric power generation installation covered by that section. This would include boiler maintenance contractors, conveyor servicing contractors, electrical contractors, and others.

example, this provision does not require the host employer to inspect utility poles for damage or defects before the contract employer starts working. The proposed rule would require instead that the host employer provide all relevant and known information to the contract employer. This paragraph does not require host employers to acquire additional unknown information but does require host employers to provide any information that was known by the host employer.

Proposed paragraph (c)(1)(ii) would require the host employer to report observed contract-employer-related violations of Subpart V to the contract employer. OSHA believes that host employers as a matter of course observe employees of the contract employer, from time to time, as they perform work under the contract. When the host employer observes contract employees violating this standard, it is important for the host employer to inform the contract employer so that the contractor can correct the violations and prevent them from occurring in the future. The contract employer is responsible for correcting these violations, but may not be aware of them. Thus, the proposal would require the host employer to report violations to the contract employer so that the contract employer will know to take corrective action.

Contracts between electric utilities and their contractors typically contain provisions requiring contractors to meet OSHA standards and other provisions addressing noncompliance with the terms of the contract. OSHA believes that host employers should take appropriate measures to enforce the terms of the contract with respect to safe work practices and get the contractor to fix any uncorrected violations. OSHA also believes that host employers should carefully review the contracts of contractors who fail to correct violations before renewing those contracts. The Agency requests comments on whether the standard should require these or other actions on the part of the host employer to promote compliance with OSHA standards.

Proposed paragraph (c)(2) addresses the responsibilities of the contract employer. Paragraph (c)(2)(i) would require the contract employer to instruct its employees in the hazards communicated to the contractor by the host employer. A note following this paragraph indicates that this instruction would be in addition to the training provided under § 1926.950(b). Proposed paragraph (c)(2)(i) would ensure that information on hazards the employees might face is conveyed to those employees. The hazard information provided by the host employer is essential to the safety of employees performing the work, especially because it includes information on hazards that the contract employees might not recognize. The contract employer would also be required, under proposed § 1926.950(b)(1)(ii), to train employees in work practices for their safety, as related to those hazards.

Proposed paragraph (c)(2)(ii) would require the contract employer to ensure that its employees follow the work practices required by the standard and the safety-related work rules imposed by the host employer. This proposed paragraph: (1) Recognizes that the contract employer has the responsibility for the actions of its employees, and (2) compels the contract employer to enforce compliance with safety and health rules imposed by the host employer as if they were requirements of the standard. The latter is particularly important. If the host employer has imposed safety-related work rules on its contractors, those rules are almost certain to impact the safety and health of employees of the host and contract employers. For example, electric utilities typically require contractors to follow the utilities' procedures for deenergizing electric circuits. If the contract employer's employees do not follow these procedures, a circuit the contractor's employees are working on might not be properly deenergized or a circuit the contractor was not working on might become reenergized. These hazards could cause the electrocution of the employees of either employer. OSHA invites comments on whether requiring a contractor to follow a host employer's safety-related work rules could possibly make the work more hazardous and, if so, how the standard should address this possibility.

Even work rules imposed primarily for reasons other than employee safety and health are likely to affect employee safety in one way or another. Work rules that address the way electric equipment is installed, for example, also affect the safety of the host employer's employees. If the equipment is installed improperly, it can fail when it is in use, possibly injuring an employee. Similarly, work rules imposed primarily for the protection of the public can also affect employee safety. For example, if a contractor's employees do not follow a rule that requires trailer loads to be tied down, employees at the host employer's facilities would be exposed to shifting or falling loads in the same way that members of the public would be. OSHA requests comments on whether host employers impose any work rules that do not significantly affect employee safety and examples of such work rules.

Proposed paragraph (c)(2)(iii) would require the contract employer to advise the host employer of: unique hazards posed by the contract employer's work; any unexpected hazards found while the contractor's employees were working; and the measures the contract employer took to correct host-employer-reported violations and to prevent them from recurring. This provision enables the host employer to take any necessary measures to protect its employees from hazards of which the host employer would not otherwise be aware. This will help protect the host employer's employees when they are working near the contractor's employees (for example, when responding to an emergency) and when the host employer's employees work on the same equipment after the contract employer departs. It will also provide essential feedback to the host employer on the safety performance of their contract employers. This feedback will also help host employers satisfy their obligations under the Agency's multiemployer enforcement policy (CPL 02–00–124).

OSHA's recognition of the need for employers on multiemployer worksites to share responsibility for workplace safety and health is reflected in the Agency's multiemployer enforcement policy. On multiemployer worksites, citations are normally issued not only to the employer whose employees are exposed to hazards (the exposing employer) but, depending on the actions the employer has taken to detect violations and protect employees, also to:

(1) The employer who creates the hazard (the creating employer);

(2) The employer who has the authority, by contract or practice, to ensure that the hazardous condition is corrected (the controlling employer); and

(3) The employer who has the responsibility for correcting the hazard (the correcting employer).

OSHA's proposed requirements concerning host employers and contractors do not affect the Agency's long-standing multiemployer enforcement policy. Neither § 1910.269(a)(4) nor § 1926.950(d) increase an employer's obligations or liability under that policy. Furthermore, nothing in the proposed rule changes OSHA's position'as expressed in CPL 02–00–124 and various court cases (*see,* for example, *Anning-Johnson* 94 O.S.H. Cas. (BNA) 1193), *Harvey Workover, Inc.* (7 O.S.H. Cas. (BNA) 1687))–that each employer is responsible for the health and safety of his or her own employees, and under certain circumstances may be cited for endangering the safety of another's employees. Because the proposed requirements will help increase communication between host employers and contractors about known hazards, however, the proposed requirements may help employers on multiemployer worksites meet their obligations under CPL 02–00–124, as noted earlier. In determining who to hold responsible under its multiemployer enforcement policy, OSHA will look at who created the hazard, who controlled the hazard, and whether all reasonable means were taken to deal with the hazard.

OSHA is not proposing to require the host employer to evaluate contract employers' safety performance. However, contract employers with poor safety performances are likely to jeopardize not only their own employees but employees of the host employer as well. Even when a host employer hires a contractor to perform jobs where employees of the host will not be present under normal circumstances, employees of the host employer will be present in some circumstances, such as during quality control inspections, in the aftermath of an accident, and during emergency restoration situations. In addition, the work performed by a contractor can affect the safety of employees of the host employer after the contractor is gone. (For example, if the contractor fails to secure a crossarm to a utility pole properly the crossarm could come down while an employee of the host employer is working on the pole.) Therefore, OSHA requests comments on the need to require host employers to evaluate the safety performance of their contractors.

Frequently, the conditions present at a jobsite can expose employees to unexpected hazards. For example, the grounding system available at an outdoor site could have been damaged by the weather or by vehicular traffic, or communications cables in the vicinity could reduce the approach distance to an unacceptable level. To protect employees from such adverse situations, the conditions present in the work area should be known so that appropriate action can be taken. Paragraph (d) of § 1926.950 would address this problem by requiring conditions existing in the work area to be determined before work is started. The language for this paragraph was based upon language in current § 1926.950(b)(1). A similar requirement can be found in ANSI C2–2002 (the NESC), Section 420D.

The conditions found as a result of compliance with this proposed paragraph would affect the application of various requirements contained within Subpart V. For example, the voltage on equipment will determine the minimum approach distances required under proposed § 1926.960(c)(1). Similarly, the presence or absence of an equipment grounding conductor will affect the work practices required under proposed § 1926.960(j). If conditions to which no specific Subpart V provision applies are found, then the employee would be trained, as required by proposed § 1926.950(b)(1)(ii), to use appropriate safe work practices.

OSHA does not intend to require employers to take measurements on a routine basis in order to make the determinations required by proposed § 1926.950(d). For example, knowledge of the maximum transient voltage level is necessary to perform many routine transmission and distribution line jobs safely; however, no measurement is necessary in the determination of what the maximum level is. It can be determined by an analysis of the electric circuit, or the employer can assume the default maximum transient overvoltages as discussed under proposed § 1926.960(c)(1). Similarly, employers can make determinations of the presence of hazardous induced voltages and of the presence and condition of grounds without taking measurements.[18]

Section 1926.951, Medical Services and First Aid

Section 1926.951 proposes requirements for medical services and first aid. Paragraph (a) of § 1926.951 emphasizes that the requirements of § 1926.50 apply. (*See* § 1926.950(a)(2).) Existing section 1926.50 includes provisions for available medical personnel, first aid training and supplies, and facilities for drenching or flushing of the eyes and body in the event of exposure to corrosive materials.

Because of the hazard of electric shock when employees are performing work on or with energized lines and equipment, electric power transmission and distribution workers suffer electrocution on the job. Many electric shock victims suffer ventricular fibrillation. Ventricular fibrillation is an abnormal, chaotic heart rhythm that prevents the heart from pumping blood and, if unchecked, leads to death. Cardiopulmonary resuscitation (CPR) is necessary in the event of electric shock so that injured employees can be revived. CPR must be started within 4 minutes to be effective in reviving an employee whose heart has gone into fibrillation.

To protect employees performing work on or associated with exposed lines or equipment energized at 50 volts or more, OSHA is proposing to require employees with first aid and CPR training to be available to render assistance in an emergency. CPR training would be required for field crews of two or more employees (a minimum of two trained employees) and for fixed worksites (enough trained employees to provide assistance within 4 minutes) in paragraphs (b)(1)(i) and (b)(1)(ii), respectively.

Paragraph (b)(1)(i) would allow employers to train all employees in CPR within 3 months of being hired in lieu of having two CPR-trained persons on every field crew. If the employer chose this alternative for field work, then only one CPR-trained employee would be required. In practice, crews with more than one person would normally have two or more CPR-trained employees on the crew, since all employees who had been working for an employer more than 3 months would be trained. However, employers who rely on seasonal labor (for example, those hired only in the summer months) might have two-person crews with only one CPR-trained employee for 3 months out of every year. Worse, that trained employee would likely be the employee directly exposed to electrical hazards, because new employees are typically hired as helpers working on the ground away from most electrical hazards. OSHA requests comments on whether allowing employers the option of training all their employees in CPR if they are trained within 3 months of being hired is sufficiently protective. The Agency also requests comments on how this provision could be revised to minimize burdens on employers while providing adequate protection for employees.

Someone must defibrillate a victim of ventricular fibrillation quickly to allow a normal heart rhythm to resume. The sooner defibrillation is started, the better the victim's chances of survival. If defibrillation is provided within the

[18] It may be necessary for measurements to be made if there is doubt as to the condition of a ground or the level of induced or transient voltage and if the employer is relying on one of these conditions to meet other requirements in the standard. For example, an engineering analysis of a particular installation might reveal that voltage induced on a deenergized line is considerable, but should not be dangerous. A measurement of the voltage is warranted if the employer is using this analysis as a basis for claiming that the provisions of proposed § 1926.964(b)(4) or hazardous induced voltage do not apply. In another case, further investigation would be warranted if an equipment ground is found to be of questionable reliability, unless the equipment is treated as energized under proposed § 1926.960(j).

first 5 minutes of the onset of ventricular fibrillation, the odds are about 50 percent that the victim will recover. However, with each passing minute, the chance of successful resuscitation is reduced by 7 to 10 percent. After 10 minutes, there is very little chance of successful rescue.

OSHA has chosen a 50 volts as a widely recognized threshold for hazardous electric shock. Although it is theoretically possible to sustain a life-threatening shock at this voltage, it is considered extremely unlikely. In addition, other OSHA and national consensus standards recognize this 50-volt threshold. For example, OSHA's general industry and construction electrical standards require guarding of live parts energized at 50 volts or more (§§ 1910.303(g)(2)(i) and 1926.403(i)(2)(i)), and the general industry electrical safety-related work practices standard requires electric circuits to be deenergized starting at 50 volts or more if electric shock is the only hazard (§ 1910.333(a)(1)). Similarly, the National Electrical Code and the National Electrical Safety Code impose electrical safety requirements starting at 50 volts.

Paragraph (b)(1) of proposed § 1926.951 would require CPR training to ensure that electric shock victims survive long enough for defibrillation to be efficacious. This paragraph would allow the employer to rely on emergency responders to provide defibrillation, which is necessary to revive a victim who has suffered ventricular fibrillation. A device that enables a CPR-trained individual to perform defibrillation is now widely available. This device is called an automated external defibrillator (AED). (See the Automated External Defibrillator FAQ.) OSHA requests public comments on whether the standard should require the employer to provide AEDs and, if so, where they should be required. Commenters recommending a requirement for AEDs should submit information on costs, safety, and efficacy of and experience with these devices.

BILLING CODE 4510–26–P

## Automated External Defibrillator FAQ

*What is an automated external defibrillator (AED)?*

An AED is a device about the size of a laptop computer that analyzes the heart's rhythm for any abnormalities and, if necessary, directs the rescuer to deliver an electric shock to the victim. This shock, called defibrillation, may help the heart to reestablish an effective rhythm of its own.

*How does an AED work?*

An AED is easy to operate. It uses prompts to instruct the rescuer. Once the machine is turned on, the rescuer will be prompted to apply two electrodes provided with the AED to the victim's chest. Once applied, the AED will begin to monitor the victim's heart rhythm. If a "shockable" rhythm is detected, the machine will charge itself and instruct the rescuer to stand clear of the victim and to press the shock button.

A microprocessor inside the defibrillator interprets (analyzes) the victim's heart rhythm through adhesive electrodes (some AED models require you to press an ANALYZE button). The computer analyzes the heart rhythm and advises the operator whether a shock is needed. AEDs advise a shock only to ventricular fibrillation and fast ventricular tachycardia. The electric current is delivered through the victim's chest wall through adhesive electrode pads.

*Why isn't cardio-pulmonary resuscitation (CPR) sufficient?*

Many electric shock victims suffer ventricular fibrillation (VF). VF is an abnormal, chaotic heart rhythm that prevents the heart from pumping blood. VF causes more cardiac arrests than any other rhythm (about 80 percent to 90 percent of cases). You must defibrillate a victim immediately to stop VF and allow a normal heart rhythm to resume. The sooner you provide defibrillation with an AED, the better the victim's chances of survival. If you provide defibrillation within the first 5 minutes of a cardiac arrest, the odds are about 50 percent that you can save the victim's life. However, with each passing minute during a cardiac arrest, the chance of successful resuscitation is reduced by 7 percent to 10 percent. After 10 minutes there is very little chance of successful rescue.

*Who can use an AED?*

In most cases, emergency medical technicians (EMTs) and first responders (police and firefighters) are required to know how to use an AED as part of their job responsibilities. Many CPR courses include AED training.

**Automated External Defibrillator FAQ (Continued...)**

*Can I buy an AED for my workplace?*

According to FDA rules, a physician prescription is needed in order to purchase an AED. This means that the medical director of a facility or a physician used by such facility must prescribe and oversee the AED program at any workplace or other facility that houses an AED.

*Will an AED always resuscitate someone in cardiac arrest?*

The AED treats only a heart in ventricular fibrillation (VF), an irregular heart rhythm. In cardiac arrest without VF, the heart does not respond to electric current but needs medication. The victim also needs breathing support. AEDs are less successful when the victim has been in cardiac arrest for more than a few minutes, especially if no CPR was provided.

*Is an AED safe to use?*

An AED is safe to use by anyone who has been trained to operate it. Studies have shown the devices to be 90 percent sensitive (able 90 percent of the time to detect a rhythm that should be defibrillated) and 99 percent specific (able 99 percent of the time to recommend not shocking when defibrillation is not indicated). Because of the wide variety of situations in which it will typically be used, the AED is designed with multiple safeguards and warnings before any energy is released. The AED is programmed to deliver a shock only when it has detected VF. However, potential dangers are associated with AED use. That is why training — including safety and maintenance — is important.

An AED will deliver a shock only when a shock is advised and the operator pushes the SHOCK button. This prevents a shock from being delivered accidentally.

**Automated External Defibrillator FAQ (Continued...)**

*What is the current treatment for ventricular fibrillation?*

The cardiac chain of survival is the current treatment for sudden cardiac arrest. The cardiac chain of survival is a series of four critical steps. All four steps of the chain must be present to help ensure survival from sudden cardiac arrest. The four steps are:

Step one: Early access to care (calling 911 or another emergency number);

Step two: Early cardiopulmonary resuscitation (CPR);

Step three: Early defibrillation;

Step four: Early advanced cardiac life support as needed.

The third step, early defibrillation, is recognized as the most critical step in restoring cardiac rhythm and resuscitating a victim of ventricular fibrillation.

*Sources*

This FAQ is based on information from the following sources:

American Heart Association:
http://www.americanheart.org/presenter.jhtml?identifier=3011859

Red Cross: http://redcross.org/services/hss/courses/aed.html

OSHA has adopted guidelines for the evaluation of first aid training by competent professionals as well as by compliance staff in the context of workplace inspections (OSHA instruction CPL 02-02-053). Because these guidelines are already in place, the Agency is not proposing requirements related to the content or adequacy of first aid or CPR training. The Agency will continue to use the guidelines in CPL 02-02-053 to determine the adequacy of first aid training courses provided to employees.

BILLING CODE 4510–26–C

OSHA has adopted guidelines for the evaluation of first aid training by competent professionals as well as by compliance staff in the context of workplace inspections (OSHA instruction CPL 02–02–053). Because these guidelines are already in place, the Agency is not proposing requirements related to the content or adequacy of first aid or CPR training. The Agency will continue to use the guidelines in CPL 02–02–053 to determine the adequacy of first aid training courses provided to employees.

In § 1926.951(b)(2), OSHA is proposing that first aid supplies required by § 1926.50(d) be placed in weatherproof containers if they could be exposed to the weather. This provision is intended to ensure that first aid supplies do not get ruined by exposure to the weather.

Paragraph (b)(3) of proposed § 1926.951 would require first aid kits to be maintained ready for use and inspected frequently enough to ensure that expended items are replaced. In any event, they would have to be inspected at least once a year. OSHA is proposing this provision to ensure that first aid kits are maintained with all of the proper equipment.

Section 1926.952, Job Briefing

In § 1926.952, OSHA is proposing a requirement for a job briefing to be conducted before each job. This section, which has no counterpart in existing Subpart V, is based upon § 1910.269(c).

Most of the work performed under the proposal requires planning in order to ensure employee safety (as well as to protect equipment and the general public). Typically, electric power transmission and distribution work exposes employees to the hazards of exposed conductors energized at thousands of volts. If the work is not thoroughly planned ahead of time, the possibility of human error is increased greatly. To avoid problems, the task sequence is prescribed before work is started. For example, before climbing a pole, the employee must determine if the pole is capable of remaining in place and if minimum approach distances are sufficient, and he or she must determine what tools will be needed and what procedure should be used for performing the job. Without job planning, the worker may not know or recognize the minimum approach distance requirements or may have to reclimb the pole to retrieve a forgotten tool or perform an overlooked task, resulting in increased exposure to the hazards of falling and contact with energized lines.

When more than one employee is involved, the job plan must be communicated to all the affected employees. If the job is planned but the plan is not discussed with the workers, one employee may perform his or her duties out of order or may otherwise not coordinate activities with the rest of the crew, endangering the entire crew. Employers performing electric power generation, transmission, and distribution work use job briefings before each job to plan the work and communicate the job plan to employees. Therefore, OSHA is requiring a job briefing before work is started.

Paragraph (c) of existing § 1910.269 contains a requirement for the employee in charge of the job to conduct the job briefing. OSHA has found in enforcing this paragraph that some employers were placing the entire burden of compliance with this rule on the part of the employee in charge of the work, whether or not that employee was a supervisor. Therefore, the Agency is proposing, in § 1926.952(a)(1), that the employer provide the employee in charge of a job with available information necessary to perform the job safely. The note following this provision indicates that the information provided by the employer is intended to supplement the training requirements of § 1926.950(b) and is likely to be more general in nature than the job briefing provided by the employee in charge. The note also clarifies that information covering all jobs for a day may be disseminated at the beginning of the day. The information does not need to be provided at the start of each job. OSHA understands that some employers assign jobs through a dispatcher, who does not have the knowledge necessary to provide a job briefing. The Agency thus invites comments on the appropriateness of this requirement and welcomes suggested alternative ways of requiring the employer to impart relevant knowledge about hazards relating to specific assignments in the job briefing process.

Paragraph (a)(2) contains the proposed requirement for the employee in charge of the job to conduct a job briefing. Proposed paragraph (b) would require the briefing to cover: hazards and work procedures involved, special precautions, energy source controls, and requirements for personal protective equipment. These two requirements have been taken from the introductory text of § 1910.269(c).

Under proposed paragraph (c)(1), at least one briefing would be required before the start of each shift. Only one briefing in a shift is needed if all the jobs are similar in nature. Additional planning discussions would be required for work involving significant changes in routine (proposed paragraph (c)(2)). For example, if the first two jobs of the day involve working on a deenergized line and the third job involves working on energized lines with live-line tools, separate briefings must be conducted for each type of job.

Under proposed paragraph (d)(1), the required briefing would normally consist of a concise discussion outlining the tasks to be performed. However, if the work is particularly hazardous or if the employees may not be able to recognize the hazards involved, then a more thorough discussion would be required by paragraph (d)(2). With this provision, OSHA recognizes that employees are familiar with the tasks and hazards involved with routine work. However, it is important to take the time to carefully discuss unusual work situations that may pose additional or different hazards to workers. (See also the preamble discussion of § 1926.950(b)(4).) OSHA has included a note following this paragraph to clarify that, regardless of how short the discussion is, the briefing must still touch on all the topics listed in paragraph (b).

OSHA recognizes the importance of job planning for all employees. Although work procedure discussions would not have relevance for an employee working alone, the Agency does not believe that an employee who labors alone needs to plan his or her tasks any less than one who is assisting others. OSHA is aware of several fatalities involving a lone employee who could have benefitted from better job planning or perhaps a briefing with the supervisor before the job started. Therefore, OSHA has included a requirement in proposed paragraph (e) for job planning for these employees.

Section 1926.953, Enclosed Spaces

The requirements being proposed in § 1926.953 have been taken from § 1910.269(e). Paragraph (e) of § 1910.269 applies to maintenance work performed in enclosed spaces, and OSHA believes that the requirements for performing construction work in these spaces should be the same.

Section 1926.953 contains requirements for entry into and work in enclosed spaces. An ''enclosed space'' is defined to be a space that has a limited means of entry or egress, that is designed for periodic entry by employees under normal operating conditions, and that is not expected to contain a hazardous atmosphere, but may contain one under unusual conditions. In this section, OSHA intends to cover only the types of enclosed spaces that are routinely entered by employees engaged in electric power transmission and distribution work and that are unique to underground utility work. Work in these spaces is part of the day-to-day activities performed by employees protected by this standard. Enclosed spaces include manholes and vaults that provide employees access to electric power transmission and distribution equipment. For reasons explained later, this section does not address other types of confined spaces, such as boilers, tanks, and coal bunkers, that are common to other industries as well. These locations are addressed in OSHA's generic permit-required confined space standard, § 1910.146, which applies to all of general industry, including industries engaged in electric power generation, transmission, and distribution work. OSHA is also developing a standard for confined space entry during construction work (RIN 1218–AB47).

Proposed § 1926.953 would apply to ''enclosed spaces.'' By definition, an enclosed space would be a permit-required confined space under § 1926.146. An enclosed space meets the definition of a confined space—it is large enough for an employee to enter; it has a limited means of access or egress; it is designed for periodic, rather than continuous, employee occupancy under normal operating conditions. An enclosed space also meets the definition of a permit space—although it is not expected to contain a hazardous atmosphere, it has the potential to contain one.

In the preamble to the permit-required confined spaces standard, OSHA acknowledged that ''the practices necessary to make confined spaces that merely have the potential to contain hazardous atmospheres (as opposed to one that contains a hazardous atmosphere under normal operating conditions) safe are widely recognized and used throughout various industries [58 FR 4486].'' The Agency recognized the electric power generation, transmission, and distribution industry as one of those industries (January 31, 1994, 58 FR 4489).

Section 1910.146 contains requirements that address hazards associated with entry into ''permit-required confined spaces'' (permit spaces). Section 1910.146 defines ''confined space'' and ''permit-required confined space'' as follows:

*Confined space* means a space that:

(1) Is large enough and so configured that an employee can bodily enter and perform assigned work; and

(2) Has limited or restricted means for entry or exit (for example, tanks, vessels, silos, storage bins, hoppers, vaults, and pits are spaces that may have limited means of entry.); and

(3) Is not designed for continuous employee occupancy.

*Permit-required confined space (permit space)* means a confined space that has one or more of the following characteristics:

(1) Contains or has a potential to contain a hazardous atmosphere;

(2) Contains a material that has the potential for engulfing an entrant;

(3) Has an internal configuration such that an entrant could be trapped or asphyxiated by inwardly converging walls or by a floor which slopes downward and tapers to a smaller cross-section; or

(4) Contains any other recognized serious safety or health hazard.

The permit-required confined space standard requires employers to implement a comprehensive confined space entry program. This standard covers the wide range of permit-required confined spaces encountered throughout general industry. Because the hazards posed by these spaces vary so greatly, § 1910.146 requires employers to implement a permit system for entry into them. The permit system must spell out the steps to be taken to make the space safe for entry and must include provisions for attendants stationed outside the spaces and for rescue of entrants, who could be disabled inside the space. However, an employer need not follow the permit-entry requirements of § 1910.146 for spaces where the hazards have been completely eliminated or for spaces where an alternative set of procedures are observed. The alternative procedures apply only where the space can be made safe for entry through the use of continuous forced air ventilation alone. The procedures, which are set forth in § 1910.146(c)(5)(ii), ensure that conditions within the permit space do not endanger an entrant's life or ability to rescue himself or herself.

OSHA believes that § 1910.146 is the proper place to regulate permit-required confined spaces other than enclosed spaces. The enclosed space requirements of the proposed rule are intended to regulate a portion of electric power transmission and distribution work that is routine and presents limited hazards to the qualified employees covered by Subpart V who are performing that work. An estimated 14,350 employees are engaged in underground transmission and distribution work (where most of the work covered by § 1926.953 occurs[19]).[20] Underground repair crews, in which these employees work, can typically expect to enter a manhole once or twice a day.[21] The enclosed space entry procedure addressed by § 1926.953 is a day-to-day part of the routine of these workers. This type of work is unique to underground utilities (such as electric, telephone, and water utilities), and the hazards presented by these spaces are widely recognized by these industries and their workers. Indeed, OSHA recognized this in promulgating § 1910.269 (January 31, 1994, 59 FR 4366).

Additionally, the hazards posed by the enclosed spaces covered in § 1926.953 are generally much more limited than the hazards posed by permit spaces addressed in § 1910.146 or in proposed § 1926.33. By definition, ''enclosed spaces'' are designed for employee occupancy during normal operating conditions. Electrical and other energy systems would not have to be shut down, nor would the space have to be drained of liquids for the employee to enter the space safely. On the other hand, other ''permit-required confined spaces,'' such as boilers, fuel tanks, and transformer and circuit breaker cases, are not designed for employee occupancy and require energy sources to be isolated and fluids to be drained from the space before an employee can safely enter.

The hazards posed by enclosed spaces consist of (1) limited access and egress, (2) possible lack of oxygen, (3) possible presence of flammable gases, and (4) possible presence of limited amounts of toxic chemicals. The potential atmospheric hazards are caused by an enclosed space's lack of adequate ventilation and can normally be controlled through the use of continuous forced air ventilation alone. Practices to control these hazards are widely recognized and are currently in use in electric, telecommunications, and other underground utility industries. Such practices include testing for the presence of flammable gases and vapors, testing for oxygen deficiency, ventilation of the enclosed space, controls on the use of open flames, and the use of an attendant outside the space. These practices are already

[19] Work in these spaces can be either maintenance work covered by Part 1910 or construction work covered by Part 1926. In fact, it is likely that both types of work are performed periodically over the course of time.

[20] ERG, ''Preparation of an Economic Impact Study for the Proposed OSHA Regulation Covering Electric Power Generation, Transmission, and Distribution,'' p. 8–8.

[21] *Id.*, p. 8–21.

required by § 1910.269(e) for the maintenance of electric power generation, transmission, and distribution installations. Section 1910.146, itself, recognizes permit spaces that are equivalent to enclosed spaces and sets separate provisions, similar to those contained in proposed § 1926.953, for those spaces.

Proposed paragraph (a) contains the scope of the enclosed space provisions. As previously noted, enclosed spaces are defined as spaces that have limited means of entry or egress, that are designed for periodic entry by employees under normal operating conditions, and that are not expected to contain hazardous atmospheres but may contain them under unusual conditions. These spaces include manholes and unvented vaults. This paragraph also notes (1) that § 1926.953 applies to routine entry into enclosed spaces in lieu of the permit-space entry requirements of § 1910.146, and (2) that the generic permit-required confined spaces standard, § 1910.146, applies to entries into enclosed spaces where the precautions taken under §§ 1926.953 and 1926.965 do not protect entrants.

The ventilation in vented vaults prevents a hazardous atmosphere from accumulating, so vented vaults are proposed to be excluded from coverage. However, the intake or exhaust of a vented vault could be clogged, limiting the flow of air through the vaults. The employee in such cases would be exposed to the same hazards as those presented by unvented vaults. Additionally, the mechanical ventilation for a vault may fail to operate. To ensure that the employee is protected from the hazards posed by lack of proper ventilation, the proposed rule exempts vented vaults only if a determination is made that the ventilation is in full operating condition. The determination must ensure that ventilation openings are clear and that any permanently installed mechanical ventilating equipment is in proper working order.

Some employers may want to comply with § 1910.146 for entry into enclosed spaces falling under § 1926.953. Because the provisions of § 1910.146 protect employees entering enclosed spaces to the same degree as § 1926.953, OSHA will accept compliance with § 1910.146 as meeting the enclosed space entry requirements of § 1926.953. A note to this effect has been included immediately following paragraph (a).

Paragraph (b) proposes the general requirement that employers ensure the use of safe work practices by their employees. These safe work practices must include procedures for complying with the specific regulations contained in paragraphs (e) through (o) and must include safe rescue procedures.

Proposed paragraph (c) would require employees who enter enclosed spaces or who serve as attendants to be trained in hazards associated with enclosed space entry, in the entry procedures, and in rescue procedures. This training will ensure that employees are trained to work safely in enclosed spaces and that they will be prepared in the event that an emergency arises within the space.

OSHA believes that there is a need for rescue equipment to be available in the event that an injured employee must be retrieved from the enclosed space. The Agency has decided to adopt a performance approach here and is proposing, in paragraph (d), that the employer provide equipment that will assure the prompt and safe rescue of injured employees. The equipment must enable a rescuer to remove an injured employee from the enclosed space quickly and without injury to the rescuer or further harm to the fallen employee. A harness, a lifeline, and a self-supporting winch can normally be used in this manner.

Some conditions within an enclosed space, such as high temperature and high pressure, make it hazardous to remove any cover from the space. For example, if high pressure is present within the space, the cover could be blown off in the process of removing it. To protect employees from such hazards, proposed paragraph (e) would require a determination of whether or not it is safe to remove the cover. This determination may take the form of a quick check of the conditions expected to 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. An evaluation must also be made of whether conditions at the site could cause a hazardous atmosphere to accumulate in the space. Any conditions making it unsafe for employees to remove the cover are required to be eliminated (that is, reduced to the extent that it is no longer unsafe). This provision is intended to require a check of whether the cover is hot, a determination of whether there were conditions in the area conducive to the formation of a hazardous atmosphere within the enclosed space, and a check (typically by means of loosening the cover slightly) of whether there was a hazardous pressure differential between the two sides of the cover. A note to this effect is included following proposed paragraph (e).

Proposed paragraph (f) would require that openings to enclosed spaces be guarded to protect employees from falling into the space and to protect employees in the enclosed space from being injured by objects entering the space. The guard could be in the form of a railing, a temporary cover, or any other temporary barrier that provides the required protection.

Proposed paragraph (g) would prohibit employees from entering enclosed spaces that contain a hazardous atmosphere. Once the hazardous atmosphere is removed (for example, by ventilating the enclosed space), employees would be allowed to enter. If an entry is to be made while a hazardous atmosphere is present, the entry is required to conform to the generic permit-required confined spaces standard, § 1910.146. The use of the term ''entry'' in this paragraph of § 1926.953 is consistent with the use of that term in § 1910.146, and OSHA is proposing to include the § 1910.146 definition of ''entry'' in Subpart V.

Proposed paragraph (h) addresses the use of an attendant outside the enclosed space to provide assistance in an emergency. An attendant would be required if a hazard exists because of traffic patterns near the opening. The purpose of the attendant would be to protect the entrant from traffic hazards while the entrant is entering or exiting the space and to provide assistance in an emergency. However, the attendant would not be precluded from performing other duties outside the enclosed space, as long as those duties do not interfere with the person's function as an attendant. The attendant would be required to have the first aid training required under § 1926.951(b)(1).

This proposed provision would require the attendant to remain outside the enclosed space during the entire entry procedure. The intent of this paragraph is to require the presence of a person with first aid training outside the enclosed space if a hazard exists due to traffic patterns outside the space. If this person were to enter the enclosed space, he or she might be unable to assist the employee already within the space. For example, if traffic hazards are present in the area of the opening to the enclosed space and if the attendant entered the space, then both the attendant and the workers he or she is intended to protect would be vulnerable upon leaving. No one would be present to minimize or control the traffic hazards. Therefore, the proposed rule explicitly states that the attendant is required to remain outside the enclosed space.

On the other hand, if no traffic hazards are present, an attendant would still be required under proposed § 1926.965(d) while work is being performed in a manhole or vault containing energized conductors. The major, though not the only, hazard in this case is that of electric shock. Assistance can be provided to a victim of electric shock by another person in the manhole or vault. Therefore, the provisions of § 1926.965(d)(2) would permit the attendant required under that paragraph to enter the manhole or vault for brief periods of time in nonemergency conditions when no traffic hazards are present.

Proposed paragraph (i) would require test instruments used to monitor atmospheres in enclosed spaces to be kept in calibration, with a minimum accuracy of ±10 percent. This will ensure that test measurements are accurate so that hazardous conditions will be detected when they arise. OSHA considers ±10 percent to be the minimum accuracy needed to detect hazardous conditions reliably. However, because proposed paragraph (i) would require the test instrument to be kept in calibration at all times, a higher accuracy might be necessary to keep the test instrument in calibration.

As noted earlier, because of the lack of adequate ventilation, enclosed spaces can accumulate hazardous concentrations of flammable gases and vapors, or an oxygen deficient atmosphere could develop. It is important to keep concentrations of oxygen and flammable gases and vapors at safe levels; otherwise, an explosion could occur while employees are in the space, or an oxygen deficiency could lead to the suffocation of an employee. Toward these ends, paragraphs (j), (k), (l), (m), (n), and (o) address the testing of the atmosphere in the space and ventilation of the space.

Proposed paragraph (j) would require the atmosphere in an enclosed space to be tested for oxygen and would require that the testing be done with a direct-reading meter or similar instrument. However, continuous forced air ventilation is permitted as an alternative to testing. Such ventilation would ensure that there is sufficient oxygen [22] in the enclosed space. (See also paragraph (m) for requirements relating to the length of time ventilation must be provided before employees are allowed to enter the space.)

Proposed paragraph (k) would require the internal atmosphere of the enclosed space to be tested for flammable gases and vapors. The results of the test must indicate that the atmosphere is safe before employees can enter. So that the results are accurate and are relevant to the atmosphere in the space at the time of employee entry, testing is required to be performed with a direct reading meter or similar instrument. Test equipment that samples the atmosphere so that the samples can be forwarded to a laboratory for analysis does not meet the requirements of this paragraph. The flammability test must be undertaken after the steps taken under paragraph (j) ensure that the enclosed space has sufficient oxygen for accurate results.

If flammable gases or vapors are detected or if an oxygen deficiency is found, proposed paragraph (l) would require the employer to provide forced air ventilation to assure safe levels of oxygen and to prevent a hazardous concentration of flammable gases or vapors from accumulating. As an alternative, an employer could use a continuous monitoring system that ensures that no hazardous atmosphere develops and no increase in flammable gas or vapor concentration occurs. The definition of hazardous atmosphere contains guidelines for the determination of whether or not the concentration of a substance is at a hazardous level. OSHA is including a note to this effect after paragraph (l). An identical note appears after paragraph (o).

Paragraph (m) proposes specific requirements for the ventilation of enclosed spaces. When forced air ventilation is used, it is required to be maintained before entry for a period of time long enough to purge the atmosphere within the space of hazardous amounts of flammable gases and vapors and long enough to supply an adequate concentration of oxygen. After the ventilation has been maintained for this amount of time, employees can then safely enter the space.

OSHA has decided not to specify a minimum number of air changes before employee entry into the enclosed space is permitted. Instead, the Agency places the burden on the employer to ensure that the atmosphere is safe before entry. The employer can discharge this duty either by testing to determine the safety of the atmosphere in the space or by a thorough evaluation of the air flow required to make the atmosphere safe. In this way, the safety of employees working in enclosed spaces will not be dependent on speculation by a supervisor or an employee.

Paragraph (m) would also require the air provided by the ventilating equipment to be directed at the area within the enclosed space where employees are at work. The forced air ventilation would be required to be maintained the entire time the employees are present within the space. These provisions would ensure that a hazardous atmosphere does not reoccur where employees are working.

In order to ensure that the air supplied by the ventilating equipment will provide a safe atmosphere, proposed paragraph (n) would require the air supply to be from a clean source and would prohibit it from increasing the hazards in the enclosed space. For example, positioning the air intake for the ventilating equipment near the exhaust from a gasoline or diesel engine would contaminate the atmosphere in the enclosed space. This practice would not be allowed under the proposal.

The use of open flames in enclosed spaces is safe only when flammable gases or vapors are not present in hazardous quantities. For this reason, proposed paragraph (o) would require additional testing for flammable gases and vapors if open flames are to be used in enclosed spaces. The tests would have to be performed immediately before the open flame device is used and at least once per hour while the device is in use. More frequent testing would be required if conditions indicate the need for it. Examples of such conditions include the presence of volatile flammable liquids in the enclosed space and a history of hazardous quantities of flammable vapors or gases in a given space.

## Section 1926.954, Personal Protective Equipment

Section 1926.954 proposes requirements for personal protective equipment (PPE), which includes eye and face protection, respiratory protection, head protection, foot protection, protective clothing, electrical protective equipment, and personal fall protection equipment. In accordance with § 1926.950(a)(2), paragraph (a) of proposed § 1926.954 emphasizes that the requirements of Subpart E of Part 1926 apply.

Paragraph (b) proposes requirements for personal fall protection systems. In paragraph (b)(1), OSHA is proposing that personal fall arrest systems meet the design, care, and use requirements of Subpart M of Part 1926. The note following proposed paragraph (b)(1) indicates that this provision applies to all personal fall arrest systems used in

[22] The definition of ''hazardous atmosphere'' determines what concentractions of oxygen are considered hazardous. (See the discussion of this term under the summary and explanation of § 1926.968 later in this preamble.) Paragraph (g) of proposed § 1926.953 would prohibit entry into an enclosed space while a hazardous atmosphere is present.

work covered by Subpart V. Thus, even if another construction standard requires the use of fall protection equipment, § 1926.954(b)(1) would require a personal fall arrest system to meet Subpart M when that form of fall protection is selected for use in work covered by Subpart V.

For example, § 1926.453(b)(2)(v) requires employees working from aerial lifts to wear a body belt with a lanyard attached to the boom or basket. Section 1926.453 sets the duty to provide fall protection but does not set criteria for the fall protection equipment to meet. Because the note following proposed § 1926.954(b)(1) would require fall arrest systems to meet Subpart M of Part 1926 and because Subpart M prohibits the use of body belts in fall arrest systems, a body belt worn by an employee performing electric power transmission or distribution work from an aerial lift could only be used as part of a restraint or tethering system, which would prevent the employee from falling.[23] (*See* the note following § 1926.453(b)(2)(v).)

The hazards of using a body belt as part of a fall arrest system are widely known and documented (54 FR 31449–31450; 59 FR 40703). Since the fall arrest forces are more concentrated for a body belt in comparison to a body harness, the risk of injury in a fall is much greater with a body belt. In addition, an employee can fall out of a body belt in a fall. Lastly, an employee faces an unacceptable risk of further injury while suspended in a body belt as he or she awaits rescue. Because of these hazards, paragraph (d) of § 1926.502, which sets requirements for personal fall arrest equipment in construction, has prohibited body belts from use in a personal fall arrest system since January 1, 1998; body harnesses must be used instead.

In paragraph (b)(2), OSHA is proposing revised requirements for work positioning equipment. Section 1926.959 of existing Subpart V contains requirements for body belts, safety straps, and lanyards. This equipment has traditionally been used as both work positioning equipment and fall arrest equipment in the maintenance and construction of electric power transmission and distribution installations. However, fall arrest equipment and work positioning equipment present significant differences in the way they are used and in the forces placed on an employee's body. With fall arrest equipment, an employee is given freedom of movement within an area restricted by the length of the lanyard or other device connecting the employee to the anchorage. In contrast, work positioning equipment is used to support an employee in position while he or she works. The employee ''leans'' into this equipment so that he or she can work with both hands free. If a fall occurs while an employee is wearing fall arrest equipment, the employee will free fall up to 1.8 meters (6 feet) before the slack is removed and the equipment begins to arrest the fall. In this case, the fall arrest forces can be very high, and they need to be spread over a relatively large area of the body to avoid injury to the employee. Additionally, the velocity at which an employee falls can reach up to 6.1 meters per second (20 feet per second). Work positioning equipment is normally used to prevent a fall from occurring in the first place. If the employee does slip and if the work positioning equipment is anchored, the employee will only fall a short distance (no more than 610 millimeters (2 feet)). This limits the forces on the employee and the maximum velocity. Additionally, because of the way the equipment is used, the employee should not be free falling. Instead, the work positioning equipment will be exerting some force on the employee to stop the fall. This will further limit the maximum force and velocity.

OSHA recognized the differences between the two types of equipment in Subpart M, Fall Protection for Construction. In this standard the two types of equipment are regulated separately, and different requirements apply to the two fall protection systems.

In this proposal, OSHA would again apply requirements to personal fall arrest systems that differ from those that apply to work positioning equipment. Personal fall arrest systems would have to meet Subpart M of Part 1926, as would be required by proposed § 1926.954(b)(1). Work positioning equipment would have to meet the requirements proposed in § 1926.954(b)(2). Employers engaged in electric power transmission and distribution work could use the same equipment for fall arrest and for work positioning provided the equipment met both sets of requirements. In fact, several manufacturers market combination body harness-body belts, which can be used as fall arrest systems by employees working on horizontal surfaces or as work positioning systems supporting employees working on vertical surfaces. OSHA requests comments on whether or not there are unique situations in electric power transmission and distribution work that warrant different requirements than those contained in existing Subpart M or in this proposal. Information is also requested on how any suggested changes will protect employees in an equivalent manner.

Proposed paragraph (b)(2) has been taken from existing § 1926.959 and from ASTM F887–04, *Standard Specifications for Personal Climbing Equipment,* which is the latest edition of the national consensus standard applicable to work positioning equipment. As in the proposed standard on electrical protective equipment (§ 1926.97) discussed earlier in this preamble, OSHA is proposing requirements derived from the ASTM standard but written in performance-oriented terms. Detailed specifications contained in the ASTM standard, which do not directly impact the safety of employees, have not been proposed. The Agency believes that this will retain the protection afforded by the ASTM standard, but will allow flexibility in meeting the OSHA standard and will accommodate changes in the ASTM standard without corresponding changes in the OSHA standard. Differences between the proposal and existing § 1926.959 are explained in the following discussion of paragraph (b)(2).

While the ASTM standard does not cover lanyards, proposed paragraph (b)(2) would apply many of the ASTM requirements to lanyards. Existing § 1926.959 imposes the same basic requirements on lanyards, and OSHA believes that lanyards used as work positioning equipment for electric power transmission and distribution work already meet these requirements. Comments are requested on whether or not any of the proposed requirements should not be applicable to lanyards used as work positioning equipment.

Proposed paragraph (b)(2)(i) would require hardware for body belts and positioning straps to be drop-forged, pressed, or formed steel or to be made of equivalent material. This hardware would also be required to have a corrosion-resistant finish. Surfaces would have to be smooth and free of sharp edges. This provision ensures that the hardware is strong enough to withstand the forces likely to be imposed, is durable, and is free of sharp

[23] The proposal would have a similar effect on work covered by § 1910.269. Paragraph (c)(2)(v) of § 1910.67 also contains a requirement for employees covered by the general industry standards to wear a body belt and lanyard when working from an aerial lift. Section 1910.67 sets the duty to provide fall protection but provides no criteria for the fall protection equipment to meet. The proposed note following § 1910.269(g)(1)(i) states that personal fall arrest systems used with aerial lifts must meet Subpart M of Part 1926. Thus, a body belt would not be permitted to be used as part of a personal fall arrest system for work from aerial lifts covered by § 1910.269.

edges that could damage attached positioning straps.

This requirement is equivalent to existing § 1926.959(a)(1), except that the existing standard does not permit hardware to be made of any material other than drop-forged or pressed steel. The ASTM standard requires hardware to be made of drop-forged steel. The drop-forged steel process produces hardware that more uniformly meets the required strength criteria and that is expected to retain its strength over a longer useful life. It is possible, however, for other processes to produce a product that is equivalent in terms of strength and durability. Additionally, § 1926.502(d)(1) and (e)(3) require ''connectors'' (that is, hardware) to be made of the same types of material as those specified in proposed § 1926.954(b)(2)(i). Therefore, OSHA is proposing to permit hardware to be made of alternative materials. Comments are invited on whether or not these alternative materials will provide adequate safety to employees.

Proposed paragraph (b)(2)(ii) would require buckles to be capable of withstanding an 8.9–kN (2,000-lbf) tension test with a maximum permanent deformation no greater than 0.4 millimeters (0.0156 inches). This is the same as existing § 1926.959(a)(2). The requirement is intended to ensure that buckles do not fail if a fall occurs.

Paragraph (b)(2)(iii) proposes that D rings be capable of withstanding a 22–kN (5,000-lbf) tensile test without cracking or breaking. This provision, which is equivalent to existing § 1926.959(a)(3), is intended to ensure that D rings do not fail if a fall occurs.

Proposed paragraph (b)(2)(iv) would require snaphooks to be capable of withstanding a 22–kN (5,000-lbf) tension test without failure. A note following this provision indicates that tensile failure is considered to be distortion of the snaphook sufficient to release the keeper.

Proposed paragraph (b)(2)(v) would prohibit the use of leather or leather substitutes from being used alone as a load bearing member in a body belt or positioning strap. Existing § 1926.959 contains no equivalent requirement. The proposed paragraph, which has been taken from ASTM F887–04, sections 14.2.1 and 15.2.1, is necessary because leather and leather substitutes do not retain their strength as they age. Because this loss in strength is not always easy to detect by visual inspection, it can lead to failure under fall conditions.

Proposed paragraph (b)(2)(vi) would require that plied fabric used in positioning straps and in load bearing portions of body belts be so constructed that raw edges are not exposed and that the plies do not separate. Existing § 1926.959 contains no similar requirement. Proposed paragraph (b)(2)(vi) has been taken from ASTM F887–04, sections 14.2.2 and 15.2.2. This requirement is intended to prevent plied fabric from separating, which could weaken a body belt or positioning strap and cause it to fail under load.

Although work positioning equipment used in electric power transmission and distribution work is not intended to be used as insulation from live parts, positioning straps could come into accidental contact with live parts while an employee is working. Thus, it is still important for this equipment to provide a certain level of insulation. Proposed paragraphs (b)(2)(vii)(A) and (b)(2)(vii)(B) would require positioning straps to be capable of passing dielectric and leakage current tests. This provision is equivalent to existing § 1926.959(b)(1). The voltages listed in these paragraphs are alternating current. The note following proposed paragraph (b)(2)(vii)(B) indicates that equivalent direct current tests would also be acceptable.

ASTM F887–04 does not require positioning straps to pass a withstand voltage test. Instead, it states in a note that the fabric used must pass a withstand voltage test.[24] OSHA invites comments on whether or not performing a withstand test on positioning straps is necessary for employee safety in electric transmission and distribution work.

Proposed paragraphs (b)(2)(vii)(C) and (b)(2)(vii)(D) would require positioning straps to be capable of passing tension tests and buckle tear tests. Existing § 1926.959 has no equivalent requirements. These tests, which have been taken from ASTM F887–04, sections 15.3.2 and 15.3.3, are intended to ensure that individual parts of positioning straps have adequate strength.

If an electric arc occurs while an employee is working, the work positioning equipment must be able to support the employee in case he or she loses consciousness. Additionally, the positioning strap or lanyard must be resistant to igniting, because, once ignited, it would quickly lose its strength and fail. Therefore, paragraph (b)(2)(vii)(E) would require positioning straps to be capable of passing a flammability test, which is described in Table V–1. This requirement and the test in Table V–1 itself has been taken from ASTM F887–04, section 15.3.4. Existing § 1926.959 contains no comparable provision.

Proposed paragraph (b)(2)(viii) would require the cushion part of a body belt to be at least 76 millimeters (3 inches) wide, with no exposed rivets on the inside. This requirement is essentially identical to existing § 1926.959(b)(2)(i) and (ii).

Existing § 1926.959(b)(2)(iii), which requires the cushion part of the body belt to be at least 0.15625 inches thick if made of leather, is not contained in the proposed rule. The strength of the body belt assembly, which is addressed by this existing specification, is adequately covered by the performance-based strength criteria contained in proposed § 1926.954(b)(2)(xii). Additionally, as noted previously, load bearing portions of the body belt would no longer be permitted to be constructed of leather alone under proposed paragraph (b)(2)(v).

Proposed paragraph (b)(2)(ix) would require that tool loops on a body belt be so situated that the 100 millimeters (4 inches) at the center of the back of the body belt are free of tool loops and any other attachments. This requirement, which has been taken from ASTM F887–04, section 14.4.3, is similar to existing § 1926.959(b)(3). It is intended to prevent spine injuries to employees who fall onto their backs while wearing a body belt.

Existing § 1926.959(b)(3) permits a maximum of four tool loops, and existing § 1926.959(b)(2)(iv) requires the belt to contain pocket tabs for the attachment of tool pockets. ASTM F887–04 contains a similar requirement for pocket tabs. OSHA does not believe that these two provisions are necessary for the protection of employees. These requirements ensure that body belts are suitable as tool belts and contribute to the usefulness of the body belt. However, they do not contribute significantly to the safety of employees; OSHA has thus not included similar requirements in the proposal.

Proposed paragraph (b)(2)(x) would require liners to be used around the bar of D rings. This provision, which is the same as existing § 1926.959(b)(4), is intended to prevent wear between the D ring and the body belt fabric. Such wear could contribute to failure of the body belt during use.

A snaphook has a keeper that is designed to prevent a D ring to which it is attached from coming out of the opening of the snaphook. (See Figure 2.) Nevertheless, if the design of the snaphook is not compatible with the design of the D ring, the D ring can roll

[24] It is not clear whether the ASTM provision is mandatory. Notes in ASTM standards are not supposed to contain requirements, but the particular note in question (Note 2 following section 15.3.1) uses the word ''shall,'' which normally indicates that the provision is mandatory.

around, press open the keeper, and free itself from the snaphook. (*See* Figure 3.)

**Figure 2—Snaphook**

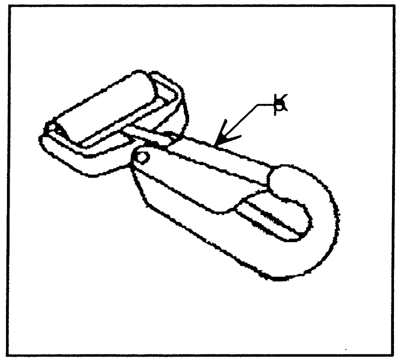
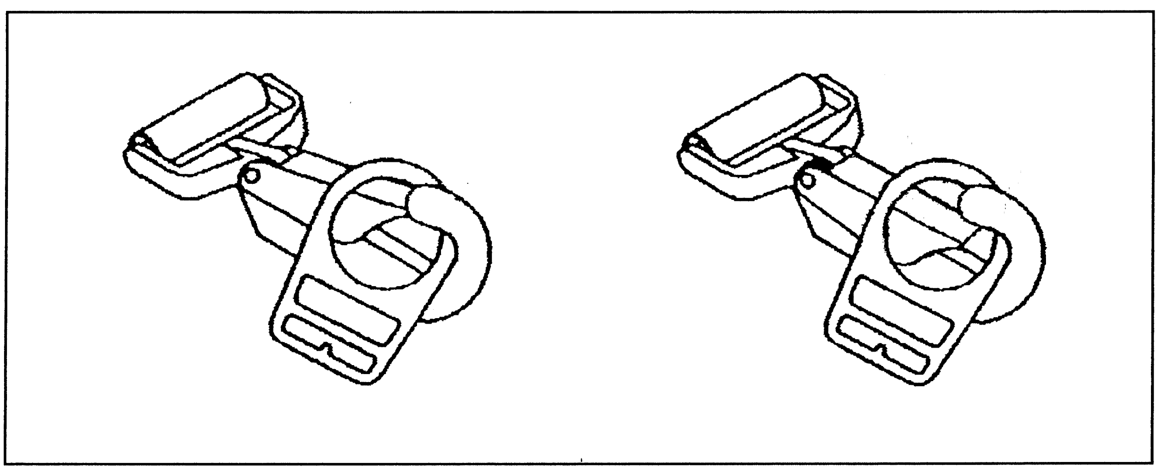


**Figure 3—Snaphook Rollout**



To address this problem, for many years, ASTM F887 had a requirement for snaphooks to be compatible with the D rings with which they are used. Even with this requirement, however, accidents resulting from snaphook roll-outs have still occurred. Several factors account for this. First, while one manufacturer can (and most do) thoroughly test its snaphooks and its D rings to ensure ''compatibility,'' no manufacturer can test its hardware in every conceivable combination with other manufacturers' hardware, especially since some models of snaphooks and D rings are no longer manufactured. While an employer might be able to test all the different hardware combinations possible with his or her existing equipment, the employer normally does not have the expertise necessary to run such tests in a comprehensive manner. Second, snaphook keepers can be depressed by objects other than the D rings to which they are attached. For example, a guy (a support line) could fall onto the keeper while an employee was repositioning himself or herself. This could allow the D ring to escape from the snaphook, and the employee would fall as soon as he or she leaned back into the work positioning equipment.

For these reasons, OSHA is proposing, in paragraph (b)(2)(xi), that snaphooks used as part of work positioning equipment be of the locking type. A locking-type snaphook will not open unless the employee releases its locking mechanism. Because their are thousands of existing non-locking snaphooks currently in use, OSHA is considering phasing in the requirement for older equipment or completely grandfathering existing equipment that otherwise complies with the proposal. The Agency requests comments on this.

OSHA is proposing three requirements for snaphooks to ensure that the keeper does not open without the intentional release of the employee using it. First, for the keeper to open, a locking mechanism would have to be released, or a destructive force would have to be placed on the keeper (paragraph (b)(2)(xi)(A)). Second, a force in the range of 6.6 N (1.5 lbf) to 17.6 N

(4 lbf) would be required to release the locking mechanism (paragraph (b)(2)(xi)(B)). Third, with a force on the keeper and with the locking mechanism released, the keeper would not be allowed to open with a force of 11.0 N (2.5 lbf) or less. Before the force exceeds 17.6 N (4 lbf), the keeper would have to begin to open (paragraph (b)(2)(xi)(C)). These requirements have been taken from ASTM F887–04, section 15.4.1. Paragraph (b)(2)(xi)(C), relating to the spring tension on the keeper, is the same as existing § 1926.959(b)(6).

Existing § 1926.959(b)(7) requires body belts, pole straps, and lanyards to be capable of passing a drop test, in which a test load is dropped from a specified height and the work positioning equipment arrests the fall. The test consists of dropping a 113.4-kg (250-lbm) bag of sand a distance of either 1.2 meters (4 feet) or 1.8 meters (6 feet), respectively for pole straps and lanyards.

The use of a bag of sand to represent a human body is one way to test work positioning equipment. However, because the bag of sand can be fitted with the body belt in different ways, the results of the test may not be consistent among different testing laboratories. To overcome this, ASTM 887–04 has adopted a drop test that uses a rigid steel mass of a specified design. To compensate for differences between a rigid mass and the more deformable human body, the ASTM standard uses a lower test mass, 100 kg (220 lbm), and a shorter drop height, 1 meter (39.4 inches). OSHA believes that the ASTM test is equivalent to the existing OSHA test. OSHA also believes that adoption of the ASTM test, because it will result in more uniform testing, will better protect employees. Therefore, the Agency is proposing to replace the sand bag drop test given in existing § 1926.959(b)(7) with a less-detailed version of the ASTM test in proposed § 1926.954(b)(2)(xii). OSHA requests comments on whether this change is reasonable and appropriate.

Proposed paragraph (b)(2)(xii)(A) would require the test mass to be constructed of steel or equivalent material having a mass of 100 kg (220.5 lbm). This mass is comparable to the 113.4-kg (250-lbm) bag of sand given in the existing OSHA standard. Even though the test mass is lighter than a heavy power line worker, the required test method places significantly more stress than an employee of the same mass because the test drop is 0.3 meters (1.28 feet) more than the maximum permitted free fall distance and because the test mass is rigid. OSHA believes that this test indicates that a body belt is sufficiently strong for the heaviest line worker who will use it, even those substantially heavier than the test mass. However, the Agency requests comments on whether the proposed test is adequate.

Proposed paragraphs (b)(2)(xii)(B) and (b)(2)(xii)(C) give the attachment means for body belts and for positioning straps, respectively. These provisions would ensure that the work positioning equipment being tested is properly attached to the test apparatus.

Proposed paragraph (b)(2)(xii)(D) would require the test mass to be dropped a distance of 1 meter (39.4 inches). This is equivalent (given the rigid test mass) to the existing standard's test distance of 1.2 meters (4 feet) for pole straps. Existing § 1926.959 requires lanyards to pass a 1.8-meter (6-foot) drop test. However, that standard sets no limit on the free fall distance required for the work positioning equipment covered under that standard. The drop distance was based primarily on the accepted practice of allowing a 1.8-meter (6-foot) maximum drop into a body belt-lanyard combination or a 0.6- or 0.9-meter (2-or 3-foot) maximum drop into a body belt-pole strap combination. Proposed paragraph (b)(3)(iv) specifies a 0.5-meter (2-foot) maximum free fall distance, eliminating the need to drop test lanyards at more than 1.2 meters (4 feet).

Proposed paragraphs (b)(2)(xii)(E) and (b)(2)(xii)(F) specify acceptance criteria for tested equipment. Body belts would have to arrest the fall successfully and be capable of supporting the test mass after the test. Positioning straps would have to arrest the fall successfully without allowing an arresting force exceeding 17.8 kN (4,000 lbf). Additionally, snaphooks on positioning straps would not be permitted to have distorted sufficiently to allow release of the keeper.

Three notes apply to paragraph (b)(2).[25] The first note indicates that paragraph (b)(2) applies to all work positioning equipment used in work covered by Subpart V.

The second note indicates that body belts and positioning straps that conform to ASTM F 887–04 are deemed to be in compliance with the manufacturing and construction requirements of paragraph (b)(2) of this section provided that the body belt or positioning strap also conforms to paragraphs (b)(2)(iv), which contains a more stringent strength requirement than ASTM F887–04, and (b)(2)(xi), which requires snaphooks to be of the locking type. OSHA's proposal is based on this ASTM standard; and, with the exception of those two provisions, is consistent with that consensus standard.

The third note indicates that body belts and positioning straps meeting existing § 1926.502(e) on positioning device systems are deemed to be in compliance with the manufacturing and construction requirements of paragraph (b)(2) of proposed § 1926.954 provided that the body belt or positioning strap also conforms to proposed § 1926.954(b)(2)(vii). This provision requires positioning straps to pass certain electrical and flame-resistance tests. It also requires positioning straps to withstand a tension test and a buckle tear test. These tests ensure that positioning straps have suitable electrical and mechanical properties to withstand the stresses that can be imposed by power line work. Body belts and positioning straps that are parts of positioning device systems addressed by § 1926.502(e) serve the same function as work positioning equipment in proposed Subpart V. OSHA believes that body belts and positioning straps that meet the design criteria specified by § 1926.502(e) will generally be sufficiently strong for power line work. However, to be fully suitable for power line work, positioning straps should also meet the electrical, flame-resistance, and other characteristics proposed in § 1926.954(b)(2)(vii).

The Agency believes that the last two notes to proposed § 1926.954(b)(2) will help manufacturers determine whether or not their equipment meets the OSHA standard. Employers will thus be able to determine, in most instances, whether or not work positioning equipment meets the OSHA standard without having to conduct their own tests.

Proposed paragraph (b)(3) addresses the care and use of fall protection equipment. Fall protection equipment provides the maximum intended safety only when it is properly used and maintained. Existing Subpart V recognizes this fact in § 1926.951(b)(3). Existing § 1926.951(b)(1) requires the use of fall protection equipment when employees are working at elevated locations on poles, towers, and similar structures; § 1926.951(b)(3) requires this equipment to be inspected before use each day. While it has carried these requirements forward into the proposal, OSHA believes that these requirements must be supplemented by additional requirements so that employees will be fully protected from fall hazards faced during electric power transmission and distribution work. Therefore, OSHA is proposing requirements from § 1910.269(g)(2) and from § 1926.502(e)

[25] These notes appear immediately after paragraph (b)(2)(xii)(F).

relating to the care and use of fall protection equipment.

Proposed paragraph (b)(3)(i) would require work positioning equipment to be inspected before use each day to determine if the equipment is safe for use. (Paragraph (d)(21) of § 1926.502 contains an equivalent requirement for fall arrest equipment to be inspected before use.) This paragraph would prohibit defective equipment from being used. This requirement helps ensure that the protective equipment in use will, in fact, be able to protect employees when called upon to do so. This requirement is equivalent to existing § 1926.951(b)(3), except that the prohibition on the use of defective equipment is stated explicitly rather than being implied. A thorough inspection of fall protection equipment can detect such defects as cracked snaphooks and D rings, frayed lanyards, loose snaphook keepers, and bent buckles. A guide to the inspection of this equipment is included in Appendix G.

Proposed paragraph (b)(3)(ii) would require personal fall arrest systems to be used in accordance with § 1926.502(d).

Personal fall arrest equipment is sometimes used as work positioning equipment during electric power transmission and distribution work. So that the employee can comfortably lean into the body harness when the equipment is used in this fashion, the normal attachment point would be at waist level. Paragraph (d)(17) of § 1926.502 requires the attachment point for body harnesses to be located in the center of the employee's back near shoulder level or located above his or her head. Such an attachment point would prevent the employee from performing his or her job. Therefore, OSHA is proposing to exempt personal fall arrest equipment used as work positioning equipment from this requirement, if the equipment is rigged so that the maximum free fall distance is 0.6 meters (2 feet). This exemption is proposed in paragraph (b)(3)(ii).

Proposed paragraph (b)(3)(iii) would require the use of a personal fall arrest system or work positioning equipment to be used to protect employees working at elevated locations more than 1.2 meters (4 feet) above the ground on poles, towers, and similar structures if other fall protection has not been provided. The term ''similar structures'' includes any structure that supports electric power transmission or distribution lines or equipment, such as lattice substation structures and H-frame wood transmission structures. The use of fall protection equipment would not be required while a qualified employee is climbing or changing location on a structure if the structure is safe to climb. The proposal lists examples illustrating when the structure would be unsafe to climb without fall protection: the presence of ice or high winds, structure designs that could cause the employee to fall, and the presence of contaminants on the structure that could cause the employee to lose his or her grip or footing.

Two informational notes follow proposed paragraph (b)(3)(iii) explain certain aspects of the proposed provision. The first note indicates that this requirement would not apply to portions of buildings, electric equipment, or aerial lifts. This note refers to the relevant portion of the construction standards that would apply in those instances (that is, Subpart M for walking and working surfaces generally and § 1926.453 for aerial lifts). The first note applies only to the ''duty'' requirement in paragraph (b)(3)(iii) to use fall protection equipment; it does not apply to other fall protection requirements in § 1926.954.

The second note indicates that employees who have not completed training in climbing or in the use of fall protection equipment would not be considered to be ''qualified'' for the purposes of paragraph (b)(3)(iii). These employees, who have not demonstrated that they can safely climb structures without using fall protection, would need fall protection anytime they are more than 1.2 meters (4 feet) above the ground.

Proposed paragraph (b)(3)(iii), which is comparable to existing § 1926.951(b)(1), is based on § 1910.269(g)(2)(v). After analyzing the extensive record built on fall protection during the § 1910.269 rulemaking, OSHA concluded that employees could safely climb and change location on poles, towers, and similar structures without the use of fall protection equipment. OSHA has carried the general industry standard's fall protection requirements forward into proposed Subpart V with two changes. First, the term ''fall arrest equipment'' has been changed to ''personal fall arrest system'' for consistency with other OSHA fall protection standards (notably Part 1926, Subpart M). Second, and more significantly, OSHA is proposing to omit the use of travel restricting equipment as a recognized fall protection system for electric power transmission and distribution work. OSHA originally proposed to recognize this equipment in § 1910.269(g)(2)(v); no comments in the rulemaking record suggested leaving it out of the final general industry standard. However, travel restricting equipment is more appropriate for work on open-sided platforms, where employees can walk around the working surface with the travel restricting equipment keeping them from approaching too close to an unguarded edge. The Agency does not believe that this type of working surface is found on poles, towers, or similar structures. Therefore, the inclusion of travel restricting equipment in fall protection requirements for work performed on these structures is inappropriate.[26] OSHA invites comments on whether or not travel restricting equipment should be recognized in § 1926.954(b)(3)(iii) and on whether or not electric power transmission and distribution structures contain open-sided platform-like working surfaces.

It should be noted that the conditions listed in paragraph (b)(3)(iii) are not the only ones warranting the use of fall protection. Other factors affecting the risk of an employee's falling include the level of competence of the employee, the condition of a structure, the configuration of attachments on a structure, and the need to have both hands free for climbing. In fact, OSHA believes that climbing without the use of fall protection is only safe if the employee is using his or her hands to hold onto the structure while he or she is climbing. If the employee is not holding onto the structure (for example, because the employee is carrying tools or equipment in his or her hands), fall protection is required under the final rule. Video tapes entered into the § 1910.269 rulemaking record by EEI (269–Ex. 12–6),[27] which they claimed represented typical, safe climbing practices in the utility industry, demonstrate employees using their hands to provide extra support and balance. Climbing in this manner will enable an employee to continue to hold onto the structure in case his or her foot slips. If the employee is not using his or her hands for additional support, he or she would be much more likely to fall as a result of a slip.

The general industry electric power generation, transmission, and distribution standard, in § 1910.269(g)(2)(v), requires the use of fall protection systems when work is performed at heights more than 1.2 meters (4 feet) above the ground. The existing standards in Subpart M of Part

[26] OSHA is also proposing to omit the use of travel restricting equipment as an acceptable form of fall protection in § 1910.269(g)(2) for employees working from poles, towers, and similar structures.

[27] Exhibits in the § 1910.269 rulemaking record (denoted as ''269–Ex'') can be found in Docket Number S–015.

1926 require fall protection (usually in the form of guard rails) for situations where employees are exposed to falls of more than 1.8 meters (6 feet). Additionally, in existing § 1926.951(b)(1), OSHA requires fall protection to be used by ''employees working at elevated locations'' without specifying the height at which such protection would be necessary. The Agency is proposing to retain the Subpart V requirement, but clarify it as requiring protection to be initiated at 1.2 meters (4 feet) to be consistent with § 1910.269(g)(2)(v), which deals with the same hazard. Comments are requested on whether or not the § 1910.269 distance of 1.2 meters (4 feet) is appropriate for electric power transmission and distribution construction work.

Work positioning equipment is intended to be used with the employee leaning into it, with the equipment supporting the employee and keeping him or her from falling. During work on towers and horizontal members on poles (such as crossarms), however, the employee sometimes stands or sits on a structural member, and the work positioning equipment is not providing any support for the employee. In such cases, the work positioning equipment is functioning more like personal fall arrest equipment. OSHA has previously concluded that body belts, which can be used as part of work positioning equipment, are not suitable for use as part of a personal fall arrest system.

Paragraph (e)(1) of § 1926.502 limits the maximum free fall distance for work positioning systems to 0.6 meters (2 feet). OSHA is adopting this same limit in § 1926.954. However, in electric power transmission and distribution work, anchorages are not always available. Many utility poles provide no attachment points lower than the lowest crossarm. If an employee is working below the crossarm, there will be nothing to which he or she can attach the work positioning equipment. The work positioning equipment is still providing a certain degree of fall protection, even in this case. The equipment holds the employee in a fixed work position and keeps him or her from falling. Therefore, proposed paragraph (b)(3)(iv) would require work positioning equipment to be rigged so that the employee can free fall no more than 0.6 meters (2 feet), unless no anchorage is available.

OSHA requests comments on whether or not this requirement will provide sufficient protection for employees, on what portable devices (such as a Pole Shark,[28] Pole Choker,[29] or similar devices) can be used as suitable anchorages, and on what alternative measures can be taken to protect employees.

Proposed paragraph (b)(3)(v) would require anchorages used with work positioning equipment to be capable of sustaining at least twice the potential impact load of an employee's fall or 13.3 kN (3,000 lbf), whichever is greater. This provision, which has been taken from § 1926.502(e)(2), is intended to ensure that an anchorage will not fail when called upon to stop an employee's fall. It should be noted that, under proposed paragraph (b)(3)(iv), the employee is not required to be tied to an anchorage if one is not available.

In paragraphs (b)(3)(vi), OSHA is proposing that snaphooks on work positioning equipment not be engaged to any of the following:

(1) Webbing, rope, or wire rope;
(2) Each other;
(3) A D ring to which another snaphook or other connector is attached;
(4) A horizontal lifeline; or
(5) Any object which is incompatibly shaped or dimensioned in relation to the snaphook such that unintentional disengagement could occur by the connected object being able to depress the snaphook keeper and release itself.

These provisions, which have been taken from § 1926.502(e)(8), prohibit methods of attachment that are considered unsafe because of the potential for accidental disengagement of the snaphooks during use.

Section 1926.955, Ladders and Platforms

Proposed § 1926.955 addresses ladders and platforms. Paragraph (a) notes that requirements for portable ladders are contained in Subpart X of the construction standards and apply to work covered by Subpart V, except as noted in proposed § 1926.955(b). This paragraph also proposes that the requirements for ladders in Subpart D of Part 1910 apply to fixed ladders used in electric power transmission and distribution construction work. Fixed ladders used in electric power transmission and distribution construction work are also considered fixed ladders under Subpart D of the General Industry Standards when used during normal maintenance activities. OSHA believes that the Part 1910, Subpart D standards should also apply during construction work. It should be noted that OSHA has proposed a revision of Subpart D of the General Industry Standards (April 10, 1990, 55 FR 13401). The Agency requests comments on whether the proposed incorporation of the general industry standard for fixed ladders is warranted, especially in light of the proposed revision of Subpart D.

Paragraph (b) proposes requirements for special ladders and platforms used for electrical work. Because of the nature of overhead line work and the limitations of structures available for ladder support, OSHA is proposing to exempt portable ladders and platforms used on structures or on overhead lines from the general provisions of §§ 1926.1053(b)(5)(i) and (b)(12), which deal with ladder support and placement. An example of these exempted ladders is a portable hook ladder used by power line workers to work on overhead power lines. These ladders are hooked over the line or other support member and are lashed in place at both ends to keep them steady while employees are working from them.

To provide employees with protection that approximates that afforded by the ''exempted'' Subpart X provisions, paragraphs (b)(1) through (b)(4) would apply to these special types of ladders and platforms. The proposed requirements provide that these special ladders and special platforms be secured, specify the acceptable loads and proper strength of this equipment, and provide that they be used only for the particular types of application for which they are designed. (The ratings and design of this equipment are specified by the manufacturer and can usually also be found in standard references, such as ASTM F 1564–95, *Standard Specification for Structure-Mounted Insulating Work Platforms for Electrical Workers.* See Appendix E to proposed Subpart V.) In the § 1910.269 rulemaking, OSHA concluded that these alternative criteria provide for the safe use of this special equipment, and the Agency is proposing to extend the application of these alternative criteria to work covered under Subpart V.

In § 1926.955(c), OSHA is proposing to prohibit the use of portable metal and other portable conductive ladders near exposed energized lines or equipment. This paragraph addresses the hazard to employees of contacting energized lines and equipment with conductive ladders. However, in specialized high-voltage work, the use of nonconductive ladders could present a greater hazard to employees than the use of conductive ladders. In such situations, the

[28] A Pole Shark is a device that uses jaws and a spur wheel to grip the pole and provide an anchorage for climbing wood poles.

[29] A Pole Choker is a pole strap with an integrated choker strap. The choker strap is tightened against the pole to prevent the pole strap from sliding down the pole.

clearances between live parts operating at differing voltages and between the live parts and grounded surfaces are large enough that it is relatively easy to maintain the minimum approach distances required by proposed § 1926.960(c)(1). Voltage is induced on objects in the vicinity of these high-voltage lines. Using a conductive ladder can minimize the voltage differences between objects [30] within an employee's reach, reducing the hazard to the employee. Therefore, the proposal would require a conductive ladder to be used where an employer can demonstrate that the use of a nonconductive ladder would present a greater hazard.

Section 1926.956, Hand and Portable Power Tools

Proposed § 1926.956 addresses hand and portable power tools, as stated in paragraph (a). Portable and vehicle-mounted generators supplying cord-and plug-connected equipment are also covered by this proposed section. These requirements have been taken from § 1910.269(i). Existing Subpart V contains requirements for hydraulic and pneumatic tools in §§ 1926.950(i) and 1926.951(f). These requirements have been retained in proposed § 1926.956(d).

Electric tools connected by cord and plug would be required to meet paragraph (b). If the equipment is supplied by the wiring of a building or other premises, existing Subpart K of Part 1926 would continue to apply, under proposed § 1926.956(b)(1), as it does now. If premises wiring is not involved (in which case Subpart K does not currently apply), paragraph (b)(2) would require that the tool frame be grounded or that the tool be double insulated or that the tool be supplied by an isolating transformer with ungrounded secondary. Any of these three methods can protect employees from electric shock, which could directly injure the employee or which could cause an involuntary reaction leading to a secondary injury. Given the widespread availability of double-insulated tools, OSHA requests comments on whether the option permitting tools to be supplied through an isolating transformer is still necessary.

Paragraph (c) of proposed § 1926.956 would require that portable and vehicle-mounted generators provide a means for grounding cord- and plug-connected equipment and allows the frame of the generator to serve as the grounding electrode (reference ground). Paragraph (c)(4) would require the neutral conductor to be bonded to the generator frame. These proposed requirements are based on existing § 1926.404(f)(3).

Proposed paragraph (d) would apply to pneumatic and hydraulic tools.

Paragraph (d)(1) of § 1926.302 requires hydraulic fluids to be fire resistant. Insulating hydraulic fluids are not inherently fire resistant and additives that could make them fire resistant generally make the hydraulic fluid unsuitable for use as insulation. Because of this and because hydraulic fluids must be insulating to protect employees performing power transmission and distribution work, existing § 1926.950(i) exempts insulating hydraulic fluids from § 1926.302(d)(1). OSHA is proposing to continue this exemption in § 1926.956(d)(1). The Agency requests information on whether or not fire-resistant insulating hydraulic fluids are available or are being developed.

Safe operating pressures would be required to be maintained by paragraph (d)(2). This protects employees from the harmful effects of tool failure. Of course, if hazardous defects are present, no operating pressure would be safe, and the tools could not be used. In the absence of defects, the maximum rated operating pressure (as specified by the manufacturer or by standard references) is the maximum safe pressure. A note to this effect has been included in the proposed rule.

If a pneumatic or hydraulic tool is used where it may contact exposed energized parts, the tool would be required to be designed and maintained for such use (paragraph (d)(3)). Hydraulic systems for tools used near live parts would need to provide protection against the formation of a partial vacuum in the hydraulic line (paragraph (d)(4)). A pneumatic tool would have to provide protection against the accumulation of moisture in the air supply (paragraph (d)(5)). These three requirements protect employees from electric shock by restricting current flow through hoses.

If hydraulic tools are used so that the highest point on the system is more than 10.7 meters (35 feet) above the oil reservoir, a partial vacuum can form inside the line. This can lead to loss of insulating value in tools used on high voltage lines and to the failure of the system while the employee is working on the power line. During the rulemaking process on § 1910.269, the IBEW reported that two accidents resulted from such an occurrence (269–DC Tr. 613). To stress the importance of the requirement proposed in paragraph (d)(4), OSHA has included a note following this paragraph stating that hydraulic lines without check valves having a separation of more than 10.7 meters (35 feet) between the oil reservoir and the upper end of the hydraulic system can promote the formation of a partial vacuum. Whether or not a partial vacuum will result in the loss of insulating value and trigger the need to take measures to prevent the formation of a partial vacuum will, of course, depend on the voltage involved.

Paragraphs (d)(6) and (d)(7) propose work-practice requirements to protect employees from the accidental release of pressure and from injection of hydraulic oil, which is under high pressure, through the skin and into the body. The first of these two provisions would require the release of pressure before connections in the lines are broken, unless the quick-acting, self-closing connectors commonly found on tools are used. In the case of hydraulic tools, the spraying hydraulic fluid itself, which is flammable, poses additional hazards. The other provision would prohibit employees from attempting to use their bodies in order to locate or stop a hydraulic leak.

Paragraph (d)(8) proposes that hoses not be kinked. Kinks in hydraulic and pneumatic hoses can lead to premature failure of the hose and to sudden loss of pressure. If this loss of pressure occurs while the employee is using the tool, an accident could result.

Section 1926.957, Live-Line Tools

Proposed § 1926.957 contains requirements for live-line tools, some of which are commonly called ''hot sticks.'' This type of tool is used by qualified employees to handle energized conductors. The tool insulates the employee from the energized line, allowing the employee to safely perform the task at hand. For example, a wire tong, a slender insulated pole with a clamp on one end, is used to hold a conductor at a distance while work is being performed. Common types of live-line tools include wire tongs, wire tong supports, tension links, and tie sticks.

Paragraph (a) would require live-line tools to be designed and constructed to be able to withstand 100,000 V/ft if made of fiberglass, 75,000 V/ft if made of wood, or other equivalent tests. (The voltage per unit length varies with material because the two different insulating materials are capable of withstanding different voltages over equal lengths. A higher design standard for wood would cause most wood to fail to meet the specification. A lower

[30] These voltages do not normally pose an electrocution hazard. However, the involuntary muscular reactions from contacting objects at different voltages can lead to falls.

design specification would allow substandard products into service. Paragraph (a), which contains the design criteria for materials used in live-line tools, is based on the capabilities of the materials in question.) Since the withstand voltages are consistent with those in existing § 1926.951(d), for fiberglass tools, and with ASTM F 711–02, *Standard Specification for Fiberglass-Reinforced Plastic (FRP) Rod and Tube Used in Live-Line Tools* (the material comprising the insulating portion of a live-line tool), tools complying with standards currently in use in the industry continue to be acceptable. A note to this effect is included after proposed § 1926.957(a)(1). Together with the minimum approach distances in § 1926.960(c)(1), paragraph (a) of proposed § 1926.957 protects employees from electric shock during use of these tools.

Paragraph (b) addresses the condition of tools. The requirements proposed in this paragraph are intended to ensure that live-line tools remain in a safe condition after they are put into service. Proposed paragraph (b)(1) would require live-line tools to be wiped clean and visually inspected before each day's use. Wiping the tool removes surface contamination that could lower the insulating value of the tool. Inspecting the tool will enable the employer and employee to discover any obvious defects that could also adversely affect the insulating value of the tool.

If any contamination or defect that could lower the insulating value or that could adversely affect the mechanical integrity of the live-line tool is present after the tool is wiped, it could be discovered during the inspection, and the tool would have to be removed from service, as required by paragraph (b)(2). This paragraph protects employees from the failure of live-line tools during use. Tools removed from service would have to be examined and tested under proposed paragraph (b)(3) before being returned to service.

The performance criteria given in paragraph (a) are intended to be ''design standards'' and are to be met at the time of manufacture. The test voltages and length of time that they are applied during the manufacturing process are not appropriate for periodic retesting of the hot sticks because the live-line tools could sustain damage during the test.

During the rulemaking on § 1910.269, OSHA found that, although no injuries related to the failure of a hot stick could be found in the record, evidence did indicate that these tools have failed in use (without injury to employees) and that employees do depend on their insulating value in using them to handle energized conductors (January 31, 1994, 59 FR 4378). The Agency believes that the fact that live-line tools are not typically used to provide protection for employees in the rain (when work is normally suspended) probably accounted for the lack of injuries in the record. Regardless, live-line tools might be used under wet conditions,[31] in which case it is important to ensure that these tools will retain their insulating qualities when they are wet. In addition, employee safety is dependent on the insulating integrity of the tool—the results of a failure of a live-line tool would almost certainly lead to serious injury or death whenever the tool is the only insulating barrier between the employee and a live part. Therefore, OSHA is proposing rules on the periodic examination and testing of live-line tools.

Although inspection can detect the presence of hazardous defects and contamination, the Agency is concerned about whether the daily inspections proposed in paragraph (b)(1) will, indeed, detect these problems. In fact, referring to live-line tools that had failed in use, a Georgia Power Company study submitted to the rulemaking record on § 1910.269 stated: ''Under visual inspection all the sticks appeared to be relatively clean with no apparent surface irregularities [269–Ex. 60].'' These tools also passed a ''dry'' voltage test, but failed a ''wet'' test. While the study further noted that the surface luster on the sticks had been reduced, apparently the normal visual inspection alone was not able to detect such defects as the ones that caused these tools to fail.

To address these concerns, OSHA is proposing requirements for the thorough examination, cleaning, repair, and testing of live-line tools on a periodic basis. The tools would undergo this process on a 2-year cycle and any time tools are removed from service on the basis of the daily inspection required by § 1926.957(b)(2). The proposed rule would first require a complete examination of the hot stick (paragraph (b)(3)(i)). After the examination, the tool would have to be cleaned and waxed, or it would have to be repaired and refinished if necessary (paragraph (b)(3)(ii)). According to proposed § 1926.957(b)(3)(iii), a test would also be required: (1) After the tool has been repaired or refinished, regardless of its composition; (2) after the examination if the tool is made of wood or hollow FRP; or (3) after the examination if the tool is solid FRP rod or foam-filled FRP tube, unless the employer could demonstrate that the examination has revealed no defects that could cause the tool to fail during use. The test method used would be required to be designed to verify the tool's integrity along its full length and, if made of FRP, its integrity under wet conditions (paragraph (b)(3)(iv)). The test voltages would be 75 kV/ft for FRP and 50 kV/ft for wood, and the voltage would have to be applied for a minimum of 1 minute (paragraph (b)(3)(v)). Other equivalent tests are permitted. The proposed rule also includes a note referring to IEEE Std. 516–2003, which contains an excellent guide to the inspection, care, and testing of live-line tools.

[31] Neither the proposed rule nor § 1910.269 prohibits use of live-line tools under wet conditions.

Section 1926.958, Materials Handling and Storage

Section 1926.958 proposes requirements for materials handling and storage. Paragraph (a) proposes that Subpart N of Part 1926 continue to apply.

Paragraph (b) addresses the storage of materials in the vicinity of energized lines and exposed parts of energized equipment. Paragraph (b)(1) proposes requirements for areas to which access is not restricted to qualified employees only. In general, materials are not allowed to be stored within 3.05 meters (10 feet) of the lines or exposed parts of equipment. This clearance distance must be increased by 0.10 meters (4 inches) for every 10 kilovolts over 50 kilovolts. The distance must also be increased to account for the maximum sag and side swing of any conductor and to account for the use of material handling equipment. Maintaining these clearances protects unqualified employees, who are not trained in the recognition and avoidance of the hazards involved, from contacting the energized lines or equipment with materials being handled.

However, the work practices these unqualified workers would employ in handling material stored near energized lines are addressed by Subpart K of Part 1926. The general approach taken in the proposed revision of Subpart V is to provide safety-related work practices for qualified employees to follow when they are performing electric power transmission and distribution work. Safe work practices for unqualified employees are not addressed in proposed Subpart V because these practices are already spelled out in Subpart K of the construction standards (*see* in particular § 1926.416 for work performed near electric power circuits). In addition, much of the work performed by unqualified employees near overhead power lines falls outside the scope of Subpart V. For example, employees laying sewer lines or handling building materials on a housing project are not performing electric power transmission or distribution work, and their work operations would not be covered by Subpart V. OSHA believes it is more appropriate to address work practices used by unqualified employees working near overhead power lines in Subpart K, because that is the standard in which employers who are not involved in electric power transmission or distribution work would look to find requirements addressing electrical hazards.

Paragraph (b)(2) proposes to regulate the storage of materials in areas restricted to qualified employees. If the materials are stored where only qualified workers have access to them, the materials may be safely stored closer to the energized parts than 3.05 meters (10 feet), providing these employees have sufficient room to perform their work. To ensure that enough room is available, paragraph (b)(2) would prohibit material from being stored in the working space around energized lines or equipment. (See the discussion of § 1926.966(b) for an explanation of the proposed requirements for access and working space.)

The working space about electric equipment is the clear space to be provided around the equipment to enable qualified employees to work on the equipment. An employee enters this space to service or maintain the electric equipment. The minimum working space specifies the minimum distance an obstruction can be from the equipment. For example, if a switchboard is installed in a cabinet into which an employee will enter, the inside walls of the cabinet must provide a minimum working space to enable the employee to work safely within the cabinet.

The minimum approach distance to be maintained from a live part is the limit of the space about the equipment that a qualified employee is not permitted to enter. The minimum approach distance a qualified employee must maintain from an energized part (covered in proposed § 1926.960(c)(1)) is smaller than the working space that is required to be provided around the part. The employee must ''enter'' the working space and still maintain the minimum approach distance. Materials must be stored outside the working space so that employees are not tempted to work on energized equipment in cramped quarters if access is necessary in an emergency and so that there is sufficient room to allow an employee to move the materials without violating the minimum approach distance.

Section 1926.959, Mechanical Equipment

Requirements for mechanical equipment are proposed in § 1926.959. Paragraph (a) proposes general requirements for mechanical equipment used in the construction of electric power transmission or distribution lines and equipment. Paragraph (a)(1) serves as a reminder that Subparts N and O of the construction standards contain pertinent requirements for the operation of mechanical equipment. However, two requirements for the operation of mechanical equipment near energized power lines are contained in those two subparts—§§ 1926.550(a)(15) and 1926.600(a)(6)—that OSHA has determined not to apply to qualified employees. (Under the proposed rule, these two requirements would continue to apply to unqualified employees.) Proposed Subpart V contains appropriate requirements for the operation of mechanical equipment by qualified employees near energized power lines and equipment. While the proposed Subpart V provisions would allow qualified employees to operate equipment closer to energized lines and equipment than permitted by the two generic construction standards, the proposal also contains the relevant safeguards for protecting employees. These safeguards include special training for qualified employees (§ 1926.950(b)(2)) and the use of special safety procedures for such operations (§ 1926.959(d)). Because of this, OSHA believes that the proposal will provide more appropriate protection for electric power transmission and distribution workers than §§ 1926.550(a)(15) and 1926.600(a)(6).

Paragraph (a)(2) would require the critical safety components of mechanical elevating and rotating equipment to be inspected before use on each shift. A thorough visual inspection would be required. It is not necessary to disassemble equipment to perform this visual inspection. The note following this paragraph describes what parts OSHA considers to be critical safety components, that is, any part whose failure would result in a free fall or free rotation of the boom. These parts are critical to safety because their failure would immediately pose serious hazards to employees.

Paragraph (a)(3) would prohibit the operator of an electric line truck from leaving his or her position at the controls while a load is suspended, unless the employer can demonstrate that no employee, including the operator, might be endangered. This ensures that the operator will be at the controls if an emergency arises that necessitates moving the suspended load. For example, due to wind or unstable soil, the equipment might start to tip over. Having the operator at the controls ensures that corrective action can be taken quickly enough to prevent an accident.

Paragraph (b) proposes requirements for outriggers. Paragraph (b)(1) would require vehicular equipment provided with outriggers to be operated with the outriggers extended and firmly set as necessary for the stability of the equipment in the particular configuration involved. The stability of the equipment in various configurations is normally provided by the manufacturer, but it can also be derived through engineering analysis. This paragraph also prohibits the outriggers from being extended or retracted outside the clear view of the operator unless all employees are outside the range of possible equipment motion. Where the work area or terrain precludes the use of outriggers, paragraph (b)(2) would permit the operation of the equipment only within the maximum load ratings as specified by the manufacturer for the particular configuration without outriggers. These two paragraphs are intended to help ensure the stability of the equipment while loads are being handled and to prevent injuries caused by extending outriggers into employees.

Proposed paragraph (c) would require mechanical equipment used to lift or move lines or other material to be operated within its maximum load rating and other design limitations. It is important for mechanical equipment to be used within its design limitations so that the lifting equipment does not fail during use and so that employees are not otherwise endangered.

Even in electric-utility operations, contact with live parts through mechanical equipment causes many fatalities each year. A sample of typical accidents involving the operation of mechanical equipment near overhead lines is given in Table IV–5. Industry practice and existing rules in Subpart V of the construction standards require aerial lifts and truck-mounted booms to be kept away from exposed energized lines and equipment at distances greater than or approximately equal to those proposed in Table V–2 (A–C Live-Line Work Minimum Approach Distance). However, some contact with the energized parts does occur during the hundreds of thousands of operations carried out near overhead power lines each year. If the equipment operator is distracted briefly or if the distances involved or the speed of the equipment towards the line is misjudged, contact with the lines is the expected result, rather than simple coincidence, especially when the minimum approach distances are relatively small. Because these types of contacts cannot be totally avoided, OSHA believes that additional requirements are necessary for operating mechanical devices near exposed energized lines. Paragraph (d) of proposed § 1926.959 addresses this problem.

TABLE IV–5.—ACCIDENTS INVOLVING THE OPERATION OF MECHANICAL EQUIPMENT NEAR OVERHEAD LINES

| Type of equipment | Number of fatalities | | | | Type of Accident |
|---|---|---|---|---|---|
| | Total | Grounded | | | |
| | | Yes | No | ? | |
| Boom Truck/Derrick Truck .. | 9 | 2 | .................. | 7 | Boom contact with energized line.<br>Pole contact with energized line. |
| Aerial lift .............................. | 8 | .................. | 1 | 7 | Boom contact with energized line.<br>Lower boom contact with energized line.<br>Employee working on deenergized line when upper boom contaced energized line.<br>Winch on lift used on energized line arced to nearby ground. |
| Vehicle ................................ | 2 | .................. | 1 | 1 | Line fell on vehicle.<br>Unknown type of vehicle and type of accident. |
| Total ............................ | 19 | 2 | 2 | 15 | |

Source: OSHA accident investigation data (269–Ex. 9–2 and 9–2A).

Proposed paragraph (d)(1) would require the minimum approach distances in Table V–2 through Table V–6 to be maintained between the mechanical equipment and the live parts while equipment was being operated near exposed energized lines or equipment. This provision would ensure that sufficient clearance is provided between the mechanical equipment and the energized part to prevent an electric arc from occurring and energizing the equipment. The requirement to maintain a minimum approach distance also lessens the chance that the mechanical equipment will strike the lines and knock them to the ground.

Aerial lifts are designed to enable an employee to position himself or herself at elevated locations with a high degree of accuracy. The aerial lift operator is in the bucket next to the energized lines and can easily judge the approach distance. This minimizes the chance that the equipment will contact an energized line and that the energized line will be struck down should contact actually occur. Furthermore, the employee operating the lift in the bucket would be protected from the hazards of contacting the live parts under the provisions of § 1926.960. As the aerial lift is insulated, employees on the ground are protected from electric shock in the case of contact with the lines. Lastly, proposed § 1926.959(c) and other provisions would protect against the possibility that the aerial lift would strike down the power line. Therefore, proposed paragraph (d)(1) would provide an exception to the requirement to maintain specific minimum approach distances for the insulated portion of an aerial lift operated by a qualified employee in the lift. It should be noted that the employee must still maintain the minimum approach distances required in proposed § 1926.960(c)(1). Paragraph (c)(1) of proposed § 1926.960 would still require the employee to maintain the required distance from conductive objects at potentials different from that on which he or she is working, and proposed § 1926.959(d)(1) would require the conductive portions of the boom to maintain the same distance from such objects. It should also be noted that the insulating portion of the boom can be bridged by improper positioning of the boom or by conductive objects suspended from the aerial lift platform. For example, the insulating portion of the boom will be bridged if it is resting against a grounded object, such as a utility pole or if the employee in an aerial bucket is holding onto a grounding jumper. For the purposes of proposed § 1926.959(d)(1), OSHA would not consider the aerial lift to be insulated when the insulation is bridged.

Determining the distance between objects that are themselves relatively far away from a mechanical equipment operator standing on the ground can sometimes be difficult. For example, different perspectives can lead to different estimates of the distance, and lack of a suitable reference can result in errors. In addition, an operator may not be in the best position to observe the clearance between an energized part and the mechanical equipment. For example, an obstruction may block his or her view of the clearance. An extra person would be required, by paragraph (d)(2), to observe the operation and give warnings when the specified minimum approach distance is approached unless the employer could demonstrate that the minimum approach distance could be accurately determined by the operator.

An aerial lift operator would not normally need to judge the distance between objects that are relatively far away. In most cases, an aerial lift operator is maintaining the minimum approach distance from energized parts relatively close to the employee, and it would be easy for the employee to stay far enough away. However, even an aerial lift operator may have difficulty maintaining the minimum approach distances in certain circumstances. Sometimes, congested configurations of overhead power lines may necessitate maintaining clearance from more than one conductor at a time. Other times, an aerial lift operator may need to judge the distance between the lower uninsulated portion of the boom and a conductor well below the employee. In situations like these, where the minimum approach distance may be difficult for an aerial lift operator to maintain, an observer would be required.

Proposed paragraph (d)(3) would require one of three alternative protective measures to be taken if the equipment could become energized. The first option (paragraph (d)(3)(i)) is for the energized lines exposed to contact to be covered with insulating protective material that will withstand the type of contact that might be made during the operation. The second option (paragraph (d)(3)(ii)) is for the equipment to be insulated for the voltage involved. Under this option, the mechanical equipment would have to be positioned so that uninsulated portions of the equipment could not come within the specified minimum approach distance of the line. The third option (paragraph (d)(3)(iii)) is for each employee to be protected from the hazards that might arise from equipment contact with the energized lines. The measures used would have to ensure that employees would not be exposed to hazardous differences in potential. (The following paragraphs describe the types of measures that must be taken. The employer must take all of these measures unless he or she can demonstrate that the methods in use protect each employee from the hazards that might arise if the equipment contacts the energized line.) The proposal is intended to protect employees from electric shock in case contact is made.

On the basis of the § 1910.269 rulemaking record, OSHA concluded that vehicle grounding alone could not always be depended upon to provide sufficient protection against the hazards of mechanical equipment contact with energized power lines (January 31, 1994, 59 FR 4403). On the other hand, the Agency recognized the usefulness of grounding as a protective measure against electric shock, when used with all of the following techniques:

(1) Using the best available ground to minimize the time the lines remain energized,

(2) Bonding equipment together to minimize potential differences,

(3) Providing ground mats to extend areas of equipotential, and

(4) Using insulating protective equipment or barricades to guard against any remaining hazardous potential differences.

The proposed rule recognizes all these techniques, which (1) minimize differences in potential, (2) minimize the time employees would be exposed to hazardous potentials, and (3) protect against any remaining hazardous potentials. Paragraph (d)(3)(iii) of proposed § 1926.959 contains the performance-oriented requirement that would assure that employees are protected from the hazards that could arise if the equipment contacts the energized parts. The protective measures used would be required to ensure that employees are not exposed to hazardous differences in potential. Information in Appendix C to proposed Subpart V provides guidelines for employers and employees that explain the various measures and how they can be used. A note referencing this appendix has been included in the proposal.

Section 1926.960, Working on or Near Exposed Energized Parts

Proposed § 1926.960 covers the hazards of working on or near exposed parts of energized lines or equipment as noted in paragraph (a). The provisions of this section have been taken from § 1910.269(l).

Paragraph (b) proposes general requirements for working on or near live parts. Paragraph (b)(1) would require employees working on or with exposed live parts (at any voltage) of electric lines or equipment and employees working in areas containing unguarded, uninsulated live parts operating at more than 50 volts to be qualified. Without proper training in the construction and operation of the lines and equipment and in the electrical hazards involved, workers would likely be electrocuted attempting to perform this type of work and would also expose others to injury, as well. In areas containing unguarded live parts energized at more than 50 volts, untrained employees would not be familiar with the practices that are necessary to recognize and avoid contact with these parts.

The definition of ''qualified employee'' contains a note to indicate that employees who are undergoing on-the-job training are considered to be qualified if they have demonstrated an ability to perform duties safely and if they are under the immediate supervision of qualified employees. (See the definition of this term in proposed § 1926.968 and the discussion of this definition under the summary and explanation of § 1926.968.) Therefore, employees in training, under the direct supervision of a qualified employee, would be permitted to perform work on live parts and in areas containing unguarded live parts. OSHA believes that the close supervision of trainees will reveal errors ''in the act,'' before they cause accidents. Allowing these workers the experience of performing tasks under actual conditions may also better prepare the employees to work safely.

Paragraph (b)(2) would require lines and equipment to be considered as energized unless they have been deenergized under the provisions of § 1926.961. Existing § 1926.950(b)(2) requires electric lines and equipment to be considered as energized until determined to be deenergized by tests or other appropriate means. The existing standard does not spell out what those appropriate means are. Additionally, even if the line or equipment has been tested and found to be deenergized, it may become reenergized through contact with another source of electric energy or by someone reenergizing it at its points of control. Proposed section 1926.961 contains requirements for deenergizing electric power transmission and distribution lines and equipment. Unless the procedures contained in that section have been followed, lines and equipment cannot reliably be considered as deenergized. Proposed paragraph (b)(2) has been taken from the last sentence of the introductory text of § 1910.269(l)(1).

*Two-person rule.* If an employee working on or near energized electric power transmission or distribution lines or equipment is injured by an electric shock, a second employee will be needed to provide emergency care to the injured employee. As noted under the summary and explanation of § 1926.951(b)(1) discussed earlier in this preamble, CPR must begin within 4 minutes after an employee loses consciousness as a result of an electric shock. OSHA is proposing to require the presence of a second employee during certain types of work on or near electric power transmission or distribution lines or equipment to ensure that CPR begins as soon as possible and to help ensure that it starts within the 4-minute window. (Note that § 1926.951(b)(1) would require at least two people trained in emergency first aid procedures, including CPR, for field work involving two or more employees at a work location. Also, note that, in the discussion of that proposed paragraph, OSHA is requesting comments on whether to require AEDs along with training in CPR.)

Paragraph (b)(3)(i) of proposed § 1926.960 would require (unless exempted by paragraph (b)(3)(ii)) the presence of at least two employees during the following types of work involving exposed energized parts:

(1) Installation, removal, or repair of lines that are 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 those posed by these operations.

This rule is based on § 1910.269(l)(1)(i). The first four work operations are those that expose employees to the greatest risk of electric shock as demonstrated by the § 1910.269 rulemaking record. OSHA has included the fifth category to cover types of work that, while not specifically identified in that record, pose equal or greater hazards. The operations covered under § 1910.269(l)(1)(i) are performed during construction as well as during maintenance. In fact, the construction operations are similar in nature to those performed during maintenance work, and the Agency believes that the hazards are the same. For example, using mechanical equipment near a 7200-volt overhead power line during the construction of a new line poses hazards that are equivalent to those posed during the use of mechanical equipment to replace a damaged pole on an existing line of the same voltage. Similarly, the installation of a new transformer near a 14.4-kilovolt line poses the same hazards as the replacement of a transformer near a 14.4-kilovolt line. Thus, OSHA is proposing to extend the general industry requirement to construction.

However, some work can be performed safely by a single employee or must be performed as quickly as possible for reasons of public safety. The proposal, in § 1926.960(b)(3)(ii), recognizes this type of work by granting exceptions to the two-person rule for the following operations:

(1) Routine switching of circuits, if the employer can demonstrate that conditions at the site allow this work to be performed safely,

(2) Work performed with live-line tools if the employee is positioned so that he or she is not within reach of or exposed to contact with energized parts, and

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

These exceptions are based on § 1910.269(l)(1)(ii). OSHA intends for these exceptions to be applied narrowly in view of the accidents that have occurred even under these limited conditions (269–Ex. 9–2). For example, accidents involving hot stick work have typically occurred only when the employee was using a live-line tool but was close enough to energized parts to be injured—sometimes through direct contact, other times by contact through conductors being handled. Employees have been injured during switching operations when unusual conditions, such as poor lighting, bad weather, and hazardous configuration or state of repair of the switching equipment, were present. Paragraph (b)(3)(ii)(A) addresses this scenario by requiring the employer to demonstrate that the operation can be performed in a manner to mitigate the hazards so that the work could be performed safely. For example, the employer could provide supplemental lighting for work performed where lighting was inadequate.

The requirement for at least two employees to be present during certain operations does not apply generally if the voltage of the energized parts involved is 600 volts or less. The § 1910.269 rulemaking record contained conflicting data regarding the safety of performing work at these voltages. Some witnesses and commenters said that it was safe to perform such work, but the data in the rulemaking record suggested that may not be true (269-Ex. 9–2). More recent accident data indicate little change. Table IV–6 shows the number of electrocutions for various voltage ranges for the years 1991 through 1998. In the years 1991 to 1994, an average of 3.0 fatalities occurred per year involving voltages of 600 volts or less. For the years 1995 to 1998, when § 1910.269 was fully in effect, the average dropped slightly to 2.5. Consequently, OSHA is requesting comments regarding the safety of employees working on lines and equipment operating at 600 volts or less. What types of work can be performed safely by an employee working alone? What additional precautions are necessary for an employee working on lines or equipment operating at 600 volts or less to make the work safe without the presence of a second employee?

TABLE IV–6.—FATALITIES BY VOLTAGE AND YEAR

| Year | Less than 600 V | 600 V to 20 kV | 20 to 80 kV | 100kV and higher |
|---|---|---|---|---|
| 1991 | 3 | 24 | 2 | 1 |
| 1992 | 5 | 24 | 2 | 0 |
| 1993 | 3 | 23 | 3 | 1 |
| 1994 | 1 | 21 | 2 | 2 |
| 1995 | 2 | 22 | 4 | 5 |
| 1996 | 4 | 16 | 0 | 2 |
| 1997 | 1 | 16 | 3 | 1 |
| 1998 | 3 | 13 | 0 | 1 |

Source: OSHA database of electric power generation, transmission, and distribution accidents. These data include only cases involving electrocution in which the voltage was indicated in the accident abstract.

*Minimum approach distances.* Paragraph (c)(1) of proposed § 1926.960 would require employees to maintain minimum approach distances from exposed energized parts. The minimum approach distances are specified in Table V–2 through Table V–6. This provision has been taken from § 1910.269(l)(2).

Electric power systems operate at a given nominal voltage. However, the actual voltage on a power line varies above and below that nominal voltage. For very brief periods, the instantaneous voltage on a line can be 3 or more times its nominal value.

The safe minimum approach distance is intended to assure that an electric arc will not form, even under the most severe transient overvoltages that can occur on a system and even if the employee makes foreseeable errors in maintaining the minimum approach distance. To determine what this distance is for a given voltage, OSHA must first determine the size of the air gap that must be present so that an arc does not occur during the most severe overvoltage on a system. This gap is the electrical component of the minimum approach distance. To determine the minimum safe approach distance, OSHA must then add an extra distance to account for ergonomic considerations, or human error.

The electrical component depends on five factors:

(1) The maximum voltage,

(2) The wave shape of this voltage,

(3) The configuration of the ''electrodes'' forming the end points of the gap,

(4) The insulating medium in the gap, and

(5) The atmospheric conditions present.

The NESC subcommittee having responsibility for the ANSI C–2 minimum approach distance tables adopted a change in minimum approach distances for the 1993 edition of the National Electrical Safety Code. The NESC subcommittee developed the minimum approach distance tables using the following principles:

- ANSI/IEEE Standard 516 [32] was to be the electrical basis of the NESC Rules for approach distances: Table 4 (Alternating Current) and Table 5 (Direct Current) for voltages above 72.5 KV. Lower voltages were to be based on ANSI/IEEE Standard 4. The application of ANSI/IEEE Standard 516 was inclusive of the formula used by that standard to derive electrical clearance distances.
- Altitude correction factors were to be in accordance with ANSI/IEEE Standard 516, Table 1.
- The maximum design transient overvoltage data to be used in the development of the basic approach distance tables were:
  - 3.0 per unit for voltages of 362 KV and less
  - 2.4 per unit for 500 to 550 KV
  - 2.0 per unit for 765 to 800 KV
- All phase-to-phase values were to be calculated from the EPRI Transmission Line Reference Book for 115 to 138 KV.
- An inadvertent movement factor (ergonomic component) intended to account for errors in judging the approach distance was to be added to all basic electrical approach distances (electrical component) for all voltage ranges. A distance of 0.31 meters (1 foot) was to be added to all voltage ranges. An additional 0.3 meters (1 foot) was to be added to voltage ranges below 72.6 KV.
- The voltage reduction allowance for controlled maximum transient overvoltage was to be such that the minimum allowable approach distance was not less than the given approach distance specified for the highest voltage of the given range.
- The transient overvoltage tables were to be applied only at voltage ranges inclusive of 72.6 KV to 800 KV. All tables were to be established using the higher voltage of each separate voltage range.

Relevant data related to the determination of the ergonomic component of the minimum approach distance include a typical arm's reach of about 610 millimeters (2 feet) and a reaction time to a stimulus of 0.2 to more than 1.0 second (269–Ex. 8–19). To prevent an employee from breaching the air gap required for the electrical component, the ergonomic distance must be sufficient for the employee to be able to recognize a hazardous approach to an energized line and withdraw to a safe position. Thus, the distance should equal the response time multiplied by the average speed of an employee's movement plus ''braking'' distance. (This is comparable to the calculation of total braking distance for a motor vehicle. This distance equals the initial speed of the vehicle times the driver's reaction time plus the braking distance for the vehicle itself after the brakes have been applied.) The maximum reach (or range of movement) may place an upper bound on the ergonomic component, however.

For system voltages up to 72.5 kV, phase-to-phase, much of the work is performed using rubber gloves, and the employee is working within arm's reach of energized parts. The ergonomic component of the minimum approach distance must account for this since the employee may not have time to react and position himself or herself out of danger. A distance of 610 millimeters (2 feet) for the ergonomic component appears to meet this criterion and was, in fact, adopted by the NESC subcommittee. OSHA also accepts this value. Therefore, for voltages of 751 V to 72.5 kV, the minimum approach distances proposed in § 1926.960 adopt the electrical component of minimum approach distance plus an ergonomic component of 0.61 meters (2 feet).

For operations involving lines energized at voltages over 72.5 kV, the applicable work practices change. Generally, live-line tools are employed to perform the work while equipment is energized. These tools hold the energized part at a fixed distance from the employee, ensuring that the minimum approach distance is maintained during the work operation. Even when hot sticks are not used, as during live-line bare-hand work, employees use work methods that more tightly control their movements than when they perform rubber glove work, and it is usually easier to plan ahead of time how to keep employees from violating the minimum approach distance. For example, employees planning a job to replace spacers on a 500-kV overhead power line can use an envelope (or bounds) of anticipated movement for the job and ensure that the work procedure they use keeps this envelope entirely outside the minimum approach distance. All the employees' movements during the job would be kept within the envelope. Additionally, exposure to conductors at a potential different from the one on which work is being performed is limited or nonexistent. This is because the distance between conductors is much greater than the distance between conductors at lower voltages and because higher voltage systems do not present the types of congestion that are commonly found on lower voltage systems. Therefore, a smaller ergonomic component is appropriate for the higher voltages. The NESC subcommittee accepted a value of 0.31 meters (1 foot) for this component. OSHA has adopted this distance as well. Therefore, for voltages over 72.5 kV, the minimum approach distances proposed in § 1926.960 adopt the electrical component of the minimum approach distance plus an ergonomic component of 0.31 meters (1 foot).

The ergonomic component of the minimum approach distance is only considered a safety factor that protects employees in case of errors in judging and maintaining the full minimum approach distance, so that the employee does not breach the electrical component of the minimum approach distance. The actual working position selected must account for the full range of movements that could normally be anticipated [33] while an employee is working. Otherwise, the employee would violate the minimum approach distance while he or she is working.

The design of electric power circuits over 72.5 kV sometimes does not provide sufficient clearance between energized parts at different potential or between energized parts and grounded surfaces to permit employees to maintain the base minimum approach distances given in proposed Table V–2. The Agency has adopted the approach of the NESC subcommittee in the proposal to permit work on such systems so long as additional measures are taken to reduce the required minimum approach distance. Proposed

[32] ANSI/IEEE Std. 516–1987 (the edition in effect when the NESC subcommittee revised the minimum approach distances) listed values for the electrical component of the minimum approach distance, both for air alone as an insulating medium and for live-line tool sticks in air, that were accepted as being accurate when the standard was adopted (by IEEE) in 1987.

[33] Anticipated movements include those necessary to perform the work as well as ''unexpected'' movements that an employee could reasonably be anticipated to perform, such as adjusting his or her hard hat, clothing, or equipment. See Appendix B to Subpart V for a discussion of the selection of working position with respect to minimum approach distances.

Table V–3, Table V–4, and Table V–5 recognize the use of gaps and other means of decreasing the surge factor on energized lines as acceptable methods of reducing the required minimum approach distance.[34] These tables list minimum approach distances for various surge factors and phase-to-phase voltages.

The proposal thus provides smaller minimum approach distances for systems with surge factors that are limited by means such as system design, switching controls, and temporary protective gaps. Frequently, built-in or temporary limits on the surge factor on a system can result in a minimum approach distance that is small enough to permit work to be performed without additional protective measures. Because the line worker cannot determine surge factors at the jobsite, surge factor reduction is permitted only when the employer can demonstrate, through engineering analysis, that the possible surges on the line will be held to values no more than permitted under Table V–3, Table V–4, and Table V–5. Methods of controlling and determining the surge factor for a system are given in Appendix B to proposed Subpart V.

OSHA accepted the principles adopted by the NESC subcommittee in forming the minimum approach distance tables in final § 1910.269. OSHA reviewed the technical information supporting the subcommittee's action and found that the data justify the NESC criteria. After the adoption of final § 1910.269, the NESC Committee issued a tentative interim amendment correcting some errors in calculating the minimum approach distances published in ANSI C2–1993. The same minimum approach distances are contained in the latest edition of that standard, ANSI C2–2002. In Table V–2 through Table V–6, OSHA is proposing to adopt the NESC minimum approach distances, as corrected.[35] The Agency believes that this will protect employees from all likely exposure conditions.

Proposed Table V–5 contains minimum approach distances for d-c voltages between 250 and 750 kilovolts, nominal. These distances have been taken directly from Table R–9 of § 1910.269. Since systems of d-c voltages other than those listed are rare, no distances were presented for them in the table.

As noted earlier, proposed Table V–3 through Table V–5 permit reduced minimum approach distances for systems having known maximum transient overvoltages. These tables are based on Table R–7 through Table R–9 of § 1910.269.

The minimum approach distances proposed in Subpart V for voltages over 750 volts are intended to provide a sufficient gap between the worker and the line so that current could not arc to the employee under the most adverse transient voltage that could be imposed on the line, plus an extra amount for inadvertent movement on the part of the employee. The electrical component of these distances is based on scientific and engineering test data, and the ergonomic component is based on the conditions likely to be present for the different types of work to be performed on electric power generation, transmission, and distribution circuits. By contrast, the minimum approach distances in existing Subpart V were based on standard industry practice in effect in 1972, when that standard was promulgated. OSHA believes that the proposed minimum approach distances, which are based on sound engineering principles, will provide significantly better protection for employees than the existing standard.

Table R–6 in existing § 1910.269 specifies ''avoid contact'' as the minimum approach distance for voltages between 50 and 1,000 volts. To make the proposal consistent with ANSI C2, OSHA is proposing to adopt minimum approach distances of 0.31 meters (1 foot) for voltages between 301 volts and 750 volts and 0.65 meters (2 feet, 2 inches) for voltages between 751 volts and 15 kilovolts. This increase in the minimum approach distance at the lower voltages should help prevent employees from contacting circuit parts energized at these still dangerous levels.[36]

The proposal allows employees to come closer than the minimum approach distance to energized parts under certain conditions, as listed in proposed § 1926.960(c)(1)(i) through (c)(1)(iii). Existing § 1926.950(c)(1)(i), from which proposed § 1926.960(c)(1)(i) has been taken, permits the employee to be insulated, guarded, or isolated from the live parts. The language specifically recognizing guarding and isolation has been omitted from the proposal. However, it should be noted that the introductory language in final § 1926.960(c)(1) requires minimum approach distances to be maintained from ''exposed'' energized parts. Guarded live parts, whether they are guarded by enclosures or barriers or are guarded by position (isolated), are not addressed by this requirement as they would not be considered ''exposed.'' Including language exempting live parts that are ''guarded'' or ''isolated'' would be redundant and could lead to misinterpretation of the rule. Additionally, similar redundancies in paragraphs (c)(1)(ii) and (iii) of § 1926.950 have not been carried forward into paragraphs (c)(1)(ii) and (c)(1)(iii) of proposed § 1926.960. To clarify the rule, however, a note has been included following paragraph (c)(1)(iii) to indicate that parts of electric circuits meeting paragraph (f)(1) of § 1926.966 are not considered as ''exposed'' unless a guard is removed or an employee enters the space intended to provide isolation from the live parts.

Proposed § 1926.960(c)(1)(i) contains the first exception to maintaining the minimum approach distances—insulating the employee from the energized part. This insulation, for example, can take the form of rubber insulating gloves and rubber insulating sleeves. This equipment protects the employee from electric shock as he or she works on the line or equipment. Even though uninsulated parts of the employee's body may come closer to the live part being worked on than would otherwise be permitted by Table V–2 through Table V–6, the employee's hand and arm would be insulated from the live part, and the working distances involved would be sufficient protection against arc-over. As noted earlier, the minimum approach distance tables include a component for inadvertent movement, which is unnecessary for employees using rubber insulating equipment. In the worst case situation, an employee would be working on a line requiring a 0.84-meter (2-foot, 9-inch) minimum approach distance. The electrical component of this minimum approach distance is 0.23 meters (9 inches).[37] The distance from the hand to the elbow is about 0.3 meters (1 foot), and it would be nearly impossible to work closer than this distance to a line being held in the hand. Therefore, the employee would be about 0.3 meters (1 foot) away from the conductor at a minimum, and, thus, in the worst case would still be more than the electrical

[34] The decreased surge factor reduces the maximum transient voltage on the line and thus reduces the electrical component of the minimum approach distance.

[35] OSHA is also proposing to make similar changes to § 1910.269.

[36] OSHA is also proposing to make similar changes to § 1910.269.

[37] The minimum approach distance for 36.1 to 46.0 kV, the highest voltage range that can be worked using rubber insulating gloves, is 0.84 meters (2 feet, 9 inches). The electrical component of the minimum approach distance is the minimum approach distance minus the ergonomic component, 0.65 meters (2 feet), which equals 0.23 meters (9 inches).

component of the minimum approach distance from the conductor. This would protect the employee from sparkover. In any event, the accident data in the record show that the overriding hazard to employees is posed by other energized conductors in the work area, to which the minimum approach distances still apply. The rubber gloves, of course, provide protection only for the line on which work is being performed.

It is important to ensure that conductors on which the employee is working cannot move unexpectedly while the employee is protected against contact only by rubber insulating gloves and sleeves. It would be considered a violation of the minimum approach distance requirement proposed in § 1926.960(c)(1) for an employee to be insulated from an energized part only by rubber insulating gloves and sleeves if the part is not under the full control of the employee at all times. OSHA is making this explicit in the parenthetical text in proposed § 1926.960(c)(1)(i) (and also in proposed § 1910.269(l)(2)(i)). For example, if an employee were cutting a conductor, that conductor would either need to be restrained from moving toward the employee after being cut or additional insulation would have to be used to protect the conductor from striking uninsulated parts of the employee's body.

The insulation used would have to be designed for the voltage. (Proposed new § 1926.97 gives use voltages for electrical protective equipment.) As a clarification, paragraph (c)(1)(i) notes that the insulation is considered as protection only against parts upon which work is being performed; the required minimum approach distances would have to be maintained from other exposed energized parts.

As a second exception to maintaining the minimum approach distances, paragraph (c)(1)(ii) of proposed § 1926.960 allows the energized part to be insulated from the employee. Such insulation could be in the form of insulating blankets or line hose or other suitable insulating equipment. Again, the insulation would have to be adequate for the voltage.

Paragraphs (c)(1)(i) and (c)(1)(ii) recognize the protection afforded to the employee by an insulating barrier between the employee and the energized part. As long as the insulation is appropriate and is in good condition, current will not flow through the worker, and he or she is protected.

The third exception (paragraph (c)(1)(iii)) to the maintenance of the minimum approach distances is to insulate the employee from exposed conductive objects other than the live part upon which work is to be performed. Much of the work performed under this option is called ''live-line bare-hand'' work. (For specific practices for this type of work, see the discussion of proposed § 1926.964(c).) In this type of work, the employee is in contact with the energized line, like a bird on a wire, but is not contacting another conductive object at a different potential. Because there is no complete circuit, current cannot flow through the worker, and he or she is protected.

Paragraph (c)(1) requires employees to maintain minimum approach distances from ''exposed'' energized parts, except as noted above. A note following paragraph (c)(1)(iii) clarifies that parts of electric circuits meeting paragraph (f)(1) of § 1926.966 are not considered as ''exposed'' unless a guard is removed or an employee enters the space intended to provide isolation from the live parts.

Several accidents occurred when employees working from aerial lifts, either insulated or uninsulated, grabbed an energized conductor. OSHA is concerned that some employers may believe that this practice is safe without following the procedures outlined in proposed § 1926.964(c) on live-line bare-hand work. OSHA requests comments on whether or not the proposed rule will adequately protect employees from this type of accident and on what additional requirements, if any, are needed to prevent this type of accident.

According to testimony in the § 1910.269 rulemaking, between five and six percent of accidents experienced by power line workers were caused when the upper arm of an employee wearing rubber insulating gloves without sleeves contacted an energized part (269-DC Tr. 558–561).[38] This is a significant portion of the total number of serious accidents occurring among electric line workers. The Agency believes that these injuries and fatalities are clearly preventable.

The use of rubber insulating sleeves would certainly have prevented most of these accidents. However, as demonstrated by the safety record of some electric utility companies, the extensive use of insulating equipment to cover energized parts in the employee's work area would also appear to prevent employees' upper arms and shoulders from contacting live parts (269-Ex. 46). In fact, if every energized part within reach of an employee was insulated, electrical contacts involving other parts of the body, such as an employee's head or back, would be averted as well. The NESC subcommittee on work rules also recognized this method as providing protection to employees.

Existing Subpart V does not require any protection for employees working on or near exposed live parts beyond the use of rubber insulating gloves. To prevent the types of accidents described above from occurring in the future, the Agency has decided to require protection in addition to that required by existing Subpart V.

The proposal includes a provision, § 1926.960(c)(2)(i), that would require the use of rubber insulating sleeves (in addition to rubber insulating gloves), unless live parts that could contact an employee's upper arm or shoulder are insulated. Employees would be able to work without sleeves by installing rubber line hose, rubber blankets, and plastic guard equipment on energized equipment. However, an employee installing such protective equipment on energized lines would have to wear rubber sleeves unless his or her upper arms and shoulders are not exposed to contact with other live parts during this operation.

OSHA believes that paragraph (c)(2)(i) incorporates the most effective approach to preventing accidents involving work on or near exposed live parts.

Several accidents have occurred while employees were performing work (generally on deenergized lines) near energized parts without using rubber insulating equipment. Because the employees were concentrating on their work, which did not involve the energized parts, the employees did not pay attention to the distance between them and the energized parts and violated the minimum approach distance. When OSHA cited the employers for violations of existing § 1926.950(c), the employers successfully argued that the standard permits employees to work near energized parts without the use of electrical protective equipment, as long as they maintain the minimum approach distance involved. They further argued that, because they require their employees to maintain these distances and because their employees have been trained, the accidents were a result of unpreventable employee misconduct. (See, for example, *Central*

[38] OSHA believes that most, if not all, of these accidents involved contact with conductors and equipment other than the one on which the employee had been working. It would be very unlikely that an employee would touch his upper arm or shoulder against the part on which he or she was working with his or her hands. On the other hand, it would be more likely that the employee touched his or her upper arm or shoulder against a different live part than the one on which he or she is working. The employee's attention would be on the live part on which work is being performed but might not be on other nearby live parts.

*Kansas Power Co., Inc.*, 6 OSHC (BNA) 2118, 1978 WL 6886 (No. 77–3127, 1978).)

OSHA does not believe that working very close to, but not on, energized parts without the use of electrical protective equipment is a safe practice. The Agency further believes that § 1910.269, which also allows this practice, is not effective in preventing these accidents and has concluded that further regulation is warranted. Toward this end, OSHA has gone beyond § 1910.269 by proposing two additional requirements:[39]

(1) If work is performed near exposed parts energized at more than 600 volts but not more than 72.5 kilovolts and if the employee is not insulated from the energized parts or performing live-line bare-hand work, the employee would have to work from a position where the employee would not be able to reach into the minimum approach distance (proposed § 1926.960(d)(2)), and

(2) If the employee is to be insulated from energized parts by the use of insulating gloves or insulating gloves with sleeves, the insulating gloves and sleeves would have to be put on and removed in a position where the employee would not be able to reach into the minimum approach distance (proposed § 1926.960(c)(2)(ii)).

These two provisions taken together will ensure that an employee working near energized parts will not be able to reach within the minimum approach distance unless using rubber insulating equipment. Thus, any time an employee is within reach of the minimum approach distance, he or she would need to be wearing rubber insulating gloves or the energized parts would need to be insulated from the employee, and any employee who is not protected by insulating equipment would need to stay far enough away from energized parts that he or she could not reach within the minimum approach distance.

Proposed paragraph (c)(2)(ii) would ensure that employees don rubber insulating gloves and sleeves from a safe position. OSHA is aware that some employers have a ground-to-ground rule requiring their employees to wear rubber insulating gloves before leaving the ground to work on energized lines or equipment and to leave the gloves and sleeves on until the employees return to the ground. This practice ensures that employees are indeed wearing the rubber gloves and sleeves before they reach the energized area and eliminates the chance that an employee will forget to don the protective equipment once he or she reaches the work position. Other employers simply require their employees to put their gloves and sleeves on before they enter the energized area. This practice normally requires the employee to use his or her judgment in determining where to begin wearing the protective equipment. The proposal recognizes both methods of protecting employees, but ensures that the rubber gloves and sleeves are being worn once the employee reaches a position from which he or she can reach into the minimum approach distance. The Agency requests comments on the need for this requirement and on whether or not the provision as proposed will protect employees from the hazards involved.

Proposed paragraph (d)(2) would ensure that an employee who is not insulated from parts energized between 600 volts and 72.5 kilovolts is working at a safe distance from the parts. This provision does not apply to voltages of 600 volts and less to permit work on equipment without requiring the employee to cover energized parts unnecessarily. Much of the work performed at these lower voltages involves the use of insulating hand tools in a panelboard or cabinet. The chance of contacting a live part with the shoulder is extremely low because of the layout of live parts within the enclosure. The electrical clearances between energized parts for voltages in this range are small enough that all energized circuit parts will normally be in front of the employee, enabling the worker to maintain the required minimum approach distance easily. The proposed paragraph does not apply when the voltage exceeds 72.5 kilovolts, because the minimum approach distances generally become greater beyond this voltage and because rubber insulating equipment cannot be used for these higher voltages.[40] OSHA requests comments on the need for this requirement and on whether there are other effective means of protecting employees from the hazard involved.

Paragraph (d)(1) of proposed § 1926.960 would require employees to position themselves, to the extent that other safety-related conditions at the worksite permit, so that a shock or slip would not cause the worker's body to move towards exposed parts at a potential different from that of the employee. Since slips, and even electric shocks, are not entirely preventable, it is important for the employee to take a working position so that such an event will not increase the severity of any incurred injury. This proposed requirement was taken from § 1910.269(l)(3). There is no counterpart to this requirement in existing Subpart V.

The Agency believes that it is important for an employee to work from a position where a slip or a shock will not bring him or her into contact with an energized part unless other conditions, such as the configuration of the lines involved, would make another working position safer. The position taken must be the most protective available to accomplish the task. In certain situations, this work position may not be the most efficient one. The language proposed in § 1926.960(d)(1) recognizes situations that preclude working from a position from which a slip would bring the employee into contact with a live part. The language contained in this provision also allows such options as guarding or insulating the live part as alternative means of compliance.

*Connecting and disconnecting lines and equipment.* Paragraph (e) addresses the practices of connecting and disconnecting lines and equipment. Common industry practice, as reflected in ANSI C2–2002, Section 443F, is to make a connection so that the source is connected as the last item in sequence and to break a connection so that the source is removed as the first item in sequence. In this way, conducting wires and devices used to make and break the connection are deenergized during almost the entire procedure. These practices would be required by paragraphs (e)(1) and (e)(2). Since these wires and devices must be handled during the procedure, the proposed requirements would reduce the chance for an electrical accident. Also, to prevent the disconnected conductors from being energized, loose ends of conductors must be kept away from live parts, as would be required by paragraph (e)(3). These three proposed provisions, which have no counterparts in existing Subpart V, have been taken from § 1910.269(l)(5).

Paragraph (f) of proposed § 1926.960, which was taken from § 1910.269(l)(6)(i), would prohibit the wearing of conductive articles by employees working within reach of exposed live parts of equipment if these articles would increase the hazards associated with accidental contact with the live parts. If an employee wants to wear metal jewelry, he or she can cover the jewelry so as to eliminate the contact hazard. This requirement is not

[39] OSHA is also proposing to make similar changes to § 1910.269.

[40] The maximum use voltage for Class 4 rubber insulating equipment is 36 kilovolts. The highest voltage on which this equipment can be used is 62 kilovolts if there is no multiphase exposure. This voltage falls in the Table V–1 range of 46.1 to 72.5 kV.

intended to preclude workers from wearing metal rings or watch bands if the work being performed already exposes them to electric shock hazards and if the wearing of metal would not increase the hazards. (For example, for work performed on an overhead line, the wearing of a ring does not increase the likelihood that an employee would contact the line, nor would it increase the severity of the injury should contact occur.) However, this requirement would protect employees working on energized circuits with small clearances and high current capacities (such as some battery-supplied circuits) from severe burn hazards to which they would otherwise be exposed. The rule also protects workers who are only minimally exposed to shock hazards from being injured as a result of a dangling chain's making contact with a energized part. This provision has no counterpart in existing Subpart V.

*Protection from electric arcs.* Proposed paragraph (g) addresses clothing worn by an employee. After reviewing the rulemaking record on § 1910.269, OSHA determined that electric power generation, transmission, and distribution workers face a significant risk of injury from burns due to electric arcs (January 31, 1994, 59 FR 4388–4389). OSHA also concluded that certain fabrics increase the extent of injuries to employees caught in an electric arc or otherwise exposed to flames. Therefore, the Agency adopted two rules: (1) paragraph (l)(6)(ii) of § 1910.269, which requires that employees exposed to flames and electric arcs be trained in the hazards related to the clothing that they wear, and (2) paragraph (l)(6)(iii) which prohibits apparel that could increase the extent of injuries received by a worker who is exposed to a flame or electric arc. OSHA also included a note following paragraph (l)(6)(iii) to indicate the types of clothing fabrics that the § 1910.269 rulemaking record demonstrated were hazardous to wear by employees exposed to electric arcs.

Since § 1910.269(l)(6)(iii) became effective on November 1, 1994, employees have continued to suffer burn injuries working on energized lines and equipment. From January 1, 1990, to October 30, 1994, there were 46 accidents investigated by Federal or State OSHA involving burns that would have been addressed by § 1910.269(l)(6)(iii). These 46 accidents resulted in 71 total injuries. Averaged over this period, there were 9.5 accidents and 14.7 injuries per year. From November 1, 1994, to December 31, 1998, there were 17 such accidents resulting in 26 injuries. Averaged over this period, there were 4.0 accidents and 6.2 injuries per year. Thus, while the clothing rule in § 1910.269 appears to have helped reduce the number of accidents and injuries by more than 50 percent, for two reasons, OSHA believes that the remaining risk of burn injury is still serious and significant. First, these accidents represent only a small fraction of those that have actually occurred during this time. Employers are only required to report to the Agency accidents involving fatalities or three or more hospitalized injuries. OSHA does not investigate accidents that are not reported by employers (that is, those involving two or fewer hospitalized employees and no deaths) unless it results in extensive property damage or presents potential worker injury and generates widespread media interest. (*See* OSHA directives CPL 02–00–103 and CPL 02–00–094.) Consequently, most injury-producing accidents, even serious ones, are not investigated by the Agency. Second, the reported burn injuries are very serious and costly. Eighty-four percent of the burn injuries were fatalities or required hospitalization. Eighty-seven percent of the accidents for which the severity of the injury was noted involved third-degree burns. Such burns are extremely painful and costly, typically requiring skin grafts and leaving permanent scars.

OSHA's existing clothing requirement in § 1910.269 does not require employers to protect employees from electric arcs through the use of flame-resistant clothing. It simply requires that an employee's clothing do no greater harm. Because of the serious nature of the still remaining risk to power workers from electric arcs, the Agency believes that the standard should be revised to require the use of flame-resistant clothing, under certain circumstances, to protect employees from the most severe burns. The electric power industry is beginning to recognize this need as evidenced by the many employers who provide flame-resistant clothing to employees, by the work of ASTM in writing standards that provide for arc ratings of protective clothing, and by the ongoing work towards a protective standard by the committee responsible for writing work rules for the NESC. The National Fire Protection Association also recognizes the need to protect employees working on energized equipment from the hazards posed by electric arcs.

In addition, when § 1910.269 was promulgated, there were no standards for clothing to protect employees from the thermal hazards resulting from electric arcs. Since then, ASTM has adopted such standards. These standards ensure not only that clothing does not ignite but that it is rated to provide protection against a given level of heat energy. Apparel that meets the ASTM standards is labeled with the amount of heat energy that it can absorb under laboratory test conditions without letting through sufficient heat to cause a second-degree burn. Clothing is currently widely available in ratings from about 4 cal/cm$^2$ to over 50 cal/cm$^2$. In general, the higher the rating, the heavier the clothing.

As described more fully below, OSHA has decided to propose a rule that would require employers to estimate the heat energy from electric arcs that may be encountered by employees and to provide clothing that will be flame resistant if it could be ignited when an electrical fault occurs and that can protect against the estimated level of energy when an electric arc occurs. The Agency believes that this rule, which is proposed in § 1926.960(g), will ensure that employees wear protective clothing that is reasonably protective for the hazards they are facing.[41]

Paragraph (g)(1) of proposed § 1926.960 would require the employer to assess the workplace to determine if employees are exposed to hazards from flames or electric arcs. This provision ensures that the employer evaluates employee exposure to flames and electric arcs so that employees who do face such exposures can be protected. Because § 1926.960 applies to work performed on or near energized parts of electric circuits, employers can base a portion of the assessment required by paragraph (g)(1) on a determination of which employees perform energized work covered by this section. It should be noted, however, that until a line or part of an electric circuit has been completely deenergized following the procedures required by § 1926.961, including any required testing and grounding, the line or part would have to be treated as energized.

Once an employer determines who is exposed to hazards from flames or electric arcs, the next step in protecting these employees is a determination of the extent of the hazard. Paragraph (g)(2) would require the employer to estimate the maximum amount of heat energy to which employees would be exposed. This estimate can be used in the selection of protective clothing, as discussed later.

OSHA is aware of various methods of calculating values of available heat energy from an electric circuit. These methods are listed in Table IV–7. Each

[41] OSHA is also proposing to make similar changes in § 1910.269.

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). Some of these parameters, such as the fault current and the clearing time, are known quantities for a given system. Other parameters, such as the length of the arc and the distance between the arc and the employee, vary widely and can only be estimated. OSHA is not endorsing any of the methods listed in Table IV–7. The Agency requests comments and information on these and any other available methods of calculating incident heat energy from electric arcs.

TABLE IV–7.—METHODS OF CALCULATING INCIDENT HEAT ENERGY FROM AN ELECTRIC ARC

1. Standard for Electrical Safety Requirements for Employee Workplaces, NFPA 70E–2004, Annex D, ''Sample Calculation of Flash Protection Boundary.''
2. Doughty, T.E., Neal, 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 1584–2002.
4. Heat Flux Calculator, a free software program created by Alan Privette (widely available on the Internet).
5. ARCPRO, a commercially available software program developed by Kinectrics, Toronto, ON, CA.

The amount of heat energy calculated by any of the methods is approximately 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 he or she is just a few more centimeters away, the heat energy drops substantially.

In addition, the fault current and clearing time are interdependent. Typically, the higher the fault current, the shorter the clearing time. It is quite possible that the maximum heat energy will result from a fault current that is well below maximum but that results in a relatively long clearing time. In order to calculate the worst case heat energy, an employer would have to perform a range of calculations for each system area.

Furthermore, the method of calculation can affect the results. Each method yields somewhat different values using the same input parameters. This is partly because of the unpredictability of an electric arc and partly because of the different ways the methods were developed. Some, like the NFPA 70E method, are based in theory. Others, like the IEEE 1584 method, are based on empirical data. Whichever method is used, it is important to use it within its limitations. For example, the values produced by the Heat Flux Calculator must be adjusted if employees are exposed to energy from a multiphase fault or if the heat energy would be reflected by nearby surfaces.[42]

Because of the variability imposed by these factors, OSHA has preliminarily concluded that it is not possible to predict exactly how much energy an employee would face if an electric arc occurs. On the other hand, it is clear that when more electrical energy is available more heat will be generated by an electric arc and the potential for severe injury is greater. The Agency believes that greater protection is warranted when greater hazards exist. Thus, OSHA is proposing a standard that requires reasonable, but not exact, estimates of the heat energy to which an employee could be exposed.

Additionally, OSHA is not proposing a standard based entirely on worst-case exposure. The worst case occurs when an electric arc powered by the maximum available fault current is against an employee's skin. In such cases, the distance between the employee and the arc is zero, and the energy is extremely high even for relatively low-current arcs. The Agency does not believe it is reasonable to require a correspondingly high degree of protection for relatively low-energy arcs, which would put employees in very heavy clothing.

On the other hand, OSHA believes that it is appropriate for the employer to provide a level of protection that is reasonably related to the thermal hazard involved. A 50-cal/cm² exposure calls for more protection than a 5-cal/cm² exposure. Although none of the methods can predict precisely how much heat energy an employee will face, they do provide a good indication of the relative severity of the exposure and the approximate level of protection needed. Thus, the Agency is proposing a rule that it believes requires reasonable estimates of the amount of heat energy an employee is likely to face and to provide a corresponding level of protection. OSHA requests comments on whether the proposed rule requires an appropriate level of protection and clearly defines employer obligations with respect to the estimates of the maximum available heat energy.

Two notes following proposed § 1926.960(g)(2) help explain how to comply with the rule. The first note states that Appendix F to Subpart V provides guidance on the estimation of available heat energy. This appendix discusses various methods of estimating electric arc heat energy levels and provides tables that can also be used for this purpose. OSHA requests comments on this appendix and on whether additional information is available to help employers and employees estimate available heat energy. The second note indicates that the employer may use broad estimates representing multiple system areas if the employer uses reasonable assumptions about the exposure distribution throughout the system and if those estimates represent the maximum exposure for those particular areas. This note clarifies that the rule is not intended to require separate calculations for each job or task.

Much of the flame-resistant clothing available today comes with an arc rating.[43] In basic terms, an arc rating indicates that a fabric is not expected to transfer sufficient thermal energy to cause a second-degree burn when tested under standard laboratory conditions exposing the fabric to an electric arc that radiates an energy at or below the rating.[44] Proposed paragraph (g)(5) would require that employees who are exposed to hazards from electric arcs wear clothing with an arc rating greater than or equal to the heat energy estimated under proposed paragraph (g)(2). This clothing will protect employees exposed to various levels of heat energy from sustaining severe burn injuries in areas covered by the clothing. The note following paragraph (g) explains that Appendix F to Subpart V contains information on the selection of appropriate clothing. This appendix

[42] This exposure is known as ''arc in a box.''

[43] The ASTM standards governing arc rating require the fabric being tested to be flame resistant. Thus, no nonflame-resistant clothing has an arc rating.

[44] Arc rating is defined in ASTM F1506–02a$^{\epsilon 1}$, 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: ''a value that indicates the arc performance of a material or system of materials. It is either the arc thermal performance value (ATPV) or breakdown threshold energy ($E_{BT}$), when the ATPV cannot be determined by Test Method F1959.'' ASTM F1959–99 defines ATPV as ''in arc testing, the incident energy on a fabric or material that results in sufficient heat transfer through the fabric or material to cause the onset of a second-degree burn based on the Stoll curve.'' That same standard defines $E_{BT}$ as ''the average of the five highest incident energy exposure values below the Stoll curve where the specimens do not exhibit breakopen.''

contains information on the ignition threshold of various fabrics, the thermal performance of typical arc-rated clothing, ways of estimating available heat energy, and ways of selecting clothing to protect employees from burn injuries resulting from electric arcs.

Even with the requirements for the employer to assess hazards (proposed paragraph (g)(2)) and for employees to wear clothing with a rating appropriate for this assessment (proposed paragraph (g)(5)), there are still situations that could arise under which an employee's clothing could ignite and lead to severe burn injuries. For example, an employee wearing a cotton-polyester blend jacket over his or her arc-rated shirt could be injured if the jacket ignites or melts when an electric arc occurs. Thus, OSHA is proposing, in paragraphs (g)(3) and (g)(4), additional provisions intended to prevent the ignition or melting of an employee's clothing.

Proposed § 1926.960(g)(3) would prohibit clothing that could either melt onto an employee's skin or ignite and continue to burn. This rule is equivalent to existing § 1910.269(l)(6)(iii).[45] This proposed provision would ensure that employees exposed to electric arcs do not wear clothing presenting the most severe burn hazards. A note following this provision lists fabrics that are specifically prohibited unless the employer demonstrates that the clothing is treated or worn to eliminate the hazard. This note is the same as the note following existing § 1910.269(l)(6)(iii). OSHA requests comments on whether additional fabrics pose similar hazards and should be added to the note.

Proposed paragraph (g)(4) would require employees to wear flame-resistant clothing whenever: (1) The employee is exposed to contact with live parts energized at more than 600 volts (paragraph (g)(4)(i)); (2) the employee's clothing could be ignited by nearby flammable material that could be ignited by an electric arc (paragraph (g)(4)(ii)); or (3) the employee's clothing could be ignited by molten metal or electric arcs from faulted conductors in the work area (paragraph (g)(4)(iii)). (A note to proposed paragraph (g)(4)(iii) indicates that this provision does not apply to conductors capable of carrying the maximum available fault current. The design of the installation is intended to prevent these conductors from melting.) The listed conditions are those in which employees' clothing has been ignited in several of the burn accidents examined by OSHA.

OSHA could have, more simply, required clothing that could not ignite and continue to burn under the heat energy conditions estimated pursuant to proposed paragraph (g)(2). However, as noted earlier, these estimates do not entirely reflect the heat energy produced by worst case conditions. If the other parameters affecting the energy in an arc are held constant, the heat energy rises exponentially with decreasing distance between the arc and the employee. Thus, an electric arc that touches an employee's clothing releases much more energy than the same arc at a distance equal to the minimum approach distance. For example, the heat energy from a 51-millimeter-long arc, generated by 20 kiloamperes of fault current at 15 kilovolts, and clearing in 6 cycles is 1.23 cal/cm$^2$ if the arc is 650 millimeters away, but is 1971 cal/cm$^2$ if the arc is 10 millimeters away.[46] None of the common fabrics listed in Table 11 in Appendix F to Subpart V (explained below) would ignite if the arc was 650 millimeters away from the employee, but every one would ignite if the arc was only 10 millimeters away.

The closest an electric arc was to an employee in electric power accidents over the years 1991 to 1998 occurred in 17 cases in which an employee contacted an energized conductor or was touching the electric arc. In eight of those cases, an employee's clothing apparently ignited.[47] On the other hand, none of the accidents involved contact with circuit parts energized at 600 volts or less. OSHA believes that the cases that have occurred demonstrate a significant risk that an employee's clothing could ignite and cause serious, even fatal, burn injuries from ignited clothing when an employee contacts circuit parts energized at more than 600 volts. Therefore, OSHA has preliminarily concluded that an employee must wear flame-resistant clothing any time he or she is subject to contact with live parts energized at more than 600 volts. The Agency requests comments on whether the requirements for flame-resistant clothing in proposed § 1926.960(g)(4) are reasonable and appropriate.

OSHA is not proposing to require a specific level of protection for skin that is not covered by clothing. Employees' hands, which are frequently the closest body part to an electric arc, would typically be protected by rubber insulating gloves and leather protectors when the employee's hands are at greatest risk of injury. Although neither rubber insulating gloves nor leather protectors have arc ratings, because of their weight and thickness, they typically provide greater protection from electric arcs than light-weight flame-resistant clothing. Their protective value is borne out in the accident data—none of the burn injuries to employees hands involved an employee wearing rubber insulating gloves. OSHA requests comments on whether the standard should require complete protection for an employee's entire body.

*Payment for Protective Clothing.* As described earlier, OSHA is requiring employers to ensure that their employees (1) wear flame-resistant clothing under certain hazardous conditions, and (2) when working on energized parts of the electric power system, wear clothing with an arc rating greater than or equal to potential heat energy exposures estimated for those parts. OSHA considers the protective clothing required by paragraph (g) to be PPE. The protective clothing would reduce the degree of injury sustained by an employee when an electric arc occurs. In some cases, the clothing would prevent injury altogether. Unlike many OSHA standards, the proposal would not require that employers provide protective clothing at no cost to employees. However, OSHA is considering including an employer-payment requirement in the final rule and is seeking comments on the issue.

OSHA has a longstanding policy that employers must provide and pay for PPE, except, in some cases, where the PPE is personal in nature and usable by the employee off of the job. This policy is supported by the plain language of the OSH Act and its legislative history. (For a complete discussion of OSHA's policy, see OSHA's preamble to the employer payment for PPE proposal, 64 FR 15402 (March 31, 1999).) Many OSHA health standards include language explicitly stating that employers must provide PPE ''at no cost'' to employees. See, for example, 29 CFR 1910.1018(h)(2)(i) and (j) (inorganic

[45] The existing rule prohibits clothing that could increase the extent of injuries to an employee if an electric arc occurs. The Agency interprets this rule as prohibiting clothing that could melt or that could ignite and continue to burn in the presence of an electric arc faced by an employee (Memorandum to the Field from James W. Stanley, ''Guidelines for the Enforcement of the Apparel Standard, 29 CFR 1910.269(l)(6), of the Electric Power Generation, Transmission, and Distribution Standard'').

[46] These heat energy estimates are calculated using ARCPRO.

[47] The accident description indicated that the clothing ignited or stated that the extent of the burns or the location of the burns was such that clothing ignition was likely to have occurred. For example, in one case, a 4100-volt conductor fell onto an employee's chest. The employee survived the electric shock but died from second- and third-degree burns over 60 percent of his body. The electrical burns from the contact were probably localized to the area near the point of contact. It is likely that the employee's clothing ignited to cause burns that were spread over 60 percent of his body though the accident description did not state that clothing ignition occurred.

arsenic); 29 CFR 1910.1025(f)(1) and (g)(1) (lead); and 29 CFR 1910.1048(g)(1) and (h) (formaldehyde). The regulatory text and preamble of some safety standards also make clear that employers must pay for PPE. See 29 CFR 1910.146(d)(4)(iv) (confined spaces); and 29 CFR 1910.266(d)(1)(iii) (logging).

Because not every OSHA standard explicitly states that employers must pay for PPE, in 1999, OSHA proposed regulatory language to clarify that employers are responsible for the cost of PPE, with only a few exceptions (64 FR 15402). The proposal added language to OSHA's general industry, shipyard, construction, marine terminal, and longshoring standards that ''[a]ll protective equipment, including [PPE] * * * shall be provided by the employer at no cost to employees [64 FR 15441 (emphasis added)].'' Exceptions were given for safety-toe protective footwear and prescription safety eyewear, provided that the employer permits them to be worn off of the job site, they are not used in a manner that makes them unsafe for use off of the job site, and they are not designed for special use on the job (64 FR 15441). OSHA recently reopened the rulemaking record on its employer payment for PPE proposal. to solicit comment on PPE that might be considered tools of the trade. See 69 FR 41221 (July 8, 2004).

OSHA also recently proposed that employers in general industry, maritime, and construction, pay for protective clothing for employees exposed to hexavalent chromium (Cr(VI)). See 69 FR 59465–59466 (Oct. 4, 2004) (''Where a hazard is present or is likely to be present from skin or eye contact with chromium (VI), the employer shall provide appropriate personal protective clothing and equipment at no cost to employees, and shall ensure that employees use such clothing and equipment.''). The Agency said that employers are in the best position to select and obtain the appropriate protective clothing and that by providing and owning protective clothing, the employer will better maintain the integrity of it (69 FR 59456). The proposal also prohibits employees from taking contaminated protective clothing home; employers are responsible for laundering or disposing of contaminated protective clothing (69 FR 59456).

OSHA believes that requiring employers to pay for the protective clothing that would be required by this proposal may also improve the safety of employees. Like Cr(VI), the purchase of protective clothing may be best handled by electric power generation, transmission, and distribution employers, who have all of the information related to the parameters of the electric power system and are in the best position to select and purchase clothing necessary to protect employees from injury. Moreover, an employer-payment requirement could also help ensure that protective clothing is replaced promptly when its protective qualities erode. Some stakeholders have told OSHA that employees, if required to pay for their own protective clothing, may delay replacing damaged protective clothing for financial reasons. Any delay in replacing an article of protective clothing that has worn thin, or that contains holes or other openings, could endanger employees. Such damaged clothing does not provide adequate protection to employees exposed to electric arcs.

Unlike Cr(VI), however, this proposal contains no prohibition on employees' taking certain protective clothing home, wearing certain protective clothing off of the job, and laundering such clothing. OSHA has not included an employer-payment requirement in this proposal because it does not have enough information at this time on the types and weights of protective clothing, if any, that may be routinely worn outside of work.[48] There may be certain types of lightweight protective clothing that employees wear both at work and at home. OSHA believes it needs more information from the public on this clothing before including a general requirement that employers pay for protective clothing. In the PPE payment proposal, OSHA expressly exempted safety shoes and prescription eyewear from the general employer-payment requirement, in part because such equipment was personal in nature and could be used outside of work. See 64 FR 15402. OSHA is seeking information from the public as to whether protective clothing worn by employees performing power generation, transmission, and distribution work falls into this same category of PPE. OSHA is also incorporating the record of the employer payment for PPE rulemaking into the record of this rulemaking and will give due consideration to all relevant comments.

[48] OSHA notes that, for ease of analysis only, it has included a cost to employers for providing protective clothing in its economic feasibility analysis—in addition to its economic impact analysis under Executive Order 12866 and the RFA—even though such a requirement is not expressly included in the proposal. See Section V, Preliminary Regulatory Impact Analysis and Initial Regulatory Flexibility Analysis, later in this preamble.

OSHA is seeking comments on its findings on protective clothing generally in addition to the following specific questions:

1. Are there types or weights of protective clothing that employees typically wear outside of work? Do employers restrict the types or weights of protective clothing that employees are allowed to wear outside of work?

2. Do employers typically provide the types of protective clothing required by the proposal at no cost to employees? Do some employers provide certain types or weights of protective clothing at no cost to employees, while requiring other types or weights of protective clothing to be paid for by employees? Should OSHA include an employer-payment requirement for heavier weights or particular types of protective clothing, but not lighter weights or other types? If so, please specify what weights or types of protective clothing should be exempt from an employer-payment requirement.

3. OSHA realizes that in the construction industry crews of employees are sometimes hired through local unions. This results in a variable workforce for many contractors. A contractor that hires employees in this manner may have to buy protective clothing for more employees than would an employer with a more stable workforce, particularly for protective clothing that only fits one employee. OSHA requests comment on whether, given this hiring practice, an employer-payment requirement is appropriate in the construction industry. Are there any alternative approaches that would be responsive to this variable workforce situation and would also be protective of construction workers performing electric power generation, transmission, and distribution work?

4. Should OSHA not address the payment for protective clothing specifically in the final rule and, instead, follow the outcome of the general employer payment for PPE rulemaking?

To protect employees from contacting energized parts, paragraph (h) of proposed § 1926.960 would require fuses to be installed and removed using insulated tools or gloves when a terminal is energized at over 300 volts or when live parts are exposed at any voltage over 50 volts. When an expulsion fuse operates on a fault or overload, the arc from the fault current erodes the tube of the fuse holder. This produces a gas that blasts the arc out through the fuse tube vent or vents, and with it any loose material in the way. Employees could be injured by the arc blast or by particles blown, by the blast, in their eyes. Employees should never install or remove such fuses using gloves alone. Therefore, paragraph (h) would also require employees installing expulsion-type fuses energized at 300 volts or more to wear eye protection, would have to use a tool rated for the voltage, and would have to stand clear of the fuse's exhaust path. This paragraph, which has no counterpart in existing Subpart V, has been taken from § 1910.269(l)(7).

Paragraph (i) explains that covered conductors are treated under the standard as uninsulated. (See the definition of ''covered conductor'' in § 1926.968.) The covering on this type of wire protects the conductor from the weather but does not provide adequate insulating value. This provision, which has no counterpart in existing Subpart V, has been taken from § 1910.269(l)(8).

Paragraph (j) proposes a requirement that noncurrent-carrying metal parts of equipment or devices be treated as energized at the highest voltage to which they are exposed unless the installation is inspected and these parts are determined to be grounded. Grounding these parts, whether by permanent grounds or by the installation of temporary grounds, would provide protection against ground faults. This requirement, which has no counterpart in existing Subpart V, is based on § 1910.269(l)(9).

Paragraph (k) would require devices used to open circuits under load conditions to be designed to interrupt the current involved. It is hazardous to open a circuit with a device that is not designed to interrupt current if that circuit is carrying current. Non-load-break switches used to open a circuit while it is carrying load current could fail catastrophically, severely injuring or killing any nearby employee. This requirement, which has no counterpart in existing Subpart V, has been taken from § 1910.269(l)(10).

Section 1926.961, Deenergizing Lines and Equipment for Employee Protection

Proposed § 1926.961 addresses the deenergizing of electric transmission and distribution lines and equipment for the protection of employees. Transmission and distribution systems are different from other energy systems found in general industry or even in the electric utility industry itself. The hazardous energy control methods for these systems are necessarily different from those covered under the general industry generic standard on the control of hazardous energy sources (§ 1910.147). Transmission and distribution lines and equipment are installed outdoors and are subject to being reenergized by means other than the normal energy sources. For example, lightning can strike a line and energize an otherwise deenergized conductor, or a line could be energized by unknown cogeneration sources not under the control of the employer. Additionally, some deenergized transmission and distribution lines are subject to being reenergized by induced voltage from nearby energized conductors or by contact with other energized sources of electrical energy. Another difference is that energy control devices are often very remote from the worksite and are frequently under the centralized control of a system operator.

For these reasons, OSHA is proposing to cover the control of hazardous energy sources related to transmission and distribution systems. This is the same approach used in § 1910.269. In fact, the requirements proposed in § 1926.961 have been taken from § 1910.269(m). Existing Subpart V also contains procedures for deenergizing transmission and distribution installations. The differences between the existing requirements, which are contained in § 1926.950(d), and those proposed in § 1926.961 are discussed later in this preamble.

In addition to setting forth the application of § 1926.961, paragraph (a) explains that conductors and equipment that have not been deenergized under the procedures of § 1926.961 have to be treated as energized. As noted earlier in this preamble under the summary and explanation of proposed § 1926.960(b)(2), existing § 1926.950(b)(2) requires electric equipment and lines to be considered as energized until determined to be deenergized by tests or other appropriate means. OSHA believes that the appropriate procedures for assuring that lines and equipment are deenergized are contained in proposed § 1926.961 and that a simple test for a deenergized condition cannot be relied upon to ensure that lines and equipment remain deenergized.

Some systems are under the direction of a central system operator who controls all switching operations. Other systems (mostly distribution installations) are not under any centralized control. These systems are energized and deenergized in the field without the direct intervention of a system operator. Paragraph (b)(1) of proposed § 1926.961 states that all of the requirements of proposed paragraph (c) would apply if a system operator is in charge of the lines and equipment and of their means of disconnection. Paragraph (b)(2) defines the general rule for crews working on lines that are not under the control of a system operator. In the usual case, one employee is designated to be in charge of the clearance. In general, all of the requirements in paragraph (c) would apply, with the employee in charge of the clearance taking the place of the system operator. In this manner, the proposal provides protection against the unintended energizing of transmission and distribution lines without requiring all lines to be under the control of one employee. One employee in a crew will be in charge of the clearance for the crew; procedures will be followed to ensure that the lines are truly deenergized; tags will be placed on the lines; and procedures will be followed to remove the tags and reenergize the lines.

However, in some cases, certain requirements contained in paragraph (c) are not necessary for the safety of employees. If only one crew will be working on transmission or distribution lines and if the means of deenergizing the lines is accessible and visible to and under the sole control of the employee in charge of the clearance, the provisions requiring tags on the disconnecting means are unnecessary. Therefore, proposed paragraph (b)(3)(i) would exempt a portion of the requirements of paragraph (c) from applying to work that is performed by a single crew of employees,[49] if the means of disconnection of the lines and equipment are accessible and visible to and under the sole control of the employee in charge of the clearance. The provisions of paragraph (c) that would not apply are those relating to (1) requesting the system operator to deenergize the lines, (2) automatic and remote control of the lines, (3) the wording on tags, (4) two crews working on the same line, and (5) tag removal. It is not necessary to request the system operator to deenergize the lines because he or she would not be in control of the disconnecting means for the lines. Only one person would be in charge of the clearance for the crew, and the means of disconnection for the lines would be accessible and visible to and under the control of that person.[50] Thus, tags would not be needed for the protection of the crew. Further, remote and automatic switching of lines and work performed by two crews working on lines or equipment controlled by the same disconnecting means would not be

[49] An employee working alone is considered to be a ''crew'' of one.

[50] The means of disconnection is under the sole control of the employee in charge of the clearance, and it need only be assessible and visible to that employee. Other employees in the crew have no control whatsoever over the disconnecting means.

recognized under paragraph (b)(3)(i). (A group of employees made up of several ''crews'' of employees who are under the direction of a single employee and who are working in a coordinated manner to accomplish a task on the same lines or equipment are considered to be a single crew, rather than as multiple independent crews, for the purposes of paragraph (b)(3)(i). In such cases, all operations that could energize or deenergize a circuit would have to be coordinated through the single employee in charge.) If the crews are independent, each crew would need an employee-in-charge of its clearance (see the discussion of proposed paragraph (b)(3)(ii), later in this section of the preamble). Therefore, no one could be considered as having sole control over the disconnecting means protecting the crews, and the exceptions listed in paragraph (b)(3)(i) would not apply.

Paragraph (d) of existing § 1926.950 also recognizes separate procedures for lines that are ''visibly open.'' However, only two requirements apply. First, paragraph (d)(2)(i) requires guards or barriers to be installed to protect against contact with adjacent lines. Second, upon completion of work, the designated employee in charge must determine that all employees in his crew are clear and that protective grounds installed by his crew have been removed, and he or she must report to the designated authority that all tags protecting the crew may be removed (paragraph (d)(2)(ii)).

The existing Subpart V provisions relating to working on lines or equipment that have their disconnecting means ''visibly open'' are insufficient to protect employees. Other requirements relating to deenergizing, testing, grounding, and reenergizing procedures are necessary for the protection of employees. While existing Subpart V does cover reenergizing procedures, it includes no provisions for deenergizing, testing, or grounding. OSHA believes that this proposal corrects these deficiencies.

If more than one independent crew is working on a line, paragraph (b)(3)(ii) would require each crew to follow the steps outlined in § 1926.961(c) separately, to ensure that a group of workers does not make faulty assumptions about what steps have been or will be taken by another group to deenergize lines or equipment. Paragraph (c) of proposed § 1926.961 would not require a separate tag for each crew; it does require, however, separate clearances for each crew. There would have to be one employee in charge of the clearance for each crew, and the clearance for a crew would be held by this employee. In complying with paragraph (b)(3)(ii), the employer would have to ensure that no tag is removed unless its associated clearances are released (paragraph (c)(11)) [51] and that no action is taken at a given point of disconnection until all protective grounds have been removed, until all crews have released their clearances, until all employees are clear of the lines or equipment, and until all tags have been removed at that point of disconnection (paragraph (c)(12)). OSHA requests comments on whether the standard should require each crew to have a separate tag and, if so, on ways to incorporate such a requirement in the standard.

Where there is a system operator, who is in charge of energizing and deenergizing lines and equipment, that person keeps track of clearances for different crews working on the same lines or equipment. When there is no system operator, the crews will need to coordinate their activities to ensure that the lines or equipment are not reenergized while an employee is still working on them. Proposed paragraph (b)(3)(ii) would require such coordination when there is no system operator.

Proposed paragraph (b)(3)(ii) has been taken from § 1910.269(m)(3)(viii). Existing Subpart V contains a comparable requirement in § 1926.950(d)(1)(vi). However, the existing requirement would simply require a tag for each independent crew. As noted earlier, the proposal would not require separate tags for each crew. However, each crew would hold a separate clearance that could not be released without authorization from the employee in charge of the clearance. Additionally, the proposal would require that each crew independently perform all the steps outlined in proposed paragraph (c) and that the crews coordinate deenergizing and reenergizing the lines or equipment if no system operator is in charge. The existing standard contains no such requirement. OSHA believes that the proposed approach better protects employees than the existing standard.

Disconnecting means that are accessible to people not under the employer's control would have to be rendered inoperable. For example, a switch handle mounted at the bottom of a utility pole that is not on the employer's premises must be locked in the open position while the overhead line is deenergized. This requirement, which is contained in paragraph (b)(4) would prevent a member of the general public or an employee (of a contractor, for example) who is not under the employer's control from closing the switch and energizing the line. This requirement, which has no counterpart in existing Subpart V, has been taken from § 1910.269(m)(2)(iv).

Paragraph (c) of proposed § 1926.961 sets forth the exact procedure for deenergizing transmission and distribution lines and equipment. The procedure must be followed in the order presented in the rule. Except as noted, the rules are consistent with existing § 1926.950(d)(1), although the language has been taken from § 1910.269(m)(3). The Agency has attempted to propose simplified language and has written the requirements in performance-oriented terms whenever possible.

Paragraph (c)(1) would require an employee to request the system operator to deenergize a particular section of line or equipment. So that control is vested in one authority, a single designated employee would be assigned this task. This designated employee thus becomes the employee in charge of and responsible for the clearance for work. This provision, which has no counterpart in existing Subpart V, has been taken from § 1910.269(m)(3)(i). The designated employee who requests the clearance need not be in charge of other aspects of the work; the proposal intends for this designated employee to be in charge of the clearance. He or she is responsible for requesting the clearance, for informing the system operator of changes in the clearance (such as transfer of responsibility), and for insuring that it is safe for the circuit to be reenergized before the clearance is released. If someone other than an employee at the worksite requests the clearance and if that clearance is in place before the employee arrives at the site, then clearance must be transferred under § 1926.961(c)(8). The Agency believes that the person requesting the clearance, once the lines are indeed deenergized, must be the one to contact in case alterations in the clearance are necessary. The employees who will be performing the actual work at some time in the future would not necessarily be aware that a clearance has been requested and would not be in position to answer questions about the clearance.

The second step (proposed § 1926.961(c)(2)) is to open all switches through which electrical energy could flow to the section of line or equipment. The disconnecting means would then be made inoperable if the design of the device permits. For example, the

[51] Unless the employer has only one crew, a tracking mechanism may be necessary so that the employer can determine what crew is protected by a tag.

removable handle of a switch could be detached. Also, the switches would have to be tagged to indicate that employees are at work. This paragraph would ensure that the lines are disconnected from their sources of supply and protects against the accidental reclosing of the switches. This rule is intended to require the disconnection of known sources of electric energy only. Hazards related to the presence of unexpected energy sources would be controlled by testing for voltage and by grounding the circuit, as proposed under paragraphs (c)(5) and (c)(6), respectively.

Proposed paragraph (c)(2) has been taken from § 1910.269(m)(3)(ii). Existing Subpart V contains comparable requirements in § 1926.950(d)(1)(i), (d)(1)(ii)(*a*), and (d)(1)(ii)(*b*). The existing provisions require: (1) the line or equipment to be identified and isolated from sources of energy (paragraph (d)(1)(i)), and (2) notification and assurance of the designated employee that all disconnecting means have been opened and tagged (paragraphs (d)(1)(ii)(*a*) and (d)(1)(ii)(*b*)). OSHA believes that the proposed language more accurately reflects the actual steps taken to deenergize lines and equipment.

Proposed § 1926.961(c)(3) would require the tagging of automatically and remotely controlled switches. An automatically or remotely controlled switch would also have to be rendered inoperable if the design of the switch allows for it to be made inoperable. This provision which has been taken from § 1910.269(m)(3)(iii), would also protect employees from being injured as a result of the automatic operation of such switches. Existing Subpart V contains an equivalent requirement in §§ 1926.950(d)(1)(ii)(*b*) and (d)(1)(ii)(*c*).

Paragraph (c)(4) of proposed § 1926.961 would require tags to prohibit operation of the switches to which they are attached. They would also be required to state that employees are at work. This requirement has been taken from § 1910.269(m)(3)(iv). Existing § 1926.950(d)(1)(ii)(*b*) contains a requirement for tags to indicate that employees are working; however, it does not require the tags to prohibit operation of the disconnecting means. The Agency believes that it is essential for the tags to contain this prohibition so that the meaning of the tag is clear.

After the previous four requirements have been met and after the employee in charge of the work has been given a clearance by the system operator, proposed paragraph (c)(5) would require the lines or equipment to be tested. This test would ensure that the lines have in fact been deenergized and is intended to prevent accidents resulting from someone's opening the wrong disconnect. It also protects employees from hazards associated with unknown sources of electric energy. This paragraph is based on § 1910.269(m)(3)(v). Existing § 1926.950(d)(1)(iii) requires a test or a visual inspection to be performed to ensure that the lines or equipment are deenergized. Visual inspection alone cannot determine whether a line or equipment is deenergized. Voltage backfeed, induced current, and leakage current can all energize electric lines and equipment without the employee being able to ''see'' it. Additionally, the § 1910.269 rulemaking showed the lack of testing to be a cause of accidents (269-Ex. 9–2, 12–12). Therefore, the proposal would require an actual test to determine whether the lines or equipment was energized. OSHA has not specified the type of test but expects employers to use testing procedures that will reliably indicate whether or not the part in question is energized. For example, using a voltage detector on the part would be one way to do this. OSHA requests comments on when and if other methods, such as fuzzing a line,[52] are acceptable testing methods.

Proposed paragraph (c)(6) would require the installation of any protective grounds required by § 1926.962 at this point in the sequence of events. Since the lines or equipment have been deenergized and tested in accordance with the previous provisions, it would now be safe to install a protective ground. This requirement is based on § 1910.269(m)(3)(vi). An equivalent requirement is contained in existing § 1926.950(d)(1)(iv).

After the six previous rules have been followed, paragraph (c)(7) would permit the lines or equipment to be treated as deenergized. This provision, which has no counterpart in existing Subpart V, is based on § 1910.269(m)(3)(vii).

In some cases, as when an employee in charge has to leave the job because of illness, it may be necessary to transfer a clearance. Under such conditions, proposed paragraph (c)(8) would require that the employee in charge inform the system operator and that the employees in the crew be informed of the transfer. If the employee holding the clearance is forced to leave the worksite due to illness or other emergency, the employee's supervisor could inform the system operator of the transfer in clearance. This requirement, which is based on § 1910.269(m)(3)(ix), has no counterpart in existing Subpart V.

After the clearance is transferred, the new employee in charge would then be responsible for the clearance. It is important that only one employee at a time be responsible for any clearance; otherwise, independent action by any worker could endanger the entire crew.

Once work is completed, the clearance will have to be released so that the lines or equipment can be reenergized. Paragraph (c)(9) of proposed § 1926.961 covers this procedure. To ensure that it is safe to release the clearance, the employee in charge would have to: (1) Notify workers in the crew of the release, (2) determine that they are clear of the lines and equipment, (3) determine that grounds have been removed, and (4) notify the system operator that the clearance is to be released. This provision is based on § 1910.269(m)(3)(x). An equivalent requirement is contained in existing § 1926.950(d)(1)(viii).

Proposed paragraph (c)(10) would require the person who is releasing the clearance to be the one who requested it, unless responsibility has been transferred. This provision would ensure that no clearance is released without the authorization of the employee who is in charge of the clearance. This proposed paragraph, which has no counterpart in existing Subpart V, is based on § 1910.269(m)(3)(xi).

Proposed paragraph (c)(11) would prohibit the removal of a tag unless its associated clearance has been released. Because the persons who place and remove the tags may not be the same, it is important for the regulation to prohibit removing a tag without the release of the clearance by the employee who is responsible for it. This provision, which has no counterpart in existing Subpart V, is based on § 1910.269(m)(3)(xii).

According to proposed paragraph (c)(12), action would be permitted to be taken to reenergize the lines or equipment only after grounds and tags have been removed, after all clearances have been released, and after all employees are in the clear. This protects employees from the possibility that the line or equipment could be reenergized while employees are still at work. The Agency does not intend for this provision to require the removal of all tags from all disconnecting means before any of them could be reclosed. It

[52] Fuzzing, or buzzing, a line involves using a live-line tool to hold a wrench or similar tool near a line and listening for the buzzing sound given off as the tool approaches a circuit part energized at a high voltage. This method has obvious disadvantages when ambient noise levels are excessive, and it is only reliable above certain voltage levels.

is intended to require that all tags for any particular switch be removed before that switch is closed. It is very important in a tagging system that no energy isolating device be returned to a position allowing energy flow if there are any tags on it that are protecting employees. For example, in the case of a 5-mile section of line that is deenergized by opening switches at both ends of the line, after all the tags are removed from any one switch that one switch could then be closed.

Proposed paragraph (c)(12), which has no counterpart in Subpart V, has been taken from § 1910.269(m)(3)(xiii).

Section 1926.962, Grounding for the Protection of Employees

Sometimes, normally energized lines and equipment that have been deenergized to permit employees to work become accidentally energized. This can happen in several ways, for example, by contact with another energized circuit, by voltage backfeed from a customer's cogeneration installation, by lightning contact, or by failure of the clearance system outlined in § 1926.961.

Transmission and distribution lines and equipment are normally installed outdoors where they are exposed to damage from the weather and from actions taken by members of the general public. Many utility poles are installed alongside roadways where they may be struck by motor vehicles. Distribution lines have been damaged by falling trees, and transmission line insulators have been used for target practice. Additionally, customers fed by a utility company's distribution line may have cogeneration or backup generation capability, sometimes without the utility company's knowledge. All these factors can reenergize a deenergized transmission or distribution line or equipment. Energized lines can be knocked down onto deenergized lines. A backup generator or a cogenerator can cause voltage backfeed on the deenergized power line. Lastly, lightning, even miles from the worksite, can reenergize a line. All of these problems pose hazards to employees working on deenergized transmission and distribution lines and equipment. In fact, these problems were a factor in 14 of the accidents in 269–Exhibit 9–2.

Grounding the lines and equipment is used to protect employees from injury should such reenergizing occur. Grounding also provides protection against induced voltages and static charges on a line. (These induced and static voltages can be high enough to endanger employees, either directly from electric shock or indirectly from involuntary reaction.)

Grounding, as a temporary protective measure, involves connecting the deenergized lines and equipment to earth through conductors. As long as the conductors remain deenergized, this maintains the lines and equipment at the same potential as the earth. However, if voltage is impressed on a line, the voltage on the grounded line rises to a value dependent upon the impressed voltage, the impedance between its source and the grounding point, and the impedance of the grounding conductor.

Various techniques are used to limit the voltage to which an employee working on a grounded line would be exposed. Bonding is one of these techniques. Conductive objects within the reach of the employee are bonded together to create an equipotential work area for the employee. Within this area of equal potentials, voltage differences are limited to a safe value.

The requirements proposed in § 1926.962 have been taken directly from § 1910.269(n). Existing § 1926.954 contains current provisions related to grounding for the protection of employees. OSHA has reviewed existing § 1926.954 and has found that it is not as protective as § 1910.269(n) and contains redundant and unnecessary requirements. For example, as noted under the summary and explanation of proposed § 1926.960(b)(2), existing § 1926.950(b)(2) requires electric lines and equipment to be considered as energized until determined to be deenergized by tests or other appropriate methods or means. Existing § 1926.954(a) similarly requires all conductors and equipment to be treated as energized until tested or otherwise determined to be deenergized or until grounded. These two provisions do not adequately protect employees from accidentally reenergized lines and equipment. As noted in the earlier discussion, electric power transmission and distribution lines and equipment can become reenergized even after they have been deenergized. Therefore, OSHA concluded in the § 1910.269 rulemaking that grounding deenergized lines and equipment is essential except under limited circumstances. The Agency is proposing to continue that approach here. In developing proposed § 1926.962, OSHA eliminated redundant requirements from existing § 1926.954, consolidated related requirements from the existing standard, and strengthened the current requirements to protect employees better.[53]

Proposed § 1926.962 addresses protective grounding and bonding.[54] As noted in paragraph (a), entire § 1926.962 applies to the grounding of deenergized transmission and distribution lines and equipment for the purpose of protecting employees. Additionally, paragraph (a) indicates that paragraph (d) of proposed § 1926.962 would apply to the protective grounding of other equipment, such as aerial lift trucks, as well. Under normal conditions, such equipment would not be connected to a source of electric energy. However, to protect employees in case of accidental contact of the equipment with live parts, protective grounding is required elsewhere in the standard (in § 1926.964(c)(11), for example); to ensure the adequacy of this grounding, the provisions of paragraph (d) must be followed.

The general requirement contained in paragraph (b) of proposed § 1926.962 states the conditions under which lines and equipment must be grounded. Basically, in order for lines or equipment to be treated as deenergized, they must be deenergized under

[53] As previously noted, existing § 1926.954(a) requires conductors and equipment to be considered as energized until determined to be deenergized or until grounded. Paragraph (c) of existing § 1926.954 requires bare communications conductors on poles or structures to be treated as energized unless they are protected by insulating materials. The hazard addressed by these requirements is covered by proposed § 1926.960(b)(2), discussed earlier in this preamble.

When equipment is being installed, it poses the same hazard to an employee that any other conductive object being manipulated near exposed energized parts does. Requirements contained in proposed § 1926.960(c) and (d) adequately address this hazard. The installation of lines however does pose additional hazards. First, the lines may be subject to hazardous induced voltage. Second, because of their length, new overhead lines are much more likely to contact existing energized lines than new equipment is. This can happen, for example, through failure of the stringing and tensioning equipment being used to install the new lines or through failure of the existing lines or support structures. These hazards are addressed in proposed § 1926.964(b), which specifically covers the installation and removal of overhead lines. Lastly, new underground lines, which are run as insulated cable, do not pose electrical hazards.

For these reasons, OSHA is not proposing to carry existing § 1926.954(b) forward. However, comments are requested on whether or not the proposal adequately protects employees from hazards associated with the installation of new lines and equipment.

[54] As used throughout the rest of this discussion and within proposed § 1926.962, the term "grounding" includes bonding. Technically, grounding refers to the connection of a conductive part to ground, whereas bonding refers to connecting conductive parts to each other. However, for convenience, OSHA is using the term "grounding" to refer to both techniques of minimizing voltages to which an employee will be exposed.

proposed § 1926.961 and grounded. Grounding could be omitted only if the installation of a ground is impracticable (such as during the initial stages of work on underground cables, when the conductor is not exposed for grounding) or if the conditions resulting from the installation of a ground would introduce more serious hazards than work without grounds. It is expected that conditions warranting the absence of protective grounds would be rare.

If grounds are not installed and the lines and equipment are to be treated as deenergized, however, precautions have to be observed, and certain conditions must be met. Obviously, the lines and equipment would still have to be deenergized by the procedures of § 1926.961. Also, there would have to be no possibility of contact with another source of voltage and no hazard of induced voltage present. Since these precautions and conditions do not protect against the possible reenergizing of the lines or equipment under all conditions, the omission of grounding is permitted only in very limited circumstances.

Paragraph (f) of existing § 1926.954 allows grounds to be omitted without the additional restrictions proposed in § 1926.962(b)(1) through (b)(3). However, the existing standard requires the lines or equipment to be treated as energized in such cases. While the proposal does not specifically permit omitting grounds for conductors that are treated as energized, it does not require grounding unless the equipment is to be considered as deenergized. (See the discussion of proposed § 1926.960(b)(2), earlier in this section of the preamble.)

Paragraph (f) of existing § 1926.954 also addresses where grounds must be placed. The existing standard requires grounds to be placed between the work location and all sources of energy and as close as practicable to the work location. Alternatively, grounds could be placed at the work location. If work is to be performed at more than one location, the existing standard would require the line section to be grounded and short circuited at one location and would require the conductor on which work is being performed to be grounded at the work location. Although these requirements are intended to protect employees in case the line on which they are working is accidentally reenergized, the existing provisions do not ensure that the grounding practices and equipment are adequate to provide this protection.

OSHA proposed requirements similar to those in existing § 1926.954(f) when it proposed § 1910.269(n). In developing final § 1910.269(n), OSHA reviewed the accidents in 269–Ex. 9–2 and 269–Ex. 9–2A for those involving improper protective grounding. There were nine accidents in these two exhibits related to protective grounding. In three cases, inadequate grounds were present. Based on the fact that grounding is a backup measure, intended to provide protection only when all other safety-related work practices fail, OSHA concluded that this was a significant incidence of faulty grounding.

Grounding practices that do not provide an equipotential zone in which an employee is safeguarded from voltage differences do not provide complete protection. In case the line is accidentally reenergized, voltages to which an employee would be exposed due to inadequate grounding would be lethal, as can be seen by some of the exhibits in the § 1910.269 rulemaking record (269–Ex. 6–27, 57). The employee would be protected only if he or she is not in contact with the line until the energy source is cleared by circuit protective devices.

For these reasons, OSHA is proposing to require grounds that will protect employees in the event that the line or equipment on which they are working is reenergized. Proposed § 1926.962(c) would require protective grounds to be so located and arranged that employees are not exposed to hazardous differences in potential. The proposal would allow employers and employees to use whatever grounding method they prefer as long as employees are protected. For employees working at elevated positions on poles and towers, single point grounding may be necessary, together with grounding straps to provide an equipotential zone for the worker. Employees in insulated aerial lifts working at midspan between two conductor supporting structures may be protected by grounding at convenient points on both sides of the work area. Bonding the aerial lift to the grounded conductor would ensure that the employee remains at the potential of the conductor in case of a fault. Other methods may be necessary to protect workers on the ground, including grounding mats and insulating platforms. The Agency believes that this performance-oriented approach would provide the flexibility needed by employers, but would also afford the best protection to employees.

Paragraph (d) of proposed § 1926.962 contains requirements that grounding equipment would have to meet. So that the protective grounding equipment does not fail, it would be required to have an ampacity high enough so that the fault current could be carried for the amount of time necessary to allow protective devices to interrupt the circuit. This provision, which has been taken from the first sentence of § 1910.269(n)(4)(i), is contained in paragraph (d)(1)(i) of proposed § 1926.962.

The design of electric power distribution lines operating at 600 volts or less frequently provides a maximum fault current and fault interrupting time that exceeds the current carrying capability of the circuit conductors. In other words, the maximum fault current on distribution secondaries of 600 volts or less is typically high enough to melt the phase conductors carrying the fault current. If protective grounding equipment were required to carry the maximum amount of fault current without regard to whether the phase conductors would fail, the size of the grounding equipment would be impractical. However, OSHA does not interpret § 1910.269(n)(4)(i) to require protective grounding equipment to be capable of carrying more current than necessary to allow the phase conductors to fail. A protective grounding jumper sized slightly larger than a phase conductor would be sufficient to meet the general industry standard, although the language of the first sentence of § 1910.269(n)(4)(i) does not make this clear.

To clarify this requirement, OSHA is proposing, in § 1926.962(d)(1)(ii), to permit, specifically, the use of protective grounding equipment that would not be large enough to carry the maximum fault current indefinitely but that would be large enough to carry this current until the phase conductor fails.[55] This would be permitted only under certain conditions. First, the grounding equipment must be able to carry the maximum fault current until the conductor being protected fails. Second, the conductor must only be considered as grounded where it is protected by the grounding equipment. In other words, the portion of the phase conductor between the grounding equipment and the employee being protected must remain intact under fault conditions. Third, since the phase conductor will likely fall once it fails, no employee must be in a position where they would be endangered by any failed conductor. OSHA has not restricted this provision to lines and equipment operating at 600 volts or less because the Agency believes that employees would be protected with these provisions regardless of voltage. However, OSHA requests comments on the issue of whether or not proposed

[55] OSHA is also proposing to make a similar change in § 1910.269.

§ 1926.962(d)(1)(ii) should be restricted to lines and equipment operating at 600 volts or less.

Paragraph (d)(1)(iii) of § 1926.962 would require protective grounding equipment to have an ampacity of at least No. 2 AWG copper. This provision would ensure that protective grounding equipment has a suitable minimum ampacity and mechanical strength.

Under paragraph (d)(2), the impedance of the grounding equipment would be required to be low enough to ensure the quick operation of the protective devices.

Paragraphs (d)(1) and (d)(2) help ensure the prompt clearing of the circuit supplying voltage to the point where the employee is working. Thus, the grounding equipment limits the duration and reduces the severity of any electric shock, though it does not itself prevent shock from occurring. (As discussed earlier, proposed § 1926.962(c) requires employees to be protected from hazardous differences in electrical potential.) OSHA has included a note referencing the ASTM standard on protective grounding equipment (ASTM F855–03) so that employers will be able to find additional information that may be helpful in their efforts to comply with the standard.

Existing § 1926.954(h), (i), and (j) contain requirements relating to the impedance and ampacity of personal protective grounds. Paragraph (i) requires tower clamps to have adequate ampacity, and paragraph (j) contains the same requirement for ground leads with an additional restriction that they be no smaller than No. 2 AWG copper. Paragraph (i) requires the impedance of a grounding electrode (if one is used) to be low enough to remove the danger of harm to employees or to permit prompt operation of protective devices.

OSHA believes that the entire grounding system should be capable of carrying the maximum fault current and should have an impedance low enough to protect employees. The existing standard contains no requirements for the impedance of grounding conductors or clamps, nor does it contain requirements relating to the ampacity of grounding clamps other than tower clamps. By addressing specific portions of the grounding systems but not addressing others, the existing standard does not require complete protection for employees. Because the proposal's grounding requirements apply to the entire grounding system, OSHA believes that the proposal will provide better protection for employees than the existing rule.

Paragraph (e) of § 1926.962 would require lines and equipment that are to be grounded to be tested for voltage before a ground is installed. If a previously installed ground is evident, no test would need to be conducted. This requirement would prevent energized equipment from being grounded, which could result in injury to the employee installing the ground. This requirement is the same as existing § 1926.954(d).

Paragraphs (f)(1) and (f)(2) propose procedures for installing and removing grounds. To protect employees in the event that the ''deenergized'' equipment to be grounded is or becomes energized, the proposal would require the ''equipment end'' of the grounding device to be applied last and removed first and that a live-line tool be used for both procedures in order to protect workers.

These provisions are similar to existing § 1926.954(e)(1) and (e)(2), except that the existing standard recognizes the use of a ''suitable device'' in addition to a live-line tool. OSHA is concerned that this language implies that rubber insulating gloves could be used to install and remove grounds under any circumstance. It should be noted that it is unsafe for an employee to be too close when connecting or disconnecting a ground. Therefore, OSHA is proposing to eliminate the phrase ''or other insulated device'' from the rule. OSHA will, however, consider any device that is insulated for the voltage and that allows an employee to apply or remove the ground from a safe position to be a live-line tool for the purposes of § 1926.962(f)(1) and (f)(2).

These two paragraphs in the proposal are based on existing § 1910.269(n)(6) and (n)(7). The proposal, however, would permit the use of insulated equipment other than live-line tools to attach protective grounds to, and to remove them from, lines and equipment operating at 600 volts or less, if the employer ensures that the line or equipment is not energized at the time or if the employer can demonstrate that the employee would be protected from any hazard that could develop if the line or equipment is energized. For example, test equipment could be connected to a line that is to be grounded, and the protective ground could be applied by an employee wearing rubber gloves while the test equipment indicated that the line was deenergized. After the ground was in place the test equipment could be removed.

Some electric utilities have complained that lines and equipment operating at 600 volts or less cannot always accommodate the placement and removal of a protective ground by a line-line tool. OSHA is proposing these alternatives to enable protective grounds to be placed on this equipment in a manner that will still protect employees.[56]

It should be noted that, during the periods before the ground is installed and after it is removed, the line or equipment involved must be considered as energized (under proposed § 1926.960(b)(2)). As a result, the minimum approach distances specified in proposed § 1926.960(c)(1) would apply when grounds are installed or removed.

With certain underground cable installations, a fault at one location along the cable can create a substantial potential difference between the earth at that location and the earth at other locations. Under normal conditions, this is not a hazard. However, if an employee is in contact with a remote ground (by being in contact with a conductor that is grounded at a remote station), he or she can be exposed to the difference in potential (because he or she is also in contact with the local ground). To protect employees in such situations, proposed § 1926.962(g) would prohibit grounding cables at remote locations if a hazardous potential transfer could occur under fault conditions. This proposed provision has no counterpart in existing Subpart V.

Proposed § 1926.962(h) addresses the removal of grounds for test purposes. Under the proposal, grounds would be permitted to be removed for test purposes. Existing Subpart V contains a comparable requirement in § 1926.954(g). However, the existing standard simply requires employees to take extreme caution when grounds are removed for testing. OSHA does not believe that the existing language contains sufficient safeguards for employees. Therefore, the Agency is proposing performance criteria that testing procedures would be required to meet. During the test procedure, the employer would be required to ensure that each employee uses insulating equipment and is isolated from any hazards involved, and the employer would be required to institute any additional measures as may be necessary to protect each exposed employee in case the previously grounded lines and equipment become energized. OSHA believes that the proposal would protect employees better than the existing rule.

[56] OSHA is also proposing to make similar changes in § 1910.269.

Section 1926.963, Testing and Test Facilities

Proposed § 1926.963 contains safety work practices covering electrical hazards arising out of the special testing of lines and equipment (namely, in-service and out-of-service, as well as new, lines and equipment) to determine maintenance needs and fitness for service. Generally, the need to conduct tests on new and idle lines and equipment as part of normal checkout procedures, in addition to maintenance evaluation, is specified in the National Electrical Safety Code (ANSI C2). Basically, as stated in paragraph (a), the rules would apply only to testing involving interim measurements utilizing high voltage, high power, or combinations of both, as opposed to testing involving continuous measurements as in routine metering, relaying and normal line work.

Proposed § 1926.963 has been taken directly from § 1910.269(o). Existing Subpart V has no counterpart to these proposed requirements. The Agency believes that these high-voltage and high-current tests are performed during construction work and that employers would benefit by the inclusion of these provisions within the construction standard in place of a reference to § 1910.269. However, it may be that this type of work is performed too infrequently to warrant repeating the requirements in Subpart V. OSHA requests comments on the need to include proposed § 1926.963 in Subpart V.

For the purposes of these proposed requirements, high-voltage testing is assumed to involve voltage sources having sufficient energy to cause injury and having magnitudes generally in excess of 1,000 volts, nominal. High-power testing involves sources where fault currents, load currents, magnetizing currents, or line dropping currents are used for testing, either at the rated voltage of the equipment under test or at lower voltages. Proposed § 1926.963 covers such testing in laboratories, in shops and substations, and in the field and on transmission and distribution lines.

Examples of typical special tests in which either high-voltage sources or high-power sources are used as part of operation and maintenance of electric power transmission and distribution systems include cable-fault locating, large capacitive load tests, high current fault-closure tests, insulation resistance and leakage tests, direct-current proof tests, and other tests requiring direct connection to power lines.

Excluded from the scope of proposed § 1926.963 are routine inspection and maintenance measurements made by qualified employees in accordance with established work practice rules where the hazards associated with the use of intrinsic high-voltage or high-power sources require only those normal precautions peculiar to such periodic work. Obviously, the work practices for these routine tests would have to comply with the rest of proposed Subpart V. Because this type of testing poses hazards that are identical to other types of routine electric power transmission and distribution work, OSHA believes that the requirements of proposed Subpart V excluding § 1926.963 adequately protect employees performing these tests. Two typical examples of such excluded test work procedures would be ''phasing-out'' testing and testing for a ''no voltage'' condition. To clarify the scope of this section, a note to this effect is included after paragraph (a).

Paragraph (b)(1) of proposed § 1926.963 would require employers to establish work practices governing employees engaged in certain testing activities. These work practices are intended to delineate precautions that employees must observe for protection from the hazards of high-voltage or high-power testing. For example, if high-voltage sources are used in the testing, employees would be required to follow the safety practices established under paragraph (b)(1) to protect against such typical hazards as inadvertent arcing or voltage overstress destruction, as well as accidental contact with objects that have become residually charged by induced voltage from electric field exposure. If high-power sources are used in the testing, employees would be required to follow established safety practices to protect against such typical hazards as ground voltage rise as well as exposure to excessive electromagnetically-caused physical forces associated with the passage of heavy current.

These practices would apply to work performed at both permanent and temporary test areas (that is, areas permanently located in the controlled environment of a laboratory or shop and in areas temporarily located in a non-controlled field environment). At a minimum, the safety work practices include:

(1) Guarding the test area to prevent inadvertent contact with energized parts,

(2) Safe grounding practices to be observed,

(3) Precautions to be taken in the use of control and measuring circuits, and

(4) Periodic checks of field test areas.

Paragraph (b)(2) complements the general rule on the use of safe work practices in test areas with a proposed requirement that all employees involved in this type of work be trained in these safety test practices. This paragraph, which makes explicit the types of training required by the general training provisions in proposed § 1926.950(b), would further require a periodic review of these practices to be conducted from time to time as a means of providing reemphasis and updating.

Although specific work practices used in test areas are generally unique to the particular test being conducted, three basic elements affecting safety are commonly found to some degree at all test sites: guarding, grounding, and the safe utilization of control and measuring circuits. By considering safe work practices in these three categories, OSHA has attempted to achieve a performance-oriented standard applicable to high-voltage and high-power testing and test facilities.

OSHA believes that guarding can best be achieved when it is provided both around and within test areas. By controlling access to all parts that are likely to become energized by either direct or inductive coupling, the standard will prevent accidental contact by employees. Within test areas, whether temporary or permanent, a degree of safety can be achieved by observing guarding practices that control access to test areas. Paragraph (c)(1) would therefore require that such guarding be provided if the test equipment or apparatus under test may become energized as part of the testing by either direct or inductive coupling. A combination of guards and barriers is intended to provide protection to all employees in the vicinity.

Paragraph (c)(2) would require permanent test areas to be guarded by having them completely enclosed by walls or some other type of physical barrier. In the case of field testing, paragraph (c)(3) attempts to achieve a level of safety for temporary test sites comparable to that achieved in laboratory test areas. For these areas, a barricade of tapes and cones or observation by an attendant would be acceptable methods of guarding. Proposed paragraph (c)(3) would accept any barrier or barricade that provides a means of limiting access to the test area physically and visually equivalent to safety tape with signs or would accept guarding by means of a test observer stationed where the entire test area could be monitored.

Since the effectiveness of the temporary guarding means can be severely compromised by failing to remove it when it is not required, frequent safety checks must be made to monitor its use. For example, leaving barriers in place for a week at a time when testing is performed only an hour or two per day is likely to result in disregard for the barriers. For this reason, paragraph (c)(4) would require the temporary barriers to be removed when they are no longer needed.

Suitable grounding is another important work practice that can be employed for the protection of personnel from the hazards of high-voltage or high-power testing. If high currents are intentionally employed in the testing, an isolated ground-return conductor, adequate for the service, is required so that no intentional passage of heavy current, with its attendant voltage rise, will occur in the ground grid or in the earth. Another safety consideration involving grounding is that all conductive parts accessible to the test operator during the time that the equipment is operating at high voltage be maintained at ground potential, except portions of the equipment that are isolated from the test operator by suitable guarding. Paragraph (d) proposes requirements for proper grounding at test sites.

Paragraph (d)(1) would require that grounding practices be established and implemented for test facilities to ensure that unguarded conductive parts accessible to the operator are grounded and that all ungrounded terminals of test equipment or apparatus under test are treated as energized until reliably determined otherwise. Paragraph (d)(2) would require visible grounds to be properly applied before work is performed on the circuit or item or apparatus under test.

Paragraph (d)(3) addresses hazards resulting from the use of inadequate ground-returns in which a voltage rise in the ground grid or in the earth can result whenever high currents are employed in the testing. Test personnel who may be exposed to such potentials would be required to be protected from the hazards involved. This paragraph would require the use of an isolated ground return so that no intentional passage of current, with its attendant voltage rise, could occur in the ground grid or in the earth. However, under some conditions (such as system fault testing), it may be necessary to perform the test under actual operating conditions, or it may otherwise be impractical to provide an isolated ground return. In such cases, it would not be reasonable to require an isolated ground-return conductor system. Therefore, paragraph (d)(3) would provide an exception to the requirement for such an isolated ground return. The exception would apply if the isolated ground-return cannot be provided because of the distance involved and if employees are protected from hazardous step and touch potentials that may develop. Consideration must always be given to the possibility of voltage gradients developing in the earth during impulse, short-circuit, inrush, or oscillatory conditions. Such voltages may appear between the feet of an observer, or between his or her body and a grounded object, and are usually referred to as ''step'' and ''touch'' potentials. Examples of acceptable protection from step and touch potentials include suitable electrical protective equipment and the removal of employees from areas that may expose them to hazardous potentials.

Another grounding situation is recognized by paragraph (d)(4) in which grounding through the power cord of test equipment may be inadequate and actually increase the hazard to test operators. Normally, an equipment grounding conductor is required in the power cord of test equipment to connect it to a grounding connection in the power receptacle. However, in some circumstances, this practice can prevent satisfactory measurements, or current induced in the grounding conductor can cause a hazard to personnel. If these conditions exist, the use of the equipment grounding conductor within the cord would not be mandatory, and paragraph (d)(4) would require that an equivalent safety ground be provided.

Paragraph (d)(5) would further require that a ground be placed on the high-voltage terminal and any other exposed terminals when the test area is entered after equipment is deenergized. In the case of high capacitance equipment or apparatus, before a direct ground can be applied, the initial grounding discharge would have to be accomplished through a resistor having an adequate energy rating.

Paragraph (d)(6) recognizes the hazards associated with field testing in which test trailers or test vehicles are used. In addition to proposing that the chassis of such vehicles be grounded, paragraph (d)(6) provides for a performance-oriented approach by proposing that protection be provided against hazardous touch potentials by bonding, by insulation, or by isolation. The protection provided by each of these methods is described in the following examples:

(1) Protection by bonding can be effected by providing, around the vehicle, an area covered by a metallic mat or mesh of substantial cross-section and low impedance which is bonded to the vehicle at several points and is also bonded to an adequate number of driven ground rods or, where available, to an adequate number of accessible points on the station ground grid. All bonding conductors must be of sufficient electrical size to keep the voltage developed during maximum anticipated current tests at a safe value. The mat must be of a size that precludes simultaneous contact with the vehicle and with the earth or with metallic structures not adequately bonded to the mat.

(2) Protection by insulation can be accomplished, for example, by providing around the vehicle an area of dry wooden planks covered with rubber insulating blankets. The physical extent of the insulated area must be sufficient to prevent simultaneous contact with the vehicle, or the ground lead of the vehicle, and with the earth or with metallic structures in the vicinity.

(3) Protection by isolation can be implemented by providing an effective means to exclude personnel from any area where simultaneous contact could be made with the vehicle (or conductive parts electrically connected to the vehicle) and with other conductive materials. A combination of barriers together with effective, interlocked gates may be employed to ensure that the system is deenergized when an employee is entering or leaving the test area.

Finally, a third category of safe work practices applicable to employees performing testing work, which complements the first two safety work practices of guarding and grounding, involves work practices associated with the installation of control and measurement circuits utilized at test facilities. Practices necessary for the protection of personnel and equipment from the hazards of high-voltage or high-power testing must be observed for every test where special signal-gathering equipment is used (that is, meters, oscilloscopes, and other special instruments). In addition, special settings of protective relays and the reexamination of backup schemes may be necessary to ensure an adequate level of safety during the tests or to minimize the effects of the testing on other parts of the system under test. As a consequence, paragraphs (e)(1) through (e)(3) address the principal safe work practices involving control and measuring circuit utilization within the test area.

Generally, control and measuring circuit wiring should remain within the test area. If this is not possible, however, paragraph (e)(1) proposes requirements to minimize hazards should it become necessary to have the test wiring routed outside the test area. Cables and other wiring would have to be contained within a grounded metallic sheath and terminated in a grounded metal enclosure, or other precautions would have to be taken to provide equivalent safety, such as guarding the area so that employees do not have access to parts that might rise to hazardous potentials.

Paragraph (e)(2) covers the avoidance of possible hazards arising from inadvertent contact with energized accessible terminals or parts of meters and other test instruments. Meters with such terminals or parts would have to be isolated from test personnel.

Work practices involving the proper routing and connection of temporary wiring to protect against damage are covered in paragraph (e)(3). This paragraph would also require the various functional wiring used for the test set-up to be kept separate, to the maximum extent possible, in order to minimize the coupling of hazardous voltages into the control and measuring circuits.

A final safety work practice requirement related to control circuits is addressed by paragraph (e)(4). This paragraph would require the presence of a test observer who can, in cases of emergency, immediately deenergize all test circuits for safety purposes.

Since the environment in which field tests are conducted differs in important respects from that of laboratory tests, extra care must be taken to ensure appropriate levels of safety. Permanent fences and gates for isolating the field test area are not usually provided, nor is there a permanent conduit for the instrumentation and control wiring. As a further hazard, there may be other sources of high-voltage electric energy in the vicinity in addition to the source of test voltage.

It is not always possible in the field to prevent ingress of persons into a test area physically, as is accomplished by the fences and interlocked gates of the laboratory environment. Consequently, readily recognizable means are required to discourage such ingress; and, before test potential or current is applied to a test area, the test operator in charge must ensure that all necessary barriers are in place.

As a consequence of these safety considerations, paragraph (f)(1) would call for a safety check to be made at temporary or field test areas at the beginning of each group of continuous tests (that is, a series of tests conducted one immediately after another). Paragraph (f)(2) would require that, as a minimum for the safety check, the person responsible for the testing verify, before the initiation of a continuous period of testing, the status of a general group of safety conditions. These conditions include the state of guards and status signals, the marking and availability of disconnects, the provision of ground connections and personal protective equipment, and the separation of circuits.

Section 1926.964, Overhead Lines

Proposed § 1926.964 would apply to work involving overhead lines or equipment. The types of work performed on overhead lines and addressed by this paragraph include the installation and removal of overhead lines, live-line bare-hand work, and work on towers and structures. While performing this type of work, employees are typically exposed to the hazards of falls and electric shock.

Section 1926.955 of existing Subpart V covers overhead lines. Several requirements in the existing standard are redundant, and OSHA believes that the existing section is poorly organized. For example, paragraphs (c) and (d) both apply to the installation of lines parallel to existing lines. Existing paragraph (c)(3) requires lines being installed where there is a danger of hazardous induced voltage to be grounded unless provisions are made to isolate or insulate employees. Paragraph (d)(1) of existing § 1926.955 contains a similar requirement, and the rest of paragraph (d) specifies exactly how the grounding is to be installed.

Paragraph (q) of § 1910.269 also addresses work on overhead lines. OSHA believes that the newer standard is much better organized, contains no redundancies, and better protects employees than the older construction standard. Therefore, the Agency has used § 1910.269(q), rather than § 1926.955, as the base document in developing proposed § 1926.964. OSHA has, however, taken requirements that pertain specifically to construction work from existing § 1926.955 and incorporated them into the proposal. Paragraph (q) of § 1910.269 does not contain these requirements, because it does not apply to construction. For example, existing § 1926.955(b) applies to metal tower construction, and no comparable provisions are contained in § 1910.269. OSHA is therefore proposing requirements from § 1926.955(b).

Paragraph (a)(2) of proposed § 1926.964 would require the employer to determine that elevated structures such as poles and towers are of adequate strength to withstand the stresses that will be imposed by the work to be performed. For example, if the work involves removing and reinstalling an existing line on a utility pole, the pole will be subjected to the weight of the employee (a vertical force) and to the release and replacement of the force imposed by the overhead line (a vertical and possibly a horizontal force). The additional stress involved may cause the pole to break, particularly if the pole has rotted at its base. If the pole or structure cannot withstand the loads to be imposed, it would have to be reinforced so that failure does not occur. This rule would protect employees from hazards posed by the failure of the pole or other elevated structure. This requirement, which is equivalent to existing § 1926.955(a)(2), (a)(3), and (a)(4), has been taken from § 1910.269(q)(1)(i).

As the last step in ascertaining whether a wood pole is safe to climb, as would be required under paragraph (a)(2), checking the actual condition of the pole is important because of the possibility of decay and other conditions adversely affecting the strength of the pole. Appendix D of final § 1910.269 contains methods of inspecting and testing the condition of wood structures before they are climbed. These methods, which can be used in ascertaining whether a wood pole is capable of sustaining the forces imposed by an employee climbing it, have been taken from Appendix D to § 1910.269. It should be noted that the employer would also be required to ascertain whether the pole is capable of sustaining any additional forces that will be imposed during the work.

OSHA realizes that the employee at the worksite will be the one to inspect the structure for deterioration and will also determine whether it is safe to climb. However, it is the employer's responsibility to ensure that this is accomplished, regardless of who performs the work. Additionally, some work might involve changing the loading on the structure. For example, replacement transformers might be heavier, and the equipment needed to perform the work will impose extra stress on the pole. The employee in the field is not necessarily skilled in structural engineering, and a determination as to whether or not the pole could withstand the stresses involved would almost always need to be performed by the employer's engineering staff. (Typically, this task is performed in the initial design of the system or when changes are made.) For this reason, OSHA believes it is necessary to specify in the standard the employer's responsibility in this regard. However, the Agency expects the determination of the condition of the pole or structure to be made at the worksite by an employee who is capable of making this determination. The employer fulfills the obligation imposed by the standard by ensuring that the design of support structures is sound, by training his or her employees in proper inspection and evaluation techniques, and by enforcing company rules that adhere to the standard.

When poles are handled near overhead lines, it is necessary to protect the pole from contact with the lines. Paragraph (a)(3)(i) of proposed § 1926.964 would prohibit letting the pole come into direct contact with the overhead lines. Measures commonly used to prevent such contact include installation of insulating guards on the pole and pulling conductors away from the area where the pole will go. This provision, which is equivalent to existing § 1926.955(a)(5)(i), has been taken from § 1910.269(q)(1)(ii).

Paragraph (a)(3)(ii) of proposed § 1926.964 would require employees handling the poles to be insulated from the pole. This provision has been taken from § 1910.269(q)(1)(iii). The comparable provision in § 1926.955(a)(6)(i) prohibits employees from contacting mechanized equipment used to set, move, or remove poles, unless the employees are using electrical protective equipment. OSHA has proposed to cover hazards of using mechanical equipment near energized parts in § 1926.958, discussed earlier in this section of the preamble. The Agency believes that the proposal will eliminate the redundant and conflicting requirements contained in existing Subpart V. Similarly, existing § 1926.955(a)(5)(ii), (a)(6)(ii), and (a)(8) are not being carried forward into this proposal, because the hazards they address (those related to operation of mechanical equipment near energized parts) are already adequately covered under proposed § 1926.958.

Paragraphs (a)(3)(i) and (a)(3)(ii) would protect employees from hazards caused by falling power lines and by contact of the pole with the line. They would be in addition to the requirements in proposed § 1926.958(d) for operations involving mechanical equipment.

To protect employees from falling into holes into which poles are to be placed, paragraph (a)(3)(iii) would require the holes to be guarded by barriers or attended by employees. This provision, which is equivalent to existing § 1926.955(a)(7), has been taken from § 1910.269(q)(1)(iv).

Paragraph (b) of proposed § 1926.964 addresses the installation and removal of overhead lines. The provisions contained in this paragraph have been taken from § 1910.269(q)(2), which was based in large part on existing § 1926.955(c) (stringing and removing lines) and § 1926.955(d) (stringing adjacent to energized lines). However, the proposed rule, like § 1910.269(q)(2), combines these provisions into a single paragraph (b). OSHA believes that the proposed provisions, which combine and simplify the construction requirements for stringing overhead lines, will be easier for employers and employees to understand.

Proposed § 1926.964(b)(1) would require precautions to be taken to prevent the line being installed or removed from contacting existing energized power lines. Common methods of accomplishing this include the use of the following techniques: stringing conductors by means of the tension stringing method (which keeps the conductors off the ground and clear of energized circuits) and the use of rope nets and guards (which physically prevent one line from contacting another). These precautions, or equivalent measures, are necessary to protect employees against electric shock and against the effects of equipment damage resulting from accidental contact of the line being installed with energized parts.

Even though the precautions taken under paragraph (b)(1) minimize the possibility of accidental contact, there is still a significant risk that the line being installed or removed could contact energized lines. OSHA believes that the hazards posed during line installation or removal are equivalent to those posed during the operations of mechanical equipment near energized parts. Employees are exposed to hazardous differences in potential if the conductor being installed or equipment being used makes contact with an energized line. The methods of protection that can be applied are also the same in both cases. Therefore, the Agency believes that the approach used for the hazard of contact between mechanical equipment and overhead lines should also be used for the hazard of contact between a line being installed or removed and an existing energized conductor. To accomplish this, paragraph (b)(2) of proposed § 1926.964 simply adopts the requirements of § 1926.958(d)(3) by reference when conductors are installed or removed close enough to energized conductors that certain failures could energize the pulling or tensioning equipment in use or the cable being installed or removed. Basically, the employer would be required to institute measures to protect employees from hazardous differences in potential at the work location. (See the discussion of proposed § 1926.958(d)(3) and Appendix C to Subpart V for acceptable methods of compliance.)

Paragraph (b)(3) of proposed § 1926.964 would require the disabling of the automatic-reclosing feature of the devices protecting any circuit that operates at more than 600 volts and that passes under conductors being installed. If it is not made inoperative, this feature would cause the circuit protective devices to reenergize the circuit after they had tripped, exposing the employees to additional or more severe injury.

Paragraph (b)(1) of proposed § 1926.964 would require the use of techniques that minimize the possibility of contact between the existing and new conductors. Paragraph (b)(2) of proposed § 1926.964 would require the use of measures that protect employees from hazardous differences in potential. These two paragraphs provide the primary protection to employees installing conductors. Paragraph (b)(3) is a redundant form of protection; it provides an additional measure of safety in case the first two provisions are violated.[57] Therefore, this paragraph would apply only to circuit reclosing devices that are designed to permit the disabling of the automatic reclosing feature. The Agency believes that the combination of these three paragraphs in proposed § 1926.964 will provide effective protection against the electrical hazards associated with installing or removing lines near energized parts.

Paragraph (b)(4) proposes rules protecting workers from the hazard of voltage induced on lines being installed near (and usually parallel to) other energized lines. These rules, which provide supplemental provisions on grounding, would be in addition to those elsewhere in the standard. In general, when employees may be exposed to the hazard of induced voltage on overhead lines, the lines being installed must be grounded to minimize the voltage and to protect employees handling the lines from electric shock.

Paragraph (b)(4) of proposed § 1926.964 would require a determination of the ''approximate'' voltage, unless the line being installed is assumed to carry a hazardous induced voltage. Additionally, workers would be

[57] Disabling the reclosing feature of circuit protective devices does not provide any protection against the initial contact with the energized circuit involved. It only prevents the devices from reenergizing the circuit after they open it on a fault condition as would occur, for example, when a line being strung by employee drops onto an energized conductor.

able to treat the line as energized rather than comply with the additional grounding requirements contained in this paragraph.

The proposal does not provide specific guidance for determining whether or not a hazard exists due to induced voltage. The hazard depends not only on the voltage of the existing line, but also on the length of the line being installed and the distance between the existing line and the new one. Electric shock, whether caused by induced or other voltage, poses two different hazards. First, the electric shock could cause an involuntary reaction, which could cause a fall or other injury. Second, the electric shock itself could cause respiratory or cardiac arrest. If no precautions are taken to protect employees from hazards associated with involuntary reactions from electric shock, a hazard is presumed to exist if the induced voltage is sufficient to pass a current of 1 milliampere through a 500-ohm resistor. (The 500-ohm resistor represents the resistance of an employee. The 1 milliampere current is the threshold of perception.) If employees are protected from injury due to involuntary reactions from electric shock, a hazard is presumed to exist if the resultant current would be more than 6 milliamperes (the let-go threshold for women). It would be up to the employer to ensure that employees are protected against serious injury from any voltages induced on lines being installed and to determine whether the voltages are high enough to warrant the adoption of the additional provisions on grounding spelled out in paragraphs (b)(4)(i) through (b)(4)(v) of proposed § 1926.964. These rules propose the following requirements:

(1) Grounds must be installed in increments of no more than 2 miles (paragraph (b)(4)(i));

(2) Grounds must remain in place until the installation is completed between dead ends (paragraph (b)(4)(ii));

(3) Grounds must be removed as the last phase of aerial cleanup (paragraph (b)(4)(iii));

(4) Grounds must be installed at each work location and at all open dead-end or catch-off points or the next adjacent structure (paragraph (b)(4)(iv)) if employees are working on bare conductors; and

(5) Bare conductors being spliced must be bonded and grounded (paragraph (b)(4)(v)).

Paragraph (b)(5) would require reel handling equipment to be in safe operating condition and to be leveled and aligned. Proper alignment of the stringing machines will help prevent failure of the equipment, conductors, and supporting structures, which could result in injury to workers.

Prevention of the failure of the line pulling equipment and accessories is also the purpose of paragraphs (b)(6), (b)(7), and (b)(8). These provisions, respectively, would require the operation to be performed within the load limits of the equipment, would require the repair or replacement of defective apparatus, and would prohibit the use of conductor grips not specifically designed for use in pulling operations. Equipment that has been damaged beyond manufacturing specifications or that has been damaged to the extent that its load ratings would be reduced are considered to be defective. Load limits and design specifications are normally provided by the manufacturer, but they can also be found in engineering and materials handbooks (*see,* for example, *The Lineman's and Cableman's Handbook,* 269–Ex. 8–5).

When the tension stringing method is used, the pulling rig (which takes up the pulling rope and thereby pulls the conductors into place) is separated from the reel stands and tensioner (which pay out the conductors and apply tension to them) by one or more spans (the distance between the structures supporting the conductors). In an emergency, the pulling equipment operator may have to shut down the operation. Paragraph (b)(9) of proposed § 1926.964 would require communication to be maintained between the reel tender and the pulling rig operator, so that in case of emergency at the conductor supply end, the pulling rig operator can shut the equipment down before injury-causing damage occurs.

Paragraph (b)(10) would prohibit the operation of the pulling rig under unsafe conditions. OSHA has included an explanatory note following paragraph (b)(10) providing examples of unsafe conditions.

Paragraph (b)(11) would prohibit employees from unnecessarily working directly beneath overhead operations or on the cross arm. This provision would minimize exposure of employees to injury resulting from the failure of equipment, conductors, or supporting structures during pulling operations.

Under certain conditions, work must be performed on transmission and distribution lines while they remain energized. Sometimes, this work is accomplished using rubber insulating equipment or live-line tools. However, this equipment has voltage and other limitations which make it impossible to insulate the employee performing work on live lines under all conditions. In such cases, usually on medium- and high-voltage transmission lines, the work is performed using the live-line bare-hand technique. If work is to be performed "bare handed," the employee works from an insulated aerial platform and is electrically bonded to the energized line. Since there is essentially no potential difference across the worker's body, he or she is protected from electric shock. Paragraph (c) of proposed § 1926.964 addresses the live-line bare-hand technique.

Proposed § 1926.964(c) has been taken directly from § 1910.269(q)(3). Existing § 1926.955(e) contains similar requirements for live-line bare hand work. Substantive differences between the proposal and the existing rule are outlined in the following summary and explanation of proposed § 1926.964(c). Because live-line bare-hand work is performed on overhead lines, OSHA has proposed to place requirements for this type of work in the section relating to work on overhead lines. This is consistent with existing Subpart V. However, it is technically possible to perform live-line bare-hand work on other types of installations as well (in substations, for example). OSHA requests comments on whether or not the live-line bare-hand requirements should be consolidated with the other regulations relating to work on energized lines contained in proposed § 1926.960.

Paragraph (c)(1) would require employees using or supervising the use of the live-line bare-hand method on energized lines to be trained in the use of the technique. Periodic retraining would have to be provided as required under paragraph (b) of proposed § 1926.950. Without this training, employees would not be able to perform the highly specialized work safely.

Before work can be started, the voltage of the lines on which work is to be performed must be known. This voltage determines the minimum approach distances and the types of equipment which can be used. If the voltage is higher than expected, the minimum approach distance will be too small and the equipment may not be safe for use. Therefore, paragraph (c)(2) of proposed § 1926.964 would require a determination to be made of the voltage of the circuit, of the minimum approach distances to ground of lines and other energized parts on which work is to be performed, and of the voltage limitations of equipment to be used.

Because an employee performing live-line bare-hand work is at the same potential as the line on which he or she is working, the employee has exposure to two different voltages. First, the employee is exposed to the phase-to-ground voltage with respect to any grounded object, such as a pole or tower. Second, the employee is exposed to the full phase-to-phase voltage with respect to the other phases on the circuit. Thus, there are two sets of minimum approach distances applicable to live-line bare-hand work-one for the phase-to-ground exposure (the distance from the employee to a grounded object) and one for the phase-to-phase exposure (the distance from the employee to another phase). The phase-to-phase voltage is higher than the phase-to-ground voltage. Consequently, the phase-to-phase-based minimum approach distance is greater than the phase-to-ground-based minimum approach distance.

Paragraph (c)(3) would require insulated tools and equipment to be designed, tested, and intended for live-line bare-hand work and that they be kept clean and dry. This requirement is important to ensure that equipment does not fail under constant contact with high voltage sources. The proposed rule would apply to insulated tools (such as live-line tools), insulated equipment (such as insulated ladders), and aerial devices and platforms used in live-line work. The Agency considers insulated equipment that is designed for long-duration contact with energized parts at the voltage on which it is used (such as a live-line tool) to meet this requirement. Insulating equipment designed for brush contact only is not suitable for live-line bare-hand work.

Paragraph (c)(4) would require the automatic-reclosing feature of circuit protective devices to be made inoperative if the design of those devices permits. In case of a fault at the worksite, it is important for the circuit to be deenergized as quickly as possible and for it to remain deenergized once the protective devices have opened the circuit.[58] This prevents any possible injuries from becoming more severe. Additionally, this measure helps limit the possible switching surge voltage, which provides an extra measure of safety. This provision is comparable to existing § 1926.955(e)(5), which requires this feature to be rendered inoperable ''where practical.'' The proposal eliminates this phrase because OSHA believes that it is essential that a line which becomes deenergized on a fault not be reenergized if it is possible to do so. During live-line bare-hand work, employees have no other back-up system providing for their safety as they would for work on deenergized lines.[59] Thus, if the employee causes a fault on the line, the line must not become reenergized automatically.

Sometimes the weather makes live-line bare-hand work unsafe. For example, lightning strikes on lines being worked can create severe transient voltages, against which the minimum approach distances required by proposed § 1926.960(c)(1) may not provide complete protection. Additionally, the wind can reduce the minimum approach distance below acceptable values. To provide protection against environmental conditions that can increase the hazards by an unacceptable degree, proposed paragraph (c)(5) would prohibit live-line bare-hand work under conditions that make the work hazardous in spite of the precautions taken under the proposed rule. Also, work would not be allowed under any conditions that reduce the minimum approach distances below required values. If insulating guards are provided to prevent hazardous approach to other energized parts and to ground, then work could be performed under conditions reducing the minimum approach distances.

Existing § 1926.955(e)(6) prohibits live-line bare-hand work only during thunderstorms. OSHA believes that expanding the prohibition to include any weather condition making it unsafe to perform this type of work will better protect employees. The language for the proposed rule has been taken from § 1910.269(q)(3)(v).

Proposed § 1926.964(c)(6) would require the use of a conductive device, usually in the form of a conductive bucket liner, which creates an area of equipotential in which the employee can work safely. The employee must be bonded to this device by means of conductive shoes or leg clips or by another effective method. Additionally, if necessary to protect employees further (that is, if differences in electrical potential at the worksite pose a hazard to employees), electrostatic shielding would be required. Proposed § 1926.964(c)(6), which has been taken from § 1910.269(q)(3)(vi), is essentially identical to existing § 1926.955(e)(7).

To avoid receiving a shock caused by charging current, the employee must bond the conductive bucket liner (or other conductive device) to the energized conductor before he or she touches the conductor. Typically, a hot stick is used to bring a bonding jumper (already connected to the conductive bucket liner) into contact with the live line. This connection brings the equipotential area surrounding the employee to the same voltage as that of the line. Proposed § 1926.964(c)(7) would require the conductive device to be bonded to the energized conductor before any employee contacts the energized conductor and would require this connection to be maintained until work is completed. Proposed § 1926.964(c)(7), which has been taken from § 1910.269(q)(3)(vii), is essentially identical to existing § 1926.955(e)(14).

Proposed § 1926.964(c)(8) would require aerial lifts used for live-line bare-hand work to be equipped with upper controls that are within reach of any employee in the bucket and with lower controls that permit override operation at the base of the boom. Upper controls are necessary so that employees in the bucket can precisely control the lift's direction and speed of approach to the live line. Control by workers on the ground responding to directions from those in the bucket could lead to contact by an employee in the lift with the energized conductor before the bonding jumper is in place. Controls are needed at ground level, however, so that employees in the lift who might be disabled as a result of an accident or illness could be promptly lowered and assisted. For this reason, paragraph (c)(9) would prohibit operation of the ground level controls except in case of emergency. Proposed paragraphs (c)(8) and (c)(9), which have been taken from § 1910.269(q)(3)(viii) and (q)(3)(ix), are essentially identical to existing § 1926.955(e)(12) and (e)(13).

Proposed § 1926.964(c)(10) would require all aerial lift controls to be checked to ensure that they are in proper working order before any employee is lifted into the working position. This paragraph, which has been taken from § 1910.269(q)(3)(x), is essentially identical to existing § 1926.955(e)(10).

To protect employees on the ground from the electric shock that would be received upon touching the truck supporting the aerial lift, proposed § 1926.964(c)(11) would require the truck to be grounded or barricaded and treated as energized. If the truck is grounded, the insulation of the lift limits the voltage on the body of the truck to a safe level. The proposed rule, which has been taken from § 1910.269(q)(3)(xi), is similar to existing § 1926.955(e)(9). The existing requirement in Subpart V, however, also includes a provision for using the outriggers on the aerial lift to stabilize

[58] If the circuit protective devices do not provide an autoreclosing feature, the circuit will remain deenergized by design. In addition, voltage surges caused by circuit reclosing would not occur.

[59] Personal protective grounding provides supplementary protection in case the deenergized line is reenergized.

the equipment. The hazard addressed by this provision is covered in proposed § 1926.959(b)(1), discussed earlier in this section of the preamble.

Aerial lifts that are used in live-line bare-hand work are exposed to the full line-to-ground voltage of the circuit for the duration of the job. To ensure that the insulating value of the lift being used is high enough to protect employees, proposed § 1926.964(c)(12) would require a boom-current test to be made before work is started each day. The test would also be required when a higher voltage is encountered and when conditions change to a degree that warrants retesting the equipment.

Under the standard, the test consists of placing the bucket in contact with a source of voltage equal to that being encountered during the job and keeping it there for at least 3 minutes. This is normally accomplished at the worksite by placing the bucket in contact with the energized line on which work is to be performed (without anyone in it, of course).

Paragraph (c)(12), which has been taken from § 1910.269(q)(3)(xii), is similar to existing § 1926.955(e)(11). To provide employees with a level of protection equivalent to that provided by American National Standard for Vehicle-Mounted Elevating and Rotating Aerial Devices (ANSI A92.2–2001), § 1926.964(c)(12) proposes to permit a leakage current of up to 1 microampere per kilovolt of nominal phase-to-*ground* voltage. In contrast, the corresponding provision in existing § 1926.955(e)(11) allows up to 1 microampere of current for every kilovolt of phase-to-*phase* voltage. (For a three-phase, Y-connected system, the phase-to-phase voltage equals 1.73 times the phase-to-ground voltage.) Because the national consensus standard and § 1910.269(q)(3)(xii) contain the more protective language, OSHA is proposing the maximum leakage current of 1 microampere per kilovolt of phase-to-*ground* voltage from the general industry standard.

Proposed § 1926.964(c)(12) would also require the suspension of related work activity any time (not only during tests) a malfunction of the equipment is evident. This proposed requirement is intended to prevent the failure of insulated aerial devices during use. Only work from an aerial lift is affected. Work not involving an aerial lift could be continued. Halting work from the lift will protect employees in the lift, as well as those on the ground, from the electrical hazards involved.

Proposed paragraphs (c)(13), (c)(14), and (c)(15) of proposed § 1926.964 would require the minimum approach distances specified in Table V–2 through Table V–6 to be maintained from grounded objects and from objects at a potential different from that at which the bucket is energized. These provisions, which are based on § 1910.269(q)(3)(xiii), (q)(3)(iv), and (q)(3)(v), are essentially identical to existing § 1926.955(e)(15), (e)(16), and (e)(17), except for the change in the minimum approach distances. (See the summary and explanation of proposed § 1926.960(c)(1) for a discussion of the derivation of minimum approach distances.) Paragraph (c)(13) would apply to minimum approach distances in general; paragraph (c)(14) would cover minimum approach distances to be used as the employee approaches or leaves the energized conductor; and paragraph (c)(15) relates to the distance between the bucket and the end of a bushing or insulator string. The latter two paragraphs clarify that the employee and the bucket are considered to be at phase potential as the employee is approaching the energized part and that the phase-to-ground minimum approach distance must be maintained from grounded objects. Similarly, the employee must maintain the phase-to-phase minimum approach distance from the other phases on the system. OSHA requests comments on whether proposed paragraphs (c)(14) and (c)(15) should address objects at different phase potential in addition to objects at ground potential.

Proposed paragraph (c)(16) would prohibit the use of hand lines between the bucket and boom and between the bucket and ground. Such use of lines could set up a potential difference between the employee in the bucket and the power line when the employee contacts the hand line. If the hand line is a nonconductive type and if it is not supported from the bucket, it may be used from the conductor to ground. Unless the rope is insulated for the voltage, employees on the ground must treat it as energized. Lastly, ropes used for live-line bare-hand work may not be used for other purposes.

This provision, which has been taken from § 1910.269(q)(3)(xvi), is similar to existing § 1926.955(e)(18). However, the existing standard, in § 1926.955(e)(18)(ii), prohibits conductive materials over 36 inches long from being placed in the aerial lift bucket. Exceptions are made for ''appropriate length jumpers, armor rods, and tools.'' OSHA is proposing to revoke this requirement. The proposal would require the minimum approach distance to be maintained regardless of the length of any conductive object. Thus, existing § 1926.955(e)(18)(ii) is unnecessary.

Proposed §§ 1926.964(c)(17) would prohibit passing uninsulated equipment or materials to an employee bonded to an energized part. Passing uninsulated objects to an employee who is bonded to an energized conductor would bridge the insulation to ground and endanger the employee. This proposed provision, which is based on § 1910.269(q)(3)(xvii), has no counterpart in existing § 1926.955(e).

Proposed § 1926.964(c)(18) would require a durable nonconductive chart reflecting the minimum approach distances prescribed by Table V–2 through Table V–6 to be mounted so that it is visible to the operator of the boom. Of course, a table prescribing minimum approach distances greater than those required would also be acceptable. This provision, which has been taken from § 1910.269(q)(3)(xviii), is essentially identical to existing § 1926.955(e)(20)(i).

Proposed § 1926.964(c)(19) would require a non-conductive measuring device to be available and readily accessible to the employee in the lift. This provision has been taken from § 1910.269(q)(3)(xix). Existing § 1926.955(e)(20)(ii) recommends, but does not require, an insulating measuring device. OSHA believes that this should be a requirement, rather than a recommendation, so that employees can accurately determine whether the required minimum approach distances are being maintained. Under the existing standard, an employee might be required by the employer to estimate the distance. Compliance with paragraphs (c)(18) and (c)(19) in proposed § 1926.964 would assist the employee in accurately determining the minimum approach distances required by the standard.

Existing § 1926.955(e)(19) prohibits an aerial lift used in live-line bare-hand work from being overstressed while lifting or supporting weights. OSHA has not proposed to include this requirement under § 1926.964. The hazard addressed by the existing requirement is a general hazard, which is present any time the aerial lift is used, not just during live-line bare-hand work. OSHA believes that this hazard is better treated in proposed § 1926.959(c), which would require mechanical equipment to be operated within its design limitations.

Paragraph (d) of proposed § 1926.964 addresses hazards associated with towers and other structures supporting overhead lines. This paragraph has been taken from § 1910.269(q)(4).

Paragraph (b) of existing § 1926.955 addresses metal tower construction.

Many of the requirements in the existing rules cover the same hazards as other provisions in the construction standards. For example, § 1926.955(b)(1), (b)(2), and (b)(3) address hazards associated with footing excavations. Power transmission and distribution workers are fully protected from these hazards by Subpart P of Part 1926.[60] Therefore, the proposed revision of Subpart V contains no counterparts to these existing requirements. Existing paragraphs (b)(5)(i) and (b)(7) contain simple references to other Part 1926 requirements. Existing paragraphs (b)(5)(iii), (b)(6)(i), (b)(6)(v), and (b)(8), which address a few of the hazards associated with mechanical equipment, contain requirements that are equivalent to provisions in existing Subpart N of Part 1926 or proposed § 1926.959. The proposed revision of Subpart V contains counterparts to none of these six paragraphs. OSHA believes that eliminating these provisions will reduce redundancy and will eliminate the potential for conflicts between different standards.

To protect employees on the ground from hazards presented by falling objects, proposed § 1926.964(d)(1) would prohibit workers from standing under a tower or other structure, unless their presence is necessary to assist employees working above. This provision, which has been taken from § 1910.269(q)(4)(i), is equivalent to existing § 1926.955(b)(4)(i) and (b)(5)(ii). The proposal eliminates the redundancy presented by these two existing requirements.

Paragraph (d)(2) of proposed § 1926.964 relates to operations that involve lifting and positioning tower sections. This provision requires tag lines or other similar devices to be used to control tower sections being positioned, unless the employer can demonstrate that the use of such devices would create a greater hazard. The use of tag lines protects employees from being struck by tower sections that are in motion. This provision, which has been taken from § 1910.269(q)(4)(ii), is the same as § 1926.955(b)(4)(ii) and (b)(6)(ii). The proposal eliminates the redundancy presented by these two existing requirements.

Paragraph (d)(3) of proposed § 1926.964 would require loadlines to remain in place until the load is secured so that it cannot topple and injure an employee. This provision, which has been taken from § 1910.269(q)(4)(iii), is essentially identical to § 1926.955(b)(4)(iii) and (b)(6)(iii). The proposal eliminates the redundancy presented by these two existing requirements.

Some weather conditions can make work from towers and other overhead structures more hazardous than usual. For example, icy conditions may make slips and falls much more likely, in fact even unavoidable. Under such conditions, work from towers and other structures would generally be prohibited by proposed § 1926.964(d)(4). However, when emergency restoration work[61] is involved, the additional risk may be necessary for public safety, and the standard permits such work to be performed even in bad weather. This provision, which has been taken from § 1910.269(q)(4)(iv), is essentially identical to existing § 1926.955(b)(6)(iv).

Section 1926.965, Underground Electrical Installations

In many electric distribution systems, electric equipment is installed in enclosures, such as manholes and vaults, set beneath the earth. Proposed § 1926.965 addresses safety for these underground electrical installations. As noted in § 1926.965(a), the requirements proposed in this section are in addition to requirements contained elsewhere in the standard (and elsewhere in Part 1926) because § 1926.965 only contains considerations unique to underground facilities. For example, proposed § 1926.953, relating to enclosed spaces, also applies to underground operations involving entry into an enclosed space.

Proposed § 1926.965 has been taken from § 1910.269(t). Existing Subpart V contains requirements for work on underground lines in § 1926.956. Differences between the existing rules and the proposed rules are explained in the following summary and explanation of proposed § 1926.965.

Paragraph (b) of proposed § 1926.965 would require the use of ladders or other climbing devices for entrance into and exit from manholes and subsurface vaults that are more than 1.22 meters (4 feet) deep. Because employees can easily be injured in the course of jumping into subsurface enclosures or in climbing on the cables and hangers which have been installed in these enclosures, the standard requires the use of appropriate devices for employees entering and exiting manholes and vaults. The practice of climbing on equipment such as cables and cable hangers is specifically prohibited by paragraph (b). This proposed provision has been taken from § 1910.269(t)(1). Subpart V contains no counterpart to this requirement.

Paragraph (c) of proposed § 1926.965 would require equipment used to lower materials and tools into manholes or vaults to be capable of supporting the weight and requires this equipment to be checked for defects before use. Paragraph (c) would also require employees to be in the clear when tools or materials are lowered into the enclosure. This provision protects employees against being injured by falling tools and material. It should be noted that, because work addressed by this paragraph exposes employees to the danger of head injury, § 1926.95(a) requires employees to wear head protection when they are working in underground electrical installations. Proposed paragraph (c) has been taken from § 1910.269(t)(2). Subpart V contains no counterpart to this requirement.

Paragraph (d) of proposed § 1926.965 would require attendants for manholes. During the time work is being performed in a manhole that contains energized electric equipment, an employee would be required to be available in the immediate vicinity (but not normally in the manhole) to render emergency assistance. However, the attendant would be allowed to enter the manhole, for brief periods, to provide other than emergency assistance to those inside.

The provisions in paragraph (d) are being proposed so that emergency assistance can be provided to employees working in manholes, where the employees work unobserved and where undetected injury could occur. Taken from § 1910.269(t)(3) and from existing § 1926.956(b)(1), these proposed requirements are intended to protect employees within the manhole without exposing the attendants outside to a risk of injury greater than that faced by those inside.

Because the hazards addressed by paragraph (t)(3) are primarily related to electric shock, allowing the attendant to

[60] Two of the requirements in the existing paragraphs are covered in other places. Under the last sentence of existing § 1926.955(b)(1), ladders must be used to provide access for pad- or pile-type footing excavations more than 4 feet deep. This hazard is already addressed in § 1926.1051(a), which requires a stairway or a ladder to be provided for access to breaks in elevation of more than 48 cm, unless a ramp, runway, sloped embankment, or personnel hoist is available. Existing § 1926.955(b)(3)(iii) addresses the stability of equipment used near excavations. Proposed § 1926.959(b) and (c) cover hazards associated with instability of mechanical equipment.

[61] Emergency restoration work is considered to be that work needed to restore an electric power transmission or distribution installation to an operating condition to the extent necessary to safeguard the general public.

enter the manhole briefly [62] has no significant effect on the safety of the employee he or she is protecting. In case of electric shock, the attendant would still be able to provide assistance. The proposed rule would require the attendant to be trained in first aid and in CPR to ensure that emergency treatment will be available if needed.

If other hazards are believed to endanger the employee in the manhole, paragraph (h) of proposed § 1926.953 would also apply.[63] This provision would require attendants for work in an enclosed space (for example, a manhole) if a hazard exists because of traffic patterns in the area of the opening to the enclosed space. Thus, an attendant would be required when traffic patterns in the area around the manhole opening endanger an entrant exiting the manhole. In such situations, the employee on the surface would be exposed to the same hazards against which he or she is trying to protect the original entrant if the attendant were to enter the manhole or vault. Therefore, the proposal would not permit attendants required under § 1926.953(h) to enter the manhole. To clarify the application of the two different attendant requirements, a note has been included following § 1926.965(d)(2). The note indicates that if an attendant is also required under § 1926.953(h), one person may serve to satisfy both requirements, but is not permitted to enter the manhole.

OSHA has included a second note following § 1926.965(d)(2). This note serves as a reminder that § 1926.960(b) would prohibit unqualified employees from working in areas containing unguarded, uninsulated energized lines or parts of equipment operating at 50 volts or more.

Paragraph (d)(3) of proposed § 1926.965 would permit an employee working alone to enter a manhole or vault for the purpose of inspection, housekeeping, taking readings, or similar work. As noted earlier, the purpose of requiring an attendant under proposed § 1926.965(d) is to provide assistance in case an electric shock occurs. When an employee is performing the types of work listed in this provision, there is very little chance that he or she would suffer an electric shock. Thus, the Agency believes it is safe for an employee to perform duties such as housekeeping and inspection without the presence of an attendant.

Under paragraph (d)(4) of proposed § 1926.965, reliable communications would be required to be maintained among all employees involved in the job, including any attendants, the employees in the manhole, and employees in separate manholes working on the same job. This requirement, which has been taken from § 1910.269(t)(3)(iv), has no counterpart in § 1926.956(b)(1).

To install cables into the underground ducts, or conduits, that will contain them, employees use a series of short jointed rods or a long flexible rod inserted into the ducts. The insertion of these rods into the ducts is known as ''rodding.'' The rods are used to thread the cable-pulling rope through the conduit. After the rods have been withdrawn and the cable-pulling ropes have been inserted, the cables can then be pulled through by mechanical means.

Paragraph (e) of proposed § 1926.965 would require duct rods to be inserted in the direction presenting the least hazard to employees. To make sure that a rod does not contact live parts at the far end of the duct line being rodded, which would be in a different manhole or vault, the proposal would also require an employee to be stationed at the remote end of the rodding operation to ensure that the required minimum approach distances are maintained. This provision, which has been taken from § 1910.269(t)(4), has no counterpart in existing Subpart V.

To prevent accidents resulting from working on the wrong cable, one that may be energized, proposed § 1926.965(f) would require the identification of the proper cable when multiple cables are present in a work area. The identification must be made by electrical means (for example, a meter), unless the proper cable is obvious because of appearance, location, or other means of readily identifying the proper cable. This proposed paragraph, which has been taken from § 1910.269(t)(5), is similar to existing § 1926.956(c)(4), (c)(5), and (c)(6); however, existing § 1926.956(c)(4) and (c)(5) apply only to excavations. The proposal would apply the requirements to all underground installations.

If any energized cables are to be moved during underground operations, paragraph (g) of proposed § 1926.965 would require them to be inspected for possible defects that could lead to a fault. (If a defect is found, paragraph (h) would apply.) These provisions protect employees against possibly defective cables, which could fault upon being moved, leading to serious injury. This paragraph in the proposal, which has been taken from § 1910.269(t)(6), has no counterpart in existing Subpart V.

Since defective energized cables may fail with an enormous release of energy, precautions must be taken to minimize the possibility of such an occurrence while an employee is working in a manhole. Therefore, paragraph (h) of proposed § 1926.965 would, in general, prohibit employees from working in a manhole which contains an energized cable with a defect that could lead to a fault. The proposal lists typical abnormalities that could expose employees to injury as: oil or compound leaking from a cable or joint (splice), a broken cable sheath or joint sleeve, hot localized surface temperatures on a cable or joint, or a joint that is swollen beyond normal tolerances. Examples of abnormalities are listed in a note following § 1926.965(h). The note states that the listed conditions are presumed to lead to or be an indication of a possible impending fault. An employer could demonstrate that any one of these conditions, in a particular case, is not indicative of an impending fault, in which case proposed § 1926.965(h) would not require protective measures to be taken. This provision, which has been taken from § 1910.269(t)(7), has no counterpart in existing Subpart V.

In the § 1910.269 rulemaking, OSHA concluded that employees may work in a manhole that contains an energized cable with abnormalities only when service load conditions and feasible alternatives prevent deenergizing the cable and only when the employees are protected from a failure (January 31, 1994, 59 FR 4416).

Under some service load conditions, it may not be feasible for the electric utility to deenergize the cable with the defect at the same time that another line is deenergized for maintenance work. In such cases, paragraph (h)(1) of proposed § 1926.965 would allow the defective cable or splice to remain energized as long as the employees in the manhole are protected against the possible effects of a failure by shields or other devices capable of containing the adverse effects of a failure. For example, a ballistic blanket wrapped around a defective

[62] The attendant would be permitted to remain within the manhole only for the short period of time necessary to assist the employee inside the manhole with a task that one employee cannot perform alone. For example, if a second employee is needed to help lift a piece of equipment into place, the attendant could enter only for the amount of time that is needed to accomplish this task. However, if significant portions of the job require the assistance of a second worker in the manhole, the attendant would not be permitted to remain in the manhole for the length of time that would be necessary, and a third employee would be required.

[63] Additionally, as noted in the discussion of proposed § 1926.953, earlier in this preamble, the entry would have to be conducted in accordance with § 1910.146, the generic permit-required confined spaces standard, if proposed §§ 1926.953 and 1926.965 would not adequately protect the entrants.

splice can protect against injury from the effects of a fault in the splice. The energy that could be released in case of a fault is known, and the energy absorbing capability of a shield or other device can be obtained from the manufacturer or can be calculated. As long as the energy absorbing capability of the shield or other device exceeds the available fault energy, employees will be protected. The proposal would require employees to be protected, regardless of the type of device used and of how it is applied. Additionally, the proposal would permit this option to be used only ''when service load conditions and a lack of feasible alternatives require that the cable remain energized.'' Employers are required to use alternatives, such as the use of shunts or other means of supplying areas with power, whenever feasible before allowing access.

Paragraph (h)(2) addresses work that could itself cause a fault in a cable, such as removing asbestos covering on a cable or using a power tool to break concrete encasing a cable. This type of work can damage the cable and create an internal fault. The energy released by the fault could injure not only the employee performing the work but any other employees nearby. Paragraph (h)(2) would require the same protective measures in those situations as paragraph (h)(1), that is, deenergizing the cable or, under certain conditions, using shields or other protective devices capable of containing the effects of the fault.

Paragraph (i) of proposed § 1926.965 would require metallic sheath continuity to be maintained while work is performed on underground cables. Bonding across an opening in a cable's sheath protects employees against shock from a difference in potential between the two sides of the opening. As an alternative to bonding, the cable sheath could be treated as energized. (The voltage to which the sheath is to be considered energized is equal to the maximum voltage that could be seen across the sheath under fault conditions.) This requirement, which has been taken from § 1910.269(t)(8), is essentially identical to existing § 1926.956(c)(7), except that the proposal would allow the cable sheath to be treated as energized in lieu of bonding. This is consistent with other parts of the proposal, such as proposed § 1926.960(j), which recognize treating objects as energized as an alternative to grounding.

Section 1926.966, Substations

Proposed § 1926.966 addresses work performed in substations. As is the case elsewhere in the standard, the provisions of this paragraph are intended to supplement (rather than modify) the more general requirements contained in other portions of Subpart V, such as § 1926.960 on working on or near live parts.

Proposed § 1926.966(b) would require enough space to be provided around electric equipment to allow ready and safe access to and operation and maintenance of the equipment. This rule would prevent employees from contacting exposed live parts as a result of insufficient maneuvering room. A note has been included to recognize, as constituting compliance, the provisions of ANSI C2–2002 for the design of workspace for electric equipment. This provision, which has been taken from § 1910.269(u)(1), has no counterpart in existing Subpart V.

OSHA realizes that older installations may not meet the dimensions set forth in the latest version of the national consensus standard. The Agency believes that the language of proposed § 1926.966(b) is sufficiently performance oriented that older installations built to specifications in the standards that were in effect at the time they were constructed would meet the requirement for sufficient workspace provided that the installation and work practices used enable employees to perform work safely within the space and to maintain the minimum approach distances specified in proposed § 1926.960(c)(1). In fact, the note for this provision states that the NESC specifications are guidelines. The ANSI standard is specifically not being incorporated by reference here. However, OSHA has included the following language in the note to proposed § 1926.966(b):

**Note to paragraph (b) of this section:** Guidelines for the dimensions of access and workspace about electric equipment in substations are contained in American National Standard National Electrical Safety Code, ANSI C2–2002. Installations meeting the ANSI provisions comply with paragraph (b) of this section. An installation that does not conform to this ANSI standard will, nonetheless, be considered as complying with paragraph (b) of 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 § 1926.960(c)(1) of this Part while they working 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 provide by access and working space meeting ANSI C2–2002.

This language accomplishes three goals. First, it explains that an installation need not be in conformance with ANSI C2–2002 in order to be considered as complying with proposed § 1926.966(b). Second, it informs employers whose installations do not conform to the latest ANSI standard of how they can demonstrate compliance with the OSHA standard. Third, it ensures that, however old an installation is, it provides sufficient space to enable employees to work within the space without significant risk of injury.

Proposed § 1926.966(c) would require draw-out-type circuit breakers to be inserted and removed while the breaker is in the open position. (A draw-out-type circuit breaker is one in which the removable portion may be withdrawn from the stationary portion without the necessity of unbolting connections or mounting supports.) Additionally, if the design of the control devices permits, the control circuit for the circuit breaker would have to be rendered inoperative. (Some circuit breaker and control device designs do not incorporate a feature allowing the control circuit for the breaker to be rendered inoperative.) These provisions are intended to prevent arcing which could injure employees. This proposed paragraph, which has been taken from § 1910.269(u)(2), has no counterpart in existing Subpart V.

Because voltages can be impressed or induced on large metal objects near substation equipment, proposed § 1926.966(d) would require conductive fences around substations to be grounded. Continuity across openings is also required in order to eliminate voltage differences between adjacent parts of the fence.

This provision has been taken from § 1910.269(u)(3). Existing § 1926.957(g)(1) requires ''[a]dequate interconnection with ground'' to be maintained between temporary and permanent fences. Existing Subpart V does not require permanent substation fences to be grounded. However, OSHA believes that grounding metal fences, whether they are temporary or permanent, is essential to the safety of employees working near the fences.

Proposed § 1926.966(e) addresses the guarding of rooms containing electric supply equipment. This paragraph has been taken from § 1910.269(u)(4). The only provisions in existing Subpart V addressing guarding of live parts in substations are contained in

§ 1926.957(c) and (g). These two provisions require barricades or barriers to be installed (paragraph (c)) and for temporary fences to be installed if sections of permanent fencing are removed (paragraph (g)). Existing § 1926.957(g)(2) also requires gates to unattended substations to be locked.

The existing requirements only address temporary guarding measures. Permanent guarding of live parts, which is generally more substantial than the tape and cone barricades permitted under the existing rule, is never mentioned in existing § 1926.957. OSHA's proposed revision of the substation rules addresses guarding of live parts in substations in a more comprehensive manner and should provide better protection for employees.

OSHA believes that it is important to prohibit unqualified persons from areas containing energized electric supply equipment regardless of the work they would be performing. Employees working in these areas must be trained in the hazards involved and in the appropriate work practices, as would be required by proposed § 1926.950(b)(2). Otherwise, they would not be able to distinguish hazardous circuit parts from non-hazardous equipment and would not be familiar with the appropriate work practices, regardless of the jobs they are performing. There have been accidents that involve contact of unqualified persons with energized parts in such areas.

Subpart V is intended to apply to electrical installations for which OSHA has few design requirements. The Subpart K electrical installation standards typically do not apply to electric power transmission and distribution installations, and such installations may pose hazards in addition to those of exposed live parts. For example, equipment enclosures may be ungrounded. If the requirements of Subpart K are not being met, then it is important to prevent unqualified persons from gaining access to areas containing electric power transmission and distribution equipment.

If, on the other hand, the installation conforms to Subpart K, at least with respect to the guarding of live parts and to the grounding of enclosures for these parts, unqualified employees may safely access substation areas. In Subpart K, suitable protection is provided by §§ 1926.403(j)(2), 1926.403(i)(2), and 1926.404(f)(7) for employees working in substations. These provisions prohibit unqualified persons from accessing areas containing exposed live parts operating at 50 volts through 600 volts and located less than 8 feet above the floor or other working surface. Unqualified persons are also prohibited from areas containing live parts operating at more than 600 volts, unless the live parts are completely enclosed in metal enclosures or are installed at an elevation of at least 8 feet, 6 inches. The metal enclosures must be grounded, and the minimum height increases with increasing voltage.

OSHA is proposing to adopt requirements here that follow the Subpart K approach. Proposed § 1926.966(e) sets forth criteria for access by unqualified persons to spaces containing electric supply lines or equipment. Paragraph (e)(1) divides areas containing electric supply equipment into three categories as follows:

(1) Areas where exposed live parts operating at 50 to 150 volts to ground are located within 2.4 meters (8 feet) of the ground or other working surface,

(2) Areas where live parts operating at between 150 and 601 volts and located within 2.4 meters (8 feet) of the ground or other working surface are guarded only by location, as permitted under paragraph (f)(1), and

(3) Areas where live parts operating at more than 600 volts are located, 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 least equivalent to an 2.4-meter (8-foot) height at 50 volts.

Proposed § 1926.966(e)(2) through (e)(5) propose requirements that would apply to these areas. The areas would have to be so enclosed as to minimize the possibility that unqualified persons will enter; warning signs would have to be displayed; and entrances not under the observation of an attendant would have to be kept locked. Additionally, unqualified persons would not be permitted to enter these areas while the electric supply lines or equipment are energized.

Proposed § 1926.966(f) also addresses guarding of live parts. This paragraph, which has been taken from § 1910.269(u)(5), has no counterpart in existing Subpart V.

Proposed § 1926.966(f)(1) would require live parts operating at more than 150 volts to be guarded (by physical guards or by location) or insulated. This provision protects qualified employees from accidentally contacting energized parts. Guidance for clearance distances appropriate for guarding by location can be found in ANSI C2. Installations meeting ANSI C2–2002 are considered to meet paragraph (f)(1), which is based on Section 124A.1 of that standard.

OSHA will consider installations that do not meet ANSI C2–2002 as meeting proposed paragraph (f)(1) provided the employer can demonstrate that the installation provides sufficient clearance based on the following evidence:

(1) That the installation meets the requirements of the edition of ANSI C2 that was in effect at the time the installation was made,

(2) That each employee is isolated from live parts at the point of closest approach, and

(3) That the precautions taken protect employees to the same degree as the clearances specified in ANSI C2–2002.

This approach would afford employers flexibility in complying with the standard and would afford employees protection from injury due to sparkover from live circuit parts.

Proposed § 1926.966(f)(2) would require the guarding of live parts within a compartment to be maintained during operation and maintenance functions. This guarding is intended to prevent accidental contact with energized parts and to prevent objects from being dropped on energized parts. However, since access must be gained to energized equipment by qualified employees, an exception to this proposed requirement allows the removal of guards for fuse replacement and other necessary access by qualified persons. In such cases, proposed paragraph (f)(3) would protect other employees working nearby by requiring the installation of protective barriers around the work area.

So that employees can receive pertinent information on conditions that affect safety at the substation, paragraph (g)(1) would require employees who do not regularly work at the station to report their presence to the employee in charge. Typical conditions affecting safety in substations include the location of energized equipment in the area and the limits of any deenergized work area. Proposed paragraph (g)(2) would require this specific information to be communicated to employees during the job briefing required by proposed § 1926.952. These two requirements have been taken from § 1910.269(u)(6).

Existing § 1926.957(a)(1) requires authorization to be obtained from the person in charge of the substation before work is performed. The proposal would not require authorization. OSHA does not believe that such a requirement is necessary. As noted, proposed § 1926.966(g)(1) would require employees who do not regularly work in the substation to report their presence to the employee in charge. The main purpose of this rule is for the flow of important safety-related information from the employee in charge to employees about to work in the substation. As long as this information is imparted to the employees performing the work and as long as the requirements proposed in the revision of Subpart V are followed, the work can be performed safely. The Agency does not believe that the requirement that the work be authorized is necessary for employee safety; however, OSHA requests comments on whether or not the lack of authorization to perform work can lead to accidents.

Existing § 1926.957(a)(2) is essentially identical to proposed § 1926.966(g)(2), except that the existing rule, in paragraph (a)(2)(ii), also requires the determination of what protective equipment and precautions are necessary. Since the job briefing is already required to cover these areas under proposed § 1926.952(b), existing § 1926.957(a)(2)(ii), which applies only to work in energized substations, would no longer be necessary.

Section 1926.967, Special Conditions

Proposed § 1926.967 proposes requirements for special conditions that are encountered during electric power transmission and distribution work.

Since capacitors store electric charge and can release electrical energy even when disconnected from their sources of supply, some precautions may be necessary—in addition to those proposed in § 1926.961 (deenergizing lines and equipment) and § 1926.962 (grounding)—when work is performed on capacitors or on lines that are connected to capacitors. Proposed § 1926.967(a), which has been taken from § 1910.269(w)(1), contains precautions which will enable this equipment to be considered as deenergized. This proposed paragraph has no counterpart in existing Subpart V.

Under proposed § 1926.967(a)(1), capacitors on which work is to be performed would have to be disconnected from their sources of supply and, after a 5-minute wait, short-circuited. This not only removes the sources of electric current but relieves the capacitors of their charge as well. It should be noted that ANSI/IEEE Standard No. 18–2002 requires all capacitors to have an internal resistor across its terminals to reduce the voltage to 50 volts or less within 5 minutes after the capacitor is disconnected from an energized source.

For work on individual capacitors in a series-parallel capacitor bank, each unit must be short-circuited between its terminals and the capacitor tank or rack, and the rack must be grounded; otherwise, individual capacitors could retain a charge. These considerations are proposed in paragraph (a)(2). Lastly, paragraph (a)(3) also requires lines to which capacitors are connected to be short-circuited before the lines can be considered deenergized.

A note referring to the requirements for deenergizing electric transmission and distribution lines and equipment (proposed § 1926.961) and for grounding (proposed § 1926.962) has been included following § 1926.967(a) to alert readers to the appropriate requirements for deenergizing and grounding.

Although the magnetic flux density in the core of a current transformer is usually very low, resulting in a low secondary voltage, it will rise to saturation if the secondary circuit is opened while the transformer primary is energized. If this occurs, the magnetic flux will induce a voltage in the secondary winding high enough to be hazardous to the insulation in the secondary circuit and to personnel. Because of this hazard to workers, proposed § 1926.967(b) would prohibit the opening of the secondary circuit of a current transformer while the primary is energized. If the primary cannot be deenergized for work to be performed on the secondary, then the secondary circuit would have to be bridged so that an open-circuit condition does not result. This provision, which has been taken from § 1910.269(w)(2), has no counterpart in existing Subpart V.

In a series streetlighting circuit, the lamps are connected in series, and the same current flows in each lamp. This current is supplied by a constant-current transformer, which provides a constant current at a variable voltage from a source of constant voltage and variable current. Like the current transformer, the constant current source attempts to supply current even when the secondary circuit is open. The resultant open-circuit voltage can be very high and hazardous to employees. For this reason, § 1926.967(c)(2) proposes a requirement, similar to that in proposed paragraph (b), that either the streetlighting transformer be deenergized or the circuit be bridged to avoid an open-circuit condition. In addition, proposed § 1926.967(c)(1) would require streetlighting circuits with an open circuit voltage of more than 600 volts to be worked in accordance with the requirements on overhead lines in proposed § 1926.964 or on underground electrical installations in proposed § 1926.965, as appropriate. These provisions, which have been taken from § 1910.269(w)(3), have no counterpart in existing Subpart V.

Frequently, electric power transmission and distribution employees must work at night or in enclosed places, such as manholes, that are not illuminated by the sun. Since inadvertent contact with live parts can be fatal, good lighting is important to the safety of these workers. Therefore, proposed § 1926.967(d) would require sufficient illumination to be provided so that work can be performed safely. This provision, which has been taken from § 1910.269(w)(4), is comparable to existing § 1926.950(f). The existing requirement, however, applies only at night. OSHA believes that it is important for employees to have sufficient lighting to perform the work safely no matter what the time of day is. The note following proposed § 1926.967(d) refers to § 1926.56 for specific levels of illumination that are required under various conditions.

To protect employees working in areas that expose them to the hazards of drowning, proposed § 1926.967(e) would require the provision and use of personal flotation devices. Additionally, to ensure that these devices would provide the necessary protection upon demand, they would have to be approved by the U.S. Coast Guard, be maintained in safe condition, and be inspected frequently enough to ensure that they do not have defects or other conditions that would render them unsuitable for use. Lastly, employees would not be permitted to cross streams unless a safe means of passage is provided. This provision, which has been taken from § 1910.269(w)(5), would replace existing § 1926.950(g). The existing rule simply references other construction standards on body belts, safety straps, and lanyards, on safety nets, and on protection for working near water, namely §§ 1926.104, 1926.105, and 1926.106. OSHA is proposing language identical to that contained in § 1910.269 for consistency with that standard, which the Agency believes affords better protection for electric power transmission and distribution employees. However, comments are invited on whether or not existing § 1926.950(g) would better protect employees.

Proposed § 1926.967(f) references Subpart P of Part 1926 for requirements on excavations. This provision is equivalent to existing § 1926.956(c)(2), which references §§ 1926.651 and 1926.652 of that subpart. The proposed rule clearly indicates that all of the requirements of Subpart P apply.

Employees working in areas with pedestrian or vehicular traffic are exposed to additional hazards compared to employees working on an employer's premises, where public access is restricted. One serious additional hazard faced by workers exposed to the public is that of being struck by a vehicle (or even by a person). To protect employees against being injured as a result of traffic mishaps, proposed § 1926.967(g) would require the placement of warning signs or flags or other warning devices to channel approaching traffic away from the work area if the conditions in the area pose a hazard to employees. If warning signs are not sufficient protection or if employees are working in an area in which there are excavations, barricades must be erected. Additionally, warning lights are required for night work. This proposed paragraph also references § 1926.200(g)(2), which covers traffic control devices. This provision in OSHA's construction standards incorporates Part VI of the Manual of Uniform Traffic Control Devices, 1988 Edition, Revision 3, September 3, 1993, FHWA–SA–94–027, or Part VI of the Manual on Uniform Traffic Control Devices, Millennium Edition, December 2000, Federal Highway Administration, by reference. Proposed § 1926.967, which has been taken from § 1910.269(w)(6), has no counterpart in existing Subpart V.

Proposed § 1926.967(h) addresses the hazards of voltage backfeed due to sources of cogeneration or due to the configuration of the circuit involved. Under conditions of voltage backfeed, the lines upon which work is to be performed remain energized after the main source of power has been disconnected. According to this proposed provision, the lines would have to be worked as energized, under proposed § 1926.960, or could be worked as deenergized, following proposed §§ 1926.961 and 1926.962. The referenced requirements contain the appropriate controls and work practices to be taken in case of voltage backfeed. This proposed paragraph, which has been taken from § 1910.269(w)(7), has no counterpart in existing Subpart V.

Sometimes, electric power transmission and distribution work involves the use of lasers. Appropriate requirements for the installation, operation, and adjustment of lasers are contained in existing § 1926.54 of the construction standards. Rather than develop different requirements for electric power transmission and distribution work, OSHA has decided to reference § 1926.54 in paragraph (i) of proposed § 1926.967. This proposed paragraph, which has been taken from § 1910.269(w)(8), has no counterpart in existing Subpart V.

To ensure that hydraulic equipment retains its insulating value, paragraph (j) of proposed § 1926.967 would require the hydraulic fluid used in insulated sections of such equipment to be of the insulating type. Paragraph (d)(1) of § 1926.302 requires hydraulic fluid used in hydraulic powered tools to be fire-resistant. Because available insulating fluids are not fire-resistant, proposed § 1926.967(j) would exempt insulating hydraulic fluid from § 1926.302(d)(1). Proposed § 1926.967(j) is essentially identical to existing § 1926.950(i).

Proposed § 1926.967(k) addresses communication facilities associated with electric power transmission and distribution systems. Typical communications installations include those for microwave signaling and power line carriers. This proposed paragraph, which has been taken from § 1910.269(s), has no counterpart in existing Subpart V.

Microwave signaling systems are addressed by paragraph (k)(1) of proposed § 1926.967. To protect employees' eyes from being injured by microwave radiation, paragraph (k)(1)(i) would require employers to ensure that employees do not look into an open waveguide or antenna that is connected to an energized source of microwave radiation.

Existing § 1910.97, which covers non-ionizing radiation, prescribes a warning sign with a special symbol indicating non-ionizing radiation hazards. Paragraph (k)(1)(ii) of proposed § 1926.967 would require areas that contain radiation in excess of the radiation protection guide set forth in § 1910.97 to be posted with the warning sign. Also, the proposal would require the lower half of that sign to be labeled as follows:

> Radiation in this area may exceed hazard limitations and special precautions are required. Obtain specific instruction before entering.

The sign is intended to warn employees about the hazards present in the area and to inform them that special instructions are necessary to enter the area.

In § 1910.97, the radiation protection guide is advisory only. Paragraph (k)(1)(iii) of proposed § 1926.967 would make the guide mandatory for electric power transmission and distribution work by requiring the employer to institute measures that prevent any employee's exposure from being greater than that set forth in the guide. These measures may be of an administrative nature (such as limitations on the duration of exposure) or of an engineering nature (such as a design of the system that limits the emitted radiation to that permitted by the guide) or may involve the use of personal protective equipment. This proposed provision would not require employers to follow the hierarchy of controls normally required for the protection of employees from occupational hazards. Employees exposed to radiation levels beyond that permitted by the radiation protection guide are typically performing maintenance tasks. OSHA typically permits the use of personal protective equipment in these situations. No employees are exposed to these levels on a routine basis. The Agency requests comments on whether the proposal adequately protects employees and whether the standard should require employers to follow the hierarchy of controls.

Power line carrier systems use the power line itself to carry signals between equipment at different points on the line. Because of this, the proposal would require, in § 1926.967(k)(2), that work associated with power line carrier installations be performed according to the requirements for work on energized lines.

Section 1926.968, Definitions

Proposed § 1926.968 contains definitions of terms used in the standard. Since these definitions have been taken, in large part, from consensus standards and existing OSHA rules and since the definitions included are generally self-explanatory, OSHA expects these terms to be well understood, and no explanation is given here, except for the definition of the term ''qualified employee.'' For other terms whose meaning may not be readily apparent, the Agency has provided an explanation in the discussion of the provision in which the term first appears. (For example, the explanation of the definitions of ''host employer'' is given in the discussion of proposed § 1926.950(c)(1), earlier in this section of the preamble.)

The definition of ''qualified employee'' is based on the definition of that term as set forth in § 1910.269(x). This definition reads as follows:

> One knowledgeable in the construction and operation of the electric power generation, transmission, and distribution equipment involved, along with the associated hazards.

OSHA does not intend to require employees to be knowledgeable in all aspects of electric power generation, transmission, and distribution equipment in order to be considered as ''qualified.'' OSHA believes that the proposed definition will convey the Agency's true intent. It should be noted that the proposal uses the term ''qualified employee'' to refer only to employees who have the training to work on energized electric power transmission and distribution installations. Paragraph (b)(2) of proposed § 1926.950 sets out the training an employee would have to have to be considered a qualified employee. A note to this effect has been included following the definition of this term.

*Appendices.* OSHA is including seven appendices to proposed Subpart V.

Appendix A refers to Appendix A to § 1910.269, which contains flow charts depicting the interface between § 1910.269 and the following standards: § 1910.146, Permit-required confined spaces; § 1910.147, The control of hazardous energy (lockout/tagout); and Part 1910, Subpart S, Electrical. While these general industry standards are not applicable to construction work, employers will still need this information when the construction work performed under Subpart V interfaces with general industry work. Thus, Appendix A will assist employers in determining which of these standards applies in different situations.

Appendix B provides information relating to the determination of appropriate minimum approach distances as proposed by § 1926.950(c)(1) and § 1926.964(c). This appendix is based on Appendix B to § 1910.269, with revisions necessary to reflect the changes to the minimum approach distances proposed for § 1910.269 and Subpart V. OSHA requests information on whether Appendix B requires additional changes, beyond what the Agency is proposing, to make it consistent with current technology. (See the summary and explanation of proposed § 1926.960(c)(1).) OSHA intends to revise the explanatory material in Appendix B similarly when the Agency issues the final rule.

Appendix C provides information relating to the protection of employees from hazardous step and touch potentials as addressed in § 1926.959(d)(3)(iii)(D), § 1926.963(d)(3)(ii), and § 1926.964(b)(2).

Appendix D contains information on the inspection and testing of wood poles addressed in § 1926.964(a)(2).

Appendix E contains references to additional sources of information that may be used to supplement the requirements of proposed Subpart V. The national consensus standards referenced in this appendix contain detailed specifications to which employers may refer in complying with the more performance-oriented requirements of OSHA's proposed rule. Except as specifically noted in Subpart V, however, compliance with the national consensus standards would not be a substitute for compliance with the provisions of the OSHA standard.

Appendix F provides guidance on the selection of protective clothing for employees exposed to electric arcs as addressed in proposed § 1926.960(g).

Appendix G contains guidelines for the inspection of work positioning equipment to assist employers in complying with proposed § 1926.954(b)(3)(i).

*C. Part 1910 Revisions*

The construction of electric power transmission and distribution lines and equipment nearly always exposes employees to the same hazards as the maintenance of electric power lines and equipment. Power line workers use the same protective equipment and safety techniques in both types of work. During the course of a workday, these employees can perform both types of work.

For example, a power line crew could be assigned to replace two transformers that have failed. In one case, the transformer is replaced with an equivalent one; in the other case, it is replaced with a transformer with a different kilovolt-ampere rating. When the employees perform the first job, they are performing maintenance work covered by Part 1910. However, the second job is considered to be construction and is covered by Part 1926. The employees would almost certainly use identical work practices and protective equipment for both jobs.

Because of this, OSHA believes that it is important to have the same requirements apply regardless of the type of work being performed. If the corresponding Part 1910 and Part 1926 standards are the same, employers can adopt one set of work rules covering all types of work. Employers and employees would not be faced with having to decide whether a particular job was construction or maintenance—a factor that in virtually every instance has no bearing on the safety of employees.

Therefore, in this rulemaking, OSHA is proposing revisions to §§ 1910.137 and 1910.269 so that the construction and maintenance standards will be the same.[64] The following distribution table presents the major revisions and OSHA's rationale for proposing them.

| Proposed part 1910 revision | Proposed part 1926 revision | Rationale and comments |
|---|---|---|
| § 1910.137(A)(1)(ii), (b)(2)(vii), and Tables I–2, I–3, I–4, and I–5. | § 1926.97(a)(1)(ii), (c)(2)(vii), and Tables E–1, E–2, E–3, and E–4. | Section 1910.137 would be revised to include Class 00 rubber insulating gloves. |
| The note following § 1910.137(a)(3)(ii)(B). | The note following § 1926.97(a)(3)(ii)(B). | The note would be revised to include the latest ASTM standards. References to ASTM definition and to an ASTM guide for visual inspection of rubber insulating equipment have been included to provide additional useful information for complying with the OSHA standard. |
| A new note following § 1910.137(b)(2)(ii). | The note following § 1926.97(b)(2)(ii). | A reference to an ASTM guide for visual inspection of rubber insulating equipment has been included to provide additional useful information for complying with the OSHA standard. |

[64] Subpart V does not contain requirements for electric power generation installations or for line-clearance tree-trimming work. See the summary and explanation of proposed § 1926.950(a)(3), earlier in this preamble.

| Proposed part 1910 revision | Proposed part 1926 revision | Rationale and comments |
| --- | --- | --- |
| § 1910.137(b)(2)(vii)(B) and (C) | § 1926.97(c)(2)(vii)(B) and (C) | Existing § 1910.137(b)(2)(vii)(B) would be split into two separate CFR units. |
| § 1901.137(c) [New] | § 1926.97(b) | A new paragraph would be added to cover electrical protective equipment that is not made of rubber. See the summary and explanation of proposed § 1926.97(b). |
| § 1910.269(a)(2)(i) | § 1926.950(b)(1) | Existing § 1910.269(a)(2)(i) would be split into three separate CFR units. The last of those units, paragraph (a)(2)(i)(c), would introduce a new requirement that the degree of training be determined by the risk to the employee. See the discussion of proposed § 1926.950(b)(1)(iii). |
| § 1910.269(a)(2)(ii)(E) [New] | § 1926.950(b)(2)(v) | A new paragraph would be added to require qualified employees to be trained to recognize and to control or avoid electrical hazards. See the discussion of proposed § 1926.950(b)(2)(v). |
| § 1910.269(a)(2)(vii) | § 1926.950(b)(7) | The existing requirement for employers to certify that employees have been trained would be replaced with a requirement for employers to determine that employees have demonstrated proficiency in the work practices involved. In addition, a new note would be added to clarify how training received in a previous job would satisfy the training requirements. See the discussion of proposed § 1926.950(b)(7). |
| § 1910.269(a)(4) [New] | § 1926.950(c) | A new paragraph would be added to require host and contract employers to share information on safety-related matters. See the discussion of proposed § 1926.950(c). |
| § 1910.269(c) | § 1926.952 | The existing provision would be reorganized and renumbered. A new requirement would be added to ensure that employers provide the employee in charge with sufficient information to be able to complete the job safely. See the discussion of proposed § 1926.952. |
| The note following § 1910.269(e)(6) | None | This note would be removed. It currently references § 1910.146 for the definition of "entry." OSHA is proposing to add a definition of this term to § 1910.269, so this note would be unnecessary. |
| § 1910.269(e)(8) | § 1926.952(h) | OSHA is proposing to remove the requirement to provide an attendant if there is reason to believe a hazard exists in the enclosed space. Paragraph (e)(1) of § 1910.269 requires the entry to conform to § 1910.146 if there are hazards for which the requirements of § 1910.269(e) and (t) do not provide adequate protection. Thus, if an employer has reason to believe that a hazard exists despite the precautions taken under § 1910.269(e) and (t), then § 1910.146 applies, and an attendant would be required by that standard. |
| § 1910.269(e)(8) | § 1926.953(i) | The existing requirement would be revised to clarify that the test instrument must have an accuracy of ±10 percent. |
| § 1910.269(e)(12) | § 1926.953(m) | The existing requirement would be revised to require the employer to be able to demonstrate that ventilation was maintained long enough to ensure that a safe atmosphere exists before employees enter an enclosed space. |
| § 1910.269(g)(2) | § 1926.954(b) | The existing requirements would be revised to maintain consistency with the construction provisions. See the discussion of proposed § 1926.954(b). |
| § 1910.269(l)(2)(i) | § 1926.960(c)(1)(i) | The existing requirement would be clarified to indicate that an energized part must be under the full control of the employee for rubber insulating gloves or rubber insulating gloves and sleeves to be considered as sufficient insulation from that part. See the discussion of proposed § 1926.960(c)(1). |
| § 1910.269(l)(3) and (4) | § 1926.960(c)(2) and (d) | OSHA is proposing to revise the existing requirements to ensure that employees use electrical protective equipment whenever they can reach within the minimum approach distance of an energized part. See the discussion of § 1926.960(c)(2) and (d). |
| § 1910.269(l)(6) [Revised] and (12) [New]. | § 1926.960(f) and (g) | OSHA is proposing to revise the existing requirements on clothing in § 1910.269(l)(6)(ii) and (iii) to require employees to be protected from electric arcs. See the discussion of proposed § 1926.960(g). |
| Table R–6 | Table V–2 | The existing table would be revised so that it contains the same minimum approach distances as ANSI C2 (on which it is based). See the discussion of proposed § 1926.960(c)(1). |
| § 1910.269(m)(3)(viii) | § 1926.961(c)(3)(ii) | The existing provision would be revised to require independent crews to coordinate energizing and deenergizing lines and equipment if no system operator is in charge. The new provision would prevent one crew from energizing a line or equipment that another crew was working on. |
| § 1910.269(n)(4) | § 1926.962(d) | The existing requirement would be revised to allow smaller protective grounds under certain conditions. See the discussion of proposed § 1926.962(d). |

| Proposed part 1910 revision | Proposed part 1926 revision | Rationale and comments |
|---|---|---|
| § 1910.269(n)(6) and (n)(7) | § 1926.962(f) | The existing requirement would be revised to allow insulating equipment other than a live-line tool to place grounds on or remove them from circuits of 600 volts or less under certain conditions. See the discussion of § 1926.962(f). |
| § 1910.269(p)(4)(i) | § 1926.959(d)(1) | OSHA is proposing to clarify the existing provision to indicate that, if an insulated aerial lift comes closer to an energized part than the minimum approach distance, the aerial lift must maintain the minimum approach distance from objects at a different potential. See the discussion of § 1926.959(d)(1). |
| § 1910.269(t)(3), (7), and (8) | § 1926.965(d), (h), and (i) | OSHA is proposing to apply these requirements to vaults as well as manholes. Additionally, OSHA is proposing to add a requirement to address work that could cause a cable to fail. See the discussion of proposed § 1926.965(d), (h), and (i). |
| The notes following § 1910.269(u)(1), (u)(5)(i), (v)(3), and (v)(5). | The notes following and § 1926.966(b) (f)(1). | The references in these notes to ANSI C2–1987 would be updated to ANSI C2–2002. |
| § 1910.269(x) | § 1926.968 | OSHA is proposing to add definitions of "contract employer," "host employer," and "entry." See the discussion of proposed §§ 1926.950(c) and 1926.953. |
| Appendix F to § 1910.269 [New] | Appendix F to Subpart V | OSHA is proposing to add a new appendix containing information on protecting employees from electric arcs. |
| Appendix G to § 1910.269 [New] | Appendix G to Subpart V | OSHA is proposing to add a new appendix containing guidelines for the inspection of work positioning equipment. |

There are some differences in language between proposed Subpart V and existing § 1910.269. Some of these differences are because § 1910.269 applies to electric power generation installations and related work practices but Subpart V does not. For example, existing § 1910.269(b)(1)(ii) addresses CPR training requirements for fixed work locations "such as generating stations." The corresponding construction provision in proposed § 1926.951(b)(1)(ii) contains the exact same requirement, but lists "substations" as examples of fixed work locations. OSHA intends to retain such differences in the final rule.

Other differences result from the application of construction standards when construction work is performed instead of general industry standards when maintenance work is performed. For example, proposed § 1926.969(a)(1) contains exemptions from §§ 1926.550(a)(15) and 1926.600(a)(6) [65] for the operation of mechanical equipment by qualified employees near overhead power lines. Existing § 1910.269 contains no similar requirement because the corresponding general industry provision, § 1910.333(c)(3), does not apply to qualified employees performing work covered by § 1910.269. In a similar fashion, proposed § 1926.953(a) does not contain § 1910.269(e)'s exemption from paragraphs (d) through (k) of § 1910.146 dealing with permit-space entries, as that general industry standard does not apply to construction work. OSHA intends to retain such differences in the final rule.

On the other hand, OSHA has identified several nonsubstantive differences between the existing language in §§ 1910.137 and 1910.269 and the language proposed in § 1926.97 and Subpart V. Table IV–8 identifies these differences. The Agency intends to carry those changes into final §§ 1910.137 and 1910.269. OSHA invites comments and questions on any differences between the proposed standards and existing §§ 1910.137 and 1910.269 and on how the respective final rules should be made consistent.

TABLE IV–8.—PROVISIONS WITH NONSUBSTANTIVE CHANGES

| Section 1926.97 provisions with nonsubstantive changes in language | Correspondong provisions in existing § 1910.137 |
|---|---|
| 1926.97(c)(2)(xii), Note.<br>1910.137(b)(2)(xii), Note. | |
| **Subpart V Provisions with Nonsubstantive Changes in Language** | **Corresponding provisions in Existing § 1910.269** |
| 1926.950(a)(2) | 1910.269(a)(1)(iii). |
| 1926.950(b)(2), introductory text | 1910.269(a)(2)(ii), introductory text. |
| 1926.950(b)(2), Note | 1910.269(a)(2)(ii), Note. |
| 1926.950(b)(4)(i) | 1910.269(a)(2)(iv)(A). |
| 1926.955(b)(4) | 1910.269(h)(2)(iii). |
| 1926.956(d)(3) | 1910.269(i)(4)(ii). |
| 1926.957(a) | 1910.269(j)(1). |
| 1926.961(c)(9)(i) | 1910.269(m)(3)(x)(A). |
| 1926.961(c)(10) | 1910.269(m)(3)(xi). |
| 1926.962(b), introductory text | 1910.269(n)(2), introductory text. |
| 1926.966(e)(1)(iii), introductory text. | 1910.269(u)(4)(i)(C), introductory text. |
| 1926.968, definition of "designated employee". | 1910.269(x), definition of "designated employee". |

[65] These provisions generally require that a 3.05-meter (10-foot) minimum clearance be provided between mechanical equipment and overhead power lines.

TABLE IV–8.—PROVISIONS WITH NONSUBSTANTIVE CHANGES—Continued

| Section 1926.97 provisions with nonsubstantive changes in language | Correspondong provisions in existing § 1910.137 |
|---|---|
| 1926.968, Note to the definition of "guarded". | 1910.269(x), Note to the definition of "guarded". |

**Notes:**
(1) This table does not list provisions in which the only change was to break up paragraphs with multiple requirements into separately numbered paragraphs. See, for example, proposed § 1926.960(b)(1)(i), (b)(1)(ii), and (b)(2), which were taken from the introductory text to existing § 1910.269(1)(1).
(2) This table also does not list provisions in which the only change was a conversion to international standard (SI) units. See, for example, proposed § 1926.966 (e)(1)(iii)(B), which was taken from existing § 1910.269(u)(4)(i)(C)(2).

OSHA expects that final Subpart V will differ from proposed Subpart V because of changes adopted based on the rulemaking record. When the final rule is published, the Agency intends to make corresponding changes to § 1910.269 to keep the two rules the same, except to the extent that substantial differences between construction work and general industry work warrant different standards. Similarly, the Agency intends to adopt changes to § 1910.137 so that it is the same as § 1926.97. Therefore, OSHA is seeking comment on entire §§ 1910.137 and 1910.269. Comments received on the general industry standards will be considered in adopting the final construction standards and vice versa. In particular, the Agency has requested comments on several issues in the proposed revision of Subpart V and in proposed new § 1926.97. Some of these issues are directed towards requirements in those construction standard that are taken from general industry provisions that OSHA is not proposing to revise. For example, earlier in this section of the preamble, the Agency requests comments on whether AEDs should be required as part of the medical and first aid requirements in proposed § 1926.951. (See the summary and explanation of proposed § 1926.951(b)(1).) Although OSHA has not proposed to revise the corresponding general industry provision, existing § 1910.269(b)(1), the Agency intends to revise that general industry provision if the rulemaking record supports a requirement for AEDs. Therefore, OSHA encourages all rulemaking participants to respond to these issues regardless of whether the participants are covered by the construction standards. Table IV–9 is a cross-reference table to help interested parties to find the section in Subpart V that corresponds to a particular paragraph in § 1910.269.

TABLE IV–9.—PROVISIONS IN SUBPART V CORRESPONDING TO PARAGRAPHS IN § 1910.269

| Paragraph in § 1910.269 | Corresponding section in subpart V | Topic |
|---|---|---|
| (a) | § 1926.950 | General, scope, and training. |
| (b) | § 1926.951 | Medical services and first aid. |
| (c) | § 1926.952 | Job briefing. |
| (e) | § 1926.953 | Enclosed spaces. |
| (f) | § 1926.967(f) | Excavations. |
| (g) | § 1926.954 | Personal protective equipment. |
| (h) | § 1926.955 | Ladders and platforms. |
| (i) | § 1926.956 | Hand and portable power tools. |
| (j) | § 1926.957 | Live-line tools. |
| (k) | § 1926.958 | Materials handling and storage. |
| (l) | § 1926.960 | Working on or near exposed energized parts. |
| (m) | § 1926.961 | Deenergizing lines and equipment for employee protection. |
| (n) | § 1926.962 | Grounding for the protection of employees. |
| (o) | § 1926.963 | Testing and test facilities. |
| (p) | § 1926.959 | Mechanical equipment. |
| (q) | § 1926.964 | Overhead lines. |
| (s) | § 1926.967(k) | Communication facilities. |
| (t) | § 1926.965 | Underground electrical installations. |
| (u) | § 1926.966 | Substations. |
| (w) | § 1926.967 | Special conditions. |
| (x) | § 1926.968 | Definitions. |

**Note:** Paragraphs (d), (r), and (v) have no counterparts in Subpart V.

*Foot protection for electrical hazards.* OSHA is also proposing to revise § 1910.136(a). Existing § 1910.136(a) reads as follows:

(a) *General requirements.* The employer shall ensure that each affected employee uses protective footwear when working in areas where there is a danger of foot injuries due to falling or rolling objects, or objects piercing the sole, and where such employee's feet are exposed to electrical hazards.

The Agency is concerned that this language is being interpreted to recognize the use of electrical hazard footwear as a primary form of electrical protection. Electrical hazard footwear is constructed to provide insulation of the wearer's feet from ground. This can provide a small degree of protection from electric shock for the wearer. This protection is limited to voltages of 600 volts or less under dry conditions and is intended to be a secondary form of electrical insulation.[66] Conductive footwear, which is not electrical hazard footwear, is designed to prevent static electricity buildup. This is one method of protecting against static electrical discharges that can damage equipment or, in hazardous locations, could possibly lead to fires or explosions.

Interpreting existing § 1910.136(a) so as to recognize electrical hazard footwear as a primary form of electrical protection could expose employees to electric shock hazards if they believe that the real primary form of electrical protection (for example, rubber insulating gloves or blankets) is no longer necessary. This is true for several reasons. First, electrical hazard footwear only insulates an employee's feet from ground. The employee can still be grounded through other parts of his or her body. Second, the insulation provided by electrical hazard footwear is good only under dry conditions. This footwear provides little if any protection once it becomes wet or damp. Lastly, the voltage rating on electrical hazard footwear is only 600 volts.

OSHA believes that, because of these limitations, electrical hazard footwear should not be addressed by § 1910.136, which is designed to provide protection to employees' feet. The Agency also believes that the need for conductive footwear, whether or not it provides protection for the foot, is adequately addressed by the general requirement in § 1910.132(a) to provide personal protection equipment. Therefore, OSHA is proposing to delete language relating to electrical hazards from § 1910.136(a).

Paragraph (d) of § 1910.132 addresses hazard assessment and selection of personal protective equipment. Paragraph (f) of § 1910.132 addresses training in the use of personal protective equipment. As noted in § 1910.132(g), paragraphs (d) and (f) of existing § 1910.132 do not apply to electrical protective equipment covered by § 1910.137. While training is covered in other electrical standards (for example, in § 1910.268, telecommunications, in § 1910.269, electric power generation, transmission, and distribution, and in § 1910.332, training in electrical safety-related work practices), many of the hazard assessment requirements in § 1910.132(d) are not addressed in any other OSHA electrical standard. OSHA requests comments on whether electrical protective equipment should be added to the scope of § 1910.132(d) or § 1910.132(f) or both.

[66] Primary insulation normally insulates an employee directly from an energized part. Rubber insulating gloves and rubber insulating blankets are examples of primary electrical protection. Secondary insulation normally insulates an employee's feet from a grounded surface. Electrical hazard footwear and rubber insulating matting are examples of secondary electrical protection.

### *D. Effective Date*

When a final rule is promulgated, OSHA typically provides a delay in effective date to allow employers to become familiar with the rule and to come into compliance. Some of the provisions in the proposal would require some employers to purchase new equipment. For example, the requirements proposed in §§ 1910.269(l)(11) and 1926.960(g) would require some employers to purchase flame-resistant clothing. OSHA requests comments generally on what an appropriate delay in effective date should be and specifically on how long employers will need to make purchases necessary for compliance with the proposed rule.

Some of the proposed provisions would require employers to replace existing noncomplying equipment with equipment that meets the proposal. For example, proposed § 1926.954(b)(2)(xi) would require snaphooks used with work positioning equipment to be of the locking type. Some employers may still use nonlocking snaphooks with work positioning equipment. OSHA requests information on the extent to which nonlocking snaphooks are used. The Agency also requests information on the useful life of such equipment and on whether OSHA should allow sufficient time for noncomplying equipment to be replaced as it wears out. Such a delay would minimize the costs incurred by employers but would expose employees to hazards for a longer period.

## V. Preliminary Regulatory Impact Analysis and Initial Regulatory Flexibility Analysis

### *A. Executive Summary*

#### Introduction

OSHA is required by the OSH Act to ensure and demonstrate that standards promulgated under the Act are technologically and economically feasible. Executive Order 12866, the Regulatory Flexibility Act, and the Unfunded Mandates Reform Act also require OSHA to estimate the costs, assess the benefits, and analyze the impacts of the rules that the Agency promulgates.

Accordingly, OSHA has prepared this Preliminary Regulatory Impact Analysis (PRIA) for OSHA's proposal to update its standards addressing electric power generation, transmission, and distribution work, and the use of electrical protective equipment. For purposes of this analysis, the terms ''proposal'' and ''proposed standard'' include all elements of this proposed rulemaking, including proposed changes to 29 CFR 1910.269, proposed changes to 29 CFR 1926, proposed changes involving electrical protective equipment requirements, and other associated revisions and additions. The consolidated set of proposed actions was analyzed in its entirety; only those parts that were identified as involving nonnegligible costs are explicitly reflected in the analysis of compliance costs and impacts.

In some past notices of proposed rulemakings, OSHA has included only an Executive Summary of the PRIA in the preamble to the proposal. For this rulemaking, OSHA is including the entire PRIA in this **Federal Register** notice for the convenience of the public.

#### Need for Regulation

Employees in work environments addressed by the proposed standards are exposed to a variety of significant hazards that can and do cause serious injury and death. The risks to employees are excessively large due to the existence of market failures, and existing and alternative methods of alleviating these negative consequences have been shown to be insufficient. After carefully weighing the various potential advantages and disadvantages of using a regulatory approach to improve upon the current situation, OSHA preliminarily concludes that in this case the proposed mandatory standards represent the best choice for reducing the risks to employees. In addition, rulemaking is necessary in this case in order to replace older existing standards with updated, clear, and consistent safety standards.

Affected Establishments

The proposal affects establishments in a variety of different industries involving electric power generation, transmission, and distribution. The proposed standards primarily affect firms that construct, operate, maintain, or repair electric power generation, transmission, or distribution systems. These firms include electric utilities as well as contractors who are hired by utilities and who are primarily classified in the construction industry. In addition, potentially affected firms are found in a variety of manufacturing and other industries which own or operate their own electric power generation, transmission, or distribution systems as a secondary part of their business operations. The proposal also potentially affects establishments performing line-clearance tree-trimming operations.

Benefits, Net Benefits, and Cost Effectiveness

The proposed revisions to the OSHA standards addressing electric power generation, transmission, and distribution work, as comprised by the proposed rulemaking, are expected to result in an increased degree of safety for the affected employees. These changes are expected to reduce the numbers of accidents, fatalities, and injuries associated with the relevant tasks, as well as reducing the severity of certain injuries, such as burns or injuries that could be sustained as a result of an arrested fall, that may still occur while performing some of the affected procedures.

An estimated 74 fatalities and 444 injuries occur annually among employees involved in electric power generation, transmission, and distribution work addressed by the provisions of this rulemaking. Based on a review and analysis of the incident reports associated with the reported injuries and fatalities, full compliance with the proposed standards would prevent 79.0 percent of the relevant injuries and fatalities, compared with 52.9 percent prevented with full compliance with the existing standards. Thus, the increase in safety that would be provided by the proposed standards is represented by the prevention of an additional 19 fatalities and 116 injuries annually. Applying an average monetary value of $50,000 per prevented injury, and a value of $6.8 million per prevented fatality, results in an estimated monetized benefit of about $135 million annually.

The net monetized benefits of the proposed standard are estimated to be about $101.1 million annually ($135 million in benefits and $33.9 million in costs). Note that these net benefits exclude any unquantified benefits associated with revising the standards to provide updated, clear, and consistent regulatory requirements to the public.

Additional benefits associated with this rulemaking involve providing updated, clear, and consistent safety standards regarding electric power generation, transmission, and distribution work to the relevant employers, employees, and interested members of the public. OSHA believes that the updated standards enhance worker safety and are easier to understand and to apply. They will benefit employers and employees by facilitating compliance while improving safety. The benefits associated with providing updated, clear, and consistent safety standards have not been monetized or quantified.

Table V–1 summarizes the costs, benefits, net benefits, and cost effectiveness of the proposed standard.

TABLE V–1.—NET BENEFITS AND COST EFFECTIVENESS

| | |
|---|---|
| Annualized Costs: | |
| Determination of Appropriate Protective Clothing | $11.0 million. |
| Provision of Appropriate Protective Clothing | $8.4 million. |
| Host/Contractor Communications | $7.8 million. |
| Expanded Job Briefings | $5.1 million. |
| Additional Training | $1.2 million. |
| Other Costs | $0.4 million. |
| Total Annual Costs | $33.9 million. |
| Annual Benefits: | |
| Number of Injuries Prevented | 116. |
| Number of Fatalities Prevented | 19. |
| Monetized Benefits (Assuming $50,000 per Injury and $6.8 million per Fatality Prevented) | 135 million. |
| OSHA standards that are updated and consistent | Unquantified. |
| Total Annual Benefits | 116 injuries and 19 fatalities prevented. |

*Net Benefits (Benefits Minus Costs): $101 million annually.*

*Cost Effectiveness*

Compliance with the proposed standards would result in the prevention of 1 fatality and 6 injuries per $1.8 million in costs, or, alternatively, $4.00 of benefits per dollar of cost.

Compliance Costs

The estimated costs of compliance for this rulemaking represent the additional costs necessary for employers to achieve full compliance. They do not include costs associated with current compliance with the new requirements imposed by the rulemaking; nor do they include costs associated with achieving full compliance with existing applicable requirements. The total annualized cost of compliance with the proposed rulemaking is estimated to be about $33.9 million.

The largest component of the compliance costs, at $11.0 million annually, is comprised of the costs necessary to comply with the requirement for the employer to make a determination regarding the type and extent of flame-resistant apparel necessary to protect employees in the event that employees may be exposed to an electric arc.

Other provisions of the proposed standards involving compliance costs include requirements for more protective clothing ($8.4 million), requirements for various communications between host employers and contractors ($7.8 million), expanded requirements for conducting job briefings ($5.1 million), and revised training requirements ($1.2 million).

Economic Impacts

To assess the nature and magnitude of the economic impacts associated with compliance with the proposed rulemaking, OSHA developed quantitative estimates of the potential economic impact of the requirements on entities in each of the affected industry sectors. The estimated costs of compliance were compared with industry revenues and profits to provide an assessment of potential economic impacts.

The costs of compliance with the proposed rulemaking are not large in relation to the corresponding annual financial flows associated with the regulated activities. The estimated costs of compliance represent about 0.01 percent of revenues and 0.14 percent of profits on average across all entities; compliance costs do not represent more than 0.24 percent of revenues or more than 4.03 percent of profits in any affected industry.

The economic impact of the proposed rulemaking is most likely to consist of a small increase in prices for electricity, of about 0.01 percent on average. It is unlikely that a price increase on the magnitude of 0.01 percent will significantly alter the services demanded by the public or any other affected customers or intermediaries. If the compliance costs of the proposed rulemaking can be substantially recouped with such a minimal increase in prices, there may be little effect on profits.

In general, for most establishments, it would be very unlikely that none of the compliance costs could be passed along in the form of increased prices. In the event that unusual circumstances may inhibit even a price increase of 0.01 percent to be realized, profits in any of the affected industries would be reduced by a maximum of about 4 percent.

OSHA concludes that compliance with the requirements of the proposed rulemaking is economically feasible in every affected industry sector.

In addition, based on an analysis of the costs and economic impacts associated with this rulemaking, OSHA preliminarily concludes that the effects of the proposed standards on international trade, employment, wages, and economic growth for the United States would be negligible.

Initial Regulatory Flexibility Analysis

The Regulatory Flexibility Act, as amended in 1996 by the Small Business Regulatory Enforcement Fairness Act, requires the preparation of an Initial Regulatory Flexibility Analysis for certain proposed rules promulgated by agencies (5 U.S.C. 601–612). Under the provisions of the law, each such analysis shall contain: (1) A description of the impact of the proposed rule on small entities; (2) a description of the reasons why action by the agency is being considered; (3) a succinct statement of the objectives of, and legal basis for, the proposed rule; (4) a description of and, where feasible, an estimate of the number of small entities to which the proposed rule will apply; (5) a description of the projected reporting, recordkeeping and other compliance requirements of the proposed rule; (6) an identification, to the extent practicable, of all relevant Federal rules which may duplicate, overlap or conflict with the proposed rule; and (7) a description and discussion of any significant alternatives to the proposed rule which accomplish the stated objectives of applicable statutes and which minimize any significant economic impact of the proposed rule on small entities.

OSHA has analyzed the potential impact of the proposed rule on small entities. As a result of this analysis, OSHA preliminarily concludes that the compliance costs are equivalent to over 5 percent of profits for some groups of affected small entities (as identified later in this analysis). Therefore, OSHA has prepared an Initial Regulatory Flexibility Analysis in conjunction with this rulemaking to describe the potential effects on small entities and to enable the Agency and the public to fully consider alternatives to the proposal.

*B. Need for Rule*

Employees performing work involving electric power generation, transmission, and distribution are exposed to a variety of significant hazards, such as fall, electric shock, and burn hazards, that can and do cause serious injury and death. As detailed below, OSHA estimates that, on average, 444 serious injuries and 74 fatalities occur annually among these workers.

Although some of these incidents may have been prevented with better compliance with existing safety standards, research and analyses conducted by OSHA have found that many preventable injuries and fatalities would continue to occur even if full compliance with the existing standards were achieved. Relative to full compliance with the existing standards, an estimated additional 116 injuries and 19 fatalities would be prevented through full compliance with the proposed standards.

Additional benefits associated with this rulemaking involve providing updated, clear, and consistent safety standards regarding electric power generation, transmission, and distribution work. The existing OSHA standards for the construction of electric power transmission and distribution systems are over 30 years old and inconsistent with the more recently promulgated OSHA standards addressing repair and maintenance work.

OSHA has different standards covering construction work on electric power transmission and distribution systems and general industry work on the same systems. In most instances, the work practices used by employees to perform construction or general industry work on these systems are the same. The application of OSHA's construction or general industry standards to a particular job depends upon whether the employer is altering the system (construction work) or maintaining the system (general industry work). For example, employers changing a cutout (disconnect switch) on a transmission and distribution system would be performing construction work if they were upgrading the cutout, but general industry work if they were simply replacing the cutout with the same model.

Since the work practices used by the employees would most likely be identical, the applicable OSHA standards should be identical. OSHA's existing requirements are not, however. Conceivably, for work involving two or more cutouts, different and conflicting OSHA standards might apply. The inconsistencies between the two standards create difficulties for employers attempting to develop appropriate work practices for their employees. For this reason, employers and employees have told OSHA that it should make the two standards identical. This proposal does so.

OSHA has preliminarily determined that the proposal is needed to reduce the number of fatalities and injuries occurring among workers involved in electric power generation, transmission, and distribution and to make the relevant standards clear and consistent. Before reaching this preliminary conclusion, many alternatives were considered, including regulatory alternatives and alternative approaches that would not involve the promulgation of revised standards.

*C. Examination of Alternative Approaches*

Alternative Regulatory Approaches

To determine the appropriate regulatory requirements to address occupational risks for employees working on electric power generation, transmission, and distribution systems, OSHA considered many different factors and potential alternatives. The Agency examined the incidence of injuries and fatalities and their direct and underlying causes to ascertain where existing standards needed to be strengthened. These standards were reviewed, current practices in the industry were assessed, information and comments from experts were collected, and the available data and research were scrutinized.

OSHA faces several constraints in determining which regulatory requirements should apply. As required under Section 3(8) of the OSH Act, the requirements of an OSHA standard must be ''reasonably necessary or appropriate to provide safe or healthful employment and places of employment.'' Also, as required under Section 6(b)(8) of the OSH Act, the requirements of an OSHA standard may only differ substantially from existing national consensus standards to the extent that the OSHA standard will better effectuate the purposes of the OSH Act than the corresponding national consensus standards. OSHA standards must also be technologically and economically feasible, as noted earlier, and be cost-effective.

A full discussion of the basis for the particular regulatory requirements chosen is provided in Section IV, Summary and Explanation of Proposed Rule, earlier in this preamble. The regulatory alternatives considered by OSHA are discussed in the Initial Regulatory Flexibility Analysis later in this section of the preamble.

Alternative Nonregulatory Approaches

*Introduction.* The stated purpose of the OSH Act is to ''assure so far as possible every working man and woman in the Nation safe and healthful working conditions and to preserve our human resources.'' This congressional mandate provides the basis for OSHA's proposed rulemaking on electric power generation, transmission, and distribution, which is designed to mitigate the occupational hazards associated with work on electric power systems.

Before issuing a standard, OSHA must assess whether there are other, nonregulatory approaches available that may provide an equal or higher level of benefits. Executive Order 12866 directs regulatory agencies to assess whether an unregulated private market can achieve the same level of social benefits as that expected to result from Federal regulation:

*Section 1. Statement of Regulatory Philosophy and Principles.*

(a) *The Regulatory Philosophy.* Federal Agencies should promulgate only such regulations as are required by law, are necessary to interpret the law, or made necessary by compelling public need, such as material failures of private markets to protect or improve the health and safety of the public, the environment, or the well-being of the American people. In deciding whether and how to regulate, agencies should assess all costs and benefits of available regulatory alternatives, including the alternative of not regulating.

The discussion below considers several nonregulatory alternatives to OSHA's proposed rulemaking: Private market incentives, information dissemination programs, tort liability options, and workers' compensation programs.

*Private Market Incentives.* Economic theory suggests that the need for government regulations would be greatly reduced if private markets worked efficiently and effectively to provide health and safety protections for employees. At issue is whether the private market will be able to produce a level of safety and health for employees that will be equal to or greater than that potentially afforded by the proposed OSHA standards. In particular, OSHA examined whether the level of risk of experiencing an injury caused by workplace hazards that would be provided by an unregulated market would be at least as protective of employee safety as the proposed electric power rulemaking.

Theoretically, unregulated markets are capable of achieving an efficient allocation of resources if certain assumptions are satisfied. Necessary assumptions include elements such as perfect and free information, perfect and costless mobility of labor and other factors of production, and an absence of any externalities.

A major conclusion of the ''perfect competition model'' of economic theory is that, in the presence of full information about market choices and outcomes and with complete mobility of the factors of production, the private market would produce an efficient allocation of resources.

In the presence of perfect and complete information regarding occupational risks, labor markets would reflect the presence of different degrees of risk across different industries, firms, and occupations. In such a market, wage premiums would be paid to compensate workers engaged in hazardous occupations for the added risk they confront on the job.

In this theoretical framework, wages would vary directly with the riskiness of a job (other things being equal), and employers would have an incentive to make investments to reduce occupational health and safety risks to the extent workers would demand compensation for being exposed to such risks. In other words, because employers would have to pay their workers a premium to induce them to work in a risky environment, employers would be willing to pay to make that environment less risky by introducing technologies and practices that lower risks to workers.

In addition, a perfectly competitive market will theoretically lead to the efficient allocation of resources only if all of the costs and benefits (pecuniary and nonpecuniary) associated with the behavior of market participants and with market transactions are fully borne by those directly involved. In economic terms, this implies that there will not be any negative externalities associated with economic activities.

If all of the costs associated with occupational safety and health risks would in fact be internalized, then market decisions about occupational safety and health conditions made by employers and workers would be based on a consideration of the full social costs of their economic actions. However, if some of the effects of these actions are externalized (that is, some costs are not borne by employers and employees but by other parties who are external to the transaction), then those costs will not be adequately incorporated into the decisions of managers and workers. The resultant market allocation of resources can then be expected to be less efficient.

Costs and other impacts that are imposed on society and are not borne directly by the economic participants involved in an activity or transaction are referred to as externalities. The existence of such externalities is one reason why an unregulated private market often fails to produce an efficient allocation of resources. The presence of these externalities also implies that economic efficiency can potentially be improved with regulatory interventions.

In a theoretically perfect market without externalities, firms would decide how much to spend on reducing safety and health risks based on the full costs associated with the presence of such risks. The costs include pain and suffering, impacts on the quality of the lives of families, and effects on society as a whole. Workers would decide whether they were willing to work in a particular job based on the relative riskiness of the job and the extent to which they believe the wages offered to them provide adequate compensation for these risks.

Research conducted by OSHA and information from several other sources show that many firms have responded to the risks posed to workers by electric power systems. Employers have increasingly recognized the costs associated with these risks and have implemented measures to reduce the occupational risks faced by their employees.

In fact, many risk control programs already implemented by employers go beyond the provisions required by the existing OSHA standards or by the proposed OSHA standards. The fact that employers are implementing these programs demonstrates that economic incentives do exist at least to some degree to motivate employers in the direction of reducing the risks associated with occupational exposures to the hazards of electric power work.

However, OSHA notes that many other employers continue to fall short of their obligations to provide even minimum safety protections for their employees. Such circumstances persist despite ongoing attempts by OSHA and other groups to provide information and assistance to employers to increase awareness and reduce the risks involved with work involving electric power systems.

The benefits section of this preliminary analysis shows that preventable injuries and fatalities continue to occur every year. The evidence indicates that market forces cannot alone curb occupational risks adequately.

Among employees engaged in work involving electric power generation, transmission, and distribution systems, there does not appear to be any risk premium reflected in wage rates that would differentiate between employers based on the extent of risks faced by employees. In fact, as presented in Section IV, Summary and Explanation of Proposed Rule, earlier in this preamble, there is some evidence that in these industries, wages for workers in similar jobs performing similar types of work are negatively correlated with the degree of risk involved: Employees of utilities tend to earn more than their counterparts working for contractors, and yet the fatality and injury rate is higher among employees of the contractors.

There are a variety of reasons why workers may not be paid the risk premiums that would theoretically be necessary to ensure that markets provide efficient levels of expenditures on safety and health. Workers have imperfect knowledge about the nature and magnitude of occupational risk factors. Many workers are not likely to be fully aware of the extent and nature of occupational risks associated with various different jobs and different employers at different points in time.

Even if workers have adequate information regarding the risks of occupational injuries, they may be unable to adequately incorporate this information into their decisions about choosing a job or staying on the job. Other factors and circumstances may affect employment choices, and decisions cannot be changed easily. There are also significant costs associated with job searches and changing jobs.

Assessing occupational risks for the purpose of determining the acceptability of wages offered is made even more difficult when differences in risk between two firms are significant but cannot be readily observed or predicted over the pertinent time periods. If differences in occupational risk between various establishments are not fully incorporated into the employment decisions of workers, the wage premiums paid for risky jobs will not accurately reflect the relative occupational risks associated with specific jobs in different firms. Thus, firms will have little incentive to individually reduce risk beyond levels present in other firms.

In addition, many employers may simply be unaware of the direct and indirect costs associated with occupational risks. Some employers may regard these costs as beyond their control or as part of general overhead costs. Employers may also not be fully aware of the availability of cost-effective ways of ameliorating or eliminating these risks and reducing the corresponding costs.

A significant problem that prevents risk premiums in an unregulated market from achieving the theoretical results that may potentially reduce occupational risks involves imperfections in the operation of labor markets. Changing jobs can be costly, and in some circumstances the costs may preclude a decision to change jobs solely on the basis of the occupational health risks involved. Factors that may make job changes particularly costly include nontransferability of occupational skills or seniority within a company, the difficulty of acquiring sufficient human capital to seek alternative employment opportunities, the costs and uncertainty associated with relocating to take advantage of better employment opportunities, the existence of institutional factors such as the nontransferability of pension plans and seniority rights, and the risk of prolonged periods of unemployment.

Often, differences in occupational risk between two firms must be very marked before a worker will change jobs on that basis. Therefore, wage rates determined by a market in which the protection of occupational safety and health is unregulated are unlikely to fully compensate workers for occupational health and safety risks, including those related to the risks of concern here.

*Information Dissemination Programs.* OSHA and other organizations currently produce and disseminate a considerable amount of information regarding the risks associated with work involving electric power generation, transmission, and distribution and the methods that can be used to reduce these risks. The dissemination of such information would continue in conjunction with the promulgation of the proposed standards; alternatively, in lieu of issuing mandatory standards, OSHA could rely on current or expanded information dissemination programs to generate the incentives necessary to produce further reductions in injuries and fatalities. Better informed workers can more accurately assess the occupational risks associated with different jobs, thereby facilitating those market interactions that result in wage premiums for relatively risky occupations.

There are several reasons, however, why reliance on information dissemination programs will not yield the level of social benefits achievable through compliance with the proposed electric power rules. First, there are no reliable incentives or mechanisms that would ensure that appropriate and sufficiently detailed information could be produced, or that such information would actually be distributed among and relied upon by workers. Furthermore, hazards associated with work on electric power systems are highly specific to individual tasks and work environments. The development of accurate knowledge about these occupational risks would require each employer to make available specific information about the risks present in his or her projects expected to be undertaken in the future. The lack of adequate incentives or mechanisms and the potentially large costs associated with the collection and reporting of the necessary information makes effective information dissemination difficult to implement in practice.

In addition, even if workers are better informed about workplace risks and hazards, other factors, such as barriers to labor mobility, that contribute to market failure would still remain. Finally, as argued above, workers may not be able to evaluate information about long-term risks accurately when making employment decisions. Better information, therefore, will not ensure that the market will produce wage risk premiums in a manner that is consistent with an efficient allocation of resources.

Currently, in addition to the applicable OSHA standards, there are consensus standards, voluntary guidelines, and other information sources for preventing injuries and fatalities while working on electric power generation, transmission, and distribution systems. Although many employers have adopted many of the practices and procedures recommended by these sources, many other employers have been less successful in the widespread implementation of all of the recommendations of these voluntary guidelines. The Costs of Compliance section of this preliminary analysis provides further information regarding current compliance with specific elements in sectors covered by the proposal.

Thus, the experience and observations regarding electric power generation, transmission, and distribution work show that, while improved access to information about occupational risks can provide for more rational decision-making in the private market, voluntary information programs will not produce an adequately low level of occupational risk.

*Tort Liability Options.* Employees currently are generally restricted from using tort law to force employers to pay for costs and damages associated with fatalities and injuries that occur on the job. Greater worker use of tort law in seeking redress from injuries associated with occupational risks involving work on electric power generation, transmission, and distribution is another example of a possible nonregulatory alternative to the proposed rule. If employees were able to effectively sue their employers for damages caused by work-related hazards, and if other conditions regarding the cost and availability of information, knowledge and mobility of workers, and externalities are satisfied, then the need for an OSHA standard would potentially be reduced or eliminated.

A tort may be described, in part, as a civil wrong (other than breach of contract) for which the courts provide a remedy in the form of an action for damages. The application of the tort system to occupationally related injuries and illnesses would mean that a worker whose disability resulted from exposure to a work place risk would sue the employer to recover damages. The tort system could thus shift the liability for the direct costs of occupational injury from the worker to the employer, at least under certain specific circumstances.

With limited exceptions, however, the tort system has not been a viable alternative to regulation in dealings between employees and employers, for a number of reasons. All States have legislation making workers' compensation either the exclusive or principal legal remedy available to employees. Generally, tort law can be applied only to third-party producers or suppliers of hazardous products or equipment, for example, asbestos products. It is often difficult, however, to demonstrate that workplace injuries have been caused by defective or negligently designed products or equipment.

Moreover, legal proceedings generally fail to fully internalize costs because of the substantial legal fees and uncertainties associated with bringing court actions. In deciding whether or not to sue, the victim must be sure that the potential award will exceed both the expense and hardship of bringing the lawsuit. Legal expenses commonly include a contingency fee for the plaintiff's lawyer, plus court fees and the costs of accumulating evidence and witnesses. The accused firm must also pay for its defense.

In sum, the use of legal action as an alternative to regulation is limited because of the expense, delays, and uncertainties involved, and because under current State laws, workers' compensation will normally be an exclusive remedy that will prevent a worker from filing a suit at all. The tort system, therefore, does not serve adequately to protect workers from exposure to risks in the workplace.

*Workers' Compensation Programs.* The existing workers' compensation programs serve to partially address the market failures that result in insufficient reductions in occupational risks. An alternative to a mandatory standard would be a continued reliance on these and other existing programs (including possible modifications or enhancements to these programs) to address occupational risk. The workers' compensation system was implemented in part as a result of the perceived failure of the unregulated market to compel employers to sufficiently reduce occupational health and safety risks and to compensate employees for bearing those risks. The system seeks to shift some of the burden of the costs associated with occupational injuries and illnesses from workers to employers. By so doing, workers' compensation requirements can ensure that more of the costs of occupational injuries and illnesses are incorporated into decisions of employers even if employees do not have full information regarding their risks or are unable to receive full wage compensation for such risks. Originally designed to force more of the social costs of occupational injuries and illnesses to be internalized, the workers' compensation program has in practice fallen short of fully achieving this goal and does not fully compensate workers for occupationally related injuries and illnesses.

Compensation tends to be especially inadequate in permanent disability cases, in part because of time limits on benefit entitlements and in part because of the failure of the system to adjust benefits for changes in a worker's expected earnings over time. Several States restrict permanent, partial, and total disability benefits either by specifying a maximum number of weeks for which benefits can be paid, or by imposing a ceiling on dollar benefits. Both temporary and permanent disability payments are commonly limited by imposing a ceiling on the income per week that can be paid. In addition, under workers' compensation, no award is made for pain and suffering.

The extent to which income is replaced by each type of indemnity payment (that is, temporary or permanent partial) differs. First, although rules vary by State, temporary disability income is designed in most states to replace two-thirds of the worker's before-tax income. However, most States place a maximum and a minimum on the amount of money paid out to the worker, regardless of his or her actual former income.

The Worker Compensation Research Institute (WCRI) has studied the extent to which workers' compensation replaces after-tax income in 19 states. These studies show that temporary total disability payments replace between 80 and 100 percent of the after-tax income of the majority of workers in all of the States examined [5].[67] From 3 to 44 percent of workers receive less than 80 percent of their after-tax income, and from 0 to 16 percent receive more than 100 percent of their previous after-tax income (as a result of the ''floor'' on payments). In 15 of the 19 States examined, more workers receive less than 80 percent of their former after-tax income than receive more than 100 percent of their former income. WCRI does not provide estimates of the average replacement rates for all workers in a State. However, based on

[67] References appear at the end of this section of the preamble.

these data, it seems reasonable to assume that, on average, workers receive no more than 90 percent of their after-tax income while on temporary disability.

In addition to not fully replacing after tax income, workers' compensation payments, which are not taxable, provide no replacement for tax losses to the Federal, State or local government as a result of an illness. This loss is properly considered part of the social losses associated with an illness or injury. Typically taxes, including State and Federal income taxes and employee and employer contribution to social security taxes will be approximately 30 percent of income. The taxes not paid when an individual is unable to work thus add an additional 30 percent of worker income as losses associated with injuries and illnesses not covered by workers' compensation.

In summary, workers' compensation often covers less than 65 percent of the financial losses associated with the costs of injuries, and does not cover any portion of losses due to pain and suffering. Thus, even if the financial costs were fully internalized by employers, workers' compensation would be insufficient to assure adequate economic incentives to address work-related injuries and illnesses.

For workers' compensation to be able to internalize costs of work-related injuries and illnesses, it would be necessary for the costs an employer pays for workers' compensation to be directly related to the employer's risk of causing work-related injuries or illnesses.

Most workers' compensation programs nominally include the employer's injury experience as a factor in determining the level of the employer's insurance premiums. However, the majority of firms are not rated individually for their safety and health record; that is, they are not ''experience rated.'' For example, small firms often are ineligible for experience rating because of the high year-to-year variance in their claim rates. Such firms are class rated, and rate reductions are granted only if the experience of the entire class improves. Segregation of loss experience into classes is somewhat arbitrary, and an individual firm may be classified with other firms that have substantially different accident rates. Even when firms have an experience rating, the premiums paid may not accurately reflect their true degree of risk. In addition, a firm's experience rating is generally based on the benefits paid to ill or injured workers, not on the firm's safety and health record or on the actual risks faced by employees. Thus, in some cases employers may have more of an incentive to reduce premiums by contesting claims than by initiating safety and health measures.

For employers who rely on workers' compensation insurance, the payment of premiums represents the employer's major cost for the occurrence of occupational injuries and illnesses. However, the mechanism for determining an employer's workers' compensation premium frequently fails to reflect the real costs associated with a particular employer's record. As a result, efforts made by an employer to reduce the incidence of occupational injuries and illnesses are not necessarily reflected in reduced workers' compensation premiums. Similarly, firms that devote fewer resources to promoting worker safety and health often may not incur commensurately higher workers' compensation costs. Consequently, the program does not provide direct incentives for most employers to reduce the occupational health and safety risks in their workplaces.

Finally, workers' compensation is an insurance mechanism through which participants spread and share the risk of injury and illness claims, and the costs associated with occupational injuries and illnesses are often spread throughout the economy through risk sharing stemming from participation in health insurance programs. For example, some direct costs may not be incurred or attributed to employers because many workers go to their private physician rather than the company's physician for work-related injuries and illnesses, even though there are systemic mechanisms in place to ensure that work-related injuries are treated through the workers' compensation system. The social burden of adverse health effects is also shared by taxpayer-supported programs such as welfare, social security disability and death benefits, and Medicare. Employers have, therefore, less incentive to avoid such losses than they would if they were directly liable for all such claims. This transfer of risk is another reason why the market does not fully internalize the social costs of occupationally related injuries and illnesses.

The workers' compensation system does provide economic incentives for larger firms, especially those that self-insure for workers' compensation, because these firms internalize a greater portion of the true costs of the work-related injuries and illnesses incurred by their workers. Thus, larger firms can generally be expected to have done more to reduce the costs associated with occupational risks than smaller firms.

In summary, the workers' compensation system suffers from several defects that seriously reduce its effectiveness in providing incentives for firms to create safe and healthful workplaces. First, because the scheduled benefits are often significantly less than the actual losses experienced by injured or ill workers and the social losses experienced by tax payers, the existence of workers' compensation programs limits an employer's liability to levels significantly below the actual costs of the injury or illness. Second, premiums for individual firms are often unrelated or only loosely related to that firm's risk environment. The firm, therefore, does not receive the proper economic incentives and consequently fails to invest sufficient resources in reducing workplace injuries and illnesses. The economic costs not borne by the employer are imposed on the employee directly or on society through social welfare programs.

*Summary.* OSHA has determined that certain workers are exposed to occupational risks associated with work on electric power generation, transmission, and distribution systems. The private market has not been effective in sufficiently reducing this level of risk due to a lack of complete information about safety risks in specific work environments, limits on worker mobility, and other factors that contribute to the failure of markets to provide an efficient allocation of resources. Options for improving the operations of markets include information dissemination programs, tort liability options, and workers' compensation programs. After considering each of these options, OSHA has concluded that none of them will provide the level of benefits achievable by the proposed electric power systems rules.

### *D. Profile of Affected Industries*

The proposal affects establishments in a variety of different industries involving electric power generation, transmission, and distribution. The proposal primarily affects firms that construct, operate, maintain, or repair electric power generation, transmission, or distribution systems. These firms include electric utilities as well as contractors who are hired by utilities and who are primarily classified in the construction industry. In addition, potentially affected firms are found in a variety of manufacturing and other industries that own or operate their own electric power generation, transmission, or distribution systems as a secondary part of their business operations. The proposal also potentially affects establishments performing line-clearance tree-trimming operations.

Table V–2 presents data on the numbers of establishments and numbers of employees for each affected industry. Across all industries, an estimated 20,765 establishments and 227,683 employees may be affected by the proposed standards.

TABLE V–2.—PROFILE OF POTENTIALLY AFFECTED ESTABLISHMENTS AND EMPLOYEES

| Industry code | Industry name | Potentially affected establishments | Potentially affected full-time equivalent (FTE) employees |
|---|---|---|---|
| NAICS 234910 | Water, sewer, and pipeline construction | 847 | 951 |
| NAICS 234920 | Power and communication transmission line construction | 2829 | 26179 |
| NAICS 234930 | Industrial nonbuilding structure construction | 266 | 1391 |
| NAICS 234990 | All other heavy construction | 656 | 5573 |
| NAICS 235310 | Electrical contractors | 1613 | 16342 |
| NAICS 235910 | Structural steel erection contractors | 652 | 300 |
| NAICS 235950 | Building equipment and other machine installation contractors | 952 | 281 |
| NAICS 235990 | All other special trade contractors | 2612 | 734 |
| NAICS 221110 | Electric power generation | 1745 | 43103 |
| NAICS 221120 | Electric power transmission, control, and distribution | 6190 | 71441 |
| NAICS 2211 | Publicly owned utilities | 923 | 9864 |
| Various | Industrial power generators | 933 | 16504 |
| SIC 0783 | Ornamental shrub and tree services | 547 | 35020 |
| Total | | 20765 | 227683 |

Source: CONSAD [2], Appendix C, pages 1–2.

As shown in Table V–2, the construction industries with the largest numbers of affected employees are Power and Communication Transmission Line Construction and Electrical Contractors, which together account for over 42,000 employees of the affected work force. Other potentially affected construction industries include Water, Sewer, and Pipeline Construction, Industrial Nonbuilding Structure Construction, All Other Heavy Construction, Structural Steel Erection Contractors, Building Equipment and Other Machine Installation Contractors, and All Other Special Trade Contractors.

Table V–2 also shows that firms classified as utilities account for over 8,000 of the potentially affected establishments, and for over 120,000 of the potentially affected employees. Utilities include establishments classified in the Electric Power Generation industry and in the Electric Power Transmission, Control, and Distribution industry.

The U.S. Department of Commerce Census data on the numbers of utilities and the numbers of workers employed by utilities do not include utilities that are owned by public sector entities. Thus, data for utilities owned by the public sector are shown separately in Table V–2.

Potentially affected utilities include publicly-owned utilities that operate in OSHA State-plan States. (State-plan States, representing about half of total U.S. employment, are States that operate their own occupational safety and health programs; these States are obligated, under formal agreements with OSHA, to impose OSHA-equivalent State regulatory requirements on public employees within their jurisdiction.) The number of potentially affected public entities and the corresponding number of employees are shown separately in Table V–2. Over 900 establishments and over 9,000 employees are part of publicly-owned utilities potentially affected by the proposed standards.

Table V–2 further shows the numbers of potentially affected establishments and employees that are part of firms in a variety of manufacturing and other industries who own or operate their own electric power generation, transmission, or distribution systems as a secondary part of their business operations. Over 900 establishments and 16,000 employees potentially affected by the proposed standards are accounted for by these firms. Based on their primary business activity, these establishments are classified as part of the following industry sectors: Oil and Gas Extraction; Mining; Water, Sewer, and Other Systems; Food Manufacturing; Wood Product Manufacturing; Paper Manufacturing; Petroleum and Coal Products Manufacturing; Chemical Manufacturing; Primary Metal Manufacturing; Wholesale Trade, Durable Goods; Educational Services; and Hospitals.

Finally, Table V–2 presents figures for the numbers of potentially affected establishments and employees in the Ornamental Shrub and Tree Services industry. OSHA estimates that over 500 establishments and over 35,000 employees in this industry are potentially affected by the provisions in the proposal involving requirements associated with providing fall protection while working in aerial lifts.

*E. Benefits, Net Benefits, and Cost Effectiveness*

The proposed revisions to the OSHA standards addressing electric power generation, transmission, and distribution work are expected to result in an increased degree of safety for the affected employees. These changes are expected to reduce the numbers of accidents, fatalities, and injuries associated with the relevant tasks, as well as reducing the severity of certain injuries, such as burns or injuries that could be sustained as a result of an arrested fall, that may still occur while performing some of the affected procedures.

To develop estimates of the potential benefits associated with this proposal, CONSAD Corp., under contract to OSHA, researched and reviewed potential sources of useful data. CONSAD, in consultation with the Agency, determined that the most reliable data sources for this purpose included OSHA's Integrated Management Information System (IMIS), and the Census of Fatal Occupational Injuries developed by the Bureau of Labor Statistics (BLS).

From these sources, CONSAD identified and analyzed injuries and fatalities that would be addressed by this proposal. This analysis was based on over 9 years of data contained in these databases. CONSAD identified relevant cases in the databases by determining the criteria provided in the databases that would apply to such cases, such as the nature of the injury, the occupation of the employee, the source of the injury, and the industry classification of the employer. CONSAD then reviewed individual accident abstracts to make a final determination whether to include the accident as one addressed by the proposed standards. A description of the methodological approach used for analyzing these data is included in the final report submitted to OSHA by CONSAD Corporation [1].

CONSAD's analysis found that an average of 74 fatalities and 25 injuries involving circumstances directly addressed by the existing or proposed standards are recorded annually in the relevant databases. These figures represent minimums since they are associated with documented cases.

The actual number of fatalities addressed by this rulemaking may be somewhat higher, but OSHA does not currently have a basis for estimating how many pertinent fatalities may have occurred that would not be represented by the relevant data sources. OSHA requests information and comments from the public regarding this issue.

The actual number of injuries addressed by this rulemaking is almost certainly much greater than the number included in the data sources. OSHA requires data to be included in its IMIS database only if an incident involves at least one fatality or three or more hospitalized injuries. However, some individual States have more stringent reporting requirements and thus include some additional injuries among the cases submitted to the IMIS database.

CONSAD performed an analysis of the IMIS fatality and injury data by State that were relevant to this rulemaking. This analysis found that the ratio of injuries to fatalities in California, which requires all hospitalized injuries to be reported, was over six.

Applying this ratio to the number of known fatalities addressed by this rulemaking results in an estimated 444 injuries occurring annually. It should be noted that even this figure excludes injuries that for various reasons may not be reported to or included in the IMIS database, such as single injuries that result in no hospitalizations. OSHA requests any information and comments from the public that may help improve the accuracy of this estimate.

Thus, OSHA estimates that 74 fatalities and 444 injuries occur annually among employees involved in electric power generation, transmission, and distribution work addressed by the provisions of this rulemaking.

Based on a review and analysis of the incident reports associated with the reported injuries and fatalities, OSHA estimates that full compliance with the existing standards would have prevented about 53 percent of the injuries and fatalities. In comparison, full compliance with the proposed standards would have prevented 79.0 percent of the relevant injuries and fatalities. Thus, the increase in safety that would be provided by the proposed standards is represented by the prevention of an additional 19 fatalities and 116 injuries annually.

Applying an average monetary value of $50,000 per prevented injury and a value of $6.8 million per prevented fatality results in an estimated monetized benefit of $135 million. In estimating the value of preventing a fatality, OSHA has followed the approach established by the U.S. Environmental Protection Agency (EPA). EPA's approach is detailed in Chapter 7 of EPA's *Guidelines for Preparing Economic Analyses,* which provides a detailed review of the methods for estimating mortality risk values and summarizes the values obtained in the literature [6]. Synthesizing the results from 26 relevant studies, EPA arrived at a mean value of a statistical life (VSL) of $4.8 million (in 1990 dollars). EPA recommends this central estimate, updated for inflation (the value is $6.8 million in 2003 dollars) for application in regulatory analyses. This VSL estimate is also within the range of the substantial majority of such estimates in the literature of $1 million to $10 million per statistical life, as discussed in OMB Circular A–4.

In estimating the value of preventing an injury, OSHA reviewed the available research literature. A critical review of 39 different studies estimating the value of a statistical injury is provided by Kip Viscusi and Joseph Aldy in their 2003 study [7]. Viscusi and Aldy found that most studies have estimates in the range of $20,000 to $70,000 per injury, and several studies have even higher values. The range of values is partly explained by the measure of nonfatal job risks used: some studies use an overall injury rate, and other studies use only injuries resulting in lost workdays. The injuries that would be prevented by this proposed electric power standard are hospitalized injuries, which are likely to be more severe, on average, than lost workday injuries. In addition, the proposed standard is expected to reduce the incidence of burn injuries, which tend to be more severe injuries, involving more pain and suffering, more expensive treatments, and generally longer recovery periods than lost workday injuries. Thus, for this rulemaking, an estimated value of a statistical injury in the upper part of the reported range of estimates would be supported. In their paper, Viscusi and Aldy reviewed the available willingness to pay (WTP) literature to identify their range of estimates; using WTP to value non-fatal injury and illness is the recommended approach, as discussed in OMB Circular A–4.

The net monetized benefits of the proposed standard are estimated to be about $101.1 million annually ($135 million in benefits and $33.9 million in costs). Note that these net benefits exclude any unquantified benefits associated with revising the standards to provide updated, clear, and consistent regulatory requirements to the public.

Table V–4 provides an overview of the estimated benefits associated with this proposed rulemaking. OSHA requests comments from the public regarding these figures and any other aspects of the estimation of the benefits associated with this rulemaking. Table V–3 summarizes the costs, benefits, net benefits, and cost effectiveness of the proposed standard.

TABLE V–3.—NET BENEFITS AND COST EFFECTIVENESS

| | |
|---|---|
| *Annualized Costs* | |
| Determination of Appropriate Protective Clothing | $11.0 million. |
| Provision of Appropriate Protective Clothing | $8.4 million. |
| Host/Contractor Communications | $7.8 million. |
| Expanded Job Briefings | $5.1 million. |
| Additional Training | $1.2 million. |
| Other Costs | $0.4 million. |
| Total Annual Costs | $33.9 million. |

TABLE V–3.—NET BENEFITS AND COST EFFECTIVENESS—Continued

| | |
|---|---|
| *Annual Benefits* | |
| Number of Injuries Prevented | 116 |
| Number of Fatalities Prevented | 19 |
| Monetized Benefits (Assuming $50,000 per Injury and $6.8 million per Fatality Prevented) | $135 million. |
| OSHA standards that are updated and consistent | unquantified. |
| Total Annual Benefits | 116 injuries and 19 fatalities prevented. |
| *Net Benefits (Benefits Minus Costs): $101 million annually Cost Effectiveness* | |
| Compliance with the proposed standards would result in the prevention of 1 fatality and 6 injuries per $1.8 million in costs, or, alternatively, $4.00 of benefits per dollar of costs. | |

Additional benefits associated with this proposal involve providing updated, clear, and consistent safety standards regarding electric power generation, transmission, and distribution work to the relevant employers, employees, and interested members of the public. The existing OSHA standards for the construction of electric power transmission and distribution systems are over 30 years old and inconsistent with the more recently promulgated standards addressing repair and maintenance work. OSHA believes that the updated standards are easier to understand and to apply and will benefit employers by facilitating compliance while improving safety.

As explained earlier, the inconsistencies between OSHA's existing standards related to electric power generation, transmission, and distribution for construction and general industry work create numerous difficulties for employers and employees. The benefits associated with providing updated, clear, and consistent safety standards are great, but they have not been monetized or quantified. OSHA requests comments regarding how these benefits can or should be estimated.

With particular regard to the benefits associated with requirements for protective clothing, OSHA estimates that an average of at least 8 electric utility burn accidents occur each year, leading to 12 nonfatal injuries and 2 fatalities per year. Of the reports indicating the extent of the burn injury, 75 percent reported third degree burns. Proper protective clothing is expected to reduce the number of fatalities and the severity of these injuries.

Requiring the use of body harnesses instead of body belts is also expected to reduce fatalities and injuries among affected workers. There are several problems with body belts. First, they are more likely to result in serious injury during a fall because they place greater stress on the workers' body. Second, body belts virtually eliminate the possibility of self rescue after the fall, and increase the probability of serious internal injuries as the worker hangs suspended. Studies performed in Europe and by the U.S. Air Force indicate high risks associated with the body belt both in fall arrest and suspension modes. Third, it is harder for supervisors to determine visually if the worker is using appropriate fall protection when belts are used. By contrast, it can easily be seen from a distance whether a harness is being worn. Finally, there is a greater risk that a worker could slip out of a body belt than out of a harness. As a result of these considerations, many employers have already switched to requiring harnesses rather than belts. French and German worker safety standards prohibit the use of body belts, and British standards impose major restrictions on their use. Studies documenting the inappropriateness of and the safety risks associated with the use of body belts as part of a fall arrest system include Exhibits 2–36, 3–7, 3–9, 3–10, and 3–13 in OSHA docket S–206 (Fall Protection), and Exhibits 9–33, 11–3, 11–4, 11–5, and 11–6 in OSHA docket S–700 (Powered Platforms).

An average of about fifteen fatalities annually involve falls from aerial lifts; in these cases, the employees were generally not wearing a belt or a harness. Since most employees do, in fact, wear a belt or a harness (according to the CONSAD report, current compliance is over 80 percent), there are likely to be at least 60 falls annually in which a belt or harness was relied upon to arrest a fall.

Employees who rely only on a belt for fall protection have been determined to be at significant risk of serious injury, and the use of body belts as part of a fall arrest system has been determined to be generally inappropriate, as OSHA has already established with an extensive record on the subject as part of the final rule for fall protection in construction. For a complete discussion of this issue, see the Summary and Explanation section of the preamble to the final OSHA rule on fall protection in construction (59 FR 40672, August 9, 1994).

TABLE V–4.—OVERVIEW OF ANNUAL BENEFITS

| | Injuries | Fatalities |
|---|---|---|
| Total Addressed by the Proposed Rulemaking | 444 | 74 |
| Preventable Through Full Compliance with Existing Standards (52.9 percent) | 235 | 39 |
| Additional Preventable with Full Compliance with Proposed Standards (26.1 percent) | 116 | 19 |
| Monetized Benefits, Assuming Value of $50,000 per injury, $6.8 million per fatality | $5.8 million | $129.2 million |
| Total Monetized Benefits | $135 million | |

Note: Additional benefits associated with this rulemaking involve providing OSHA standards that are updated, clear, and consistent.
Sources: CONSAD [1]; OSHA, Office of Regulatory Analysis.

*F. Technological Feasibility*

In accordance with the OSH Act, OSHA is required to demonstrate that occupational safety and health standards promulgated by the Agency are technologically feasible. In fulfillment of this requirement, OSHA has reviewed the requirements that would be imposed by the proposal, and has assessed their technological feasibility. As a result of this review, OSHA has determined that compliance with the requirements of the proposal is technologically feasible for all affected industries.

The proposal would require employers to provide protective equipment and clothing, to provide training, and to implement work practices to reduce the hazards associated with work involving electric power generation, transmission, and distribution. Compliance with all of the proposed requirements can be achieved with readily and widely available technologies. OSHA believes that there are no technological constraints associated with compliance with any of the proposed requirements, and requests comments regarding this conclusion.

*G. Costs of Compliance*

Introduction

This section of the preliminary analysis presents the estimated costs of compliance for the proposed electric power generation, transmission, and distribution rulemaking. The estimated costs of compliance represent the additional costs necessary for employers to achieve full compliance. They do not include costs associated with current compliance with the new requirements; nor do they include costs associated with achieving full compliance with existing applicable requirements.

For purposes of this analysis, the terms ''proposal'' and ''proposed standard'' include all elements of this proposed rulemaking, including proposed changes to 29 CFR 1910.269, proposed changes to 29 CFR 1926, proposed changes involving electrical protective equipment requirements, and other associated revisions and additions. The consolidated set of proposed actions was analyzed in its entirety; only those parts that were identified as involving nonnegligible costs are explicitly reflected in the analysis of compliance costs and impacts.

Table V–5 presents the total annualized estimated costs by provision and by industry sector. As shown in Table V–5, the total annualized cost of compliance with the proposed rulemaking is estimated to be about $33.9 million.

The largest component of the compliance costs, at $11.0 million annually, is comprised of the costs necessary to comply with the requirement for the employer to make a determination regarding the type and extent of flame-resistant apparel necessary to protect employees in the event that employees may be exposed to an electric arc. For purposes of estimating costs of compliance with this provision, OSHA expects generally that utilities will conduct system-wide analyses of the extent of potential hazards in various parts of the system and will communicate the relevant information to contractors. The contractors, in turn, will use the information provided by the utilities to determine the appropriate type and extent of flame-resistant apparel that employees on a particular project must wear.

TABLE V–5.—SUMMARY OF COMPLIANCE COST BY INDUSTRY AND BY PROVISION

| Industry code | Industry name | Revised training requirements | Existing 1910.269 for construction (except training) | Host-contractor communication requirements | Expanded job briefing requirements | Determination of appropriate protective clothing | Provision of appropriate clothing | Use of harnesses in aerial lifts | Total annual compliance costs |
|---|---|---|---|---|---|---|---|---|---|
| NAICS 234910 | Water, Sewer, and Pipeline Construction | $25,850 | $3,043 | $84,325 | $37,642 | $23,055 | $79,174 | $0 | $253,089 |
| NAICS 234920 | Power and Communication Transmission Line Construction | 614,829 | 83,773 | 1,062,275 | 945,140 | 581,517 | 2,071,169 | 0 | 5,358,702 |
| NAICS 234930 | Industrial Nonbuilding Structure Construction | 2,358 | 0 | 114,887 | 42,827 | 47,048 | 94,957 | 0 | 302,077 |
| NAICS 234990 | All Other Heavy Construction | 138,029 | 17,834 | 508,846 | 270,538 | 228,773 | 499,701 | 0 | 1,663,721 |
| NAICS 235310 | Electrical Contractors | 334,494 | 52,294 | 1,629,823 | 829,851 | 611,134 | 1,517,936 | 0 | 4,975,533 |
| NAICS 235910 | Structural Steel Erection Contractors | 3,856 | 0 | 29,071 | 16,637 | 16,448 | 25,664 | 0 | 91,676 |
| NAICS 235950 | Building Equipment and Other Machine Installation Contractors | 5,481 | 0 | 27,230 | 15,584 | 15,407 | 24,039 | 0 | 87,741 |
| NAICS 235990 | All Other Special Trade Contractors | 16,094 | 0 | 77,081 | 55,111 | 54,532 | 76,318 | 0 | 279,136 |
| NAICS 221110 | Electric Power Generation | 11,645 | 0 | 1,021,719 | 662,584 | 2,106,375 | 1,224,001 | 0 | 5,026,324 |
| NAICS 221120 | Electric Power Transmission, Control, and Distribution | 25,205 | 0 | 2,725,314 | 1,102,340 | 5,900,695 | 2,033,643 | 0 | 11,787,197 |
| NAICS 2211 | Publicly Owned Utilities | 3,559 | 0 | 280,791 | 145,737 | 676,998 | 273,101 | 0 | 1,380,186 |
| Various | Industrial Power Generators | 3,986 | 0 | 232,289 | 235,334 | 778,076 | 444,284 | 67,422 | 1,761,391 |
| SIC 0783 | Ornamental Shrub and Tree Services | 59,968 | 0 | 0 | 700,013 | 0 | 0 | 216,578 | 976,559 |
| Total | | $1,245,355 | $156,944 | $7,793,651 | $5,059,338 | $11,040,058 | $8,363,987 | $284,000 | $33,943,333 |

Source: CONSAD [2], Appendix C; OSHA estimates.

As shown in Table V–5, other provisions of the proposed standards involving compliance costs include requirements for protective clothing ($8.4 million), requirements for various communications between host employers and contractors ($7.8 million), expanded requirements for conducting job briefings ($5.1 million), and revised training requirements ($1.2 million).

The remainder of this section provides and explains the details underlying the calculations of the compliance costs associated with the proposal. OSHA estimated compliance costs for each provision of the proposal that involves nonnegligible costs and for each affected industry sector. Total annualized costs were calculated by annualizing nonrecurring first-year costs (at 7 percent over 10 years) and then adding these to recurring annual costs.

The calculations of the estimated costs associated with compliance are intended to be representative of the average resources necessary to achieve compliance with the proposed standards. Affected establishments may achieve compliance through other means with an equivalent amount of resources.

Labor costs are based on industry-specific wage rates published by BLS, adjusted upwards by 37 percent to account for benefits and other employee-related costs and are presented in Table V–6. Supervisory wage rates, including benefits, are estimated to be $22.45 per hour in the Ornamental Shrub and Tree Services industry, and are estimated to range from $31.56 to $41.00 in all other affected industries. Employee wage rates (except those for engineers), including benefits, are estimated to be $16.66 per hour in the Ornamental Shrub and Tree Services industry, and are estimated to range from $24.00 to $34.84 in all other affected industries. Wage rates for engineers, including benefits, are estimated to be $41.00 per hour. Clerical wage rates, including benefits, are estimated to be $16.78 per hour in the Ornamental Shrub and Tree Services industry, and are estimated to range from $17.91 to $23.70 in all other affected industries. [1, Table 5.3]

TABLE V–6.—SUMMARY OF WAG RATES FOR CALCULATING COMPLIANCE COSTS, BY INDUSTRY

| Wage rates | | | | | | |
|---|---|---|---|---|---|---|
| | | Salaries (including Fringe Benefits [1]) Based on Jobs Description | | | | |
| Industry code | Industry description | Supervisor | Clerical | Power generation-power line construction/maintenance/repair worker [2] | Utility/other power plant supervisor | Utility/other power plant engineer |
| SIC 0783 | Ornamental Shrub and Tree Services | $22.45 | $16.78 | $16.66 | | |
| NAICS 2211–10 | Electric Power Generation | 41.00 | 23.70 | 32.66 | $41.00 | $44.37 |
| NAICS 2211–20 | Electric Power Transmission, Control, and Distribution | 41.00 | 23.70 | 32.66 | 41.00 | 44.37 |
| NAICS 2349–10 | Water, Sewer, and Pipeline Construction | 31.56 | 19.11 | 24.00 | | |
| NAICS 2349–20 | Power and Communication Transmission Line Const | 31.56 | 19.11 | 24.00 | | |
| NAICS 2349–30 | Industrial Nonbuilding Structure Construction | 31.56 | 19.11 | 28.28 | | |
| NAICS 2349–90 | All Other Heavy Construction | 31.56 | 19.11 | 26.85 | | |
| NAICS 2353–10 | Electrical Contractors | 33.99 | 17.91 | 25.46 | | ; |
| NAICS 2359–10 | Structural Steel Erection Contractors | 34.13 | 18.08 | 34.84 | | |
| NAICS 2359–50 | Building Equipment and Other Machine Installation Contr. | 34.13 | 18.08 | 34.84 | | |
| NAICS 2359–90 | All Other Special Trade Contractors | 34.13 | 18.08 | 34.84 | | |
| | Major Publicly Owned Utilities | 41.00 | 23.70 | 32.66 | 41.00 | 44.37 |
| | Industrial Generators | 41.00 | 23.70 | 33.02 | 41.00 | 44.37 |

[1] Assumes an additional 37 percent of base salary for fringe benefit costs.
[2] Depending upon the industry and the type of work performed (that is, power generation, power line, or both), these workers include line workers, tree-trimming crew members, power plant workers, and substation workers.
Source: CONSAD Research Corporation, "Analytical Support and Data Gathering for a Preliminary Economic Analysis for Proposed Standards for Work on Electric Power Generation, Transmission, and Distribution Lines and Equipment (29 CFR 1910.269 and 29 CFR 1926—Subpart V)," 2005, prepared for the U.S. Department of Labor, Occupational Safety and Health Administration, Office of Regulatory Analysis under Contract No. J9–F9–0013, Task Order Number 31, Pittsburgh, PA.

First-Year Costs for Revising Training Programs

The proposed revisions to the OSHA standards addressing electric power generation, transmission, and distribution work would require establishments covered by 29 CFR 1910.269 to revise existing training programs.

The costs associated with such a revision were estimated as involving 8 hours of supervisory time plus an hour of clerical time for all industries except Ornamental Shrub and Tree Services. Due to the more limited and less complex nature of the training for employees in the Ornamental Shrub and Tree industry, the costs associated with revising a training program in this industry were estimated to involve 4 hours of supervisory time plus half an hour of clerical time. [2, Appendix C, pages 3–4]

Thus, OSHA estimates that the average cost of compliance per affected establishment covered by 29 CFR 1910.269 for revising existing training programs would be $196 for establishments in the Ornamental Shrub and Tree Services industry, and would range from $272 to $351 in all other affected industries.

Most establishments in all affected industries either already have training programs that meet the requirements of the proposed standards, or regularly revise their training programs to account for new information or work practices. For these establishments, no additional costs would be necessary to achieve compliance with the proposed standards.

Rates of current compliance were estimated for each affected industry. Within each industry, rates of current compliance were estimated separately for establishments based on their size and based on whether their work force was unionized or not. In the Ornamental Shrub and Tree Services industry, estimated rates of current compliance ranged from 50 to 75 percent. In all other affected industries, rates of current compliance were estimated to range from 75 to 98 percent. [2, Appendix C, pages 3–4]

The total estimated first-year cost of compliance for revising training programs was thus estimated to be $516,000, as shown in Table V–7. Table V–7 also shows the costs of compliance for each affected industry. In calculating the total annual cost associated with all of the revised training requirements, this nonrecurring first-year cost was annualized at a rate of 7 percent over 10 years and was then added to the other annual costs.

TABLE V–7.—FIRST-YEAR COSTS FOR REVISING TRAINING PROGRAMS

| Industry code | Industry name | Establishments affected (%) | Average cost per affected establishment | Compliance rate (%) low/high | First-year compliance costs |
|---|---|---|---|---|---|
| NAICS 234910 | Water, Sewer, and Pipeline Construction | 95 | $272 | 75/95 | $28,036 |
| NAICS 234920 | Power and Communication Transmission Line Construction. | 95 | 272 | 75/95 | 95,269 |
| NAICS 234930 | Industrial Nonbuilding Structure Construction | 100 | 272 | 75/95 | 7,859 |
| NAICS 234990 | All Other Heavy Construction | 95 | 272 | 75/95 | 23,120 |
| NAICS 235310 | Electrical Contractors | 95 | 290 | 75/95 | 61,211 |
| NAICS 235910 | Structural Steel Erection Contractors | 100 | 291 | 75/95 | 24,714 |
| NAICS 235950 | Building Equipment and Other Machine Installation Contractors. | 100 | 291 | 75/95 | 36,315 |
| NAICS 235990 | All Other Special Trade Contractors | 100 | 291 | 75/95 | 106,576 |
| NAICS 221110 | Electric Power Generation | 100 | 351 | 95/98 | 21,793 |
| NAICS 221120 | Electric Power Transmission, Control, and Distribution. | 100 | 351 | 95/98 | 77,343 |
| NAICS 2211 | Publicly Owned Utilities | 100 | 351 | 95/98 | 11,790 |
| Various | Industrial Power Generators | 100 | 351 | 98/98 | 6,563 |
| SIC 0783 | Ornamental Shrub and Tree Services | 100 | 196 | 50/75 | 15,885 |
| Total | | | | | 516,474 |

Source: CONSAD [1], Table 5.3 and CONSAD [2], Appendix C, pages 3–4.

First-Year Costs for Provision of Additional Training for Employees Already Covered by 29 CFR 1910.269

The proposed revisions to the OSHA standards addressing electric power generation, transmission, and distribution work may involve costs for providing additional training.

The costs associated with the provision of additional training were estimated as involving resources (including labor costs or other expenditures) equivalent to 1.5 hours of employee time, plus 12 minutes of supervisory time, plus 3 minutes of clerical time per employee for all affected industries except Ornamental Shrub and Tree Services. For establishments in the Ornamental Shrub and Tree Services industry, the provision of additional training was estimated as involving resources (including labor costs or other expenditures) equivalent to 0.75 hours of employee time, plus 6 minutes of supervisory time, plus 3 minutes of clerical time per employee. [2, Appendix C, pages 5–6]

Half of the incremental cost of this additional training is attributable to the need to train current employees on the changes in requirements that would be associated with the adoption of the proposed standards and that would substitute for previous training. This part of the cost would only need to be incurred in the first year; in subsequent years, the corresponding part of the training would be substituted for the previous training. The other half of the additional training in the first year represents additional training that may be necessary to fully comply with the revised training requirements of the proposal.

OSHA estimates that the average cost of compliance for providing the additional training would be $40 per employee for establishments in the Ornamental Shrub and Tree Services industry, and would range from $50 to $67 per employee in all other affected industries.

Based on research conducted by CONSAD, most establishments in all affected industries are estimated to already provide training that fully complies with the requirements of the proposed standards [2, Appendix C, pages 5–6]. For these establishments, no additional costs would be necessary to achieve compliance.

Rates of current compliance with the proposed requirements were estimated for each affected industry. Within each industry, rates of current compliance were estimated separately for establishments based on their size and based on whether their work force was unionized or not. In the Ornamental Shrub and Tree Services industry, estimated rates of current compliance ranged from 50 to 75 percent. In all other affected industries, rates of current compliance were estimated to range from 75 to 98 percent [2, Appendix C, pages 5–6].

The total estimated first-year cost of compliance for providing training meeting the requirements of the proposed standards was thus estimated to be $572,000, as shown in Table V–8. Table V–8 also shows the costs of compliance for each affected industry. In calculating the total annual cost associated with all of the revised training requirements, this nonrecurring first-year cost (less the corresponding annual cost shown in Table V–10) was annualized at a rate of 7 percent over 10 years and was then added to the recurring annual costs.

TABLE V–8.—FIRST-YEAR COSTS FOR PROVIDING ADDITIONAL TRAINING TO EMPLOYEES ALREADY COVERED BY § 1910.269

| Industry code | Industry name | Employees affected (%) | Average cost per affected employee | Compliance rate (%) low/high | First-year compliance costs |
|---|---|---|---|---|---|
| NAICS 234910 | Water, Sewer, and Pipeline Construction | 95 | $50 | 75/95 | $4,028 |
| NAICS 234920 | Power and Communication Transmission Line Construction. | 95 | 50 | 75/95 | 106,246 |
| NAICS 234930 | Industrial Nonbuilding Structure Construction | 100 | 58 | 75/95 | 6,041 |
| NAICS 234990 | All Other Heavy Construction | 95 | 55 | 75/95 | 27,622 |
| NAICS 235310 | Electrical Contractors | 95 | 51 | 75/95 | 78,696 |
| NAICS 235910 | Structural Steel Erection Contractors | 100 | 67 | 75/95 | 1,854 |
| NAICS 235950 | Building Equipment and Other Machine Installation Contractors. | 100 | 67 | 75/95 | 1,736 |
| NAICS 235990 | All Other Special Trade Contractors | 100 | 67 | 75/95 | 5,071 |
| NAICS 221110 | Electric Power Generation | 100 | 60 | 95/98 | 55,278 |
| NAICS 221120 | Electric Power Transmission, Control, and Distribution. | 100 | 60 | 95/98 | 91,945 |
| NAICS 2211 | Publicly Owned Utilities | 100 | 60 | 95/98 | 12,187 |
| Various | Industrial Power Generators | 100 | 61 | 98/98 | 19,744 |
| SIC 0783 | Ornamental Shrub and Tree Services | 100 | 40 | 50/75 | 162,035 |
| Total | | | | | 572,483 |

Source: CONSAD [1], Table 5.3 and CONSAD [2], Appendix C, pages 5–6.

First-Year Costs for Additional Training for Employees Not Already Covered by 29 CFR 1910.269

The proposed revisions to the OSHA standards addressing electric power generation, transmission, and distribution work include revisions to the existing training requirements in 29 CFR 1910.269 and more substantial revisions to the training requirements applicable to construction work.

Companies that perform construction work associated with electric power generation, transmission, and distribution systems would also be able and willing to perform (and, in fact, do perform) similar work involving the repair and maintenance of such systems. The distinction between construction work and repair or maintenance work can be difficult to make in some situations. For example, the distinction may hinge on whether a particular piece of equipment is regarded as an upgrade or a ''replacement-in-kind.''

Since the nature of the work is often almost identical, companies are not likely to restrict themselves to only repair or maintenance work or to only construction work with regard to potential jobs involving electric power generation, transmission, and distribution. Thus, it would be reasonable to assume that any company involved in such work would have their employees trained in accordance with accepted industry safety practices, as required by the existing OSHA standard addressing this type of work in general industry in 29 CFR 1910.269.

Small business representatives from the affected industries providing comments to OSHA on a draft of the proposal generally indicated that construction contractors follow and comply with the standards applicable to general industry work (29 CFR 1910.269) for all of their work, including construction work. But some small business representatives indicated that there are some companies who follow the standards for construction work in 29 CFR 1926, rather than the standards for general industry work in 29 CFR 1910.269. [3, p. 14]

For certain aspects of a particular construction job, it may be possible to avoid some expenses associated with compliance with some of the requirements of 29 CFR 1910.269 not dealing with training. However, if the employees of the company ever do any work considered repair or maintenance, or any other work covered by 29 CFR 1910.269, then they must have been trained in accordance with that standard. Thus, compliance with the training requirements of 29 CFR 1910.269 in particular is likely, even if a specific job involves only construction work and the employer follows the relevant provisions of the Construction Standard, Subpart V.

The number of firms, if any, who actually limit themselves to construction work as defined by OSHA, and therefore avoid providing a basic training regimen for employees under 29 CFR 1910.269, is difficult to estimate. One small entity representative estimated that about 10 to 30 percent of contractors involved in electric power transmission and distribution work may exclusively do construction; another representative stated that they do not know of any contractor firms that do exclusively construction work [3, p. 15].

It is not clear to what extent it is understood by potentially affected firms that much work that is commonly regarded as construction or that is commonly performed by construction companies does in fact fall under OSHA's definition of general industry work, which includes repair and maintenance. Thus, it would be easy for firms or people to mistakenly believe that they (or others) are only involved in construction work when in fact some of their work falls under the scope of OSHA's general industry standards.

It is very unlikely that contractors performing electric power generation, transmission, or distribution work meet both of the following criteria: (1) They know and expect that for all projects performed, only construction work will be done such that the training required by 29 CFR 1910.269 would not be required to be provided, and (2) they have employees perform such work without providing them with what many consider to be a minimum amount of basic safety training applicable to this type of work, as reflected in the training requirements of 29 CFR 1910.269. Only contractors meeting both of these criteria would experience additional training costs due to the formal extension of the training requirements in 29 CFR 1910.269 to the construction industry.

Nevertheless, for purposes of estimating the potential costs of compliance that may be associated with this proposal, OSHA estimates that 5 percent of the work force in several construction industries would need to be provided with the training currently required by 29 CFR 1910.269 in order to achieve full compliance with the proposed standards.

In the development of the proposal, OSHA was not able to identify any employers that performed work covered by Subpart V of Part 1926, but no work covered by 29 CFR 1910.269. However, OSHA has calculated costs based on an estimate that 5 percent of the affected construction work force performs no work covered by 29 CFR 1910.269, primarily in response to the recommendations of the SBREFA Panel, as discussed in the Initial Regulatory Flexibility Analysis.

Specifically, OSHA estimates that 5 percent of the relevant work force would be affected in the following industries: Water, Sewer, and Pipeline Construction; Power and Communication Transmission Line Construction; All Other Heavy Construction; and Electrical Contractors. OSHA requests comments and information from the public regarding this issue and the associated estimates.

The costs associated with the additional training that may be necessary to achieve full compliance with the new training provisions for employees not already covered by 29 CFR 1910.269 were estimated as involving resources (including labor costs or other expenditures) equivalent to 24.75 hours of employee time, plus 3 minutes of clerical time per employee in the affected industries.

Thus, OSHA estimates that the average cost of compliance per affected employee for the required training would range from $690 to $772 in the affected industries.

For the establishments and employees considered to be affected by the expansion of the scope of applicability of this training requirement, current compliance was estimated to be zero. [2, Appendix C, pages 5–6]

The total estimated first-year cost of compliance for providing additional training for employees not already covered by 29 CFR 1910.269 (and not already provided with such training) was thus estimated to be $4.1 million, as shown in Table V–9. Table V–9 also shows the costs of compliance for each affected industry. In calculating the total annual cost associated with all the revised training requirements, this nonrecurring first-year cost (less the corresponding annual cost shown in Table V–11) was annualized at a rate of 7 percent over 10 years and was then added to the recurring annual costs.

TABLE V–9.—FIRST-YEAR COSTS FOR ADDITIONAL TRAINING FOR EMPLOYEES NOT ALREADY COVERED BY § 1910.269

| Industry code | Industry name | Employees affected (%) | Average cost per affected employee | Compliance rate (%) low high | First-year compliance costs |
|---|---|---|---|---|---|
| NAICS 234910 | Water, Sewer, and Pipeline Construction | 5 | $690 | 0 | $78,184 |
| NAICS 234920 | Power and Communication Transmission Line Construction. | 5 | 690 | 0 | 2,153,238 |
| NAICS 234930 | Industrial Nonbuilding Structure Construction | 0 | | | 0 |
| NAICS 234990 | All Other Heavy Construction | 5 | 772 | 0 | 479,611 |
| NAICS 235310 | Electrical Contractors | 5 | 700 | 0 | 1,344,110 |
| NAICS 235910 | Structural Steel Erection Contractors | 0 | | | 0 |
| NAICS 235950 | Building Equipment and Other Machine Installation Contractors. | 0 | | | 0 |
| NAICS 235990 | All Other Special Trade Contractors | 0 | | | 0 |
| NAICS 221110 | Electric Power Generation | 0 | | | 0 |
| NAICS 221120 | Electric Power Transmission, Control, and Distribution. | 0 | | | 0 |
| NAICS 2211 | Publicly Owned Utilities | 0 | | | 0 |
| Various | Industrial Power Generators | 0 | | | 0 |
| SIC 0783 | Ornamental Shrub and Tree Services | 0 | | | 0 |
| Total | | | | | 4,055,143 |

Source: CONSAD [1], Table 5.3; CONSAD [2], Appendix C, pages 5–6; OSHA estimates.

Annual Costs for Provision of Additional Training for Employees Already Covered by 29 CFR 1910.269

The proposed revisions to the OSHA standards addressing electric power generation, transmission, and distribution work may involve annual costs for providing additional training due to workforce turnover.

The costs associated with the provision of additional training were estimated as involving resources (including labor costs or other expenditures) equivalent to 0.75 hours of employee time, plus 6 minutes of supervisory time, plus 3 minutes of clerical time per employee for all affected industries except Ornamental Shrub and Tree Services. For establishments in the Ornamental Shrub and Tree Services industry, the provision of additional training was estimated as involving resources (including labor costs or other expenditures) equivalent to 0.375 hours of employee time, plus 3 minutes of supervisory time, plus 3 minutes of clerical time per employee.

OSHA estimates that the average cost of compliance for providing the additional training would be $20 per affected employee for establishments in the Ornamental Shrub and Tree Services industry and would range from $25 to $34 per affected employee in all other affected industries.

The number of affected employees in each establishment was estimated by determining the corresponding work force turnover rate. The work force turnover rate associated with the relevant occupational category was estimated for each potentially affected industry. The turnover rates among employees performing electric power generation, transmission, and distribution work were estimated to range from 11 to 16 percent in the construction industries, were estimated to be 3 percent in generation and utility industries, and were estimated to be 31 percent for establishments in the Ornamental Shrub and Tree Services industry [2, Appendix C, p. 7–8].

Based on research conducted by CONSAD, OSHA estimates that most establishments in all affected industries already provide training that fully complies with the requirements of the proposed standards [2, Appendix C, pages 7–8]. For these establishments, no additional costs would be necessary to achieve compliance.

Rates of current compliance with the proposed requirements were estimated for each affected industry. Within each industry, rates of current compliance were estimated separately for establishments based on their size and based on whether their work force was unionized or not. In the Ornamental Shrub and Tree Services industry, estimated rates of current compliance ranged from 50 to 75 percent. In all other affected industries, rates of current compliance were estimated to range from 75 to 98 percent [2, Appendix C, pages 7–8].

The total estimated annual cost of compliance for providing training meeting the requirements of the proposed standards was thus estimated to be about $58,000, as shown in Table V–10. Table V–10 also shows the costs of compliance for each affected industry.

TABLE V–10.—ANNUAL COSTS FOR PROVIDING ADDITIONAL TRAINING FOR EMPLOYEES ALREADY COVERED BY § 1910.269

| Industry code | Industry name | Employees affected (%) | Average cost per affected employee | Compliance rate (%) low/high | Annual compliance costs |
|---|---|---|---|---|---|
| NAICS 234910 | Water, Sewer, and Pipeline Construction | 15 | $25 | 75/95 | $299 |
| NAICS 234920 | Power and Communication Transmission Line Construction. | 15 | 25 | 75/95 | 7,870 |
| NAICS 234930 | Industrial Nonbuilding Structure Construction | 16 | 29 | 75/95 | 448 |
| NAICS 234990 | All Other Heavy Construction | 15 | 28 | 75/95 | 2,046 |
| NAICS 235310 | Electrical Contractors | 10 | 26 | 75/95 | 4,103 |
| NAICS 235910 | Structural Steel Erection Contractors | 11 | 34 | 75/95 | 97 |
| NAICS 235950 | Building Equipment and Other Machine Installation Contractors. | 11 | 34 | 75/95 | 91 |
| NAICS 235990 | All Other Special Trade Contractors | 11 | 34 | 75/95 | 280 |
| NAICS 221110 | Electric Power Generation | 3 | 30 | 95/98 | 817 |
| NAICS 221120 | Electric Power Transmission, Control, and Distribution. | 3 | 30 | 95/98 | 1,359 |
| NAICS 2211 | Publicly Owned Utilities | 3 | 30 | 95/98 | 180 |
| Various | Industrial Power Generators | 3 | 31 | 98/98 | 292 |
| SIC 0783 | Ornamental Shrub and Tree Services | 31 | 20 | 50/75 | 40,447 |
| Total | | | | | 58,329 |

Source: CONSAD [1], Table 5.3; CONSAD [2], Appendix C, pages 7–8; OSHA estimates.

Annual Costs for Additional Training for Employees Not Already Covered by 29 CFR 1910.269

As noted earlier, OSHA has included training costs based on an estimate that 5 percent of the affected construction work force performs no work covered by 29 CFR 1910.269. Specifically, OSHA estimates that 5 percent of the relevant work force would be affected in the following industries: Water, Sewer, and Pipeline Construction; Power and Communication Transmission Line Construction; All Other Heavy Construction; and Electrical Contractors.

The annual costs associated with this additional training were estimated for new affected employees as involving resources (including labor costs or other expenditures) equivalent to 24.75 hours of employee time, plus 3 minutes of clerical time per employee. OSHA estimates that the average cost of compliance per affected employee for the required training would range from $690 to $772 in the affected industries.

The number of affected employees in each establishment was estimated by determining the corresponding work force turnover rate. The work force turnover rate associated with the relevant occupational category was estimated for each potentially affected industry. The turnover rates among employees performing electric power generation, transmission, and distribution work were estimated to range from 11 to 16 percent in the affected construction industries [2, Appendix C, p. 9–10].

For the establishments and employees considered to be affected by the expansion of the scope of applicability of this training requirement, current compliance was estimated to be zero [2, Appendix C, pages 9–10].

The total estimated annual cost of compliance for providing additional training for employees not already covered by 29 CFR 1910.269 (and not already provided with such training) was thus estimated to be about $542,000, as shown in Table V–11. Table V–11 also shows the costs of compliance for each affected industry.

TABLE V–11.—ANNUAL COSTS FOR PROVISION OF ADDITIONAL TRAINING FOR EMPLOYEES NOT ALREADY COVERED BY § 1910.269

| Industry code | Industry name | Employees affected (%) | Average cost per affected employee | Compliance rate (%) low/high | Annual compliance costs |
|---|---|---|---|---|---|
| NAICS 234910 | Water, Sewer, and Pipeline Construction | 1 | $690 | 0 | $11,583 |
| NAICS 234920 | Power and Communication Transmission Line Construction. | 1 | 690 | 0 | 318,999 |
| NAICS 234930 | Industrial Nonbuilding Structure Construction | 0 | | | 0 |
| NAICS 234990 | All Other Heavy Construction | 1 | 772 | 0 | 71,053 |
| NAICS 235310 | Electrical Contractors | 1 | 700 | 0 | 140,144 |

TABLE V–11.—ANNUAL COSTS FOR PROVISION OF ADDITIONAL TRAINING FOR EMPLOYEES NOT ALREADY COVERED BY § 1910.269—Continued

| Industry code | Industry name | Employees affected (%) | Average cost per affected employee | Compliance rate (%) low/high | Annual compliance costs |
|---|---|---|---|---|---|
| NAICS 235910 | Structural Steel Erection Contractors | 0 | | | 0 |
| NAICS 235950 | Building Equipment and Other Machine Installation Contractors. | 0 | | | 0 |
| NAICS 235990 | All Other Special Trade Contractors | 0 | | | 0 |
| NAICS 221110 | Electric Power Generation | 0 | | | 0 |
| NAICS 221120 | Electric Power Transmission, Control, and Distribution. | 0 | | | 0 |
| NAICS 2211 | Publicly Owned Utilities | 0 | | | 0 |
| Various | Industrial Power Generators | 0 | | | 0 |
| SIC 0783 | Ornamental Shrub and Tree Services | 0 | | | 0 |
| Total | | | | | 541,779 |

Source: CONSAD [1], Table 5.3; CONSAD [2], Appendix C, pages 9–10; OSHA estimates.

Costs To Comply With Existing 29 CFR 1910.269 (Other Than Training) for Employees Not Already Covered by 29 CFR 1910.269

As described earlier, OSHA believes that construction contractors who perform work involving electric power generation, transmission, or distribution generally comply with the requirements of the OSHA general industry standard 29 CFR 1910.269. Nevertheless, for purposes of estimating the potential costs of compliance associated with this rulemaking, costs associated with complying with existing requirements in 29 CFR 1910.269 were estimated for some construction establishments. For purposes of calculating a cost estimate, OSHA estimates that the equivalent of 5 percent of the work force in several construction industries currently are not provided with any of the additional safety protections that were newly provided by the existing 29 CFR 1910.269 when that standard was updated by OSHA in 1994.

Specifically, OSHA estimates that the compliance costs associated with achieving full compliance with the requirements of the existing 29 CFR 1910.269 for the construction industry would be equivalent to that represented by 5 percent of the relevant work force being out of compliance with the requirements of the existing 29 CFR 1910.269 that were newly introduced in general industry in 1994. The relevant work force would be the affected employees in the following industries: Water, Sewer, and Pipeline Construction; Power and Communication Transmission Line Construction; All Other Heavy Construction; and Electrical Contractors.

The costs necessary to achieve full compliance with the relevant nontraining requirements of 29 CFR 1910.269 were estimated based on those associated with the final rule promulgated by OSHA in 1994. Many of these requirements have become standard industry practice and thus would no longer involve additional costs. Thus, the estimate of compliance costs would allow for more widespread noncompliance among other requirements, or for the incorporation of other aspects of achieving compliance.

The resources necessary to achieve compliance with the relevant requirements were estimated to be represented by an average of $64 per employee. This cost is equivalent to that associated with compliance with the revised 29 CFR 1910.269, as supported by the public record corresponding to the promulgation of that standard.

The total estimated annual costs associated with achieving compliance with the nontraining requirements of the existing 29 CFR 1910.269 for the construction industry was thus estimated to be $157,000, as shown in Table V–12. Table V–12 also shows the costs of compliance for each affected industry.

TABLE V–12.—COSTS TO COMPLY WITH EXISTING 1910.269 (OTHER THAN TRAINING) FOR EMPLOYEES NOT ALREADY COVERED BY § 1910.269

| Industry code | Industry name | Employees affected (%) | Employees affected (%) | Average cost per affected employee | Compliance rate (%) low/high |
|---|---|---|---|---|---|
| NAICS 234910 | Water, Sewer, and Pipeline Construction | 5 | $64 | 0 | $3,043 |
| NAICS 234920 | Power and Communication Transmission Line Construction. | 5 | 64 | 0 | 83,773 |
| NAICS 234930 | Industrial Nonbuilding Structure Construction | 0 | | | 0 |
| NAICS 234990 | All Other Heavy Construction | 5 | 64 | 0 | 17,834 |
| NAICS 235310 | Electrical Contractors | 5 | 64 | 0 | 52,294 |
| NAICS 235910 | Structural Steel Erection Contractors | 0 | | | 0 |
| NAICS 235950 | Building Equipment and Other Machine Installation Contractors. | 0 | | | 0 |
| NAICS 235990 | All Other Special Trade Contractors | 0 | | | 0 |
| NAICS 221110 | Electric Power Generation | 0 | | | 0 |
| NAICS 221120 | Electric Power Transmission, Control, and Distribution. | 0 | | | 0 |
| NAICS 2211 | Publicly Owned Utilities | 0 | | | 0 |
| Various | Industrial Power Generators | 0 | | | 0 |

TABLE V–12.—COSTS TO COMPLY WITH EXISTING 1910.269 (OTHER THAN TRAINING) FOR EMPLOYEES NOT ALREADY COVERED BY § 1910.269—Continued

| Industry code | Industry name | Employees affected (%) | Employees affected (%) | Average cost per affected employee | Compliance rate (%) low/high |
|---|---|---|---|---|---|
| SIC 0783 | Ornamental Shrub and Tree Services | 0 | | | 0 |
| Total | | | | | 156,944 |

Source: OSHA, Office of Regulatory Analysis.

Annual Costs for Required Communications Between Host Employers and Contractors

The proposed revisions to the OSHA standards addressing electric power generation, transmission, and distribution work would require certain communications to take place between host employers and contractors. These requirements would apply for each project that is performed by a contractor for a host employer.

Under the proposed standards, the host employer would be required to provide to the contractor information on hazards that the contract employer might not be able to recognize. However, the proposed standards would not require the host employer to survey the work area for hazards, and would not require the host employer to acquire additional unknown information.

The proposed standards would also require the host employer to report to the contractor any violations of the applicable OSHA standards that may happen to be observed by the host employer. This requirement would not impose any additional costs on host employers or on contractors to the extent that contractors are in compliance with the applicable standards.

Contractors are also required under the proposed standards to inform the host employer about any unique hazards posed by the work of the contractor, about any unexpected hazards found in the course of performing the contracted work, and about the measures taken by the contractor to correct violations reported by the host employer and the measures taken to prevent such violations from recurring. These communications are generally considered to be consistent with current industry practices for projects involving contracted work on electric power generation, transmission, and distribution systems.

An estimated 2.7 million projects are performed by contractors for host employers annually. Of these, about 1.3 million are performed by contractors classified in the Power and Communication Transmission Line Construction industry, and another 0.9 million are performed by establishments classified in the Electrical Contractors industry. [2, Appendix C, p. 1]

Projects performed by the host employers themselves would not be affected by the proposed new requirements. Also, projects for which there is no host employer would not be affected by these requirements. Host employer is defined in the proposal as ''[a]n employer who operates and maintains'' an electric power system and who hires a contract employer to perform work on the system. Furthermore, the requirements do not apply to line-clearance tree trimmers. OSHA requests comments regarding the scope and application of these requirements, and regarding additional costs, if any, that would need to be incurred by tree trimmers if they were to be covered by this requirement.

Some projects would be sufficiently small and straightforward to preclude the need for any required communication. An estimated 50 percent of the projects performed by establishments with fewer than 20 employees would be unaffected by the proposed new communication requirements. All projects performed by establishments with 20 or more employees are considered affected by these requirements. [2, Appendix C, p. 11–12]

The costs associated with these provisions were estimated as involving resources (including labor costs or other expenditures) equivalent to 10 minutes of supervisory time each for the host employer and for the contractor on affected projects involving establishments with fewer than 20 employees, and resources equivalent to 15 minutes of supervisory time each for the host employer and for the contractor on affected projects involving establishments with 20 or more employees. [2, Appendix C, pages 11–12]

Thus, OSHA estimates that the average cost of compliance to contractors associated with the requirements for communications between host employers and contractors would be $5 to $6 per affected project performed by a smaller establishment, and $8 to $9 per affected project performed by a larger establishment. The corresponding cost of compliance to utilities associated with these requirements would range from $7 to $10 per affected project.

Based on research conducted by CONSAD, OSHA believes that the communications that would be required by the proposed standards already occur for most affected projects. Employers involved in an estimated 50 percent of the affected projects performed by smaller establishments are already in compliance with the proposed requirements. Depending on the construction contractor involved, an estimated 75 to 90 percent of the affected projects performed by larger contractors are also already in compliance. For these projects, no additional costs would be necessary to achieve compliance with the proposed standards. [2, Appendix C, p. 11–12]

The total estimated annual cost of compliance associated with the proposed requirements involving communications between host employers and contractors was thus estimated to be $7.8 million, as shown in Table V–13. Table V–13 also shows the costs of compliance for each affected industry.

TABLE V–13.—COSTS FOR REQUIRED COMMUNICATIONS BETWEEN HOST EMPLOYERS AND CONTRACTORS

| Industry code | Industry name | Projects performed annually | Projects affected (%) small/large | Cost per project small/large | Compliance rate (%) low/high | Annual compliance costs |
|---|---|---|---|---|---|---|
| NAICS 234910 | Water, Sewer, and Pipeline Construction. | 49,019 | 50/100 | $5/$8 | 50/75 | $84,325 |
| NAICS 234920 | Power and Communication Transmission Line Construction. | 1,282,310 | 50/100 | 5/8 | 65/90 | 1,062,275 |
| NAICS 234930 | Industrial Nonbuilding Structure Construction. | 58,790 | 50/100 | 5/8 | 50/75 | 114,887 |
| NAICS 234990 | All Other Heavy Construction | 309,377 | 50/100 | 5/8 | 50/75 | 508,846 |
| NAICS 235310 | Electrical Contractors | 939,790 | 50/100 | 6/9 | 50/75 | 1,629,823 |
| NAICS 235910 | Structural Steel Erection Contractors. | 15,889 | 50/100 | 6/9 | 50/75 | 29,071 |
| NAICS 235950 | Building Equipment and Other Machine Installation Contractors. | 14,883 | 50/100 | 6/9 | 50/75 | 27,230 |
| NAICS 235990 | All Other Special Trade Contractors | 47,250 | 50/100 | 6/9 | 50/75 | 77,081 |
| NAICS 221110 | Electric Power Generation | 1,894,521 | [1] 0 | 7/10 | | 1,021,719 |
| NAICS 221120 | Electric Power Transmission, Control, and Distribution. | 3,147,692 | [1] 0 | 7/10 | | 2,725,314 |
| NAICS 2211 | Publicly Owned Utilities | 422,708 | [1] 0 | 7/10 | | 280,791 |
| Various | Industrial Power Generators | 687,667 | [1] 0 | 7/10 | | 232,289 |
| SIC 0783 | Ornamental Shrub and Tree Services. | 2,251,278 | 0 | | | 0 |
| Total | | | | | | 7,793,651 |

[1] **Note:** Projects performed directly by utilities are excluded; costs to utilities reflect costs of communication on projects contracted out.
Source: CONSAD [1], Table 5.3 and CONSAD [2], appendix C, pages 11–12.

### Annual Costs Associated With Expanded Requirements for Job Briefings

The proposed revisions to the OSHA standards would expand the requirements for employers to conduct job briefings prior to beginning work on affected electric power projects. Specifically, in addition to existing requirements to provide a job briefing for employees, affected employers would be required to provide the employee in charge of the job with available information to perform the job safely.

An estimated 11.1 million projects are performed by construction contractors, utilities, other power generators, and line-clearance tree trimmers annually. Of these, about 6.2 million projects are performed by utilities and power generators, 2.7 million projects are performed by contractors classified in the construction industry, and another 2.3 million projects are performed by establishments classified in the Ornamental Shrub and Tree Services industry. All of these projects would be potentially affected by the proposed new requirements [2, Appendix C, p. 1 and p. 13–14].

Compliance with the proposed standards would be expected to be achieved through a small addition to routine communications that already take place regularly between and among employers and employees involved in the affected projects. The costs of compliance associated with the revised job briefing provisions were estimated as involving resources (including labor costs or other expenditures) equivalent to 5 minutes of supervisory time and 5 minutes of employee time for each affected project [2, Appendix C, pages 11–12].

Thus, OSHA estimates that the average cost of compliance associated with the revised requirements for job briefings would be $5 to $6 per affected project performed by utilities, other power generators, and construction contractors. The estimated average cost of compliance for projects performed by establishments in the Ornamental Shrub and Tree Services industry would be about $3 per project.

Based on research conducted by CONSAD, OSHA estimates that the job briefings that would be required by the proposed standards are already provided for most affected projects. Employers involved in an estimated 85 percent of the affected projects performed by establishments with fewer than 20 employees are already in compliance with the proposed requirements. Employers involved in an estimated 95 percent of the affected projects performed by establishments with 20 or more employees are also already in compliance with the proposed requirements. Among utilities and other power generators, an estimated 95 percent to 98 percent of the potentially affected projects involve employers already fully in compliance with the proposed job briefing provisions. For these projects, no additional costs would be necessary to achieve compliance with the proposed standards. [2, Appendix C, pages 13–14]

The total estimated annual cost of compliance associated with the proposed requirements regarding job briefings was thus estimated to be $5.1 million, as shown in Table V–14. Table V–14 also shows the costs of compliance for each affected industry.

TABLE V–14.—COSTS ASSOCIATED WITH EXPANDED REQUIREMENTS FOR JOB BRIEFINGS

| Industry code | Industry name | Projects performed annually | Projects affected (%) | Cost per project | Compliance rate (%) low high | Annual compliance costs |
|---|---|---|---|---|---|---|
| NAICS 234910 | Water, Sewer, and Pipeline Construction. | 49,019 | 100 | 5 | 85/95 | $37,642 |

TABLE V–14.—COSTS ASSOCIATED WITH EXPANDED REQUIREMENTS FOR JOB BRIEFINGS—Continued

| Industry code | Industry name | Projects performed annually | Projects affected (%) | Cost per project | Compliance rate (%) low high | Annual compliance costs |
|---|---|---|---|---|---|---|
| NAICS 234920 | Power and Communication Transmission Line Construction. | 1,282,310 | 100 | 5 | 85/95 | 945,140 |
| NAICS 234930 | Industrial Nonbuilding Structure Construction. | 58,790 | 100 | 5 | 85/95 | 42,827 |
| NAICS 234990 | All Other Heavy Construction | 309,377 | 100 | 5 | 85/95 | 270,538 |
| NAICS 235310 | Electrical Constructors | 939,790 | 100 | 5 | 85/95 | 829,851 |
| NAICS 235910 | Structural Steel Erection Constructors. | 15,889 | 100 | 6 | 85/95 | 16,637 |
| NAICS 235950 | Building Equipment and Other Machine Installation Constructors. | 14,883 | 100 | 6 | 85/95 | 15,584 |
| NAICS 235990 | All Other Special Trade Constructors. | 47,250 | 100 | 6 | 85/95 | 55,111 |
| NAICS 221110 | Electric Power Generation | 1,894,521 | 100 | 6 | 95/98 | 662,584 |
| NAICS 221120 | Electric Power Transmission, Control, and Distribution. | 3,147,692 | 100 | 6 | 95/98 | 1,102,340 |
| NAICS 2211 | Publicly Owned Utilities | 422,708 | 100 | 6 | 95/98 | 145,737 |
| Various | Industrial Power Generators | 687,667 | 100 | 6 | 98/98 | 235,334 |
| SIC 0783 | Ornamental Shrub and Tree Services. | 2,251,278 | 100 | 3 | 85/95 | 700,013 |
| Total | | | | | | 5,059,338 |

Source: CONSAD [1], Table 5.3 and CONSAD [2], Appendix C, pages 13–14.

Annual Costs Associated With Determinations Regarding Electric Arc Hazards and Appropriate Employee Protection

Under OSHA's proposed revisions, employers are required to determine whether employees may be exposed to hazards from flames or from electric arcs. For employees exposed to hazards from electric arcs, the employer must estimate the available heat energy to which the employee would be exposed. Where the covered hazards exist, the employer must determine the corresponding appropriate clothing or other protection for employees.

As noted in the proposal, the calculations of potential heat energy exposures do not need to be made separately or repeated for each individual project performed. Estimates that cover multiple system areas can be developed initially, and then information from the resulting system-wide analysis can be used repeatedly as needed. The relevant information applicable for a specific project can be identified and communicated to contractors by referring to the results of the system-wide assessment or by providing the relevant system area parameters (such as maximum fault current and clearing times) so that the contractor can perform the calculations.

An estimated 11.1 million projects are performed by construction contractors, utilities, other power generators, and line-clearance tree trimmers annually. Of these, about 6.2 million projects are performed by utilities and power generators, 2.7 million projects are performed by contractors classified in the construction industry, and another 2.3 million projects are performed by establishments classified in the Ornamental Shrub and Tree Services industry. [2, Appendix C, p. 1].

The requirements involving determinations associated with electric arc hazards do not apply to projects performed by establishments classified in the Ornamental Shrub and Tree Services industry. In addition, the requirements do not apply to projects involving only deenergized lines and equipment, even if these could involve potential electric arc hazards.

An estimated 50 percent of the projects involving electric power transmission and distribution involve work on deenergized lines and equipment; all projects involving electric power generation were assumed to involve energized lines or equipment. Thus, the percent of projects potentially affected by the requirements involving determinations associated with electric arc hazards ranges from 50 percent to 100 percent across affected industries depending on the proportion of the work in each industry that involves energized lines or equipment. [2, Appendix C, p. 13–14]

Compliance with the proposed standards would be expected to be achieved through the completion of a single system-wide assessment for each of the affected electric power generation, transmission, or distribution systems, in conjunction with the communication of the relevant results of that assessment to the appropriate persons in charge of specific projects. Contractors would use the necessary information from the system-wide analysis relevant to each particular project to make a determination regarding the appropriate protection to provide employees for each project.

The costs of compliance associated with the proposed requirements to make determinations associated with electric arc hazards were estimated as involving resources (including labor costs or other expenditures) for two activities. First, costs were estimated for conducting and updating a system-wide assessment of potential energy for each utility and other power generator. Second, costs were estimated for making a determination regarding appropriate employee protection, using information from a system-wide assessment, for each affected project.

The cost associated with conducting a system-wide assessment would depend on the size and complexity of the system, which tends to correspond closely to the number of employees working for the company that operates the system. Thus, the costs were estimated on a per-employee basis for each affected utility. The annual cost for each system was estimated as involving resources (including labor costs or other expenditures) equivalent to the cost of 2 hours of an electric power system engineer's time plus 6 minutes of clerical time, per employee of the utility. In their report, CONSAD had estimated that on a per-employee basis the cost of conducting a system-wide assessment would be equivalent to the cost of 3 hours of an engineer's time plus 9 minutes of clerical time [2, Appendix C, pages 13–14]. OSHA revised these estimates downwards by one third to reflect subsequent changes to the proposal that reduced the associated costs.[68] For example, for a utility with 1,000 employees, the estimated annual cost would be equivalent to the cost of 2,000 hours of an engineer's time plus 6,000 minutes of clerical time. OSHA requests comments on the use and accuracy of this approach for purposes of estimating these costs. In particular, the Agency requests comments on whether employers will incur these costs on an annual basis or on a one-time basis, with smaller periodic updates.

Thus, the estimated average cost associated with conducting a system-wide assessment would be about $91 per system employee. For example, the estimated average annual cost for a utility with 100 employees would be $9,100, and the average annual cost for a utility with 1,000 employees would be $91,000.

The cost associated with making a determination regarding the appropriate employee protection, using information from a system-wide assessment, was estimated as involving resources (including labor costs or other expenditures) equivalent to 3 minutes of supervisor time for affected contractors and for each affected project [2, Appendix C, pages 13–14].

Thus, the estimated average cost associated with making a determination regarding the appropriate employee protection, using information from a system-wide assessment, was estimated to $2 per project.

Based on research conducted by CONSAD, OSHA estimates that the determinations that would be required by the proposed standards are already made for most affected projects. An estimated 75 percent of the establishments of utilities and other generators with fewer than 20 employees already perform system-wide assessments regarding the available heat energy to which employees may be exposed. An estimated 85 percent of the establishments of utilities and other generators with 20 or more employees already perform system-wide assessments regarding the available heat energy to which employees may be exposed. For these utilities, no additional costs would be necessary to achieve compliance with the proposed standard's requirement for determining heat energy estimates. [2, Appendix C, p. 13–14]

Among construction contractors, determinations regarding appropriate employee protection are made for an estimated 25 percent of the projects performed by smaller establishments and for an estimated 50 percent of the projects performed by larger contractors. For these projects, no additional costs would be necessary to achieve compliance with the proposed standards. [2, Appendix C, p. 13–14]

The total estimated annual cost of compliance associated with the proposed requirements regarding the determinations associated with electric arc hazards and the corresponding appropriate employee protection was thus estimated to be $11.0 million, as shown in Table V–15. Table V–15 also shows the costs of compliance for each affected industry.

TABLE V–15.—COSTS ASSOCIATED WITH DETERMINING MAXIMUM POTENTIAL HEAT ENERGY AND CORRESPONDING APPROPRIATE EMPLOYEE PROTECTION

| Industry code | Industry name | Projects performed annually | Projects affected (%) | Cost per project | Compliance rate (%) low/high | Annual compliance costs |
|---|---|---|---|---|---|---|
| NAICS 234910 | Water, Sewer, and Pipeline Construction. | 49,019 | 50 | $2 | 25/50 | 23,055 |
| NAICS 234920 | Power and Communication Transmission Line Construction. | 1,282,310 | 50 | 2 | 25/50 | 581,517 |
| NAICS 234930 | Industrial Nonbuilding Structure Construction. | 58,790 | 100 | 2 | 25/50 | 47,048 |
| NAICS 234990 | All Other Heavy Construction | 309,377 | 75 | 2 | 25/50 | 228,773 |
| NAICS 235310 | Electrical Contractors | 939,790 | 60 | 2 | 25/50 | 611,134 |
| NAICS 235910 | Structural Steel Erection Contractors. | 15,889 | 100 | 2 | 25/50 | 16,448 |
| NAICS 235950 | Building Equipment and Other Machine Installation Contractors. | 14,883 | 100 | 2 | 25/50 | 15,407 |
| NAICS 235990 | All Other Special Trade Contractors | 47,250 | 100 | 2 | 25/50 | 54,532 |
| NAICS 221110 | Electric Power Generation | 1,894,521 | 75 | (1) | 75/85 | 2,106,375 |
| NAICS 221120 | Electric Power Transmission, Control, and Distribution. | 3,147,692 | 55 | (1) | 75/85 | 5,900,695 |
| NAICS 2211 | Publicly Owned Utilities | 422,708 | 75 | (1) | 75/85 | 676,998 |
| Various | Industrial Power Generators | 687,667 | 100 | (1) | 85/85 | 778,076 |
| SIC 0783 | Ornamental Shrub and Tree Services. | 2,251,278 | 0 | | | 0 |
| Total | | | | | | 11,040,058 |

[1] **Note:** Costs for utilities include labor costs for performing system-wide assessments regarding potential arc hazards, estimated as $91 per utility employee annually. Costs for contractors reflect labor costs for determining appropriate clothing based on information provided by utilities.

Source: CONSAD [1], Table 5.3 and CONSAD [2], Appendix C, pages 13–14, and OSHA estimates.

[68] After CONSAD completed its report, OSHA added tables to the appendices explaining the proposed protective clothing requirements. Employers may use the heat exposure levels in these tables rather than perform an engineering assessment for portions of their systems that fall within the ranges covered by the tables.

Annual Costs for Providing Flame-Resistant Apparel (FRA) and Other Protective Clothing

The proposed revisions to the OSHA standards addressing electric power generation, transmission, and distribution work include revisions to the requirements addressing the extent of protective clothing that employees must wear. Under the proposed standards, affected employers must provide appropriate protective clothing to employees based on the determination of the hazards that the employees may face.[69]

The average costs associated with providing the clothing that would be necessary to achieve full compliance with the proposed standards were estimated as involving resources equivalent to those associated with the following illustrative case example. An employer could generally be expected to achieve compliance with the proposed standard's clothing provisions by purchasing eight sets of flame-resistant apparel per employee and one switching coat or flash jacket for every three employees.

[69] OSHA has not proposed to require employers to purchase the FRA needed to meet the clothing-related provisions of the proposal. However, for costs purposes, the Agency is assuming that all costs of purchasing FRA will be borne by employers. See the discussion of the issue of whether employers should purchase this clothing in the discussion of proposed § 1926.960(g)(4) in Section IV, Summary and Explanation of Proposed Rule, earlier in this preamble.

A single set of flame-resistant apparel is estimated to cost about $110, and with 8 sets provided for each employee, the useful life of this apparel is expected to be 4 years. A switching coat or flash jacket is estimated to cost about $200 and to have an expected life of 10 years. [2, Appendix C, p. 15–16]

The flame-resistant apparel will generally be substituted for clothing that the employee or the employer would already be providing. The savings associated with no longer needing to purchase and launder the clothing that would otherwise be worn by employees were not included in this analysis.

The flame-resistant apparel provided to employees is generally worn in lieu of clothing that would otherwise be provided by and cared for by the employees themselves, and typically does not require special laundering. Thus, the proposed requirement to provide flame-resistant apparel would not create additional burdens associated with laundering. Employers would not be required under the proposal to launder clothes for employees. To the extent that employers choose to begin laundering clothes or providing laundering services for employees in conjunction with providing flame-resistant apparel for them, the cost would not be attributable to the proposed regulatory requirements, and any such costs would be regarded as transfers from employers to employees rather than additional costs to society.

Based on research conducted by CONSAD, OSHA estimates that most establishments in all affected industries already provide employees with flame-resistant apparel and other required protective clothing that fully complies with the requirements of the proposed standards. [2, Appendix C, pages 15–16] For these establishments, no additional costs would be necessary to achieve compliance.

Rates of current compliance with the proposed requirements were estimated for each affected industry. Within each industry, rates of current compliance were estimated separately for establishments based on their size. Among construction contractors, the estimated average rate of current compliance for establishments with fewer than 20 employees was 50 percent. The average rate of current compliance among construction contractor establishments with 20 or more employees was estimated to be 75 percent. Among electric utilities and other electric power generators, current compliance was estimated to be 80 percent for establishments with fewer than 20 employees and 90 percent for establishments with 20 or more employees. [2, Appendix C, p. 15–16]

The total estimated annual cost of compliance for providing flame-resistant apparel and other protective clothing was thus estimated to be $8.4 million, as shown in Table V–16. Table V–16 also shows the costs of compliance for each affected industry.

TABLE V–16.—COSTS ASSOCIATED WITH PROVIDING FLAME-RESISTANT APPAREL (FRA), SWITCHING COATS, AND FLASH JACKETS

| Industry code | Industry name | Employees affected (%) | Sets of FRA provided per employee | Cost per set of FRA | Useful life of FRA with 8 sets/employee (years) | Switching coat/flash jacket per employee | Cost per switching coat/flash jacket | Useful life of switching coat/flash jacket (years) | Compliance rate (%) low/high | Annual compliance costs |
|---|---|---|---|---|---|---|---|---|---|---|
| NAICS 234910 | Water, Sewer, and Pipeline Construction | 100 | 8 | $110 | 4 | 0.33 | $200 | 10 | 50/75 | $79,174 |
| NAICS 234920 | Power and Communication Transmission Line Construction | 100 | 8 | 110 | 4 | 0.33 | 200 | 10 | 50/75 | 2,071,169 |
| NAICS 234930 | Industrial Nonbuilding Structure Construction | 100 | 8 | 110 | 4 | 0.33 | 200 | 10 | 50/75 | 94,957 |
| NAICS 234990 | All Other Heavy Construction | 100 | 8 | 110 | 4 | 0.33 | 200 | 10 | 50/75 | 499,701 |
| NAICS 235310 | Electrical Contractors | 100 | 8 | 110 | 4 | 0.33 | 200 | 10 | 50/75 | 1,517,936 |
| NAICS 235910 | Structural Steel Erection Contractors | 100 | 8 | 110 | 4 | 0.33 | 200 | 10 | 50/75 | 25,664 |
| NAICS 235950 | Building Equipment and Other Machine Installation Contractors. | 100 | 8 | 110 | 4 | 0.33 | 200 | 10 | 50/75 | 24,039 |
| NAICS 235990 | All Other Special Trade Contractors | 100 | 8 | 110 | 4 | 0.33 | 200 | 10 | 50/75 | 76,318 |
| NAICS 221110 | Electric Power Generation | 100 | 8 | 110 | 4 | 0.33 | 200 | 10 | 80/90 | 1,224,001 |
| NAICS 221120 | Electric Power Transmission, Control, and Distribution | 100 | 8 | 110 | 4 | 0.33 | 200 | 10 | 80/90 | 2,033,643 |
| NAICS 2211 | Publicly Owned Utilities | 100 | 8 | 110 | 4 | 0.33 | 200 | 10 | 80/90 | 273,101 |
| Various | Industrial Power Generators | 100 | 8 | 110 | 4 | 0.33 | 200 | 10 | 90/90 | 444,284 |
| SIC 0783 | Ornamental Shrub and Tree Services | 0 | | | | | | | | 0 |
| Total | | | | | | | | | | 8,363,987 |

Source: CONSAD [2], Appendix 1P. 15–16

Annual Costs for Providing Harnesses for Fall Protection in Aerial Lifts

The proposal includes provisions addressing the equipment that must be used as part of fall arrest systems, fall restraint systems, and work positioning systems. Under the proposal, employees in aerial lifts performing work covered by 29 CFR 1910.269 would no longer be able to use body belts as part of fall arrest systems and would be required to use harnesses; belts would still be allowed to be used under certain circumstances, as part of work positioning systems and fall restraint systems.

The average costs associated with providing harnesses in lieu of belts were estimated to be about $100 per affected employee [2, Appendix C, pages 17–18].

The percentage of the work force that would potentially be affected by the proposed regulatory changes was estimated for each industry. For construction contractors, utilities, and other electric power generators, an estimated 67 percent of the employees who perform electric power generation, transmission, and distribution work are potentially affected. Among employees in the Ornamental Shrub and Tree Services industry who perform line-clearance tree-trimming operations, an estimated 50 percent of the work force would be potentially affected. [2, Appendix C, pages 17–18]

Based on research conducted by CONSAD, OSHA estimates that many establishments in all affectd industries already provide employees with harnesses as required by the applicable provisions in the proposal [2, Appendix C, pages 17–18]. For these establishments, no additional costs would be necessary to achieve compliance with the proposal.

Rates of current compliance with the proposed requirements were estimated for each affected industry. Among construction contractors and utilities, current compliance with the requirement to provide harnesses was estimated to be 100 percent. OSHA already requires the use of harnesses for fall arrest for construction work. The average rate of current compliance among industrial power generators was estimated to be 75 percent. Among employees performing line-clearance tree-trimming operations, current compliance was estimated to be 25 percent for establishments with fewer than 20 employees and 50 percent for establishments with 20 or more employees. [2, Appendix C, p. 17–18]

The total estimated annual cost of compliance for providing harnesses for fall protection in aerial lifts was thus estimated to be $284,000, as shown in Table V–17. Table V–17 also shows the costs of compliance for each affected industry.

TABLE V–17.—COSTS FOR PROVIDING HARNESSES FOR FALL PROTECTION IN AERIAL LIFTS

| Industry code | Industry name | Employees affected (%) | Incremental cost of harness in lieu of belt | Compliance rate (%) low/high | Annual compliance costs |
|---|---|---|---|---|---|
| NAICS 234910 | Water, Sewer, and Pipeline Construction | 67 | $100 | 100/100 | $0 |
| NAICS 234920 | Power and Communication Transmission Line Construction | 67 | 100 | 100/100 | 0 |
| NAICS 234930 | Industrial Nonbuilding Structure Construction | 67 | 100 | 100/100 | 0 |
| NAICS 234990 | All Other Heavy Construction | 67 | 100 | 100/100 | 0 |
| NAICS 235310 | Electrical Contractors | 67 | 100 | 100/100 | 0 |
| NAICS 235910 | Structural Steel Erection Contractors | 67 | 100 | 100/100 | 0 |
| NAICS 235950 | Building Equipment and Other Machine Installation Contractors | 67 | 100 | 100/100 | 0 |
| NAICS 235990 | All Other Special Trade Contractors | 67 | 100 | 100/100 | 0 |
| NAICS 221110 | Electric Power Generation | 67 | 100 | 100/100 | 0 |
| NAICS 221120 | Electric Power Transmission, Control, and Distribution | 67 | 100 | 100/100 | 0 |
| NAICS 2211 | Publicly Owned Utilities | 67 | 100 | 100/100 | 0 |
| Various | Industrial Power Generators | 67 | 100 | 75/75 | 67,422 |
| SIC 0783 | Ornamental Shrub and Tree Services | 50 | 100 | 25/50 | 216,578 |
| Total | | | | | 284,000 |

[1] Source: CONSAD [2], Appendix C, p. 17–18.

*H. Economic Feasibility and Impacts*

This section of the preliminary analysis presents OSHA's analysis of the economic impacts of the proposal, and an assessment of the economic feasibility of compliance with the requirements imposed by the rulemaking.

A separate analysis of the potential economic impacts on small entities (as defined in accordance with the criteria established by the Small Business Administration (SBA)) and on very small establishments (defined as those with fewer than 20 employees) is presented in the following section as part of the Initial Regulatory Flexibility Analysis, as required by the Regulatory Flexibility Act.

In order to assess the nature and magnitude of the economic impacts associated with compliance with the proposal, OSHA developed quantitative estimates of the potential economic impact of the requirements on entities in each of the affected industry sectors. The estimated costs of compliance presented previously in this economic analysis were compared with industry revenues and profits to provide an assessment of potential economic impacts.

Table V–18 presents data on the revenues associated with electric power generation, transmission, and distribution work for each affected industry sector, along with the corresponding industry profits and the estimated costs of compliance in each sector.

TABLE V–18.—POTENTIAL ECONOMIC IMPACTS

| Industry code | Industry name | Compliance costs | Comparable industry revenues | Comparable industry profits | Costs as a percent of revenues | Costs as a percent of profits |
|---|---|---|---|---|---|---|
| NAICS 234910 | Water, Sewer, and Pipeline Construction. | $253,089 | $157,458,000 | $8,817,648 | 0.16 | 2.87 |

TABLE V–18.—POTENTIAL ECONOMIC IMPACTS—Continued

| Industry code | Industry name | Compliance costs | Comparable industry revenues | Comparable industry profits | Costs as a percent of revenues | Costs as a percent of profits |
|---|---|---|---|---|---|---|
| NAICS 234920 | Power and Communication Transmission Line Construction. | 5,358,702 | 3,118,256,000 | 174,622,336 | 0.17 | 3.07 |
| NAICS 234930 | Industrial Nonbuilding Structure Construction. | 302,077 | 1,732,944,000 | 84,914,256 | 0.02 | 0.36 |
| NAICS 234990 | All Other Heavy Construction | 1,663,721 | 1,033,946,000 | 50,663,354 | 0.16 | 3.28 |
| NAICS 235310 | Electrical Contractors | 4,975,533 | 2,055,435,000 | 123,326,100 | 0.24 | 4.03 |
| NAICS 235910 | Structural Steel Erection Contractors. | 91,676 | 119,735,000 | 6,226,000 | 0.08 | 1.47 |
| NAICS 235950 | Building Equipment and Other Machine Installation Contractors. | 87,741 | 113,999,000 | 3,647,968 | 0.08 | 2.41 |
| NAICS 235990 | All Other Special Trade Contractors. | 279,136 | 160,909,000 | 7,401,814 | 0.17 | 3.77 |
| NAICS 221110 | Electric Power Generation | 5,026,324 | 69,385,043,000 | 6,730,349,171 | 0.01 | 0.07 |
| NAICS 221120 | Electric Power Transmission, Control, and Distribution. | 11,787,197 | 176,509,052,000 | 17,121,378,044 | 0.01 | 0.07 |
| NAICS 2211 | Publicly Owned Utilities | 1,380,186 | 25,075,725,000 | | 0.01 | |
| Various | Industrial Power Generators | 1,761,391 | 2,630,428,000 | | 0.07 | |
| SIC 0783 | Ornamental Shrub and Tree Services. | 976,559 | 2,100,129,000 | 149,109,159 | 0.05 | 0.65 |
| Total | | 33,943,333 | 284,193,059,000 | 24,460,456,070 | 0.01 | 0.14 |

Source: CONSAD [2], Table 6.3 and Appendix C, adjusted for revised cost estimates.

As evident from the data presented in Table V–18, the costs of compliance with the proposed rulemaking are not large in relation to the corresponding annual financial flows associated with the regulated activities. The estimated costs of compliance represent about 0.01 percent of revenues and 0.14 percent of profits on average across all entities; compliance costs do not represent more than 0.24 percent of revenues or more than 4.03 percent of profits in any affected industry.

The economic impact of the proposal is most likely to consist of a small increase in prices for electricity, of about 0.01 percent on average. It is unlikely that a price increase on the magnitude of 0.01 percent will significantly alter the services demanded by the public or any other affected customers or intermediaries. If the compliance costs of the proposal can be substantially recouped with such a minimal increase in prices, there may be little effect on profits.

In general, for most establishments, it would be very unlikely that none of the compliance costs could be passed along in the form of increased prices. In the event that unusual circumstances may inhibit even a price increase of 0.01 percent to be realized, profits in any of the affected industries would be reduced by a maximum of about 4 percent.

In profit-earning entities, compliance costs can generally be expected to be absorbed through a combination of increases in prices or reduction in profits. The extent to which the impacts of cost increases affect prices or profits depends on the price elasticity of demand for the products or services produced and sold by the entity.

Price elasticity of demand refers to the relationship between changes in the price charged for a product and the resulting changes in the demand for that product. A greater degree of elasticity of demand implies that an entity or industry is less able to pass increases in costs through to its customers in the form of a price increase and must absorb more of the cost increase through a reduction in profits.

In the case of cost increases that may be incurred due to the requirements of the proposal, all businesses within each of the covered industry sectors would be subject to the same requirements. Thus, to the extent potential price increases correspond to costs associated with achieving compliance with the standards, the elasticity of demand for each entity will approach that faced by the industry as a whole.

Given the small incremental increases in prices potentially resulting from compliance with the proposed standards and the lack of readily available substitutes for the products and services provided by the covered industry sectors, demand is expected to be sufficiently inelastic in each affected industry to enable entities to substantially offset compliance costs through minor price increases without experiencing any significant reduction in total revenues or in net profits.

For the economy as a whole, OSHA expects the economic impact of the proposed rulemaking to be both an increase in the efficiency of production of goods and services and an improvement in the welfare of society.

First, as demonstrated by the analysis of costs and benefits associated with compliance with the requirements of the rule, OSHA expects that societal welfare will increase as a result of these standards, as the benefits achieved clearly and strongly justify the relatively small costs necessary. The impacts of the proposal involve net benefits of over $100 million that are achieved in a relatively cost-effective manner.

Second, many of the costs associated with the injuries and fatalities resulting from the risks addressed by the proposal have until now been externalized. That is, the costs incurred by society to supply certain products and services associated with electric power generation, transmission, and distribution work have not been fully reflected in the prices of those products and services. The costs of production have been partly borne by workers who suffer the consequences associated with the activities causing the risks. To the extent that fewer of these costs are externalized, the price mechanism will enable the market to result in a more efficient allocation of resources. It should be noted that reductions in externalities by themselves do not necessarily increase efficiency or social welfare unless the costs of achieving the reductions are outweighed by the associated benefits.

OSHA concludes that compliance with the requirements of the proposal is economically feasible in every affected industry sector. This conclusion is based on the criteria established by the OSH Act, as interpreted in relevant case law.

In general, the courts have held that a standard is economically feasible if there is a reasonable likelihood that the estimated costs of compliance ‘‘will not threaten the existence or competitive structure of an industry, even if it does portend disaster for some marginal firms'' [*United Steelworkers of America* v. *Marshall,* 647 F.2d 1189, 1272 (D.C. Cir. 1980)]. As demonstrated by this preliminary regulatory impact analysis and the supporting evidence, the potential impacts associated with achieving compliance with the proposal fall far within the bounds of economic feasibility in each industry sector. OSHA does not expect compliance with the requirements of the proposal to threaten the viability of entities or the existence or competitive structure of any of the affected industry sectors.

In addition, based on an analysis of the costs and economic impacts associated with this rulemaking, OSHA preliminarily concludes that the effects of the proposal on international trade, employment, wages, and economic growth for the United States would be negligible.

Statement of Energy Effects

As required by Executive Order 13211, and in accordance with the guidance for implementing Executive Order 13211 and with the definitions provided therein as prescribed by the Office of Management and Budget, OSHA has analyzed the proposed standard with regard to its potential to have a significant adverse effect on the supply, distribution, or use of energy.

As a result of this analysis, OSHA has determined that this action is not a significant energy action as defined by the relevant OMB guidance.

*I. Initial Regulatory Flexibility Analysis*

The Regulatory Flexibility Act, as amended in 1996, requires the preparation of an Initial Regulatory Flexibility Analysis (IRFA) for certain proposed rules (5 U.S.C. 601–612). Under the provisions of the law, each such analysis shall contain:

1. A description of the impact of the proposed rule on small entities;
2. A description of the reasons why action by the agency is being considered;
3. A succinct statement of the objectives of, and legal basis for, the proposed rule;
4. A description of and, where feasible, an estimate of the number of small entities to which the proposed rule will apply;
5. A description of the projected reporting, recordkeeping and other compliance requirements of the proposed rule, including an estimate of the classes of small entities which will be subject to the requirements and the type of professional skills necessary for preparation of the report or record;
6. An identification, to the extent practicable, of all relevant Federal rules which may duplicate, overlap or conflict with the proposed rule; and
7. A description and discussion of any significant alternatives to the proposed rule which accomplish the stated objectives of applicable statutes and which minimize any significant economic impact of the proposed rule on small entities, including

(a) The establishment of differing compliance or reporting requirements or timetables that take into account the resources available to small entities;

(b) The clarification, consolidation, or simplification of compliance and reporting requirements under the rule for such small entities;

(c) The use of performance rather than design standards; and

(d) An exemption from coverage of the rule, or any part thereof, for such small entities.

The Regulatory Flexibility Act further states that the required elements of the IRFA may be performed in conjunction with or as part of any other agenda or analysis required by any other law if such other analysis satisfies the relevant provisions.

1. Impact of the proposed rule on small entities.

OSHA has analyzed the potential impact of the proposed standards on small entities, as described below.

The total annual cost of compliance with the proposal for small entities is estimated to be $15.2 million [2, Table 5.7]. These costs were calculated by provision, by industry, and by size of establishment, as described in the cost of compliance section of this economic analysis.

To assess the potential economic impact of the proposal on small entities, OSHA calculated the ratios of compliance costs to profits and to revenues. These ratios are presented for each affected industry in Table V–19. OSHA expects that among small entities potentially affected by the proposal, the average increase in prices necessary to completely offset the compliance costs would be less than 0.3 percent in each affected industry.

TABLE V–19.—POTENTIAL ECONOMIC IMPACTS ON SMALL ENTITIES

| Industry code | Industry name | Compliance costs per firm | Compliance costs as a percent of sales | Compliance costs as a percent of profits |
|---|---|---|---|---|
| NAICS 234910 | Water, Sewer, and Pipeline Construction | $179 | 0.15 | 4.27 |
| NAICS 234920 | Power and Communication Transmission Line Construction | 1,142 | 0.16 | 4.58 |
| NAICS 234930 | Industrial Nonbuilding Structure Construction | 590 | 0.02 | 0.30 |
| NAICS 234990 | All Other Heavy Construction | 1,377 | 0.15 | 2.34 |
| NAICS 235310 | Electrical Contractors | 2,085 | 0.24 | 5.31 |
| NAICS 235910 | Structural Steel Erection Contractors | 89 | 0.07 | 1.45 |
| NAICS 235950 | Building Equipment and Other Machine Installation Contractors | 51 | 0.08 | |
| NAICS 235990 | All Other Special Trade Contractors | 79 | 0.16 | 3.35 |
| NAICS 221110 | Electric Power Generation | 1,917 | 0.01 | 0.09 |
| NAICS 221120 | Electric Power Transmission, Control, and Distribution | 1,917 | 0.01 | 0.09 |
| NAICS 2211 | Publicly Owned Utilities | 2,444 | 0.00 | |
| Various | Industrial Power Generators | 2,655 | 0.07 | |
| SIC 0783 | Ornamental Shrub and Tree Services | 545 | 0.04 | 0.62 |

Source: CONSAD [2], Table 6.4, adjusted for revised cost estimates.

Only to the extent that such price increases are not possible would there be any effect on the average profits of small entities. Even in the unlikely event that no costs could be passed through, the compliance costs could be completely absorbed through an average reduction in profits of less than 3 percent in most affected industries, and through an average reduction in profits of less than 6 percent in all affected industries.

In order to further ensure that potential impacts on small entities were fully analyzed and considered, OSHA also separately examined the potential impacts of the proposed standards on very small entities, defined as those with fewer than 20 employees.

To assess the potential economic impact of the proposed standards on very small entities, OSHA calculated the ratios of compliance costs to profits and to revenues. These ratios are presented for each affected industry in Table V–20. OSHA expects that among very small entities potentially affected by the proposed standards, the average increase in prices necessary to completely offset the compliance costs would be 0.4 percent or less in each affected industry.

TABLE V–20.—POTENTIAL ECONOMIC IMPACTS ON VERY SMALL ENTITIES

[Those with fewer than 20 employees]

| Industry code | Industry name | Compliance costs per firm | Compliance costs as a percent of sales | Compliance costs as a percent of profits |
|---|---|---|---|---|
| NAICS 234910 | Water, Sewer, and Pipeline Construction | $131 | 0.24 | 4.49 |
| NAICS 234920 | Power and Communication Transmission Line Construction | 679 | 0.28 | 5.63 |
| NAICS 234930 | Industrial Nonbuilding Structure Construction | 70 | 0.03 | 3.43 |
| NAICS 234990 | All Other Heavy Construction | 1,236 | 0.26 | 31.67 |
| NAICS 235310 | Electrical Contractors | 1,623 | 0.35 | 4.84 |
| NAICS 235910 | Structural Steel Erection Contractors | 72 | 0.12 | 11.00 |
| NAICS 235950 | Building Equipment and Other Machine Installation Contractors | 48 | 0.13 | 7.39 |
| NAICS 235990 | All Other Special Trade Contractors | 74 | 0.20 | 6.25 |
| NAICS 221110 | Electric Power Generation | 546 | 0.01 | 0.09 |
| NAICS 221120 | Electric Power Transmission, Control, and Distribution | 392 | 0.01 | 0.09 |
| NAICS 2211 | Publicly Owned Utilities | 160 | 0.00 | |
| Various | Industrial Power Generators | | | |
| SIC 0783 | Ornamental Shrub and Tree Services | 664 | 0.11 | 1.41 |

Source: CONSAD [2], Table 6.3, adjusted for revised cost estimates.

Only to the extent that such price increases are not possible would there be any effect on the average profits of small entities. Even in the unlikely event that no costs could be passed through, the compliance costs could be completely absorbed through an average reduction in profits of 11 percent or less in all affected industries except NAICS 2349–90, All Other Heavy Construction.

In the All Other Heavy Construction industry, the reported profit rate for very small entities is extraordinarily low, which causes the compliance costs to appear relatively large in relation to profits. The average costs of compliance for very small entities in this industry represent less than 0.3 percent of corresponding revenues. OSHA anticipates that the compliance costs will be recouped through price increases of less than 0.3 percent, leaving profits unaffected. OSHA requests comments regarding the estimated economic impacts of the proposed standard on this industry.

2. A description of the reasons why action by the agency is being considered.

Employees performing work involving electric power generation, transmission, and distribution are exposed to a variety of significant hazards, such as electric shock, fall, and burn hazards, that can and do cause serious injury and death. OSHA estimates that 444 serious injuries and 74 fatalities occur annually among these workers.

Although some of these incidents may have been prevented with better compliance with existing safety standards, research and analyses conducted by OSHA have found that many preventable injuries and fatalities would continue to occur even if full compliance with the existing standards were achieved. Without counting incidents that would potentially have been prevented with compliance with existing standards, an estimated additional 116 injuries and 19 fatalities would be prevented annually through full compliance with the proposed standards.

As explained above, additional benefits associated with this rulemaking involve providing updated, clear, and consistent safety standards regarding electric power generation, transmission, and distribution work to the relevant employers, employees, and interested members of the public. The existing OSHA standards for the construction of electric power transmission and distribution systems are over 30 years old and inconsistent with the more recently promulgated standards addressing repair and maintenance work. OSHA believes that the proposed updated standards are easier to understand and to apply and will benefit employers and employees by facilitating compliance while improving safety.

3. Statement of the objectives of, and legal basis for, the proposed rule.

The primary objective of the proposed standards is to provide an increased degree of occupational safety for employees performing electric power generation, transmission, and distribution work. As stated above, an estimated 116 injuries and 19 fatalities would be prevented annually through compliance with the proposed standards in addition to those that may be prevented through compliance with existing standards.

Another objective of the proposed rulemaking is to provide updated, clear, and consistent safety standards regarding electric power generation, transmission, and distribution work to the relevant employers, employees, and interested members of the public. The proposed updated standards are easier to understand and to apply, and they will benefit employers by facilitating compliance while improving safety.

The legal basis for the rule is the responsibility given the Department of Labor through the Occupational Safety and Health (OSH) Act of 1970. The OSH Act authorizes and obligates the Secretary of Labor to promulgate mandatory occupational safety and health standards as necessary ‘‘to assure so far as possible every working man and woman in the Nation safe and healthful working conditions and to preserve our human resources.’’ 29 U.S.C. 651(b). The legal authority can also be cited as 29 U.S.C. 655(b); 40 U.S.C. 333.

4. Description of and estimate of the number of small entities to which the proposed rule will apply.

OSHA has completed a preliminary analysis of the impacts associated with this proposal, including an analysis of the type and number of small entities to which the proposed rule would apply. In order to determine the number of small entities potentially affected by this rulemaking, OSHA used the definitions of small entities developed by the SBA for each industry.

For the construction industry, SBA defines small businesses using revenue-based criteria. Specifically, for the four heavy construction industries (NAICS 2349–10, 2349–20, 2349–30, and 2349–90), firms with annual revenues of less than $28.5 million are classified as small businesses. For specialty contractors (NAICS 2353–10, 2359–10, 2359–50, and 2359–90), firms with annual revenues of less than $12 million are considered to be small businesses. For SIC 0783, Ornamental Shrub and Tree Services, firms with annual revenues of less than $5 million are considered to be small businesses. For electric utilities (NAICS 2211), the SBA defines small businesses using power production or transmission-based criteria. Specifically, firms that produce or transmit less than 4 million megawatt hours annually are considered to be small businesses.

The proposed standards would primarily impact firms performing construction, maintenance, and repair work on power generation, transmission, and distribution facilities, lines, and equipment. Based on the definitions of small entities developed by SBA for each industry, the proposal is estimated to potentially affect a total of 12,619 small entities.

The estimated number of potentially affected small entities in each industry is presented in Table V–21. As shown in this table, of the 12,619 small entities potentially affected, an estimated 2,661 entities are in the Power and Communication Transmission Line Construction industry, an estimated 2,552 entities are in the All Other Special Trade Contractors industry, an estimated 1,577 entities are in the Electrical Contractors industry, and an estimated 1,336 entities are in the Electric Power Transmission, Control, and Distribution industry.

TABLE V–21.—PROFILE OF POTENTIALLY AFFECTED SMALL ENTITIES

| Industry code | Industry name | Potentially affected small entities (SBA definitions) | Potentially affected establishments with fewer than 20 employees |
|---|---|---|---|
| NAICS 234910 | Water, Sewer, and Pipeline Construction | 797 | 629 |
| NAICS 234920 | Power and Communication Transmission Line Construction | 2,661 | 2,198 |
| NAICS 234930 | Industrial Nonbuilding Structure Construction | 253 | 118 |
| NAICS 234990 | All Other Heavy Construction | 624 | 571 |
| NAICS 235310 | Electrical Contractors | 1,577 | 1,435 |
| NAICS 235910 | Structural Steel Erection Contractors | 621 | 504 |
| NAICS 235950 | Building Equipment and Other Machine Installation Contractors. | 714 | 748 |
| NAICS 235990 | All Other Special Trade Contractors | 2,552 | 2,418 |
| NAICS 221110 | Electric Power Generation | 376 | 902 |
| NAICS 221120 | Electric Power Transmission, Control, and Distribution | 1,336 | 3,203 |
| NAICS 2211 | Publicly Owned Utilities | 262 | 33 |
| Various | Industrial Power Generators | 594 | 0 |
| SIC 0783 | Ornamental Shrub and Tree Services | 252 | 100 |
| Total | | 12,619 | 12,859 |

Source: CONSAD [1]. Table 6.2 and Appendix C, pages 1–2.

5. Description of the projected reporting, recordkeeping and other compliance requirements of the proposed rule.

OSHA is proposing to revise the standards addressing the work practices to be used, and other requirements to be followed, for the operation and maintenance of, and for construction work involving, electric power generation, transmission, and distribution installations. The existing rules for this type of work were issued in 1972 for construction work and in 1994 for work covered by general industry standards. The construction standards, in particular, are out of date and are not consistent with the more recent, corresponding general industry rules for the operation and maintenance of electric power generation, transmission, and distribution systems. As described in detail earlier, this proposal will make the construction and general industry standards for this type of work the same.

Existing § 1910.269 contains requirements for the maintenance and operation of electric power generation, transmission, and distribution installations. Section 29 CFR 1910.269 is primarily a work-practices standard. Its requirements are based on recognized safe industry practices as reflected in current national consensus standards covering this type of work, such as the National Electrical Safety Code (ANSI/IEEE C2). OSHA promulgated this standard in 1994.

Section 29 CFR 1910.269 contains provisions intended to protect employees from the most serious hazards they face in performing this type of work, primarily, those causing falls, burns, and electric shocks. The requirements in this standard cover training and job briefings, working near energized parts, deenergizing lines and equipment and grounding them for employee protection, work on underground and overhead installations, work in power generating stations and substations, work in enclosed spaces, and other special conditions and equipment unique to the generation, transmission, and distribution of electric energy.

OSHA is also proposing to extend its general industry standard on electrical protective equipment to the construction industry. The current construction standards for the design of electrical protective equipment, which apply only to electric power transmission and distribution work, adopt several national consensus standards by reference. The proposed new standard would replace the incorporation of these out-of-date consensus standards with a set of performance-oriented requirements that are consistent with the latest revisions of these consensus standards and with the corresponding standard for general industry. Additionally, OSHA is proposing new requirements for the safe use and care of electrical protective equipment to complement the equipment design provisions. The new standard, which will apply to all construction work, will update the existing OSHA industry-specific standards and will prevent accidents caused by inadequate electrical protective equipment.

As discussed in detail earlier, this transfer to the construction standards of the existing general industry standards (electrical protective equipment and 29 CFR 1910.269) is not expected to impose a significant burden on employers. Generally, many employers doing construction work also do general industry work, and thus OSHA believes that they would already be following the updated general industry standards in all of their work. The proposed standards for construction are also consistent with the latest national consensus standards.

OSHA is also proposing miscellaneous changes to the two corresponding general industry standards. These changes address: Class 00 rubber insulating gloves; electrical protective equipment made from materials other than rubber; training for electric power generation, transmission, and distribution workers; host-contractor responsibilities; job briefings; fall protection; insulation and working position of employees working on or near live parts; protective clothing; minimum approach distances; deenergizing transmission and distribution lines and equipment; protective grounding; operating mechanical equipment near overhead power lines; and working in manholes and vaults.

These changes to the general industry standards, because they apply also to construction, would ensure that employers, where appropriate, face consistent requirements for work performed under the construction and general industry standards and would further protect employees performing electrical work covered under the general industry standards. The proposal would also update references to consensus standards in 29 CFR 1910.137 and 29 CFR 1910.269 and would add a new appendix to help employers comply with the new clothing provisions.

Section IV, Summary and Explanation of Proposed Rule, earlier in this preamble, provides further detail regarding the new and revised provisions of the proposed rulemaking in. A description of the classes of small entities which would be subject to the new and revised requirements, and the type of professional skills necessary for compliance with the requirements, is presented in the preceding sections of this economic analysis.

6. Federal rules which may duplicate, overlap or conflict with the proposed rule.

OSHA has not identified any Federal rules which may duplicate, overlap, or conflict with the proposal, and requests comments from the public regarding this issue.

OSHA does not believe that the proposed provisions on host-contractor responsibilities duplicate or overlap OSHA's multi-employer citation policy (CPL 02–00–124). Section IV, Summary and Explanation of Proposed Rule, earlier in this preamble, provides clarification of the intent and application of the host-contractor requirements and their relationship to OSHA's multi-employer citation policy.

It is not OSHA's intent that the provisions on host-contractor responsibilities would affect in any way the employer-employee relationship under the Fair Labor Standards Act or under the Internal Revenue Service regulations. The OSHA requirements are not intended to establish an employer-employee relationship with contractors or employees of contractors, as defined by the relevant statutes and regulations.

7. Alternatives to the proposed rule which accomplish the stated objectives of applicable statutes and which minimize any significant economic impact of the proposed rule on small entities.

OSHA evaluated many alternatives to the proposed standards to ensure that the proposed requirements would accomplish the stated objectives of applicable statutes and would minimize any significant economic impact of the proposal on small entities.

In developing the proposal, and especially in establishing compliance or reporting requirements or timetables that affect small entities, the resources available to small entities were taken into account. Compliance and reporting requirements under the proposal applicable to small entities were clarified, consolidated, and simplified to the extent practicable. Wherever possible, OSHA has proposed the use of performance rather than design standards. An exemption from coverage of the rule for small entities was not considered to be a viable option because the safety and health of the affected employees would be unduly jeopardized.

Many other specific alternatives to the proposed requirements were considered. Section IV, Summary and Explanation of Proposed Rule, earlier in this preamble, provides discussion and explanation of the particular requirements of the proposal.

Other regulatory alternatives considered were those raised by the Small Business Advocacy Review Panel, which was convened for purposes of soliciting comments on the proposal from affected small entities. A discussion of these alternatives is provided later in this economic analysis.

Nonregulatory alternatives were also considered in determining the appropriate approach to reducing occupational hazards associated with electric power generation, transmission, and distribution work. These alternatives were discussed in the section of this economic analysis entitled ''Examination of Alternative Approaches,'' earlier in this preamble.

## Alternatives Considered and Changes Made in Response to Comments From Small Entity Representatives and Recommendations From the Small Business Advocacy Review Panel

On May 1, 2003, OSHA convened a Small Business Advocacy Review Panel (SBAR Panel or Panel) for this rulemaking in accordance with the provisions of the Small Business Regulatory Enforcement Fairness Act of 1996 (Pub. L. 104–121), as codified at 5 U.S.C. 601 *et seq.*

The SBAR Panel consisted of representatives of OSHA, of the Office of Information and Regulatory Affairs (OIRA) in the Office of Management and Budget, and of the Office of Advocacy within the U.S. Small Business Administration. The Panel received oral and written comments on a draft proposal and a draft economic analysis from small entities that would potentially be affected by this rulemaking. The Panel, in turn, prepared a written report, which was delivered to the Assistant Secretary for Occupational Safety and Health [3]. The report summarized the comments received from the small entities, and included recommendations from the Panel to OSHA regarding the proposal and the associated analysis of compliance costs.

Table V–22 lists each of the recommendations made by the Panel and describes the corresponding answers or changes made by OSHA in response to the issues raised.

TABLE V–22.—PANEL RECOMMENDATIONS AND OSHA RESPONSES

| Panel recommendations | OSHA responses |
|---|---|
| 1. The Small Entity Representatives (SERs) generally felt that OSHA had underestimated the costs and may have overestimated the benefits in its preliminary economic analysis. The Panel recommends that OSHA revise its economic and regulatory flexibility analysis as appropriate, and that OSHA specifically discuss the alternative estimates and assumptions provided by SERs and compare them to OSHA's revised estimates. | OSHA revised its economic and regulatory flexibility analysis as appropriate in light of the additional information received from the SERs. Many of the comments from the SERs asserting deficiencies in the estimates of the compliance costs were the result of differing interpretations of what would have to be done in order to achieve compliance with particular requirements.<br>Some SERs felt that OSHA had underestimated the time and resources that would be necessary to develop and maintain written records associated with requirements for making determinations regarding training and protective clothing, for documenting employee training, and for communicating with host employers or contractors about hazards and appropriate safety practices. OSHA has clarified that written records are not in fact required to achieve compliance with these provisions of the proposed standards.<br>In some cases, the SERs also interpreted the draft requirements associated with job briefings, host/contractor responsibilities, and electric arc hazard calculations in ways that would involve higher compliance costs than those estimated by OSHA, but that were not consistent with the way in which OSHA intended for compliance to be achieved. In these cases, OSHA clarified what would be necessary to comply with the standards such that the corresponding potential cost and impact concerns raised by the SERs would be alleviated.<br>With regard to the cost of training that would be necessary for employees who currently are not covered by the existing training requirements in 29 CFR 1910.269, OSHA revised its compliance cost calculations to reflect that an additional 24.75 hours of training per employee newly covered by the training currently required by 29 CFR 1910.269 would be necessary to comply with the proposed standard for construction.<br>The SERs generally indicated that the job briefing requirements of the proposed standards are generally consistent with current practices, and that 5 minutes for the additional job briefing requirements per project would be a reasonable estimate for the amount of time that would be involved. For purposes of estimating compliance costs with the proposal in this preliminary analysis, OSHA used estimates of current compliance of 85 percent to 95 percent, and estimated that 5 minutes of supervisor time and 5 minutes of employee time would be involved per affected project.<br>With regard to the cost associated with providing flame resistant apparel to employees, in general the SERs suggested that OSHA's estimate of two sets per employee per year for small establishments, and five sets per employees every five years for large establishments, was an underestimate. The SERs also gave OSHA broad estimates of FRA, ranging from $50 per shirt to $150 for switching flash jackets. Several SERs agreed that many companies contract out clothing supplies and laundering with uniform companies. In this preliminary analysis of compliance costs associated with the requirements to provide FRA, OSHA estimates that, on average, 8 sets of FRA clothing would be provided per employee, and that with 8 sets per employee the useful life of the FRA would average 4 years. The cost per set of FRA was estimated to be $110. Laundering costs were excluded since the FRA is worn in lieu of street clothes, and laundering would be needed whether the clothing was FRA, street clothing, or any other type of clothing. Additionally, the proposal does not require employers to launder the FRA.<br>For employees who are currently provided the training required by the existing 29 CFR 1910.269 standard, OSHA notes and has clarified that training that was deemed sufficient for compliance with 29 CFR 1910.269 will be considered sufficient for compliance with the proposal to allow employers to tailor their training to the risk faced by employees. OSHA has included, however, the cost of providing 1.5 hours of additional training per employee in the first year for current employees and 0.75 hours of additional training for new employees in the estimation of the compliance costs associated with the proposed standards. |

TABLE V–22.—PANEL RECOMMENDATIONS AND OSHA RESPONSES—Continued

| Panel recommendations | OSHA responses |
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| 2. In its economic and RFA analyses, OSHA assumed that all affected firms apply existing 29 CFR 1910.269 to construction related activities, even though not required to do so. The reason OSHA made this assumption is OSHA though that all affected firms are either covered solely by 29 CFR 1910, or engage in both 29 CFR 1910 and 29 CFR 1926 activities, and find it easiest to adopt the general industry standard for all activities. SERs confirmed that most firms do in fact follow 29 CFR 1910.269. However, they also pointed out that there are some firms that are engaged solely in construction activities and thus may not be following the 29 CFR 1910 standards. The Panel recommends that OSHA revise its economic and regulatory flexibility analyses to reflect the costs associated with some firms coming into compliance with 29 CFR 1910.269. The SERs also reported that compliance training under 29 CFR 1910.269 is extensive. One SER estimated that in excess of 30 hours per employee is necessary in the first year. The Panel recommends that OSHA consider the SER comments on training and revise its estimate of training costs as necessary. | OSHA has revised its economic and regulatory flexibility analyses to reflect the costs associated with some firms coming into compliance with 29 CFR 1910.269.<br>Specifically, OSHA estimated that these firms would incur compliance costs equivalent to those incurred by firms who were affected by the new requirements of 29 CFR 1910.269 when it was originally promulgated in 1994.<br>In addition, OSHA considered the SER comments on training and revised its estimate of training costs accordingly. OSHA added a separate training cost for firms who are not currently covered by the existing training requirements in 29 CFR 1910.269, as presented in the compliance cost chapter of this economic analysis. |
| 3. Most SERs were concerned that a ''performance standard'' such as this means that even in cases where OSHA does not require recordkeeping, such as for training, many small entities will find recordkeeping (1) useful for internal purposes and (2) virtually the only way they will be able to demonstrate compliance with the rule. The Panel recommends that OSHA consider whether recordkeeping is necessary to demonstrate compliance with the standard, and, if not, that OSHA explicitly discuss ways in which employers can demonstrate compliance without using recordkeeping. | The proposal would not require employers to maintain records of training. Employees themselves can attest to the training they have received, and OSHA will determine compliance with the training requirements primarily through employee interviews. |
| 4. SERs pointed out that the requirements for observation and follow-up would result in paperwork and reporting requirements not presented in the cost analysis. The Panel recommends that OSHA include such costs and paperwork burdens in its economic analysis as appropriate. | The proposal would not require host employers to observe contract employees. Rather, it would require host employers to report to the contract employer violations of the standard's work practice requirements by contract employees that the host employer observes in the normal course of conducting their own operations. For example, a host employer may observe contract employees during a quality control check of the contractor's work or while employees of the host employer are working on a project alongside employees of the contract employer. Consequently, OSHA has not included a cost for conducting observations.<br>OSHA has eliminated the draft requirement for the host employer ''to note any failures of the contract employer to correct such violations, take appropriate measures to correct the violations, and consider the contract employer's failure to correct violations in evaluating the contract employer.'' The proposal would require the contract employer to report to the host contractor any measures taken to correct reported violations. Thus, OSHA has not included costs for the host employer to follow up to ensure that the contract employer has corrected any violations.<br>OSHA has included estimates of the costs of information collection requirements and of the associated paperwork burdens in the paperwork analysis for the proposal. |
| 5. Several SERs argued that requiring consideration of safety records would restrict the number of eligible contractors, resulting in both increased costs and potential impacts on small firms. Several SERs also were concerned that the draft requirement would result in the increased use of methods such as pre-qualification in the hiring of contractors or would increase reliance on favored contractors; the SERs said that both of these effects could result in increased costs and restricted business opportunities, especially for small businesses. The Panel recommends that OSHA study the extent of such costs and impacts and solicit comment on them. | OSHA has eliminated the draft requirement for the host employer to obtain and evaluate information on contractors' safety performance and programs. Consequently, the preliminary regulatory flexibility analysis does not include costs associated with this draft provision. However, the Agency requests comments on the need for such a requirement and on the associated costs and restricted business opportunities, particularly with respect to small businesses. |
| 6. Several SERs questioned OSHA's estimates of the number of sets of flame resistant clothing an employee would need, and its assumptions and cost estimates. The panel recommends that OSHA reexamine its assumptions and cost estimates in light of these comments. | OSHA has reexamined its assumptions and cost estimates with regard to the requirements to provide flame-resistant clothing. The comments from the SERs and OSHA's revised estimates are described in response to Panel recommendation 1 above. |

TABLE V–22.—PANEL RECOMMENDATIONS AND OSHA RESPONSES—Continued

| Panel recommendations | OSHA responses |
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| 7. Many SERs questioned whether the new revisions to 29 CFR 1910.269 would in fact save any lives or prevent any accidents. Some commented that they had never seen an accident that would have been prevented by any of the new provisions. Some SERs suggested that OSHA's analysis might have included fatalities in municipal facilities that may not be covered by the standard. Others suggested OSHA should discuss the extent to which the existing general industry standard had resulted in reduced fatalities and injuries, and how this compares with OSHA estimates of how many fatalities and injuries would be prevented by the proposal. The Panel recommends that OSHA provide more documentation regarding the sources and nature of the anticipated benefits attributed to the draft proposal. The estimated benefits should also be reexamined in light of the SER comments and experiences regarding the perceived effectiveness of the new provisions. In particular, OSHA should focus attention on the benefits associated with the provisions on flame retardant apparel, training, host/contractor responsibilities, and fall protection. | OSHA has collected and compiled information from a variety of sources to document and support the need for the provisions of the proposed standards. Data on the fatalities and injuries that have occurred among the affected work force over the past decade has been analyzed specifically with regard to the effectiveness of both the existing and proposed requirements in preventing such incidents. This evaluation is summarized in the benefits chapter of this preliminary analysis; a detailed explanation of this evaluation is provided in the corresponding research report [1].<br>In order to quantitatively determine the effectiveness of the existing and proposed standards in preventing injuries and fatalities, a detailed review of the descriptions of accidents was performed. For each accident reviewed, the detailed description of the accident, along with the citations issued, the nature of the injuries incurred, and the causes associated with the accident, were analyzed to estimate the likelihood that the accident would have been preventable under, first, the existing applicable standards, and second, under the proposed standard. Based on these analyses, CONSAD found that full compliance with the existing standards would have prevented 52.9 percent of the injuries and fatalities; compliance with the proposed standards, however, would prevent 79.0 percent of the relevant injuries and fatalities. The increase in safety that would be provided by the proposed standards is represented by the prevention of an additional 19 fatalities and 116 injuries annually.<br>In addition, the proposed revisions improve safety by clarifying and updating the existing standards to reflect modern technologies, work practices, and terminology, and by making the standards consistent with current consensus standards and other related standards and documents. By facilitating the understanding of and compliance with these important safety standards, the proposal also achieves better protection of employee safety while reducing uncertainty, confusion, and compliance burdens on employers.<br>Section IV, Summary and Explanation of Proposed Rule, earlier in this preamble, includes explanations of the need for, and the expected benefit associated with particular with, particular provisions of the proposed standard. In particular, see the summary and explanation of §§ 1926.950(c) (host-contractor responsibilities), 1926.954(b) (fall protection), and 1926.960(g) (flame-resistant apparel) for a discussion of the need for and a qualitative explanation of the benefits of these provisions. |
| 8. There were no comments from the SERs on OSHA's estimates of the number and type of small entities affected by the proposal. However, some SERs pointed out that there may be some small entities that engage in only construction related activities. The Panel recommends that OSHA's estimates of current baseline activities and OHSA's cost estimates reflect such firms. | As presented in the chapter on compliance costs in this preliminary analysis, OSHA has revised its analysis, including its estimates of baseline activities and its cost estimates, to reflect the possible existence of some firms that are not currently covered by the existing 29 CFR 1910.269 and that do not comply with these provisions when performing construction work on electric power generation, transmission, or distribution installations. |

TABLE V–22.—PANEL RECOMMENDATIONS AND OSHA RESPONSES—Continued

| Panel recommendations | OSHA responses |
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| 9. Most SERs were uncertain about how to comply with performance oriented provisions of the proposal, and further, some felt that additional expenses might be required to be confident that they were in compliance with such provisions. The Panel recommends that OSHA study and address these issues and consider the use of guidance material (e.g. non-mandatory appendices) to describe specific ways of meeting the standard, which will help small employers comply, without making the standard more prescriptive. | OSHA has added appendices containing guidelines on the inspection of work positioning equipment to assist employers in complying with the requirement to conduct such inspections proposed in 29 CFR 1910.269(g)(2)(iii)(a) and 29 CFR 1926.954(b)(3)(i). The proposal also includes appendices on clothing in 29 CFR 1910.269 and Subpart V of 29 CFR Part 1926. These appendices should help employers comply with the clothing provisions proposed in 29 CFR 1910.269(1)(11) and 29 CFR 1926.960(g).<br>The proposal also includes many references to consensus standards that contain information helping employers comply with various provisions of the proposed standards. For example, the note to proposed 29 CFR 1926.957(b) directs empl9yers to the Institute of Electrical and Electronics Engineers' IEEE Guide for Maintenance Methods on Energized Power Lines, IEEE Std. 516–2003 for guidance on the examination, cleaning, repairing, and in-service testing of live-line tools to help employers comply with that provision in the OSHA standards. Lastly, Appendix E to 29 CFR 1910.269 and Appendix E to Subpart V of 29 CFR Part 1926 contain lists of reference documents to which employers can turn for help in complying with OSHA's proposal.<br>The preamble to the proposed standards and this preliminary analysis both contain additional descriptions of what would be considered necessary and sufficient for purposes of achieving compliance with the requirements of the proposed standards. OSHA requests comments regarding which provisions, if any, require further clarification on what specific measures would or would not constitute compliance with the standards.<br>The Agency also requests comments on what additional guidance material is needed to assist employers in complying with the standards. OSHA also encourages interested parties to submit such guidance material for possible inclusion in the final rule. |
| 10. Most SERs were highly critical of the host contractor provisions and had trouble understanding what OSHA required. If these provisions are to be retained, the Panel recommends that they be revised. The Panel recommends that OSHA clarify what constitutes adequate consideration of contractor safety performance, clarify what is meant by "observation," clarify how the multi-employer citation policy is related to the proposal, and clarify whether the requirement to communicate hazards does or does not represent a requirement for the host employer to conduct their own risk assessment. The Panel also recommends that OSHA examine the extent to which state contractor licensing could make the host contractor provisions in the proposal unnecessary. | OSHA has modified the provisions on host-contractor responsibilities substantially from the draft requirements reviewed by the SERs. The Agency believes that the changes address the concerns expressed by the SERs.<br>The summary and explanation of proposed 29 CFR 1926.950(c), earlier in the preamble, provides clarification of the intent and application of the host-contractor requirements and their relationship to OSHA's multiemployer citation policy.<br>The proposal includes a requirement in 29 CFR 1910.269(a)(4)(i)(A)(1) and 29 in CFR 1926.950(c)(1)(i)(A) that host employers inform contract employers of known hazards that are covered by the standards, that are related to the contract employer's work, and that might not be recognized by the contract employer or its employees. This provision does not require host employers to conduct a risk assessment of the work to be performed by the contract employer. However, proposed 29 CFR 1910.269(a)(4)(i)(A)(2) and 29 CFR 1926.950(c)(1)(i)(B) would require the host employer to provide information about the employer's installation to the contract employer to enable the contract employer to make the assessments required by the standards. This change should clarify that OSHA intends for the contract employer to conduct appropriate hazard identification and assessment for his or her own employees.<br>OSHA does not believe that State contractor licensing makes the proposed host-contractor provisions unnecessary. Not all States require electric power generation, transmission, and distribution contractors to be licensed. For example, Illinois and New York do not require licensing at the State level. (See *http://www.electric-find.com/licnese.htm*) Additionally, the States with such licensing requirements judge primarily the contractors' ability to install electric equipment in accordance with State or national installation codes and not their ability to perform electric power generation, transmission, and distribution work safely. |
| 11. Some SERs questioned the need for flame resistant clothing beyond the existing clothing provisions in 29 CFR 1910.269. Some argued that there was a trade-off between possible decreased injuries from burns and heat stress injuries as a result of using flame resistant clothing. The Panel recommends that OSHA consider and solicit comments on these issues. | OSHA has considered these issues in the development of the clothing requirements proposed in 29 CFR 1910.269(1)(11) and 29 CFR 1926.960(g), as explained in the summary and explanation of proposed 29 CFR 1926.960(g) earlier in the preamble. In that section of the preamble, the Agency has solicited comments on a wide range of issues related to protection of employees from the hazards posed by electric arcs. |

TABLE V–22.—PANEL RECOMMENDATIONS AND OSHA RESPONSES—Continued

| Panel recommendations | OSHA responses |
| --- | --- |
| 12. Many SERs were uncertain whether OSHA's requirements for determining the need for flame resistant clothing would allow the use of such methods as (1) "worst case" analysis or (2) specifying minimum levels of protection for use when a system does not exceed certain limits. The Panel recommends that OSHA clarify what methods are acceptable to meet these requirements, and specify these methods in such a way that small entities can be confident that they have met the requirements of the standards. | OSHA has revised the clothing requirements in proposed 29 CFR 1910.269(1)(11) and 29 CFR 1926.960(g) to provide additional guidance explaining ways an employer can comply. For example, the Agency has included two notes and additional appendix material explaining how an employer can calculate estimates of available heat energy. For additional information, see the summary and explanation of proposed 29 CFR 1926.960(g), earlier in the preamble. |
| 13. OSHA made some changes to the training provisions in 29 CFR 1910.269, including dropping certification requirements and allowing training to vary with risk. OSHA stated that both of these changes were designed to give the rules a greater performance orientation and to ease compliance. Some SERs felt that these changes might make compliance more complicated by making it less clear what needs to be done. The panel recommends that OSHA clarify the performance orientation of these changes and consider explaining that existing compliance methods would still be considered adequate under the new rules. The Panel further recommends that OSHA examine the requirement that employees demonstrate proficiency and provide examples of how that can be accomplished. The Panel also recommends that OSHA consider the possibility that the proposed draft may introduce costs to small businesses that are uncertain of how to comply with the new performance oriented training provisions. | OSHA believes that the proposed changes to the training requirements contained in 29 CFR 1910.269 clarify the standard and reduce burdens on employers. If employees are trained as required under the existing general industry standard, then no additional training would be required by the proposed requirement to provide a level of training based on the risk to the employer or by the proposal to remove the requirement that training be certified. Moreover, no additional costs would be incurred.<br>Existing 29 CFR 1910.269(a)(2)(vii) already requires employees to demonstrate proficiency in the work practices involved. OSHA believes that most employers are already complying with this requirement in various ways. For example, some employers have employees demonstrate proficiency in climbing after completing a pole climbing class that includes climbing on practice poles as part of the curriculum. In addition, many employers use an apprenticeship program, in which journeyman line workers acting as crew leaders observe trainees over the course of the program. The trainees pass through the apprenticeship program by successfully completing each step, demonstrating proficiency in various tasks along the way, until the trainees reach the journeyman level. |
| 14. Several SERS argued that the proposal placed restrictions on the length of the lanyard and that these restrictions were unworkable. The Panel recommends that OSHA clarify the intent of the fall protection provisions. Other SERs argued that fall fatalities from aerial lifts were either the result of catastrophic failures in which case fall protection would not have prevented the death, or the result of failure to use any form of fall arrest or fall restraint. Some SERs argued that some workers might find harnesses more awkward than belts and be less likely to wear them. The Panel recommends that OSHA consider and solicit comment on these issues. | OSHA has clarified the intent of the proposed changes to the fall protection requirements proposed in 29 CFR 1910.269(g)(2)(i) and (ii) in the summary and explanation of those provisions earlier in the preamble.<br>It is easy for an employer to enforce the use of fall arrest equipment, which incorporates a harness, by employees working from aerial lifts. It is relatively easy for an employer to observe that an employee is wearing a harness, which extends over the employee's shoulders, and that a lanyard is attached to the connector between the employee's shoulders and to the anchorage on the boom of the aerial lift. Body belts, which were the predominant form of protection used in the time period represented by the accidents, are worn near an employee's hips. It is not usually possible to determine whether an employee in an aerial lift bucket is wearing a body belt or, if he or she is, whether the lanyard is attached to the D-ring on the body belt. It would be much easier for an employer to enforce the use of personal fall arrest equipment than to enforce the use of body belts even if employees do not want to wear them. Thus, to the extent that fall injuries are the result of the failure of an employee to use any form of fall protection equipment, the proposal would help prevent many of those injuries.<br>Neither personal fall arrest systems nor work positioning equipment will protect against catastrophic failure of the boom of an aerial lift; the employee would fall with the bucket or platform. However, a personal fall arrest system, and in some cases work positioning equipment, can protect an employee if the bucket or platform detaches from the boom as long as the fall protection equipment is attached to the boom and not to the bucket or platform.<br>In the hopes of further clarifying the standard, OSHA requests comments on the fall protection issues raised by the SERs. |

TABLE V–22.—PANEL RECOMMENDATIONS AND OSHA RESPONSES—Continued

| Panel recommendations | OSHA responses |
| --- | --- |
| 15. This rule was designed by OSHA to eliminate confusing differences between the applicable construction and general industry standards, by making the standards consistent. Several SERs felt this was a worthwhile goal. Some SERs felt that the host contractor provisions of the rule could result in causing contractor employees to be considered employees of the host employer under the Fair Labor Standards Act and under the Internal Revenue Service regulations. In addition, the SERs identified OSHA's multi-employer citation policy as duplicative and overlapping of the host contractor provisions in the proposal. The Panel recommends that, if this provision is retained, OSHA investigate this issue and clarify these provisions to assure that contractor employees do not become direct employees of the host employer as a result of complying with possible OSHA requirements. | OSHA does not believe that the proposed provisions on host-contractor responsibilities duplicate or overlap the Agency's multiemployer policy. See the summary and explanation of proposed § 1926.950(c) earlier in this preamble for clarification of the intent and application of the host-contractor requirements and their relationship to OSHA's multiemployer citation policy.<br>It is not OSHA's intent that the provisions on host-contractor responsibilities would affect in any way of the employer-employee relationship under the Fair Labor Standards Act or under the Internal Revenue Service regulations. The OSHA requirements are not intended to establish an employer-employee relationship with contractors or employees of contractors, as defined by the relevant statutes and regulations. |
| 16. Some SERs were unconvinced about the need for revisions to the existing 29 CFR 1910.269 standard in light of their potential to improve safety beyond what compliance with the requirements in existing 29 CFR 1910.269 would achieve. The Panel recommends that OSHA consider and solicit comment on the regulatory alternative of extending the requirements of 29 CFR 1910.269 to construction, without further modification. | OSHA requests comments on the regulatory alternative of extending the requirements of 29 CFR 1910.269 to construction, without further modification. Commenters should explain how, if the Agency adopted this option, it could comply with section 6(b)(8) of the OSHA Act, which requires OSHA to explain why a promulgated rule that differs substantially from a national consensus standard will better effectuate the purposes of the Act than the national consensus standard. Furthermore, as explained fully above, OSHA's analysis preliminarily finds that the additional changes to both 29 CFR 1910.269 and Subpart V will prevent a significant number of fatalities and injuries each year. |
| 17. The Panel notes that the host/contractor provisions were particularly troublesome for almost all SERs, and that as a result, OSHA should provide either some change or provide extensive clarification to these provisions. The Panel recommends that OSHA consider, analyze, and solicit comment on a variety of alternatives to these provisions, including:<br>1. Dropping all or some of these provisions<br>2. Specifying in detail methods that would be considered adequate for purposes of compliance for those provisions retained<br>3. Changing the provision for consideration of safety performance to indicate how employers can be sure they have complied with the provision<br>4. Changing the provisions concerning observed violations by:<br>• Dropping the provision concerning observed violations entirely;<br>• Changing the provision concerning observed violations to clearly indicate that "inspections" are not required;<br>• Minimizing the amount of follow-up and responsibility placed on the host employer when a violation is observed;<br>• Requiring only that the contractor be notified of observed violations (no requirement for subsequent monitoring of evaluation);<br>• Changing the provision to require observation for the purpose of determining if the contractor is performing safe work practices, requiring observed violations to be reported to the contractor (no requirement for subsequent monitoring or evaluation);<br>• Providing explicit language that line clearance tree trimmers are not covered by this provision;<br>• Specifying that only observations made by a "safety professional" or other individual qualified to identify hazards must be reported to the contractor<br>5. Changing the provision for hazard communication to make clear that the host employer is not required to conduct his or her own hazard analysis, but only to communicate such hazards of which the host employer may be aware | OSHA has considered these options and has adopted several of them. The Agency has dropped the draft requirement for host employers to obtain and evaluate information on contractor safety performance and programs. OSHA has also eliminated draft provisions that would have required the host employer to follow up on observed violations. Instead, the proposal, in 29 CFR 1910.269(a)(4)(ii)(C)(3) and in 29 CFR 1926.950(c)(2)(iii)(C), would require the contract employer to report what measures the contractor took to correct any violations and to prevent their recurrence.<br>OSHA requests comments on whether the changes, along with the accompanying summary and explanation of the proposal, adequately clarify the host-contractor requirements, whether there are other options that the Agency should consider, and whether the proposed provisions will adequately protect employees. |

TABLE V–22.—PANEL RECOMMENDATIONS AND OSHA RESPONSES—Continued

| Panel recommendations | OSHA responses |
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| 18. The Panel recommends that OSHA consider and solicit comment on two kinds of options with respect flame resistant clothing. First, OSHA should consider the alternative of no further requirements beyond existing 29 CFR 1910.269 for the use of flame resistant clothing. Second, should the draft requirement be retained in some manner, OSHA should consider and solicit comment on one or a combination of alternative means of determining how much protection is needed or required. These alternatives should include:<br>1. Allowing the employer to estimate the exposure assuming that the distance from the employee to the electric arc is equal to the minimum approach distance<br>2. Providing tables showing heat energy for different exposure conditions as an alternative assessment method<br>3. Specifying a minimum level of protection for overhead line work (for example, 10 cal/cm$^2$) for use when the system does not exceed certain limits as an alternative to hazard assessment<br>4. Allowing the employer to reduce protection when other factors interfere with the safe performance of the work (for example, severe heat stress) after the employer has considered alternative methods of performing the work, including the use live-line tools and deenergizing the lines and equipment, and has found them to be unacceptable<br>5. Allowing employers to base their assessments on a "worst case analysis."<br>6. Requiring employers to use appropriate flame retardant clothing without specifying any assessment method. | OSHA has considered the options recommended by the panel. The Agency has adopted the second option suggested by the Panel. Appendix F to 29 CFR 1910.269 and Appendix F to 29 CFR Part 1926, Subpart V propose tables that employers may use to estimate available heat energy. Although these tables do not cover every circumstance, they do address many exposure conditions found in overhead electric power transmission and distribution work. Other assessment aids are available, and also are listed in Appendix F, for other exposure conditions, including typical electric power generation exposures. There is less need for an underground assessment aid since most underground work is performed on deenergized lines.<br>OSHA has not incorporated any of the other Panel-recommended options into the proposal because the Agency either currently believes that they are not sufficiently protective or has insufficient information to incorporate them.<br>However, the Agency does wish to facilitate compliance with the provisions proposed in 29 CFR 1910.269(1)(11) and 29 CFR 1926.960(g) requiring employees to be protected from electric arcs. OSHA also wishes to promulgate a rule that will protect employees from electric arcs in the most cost-effective manner possible. The Agency encourages interested parties to provide information that can help simplify the rule or make it more cost effective or that can assist in the development of compliance assistance materials. |
| 19. Some SERs were concerned that the revised training requirements complicated the question of demonstrating that training had been provided, and that the requirement that training be related to the risk would require additional training, additional documentation, or both. The Panel recommends that OSHA consider making it clear that employers that follow the existing training provisions in 29 CFR 1910.269 will be in compliance with the new rules, and that OSHA clarify alternative methods that would be considered acceptable for demonstrating adequacy of training and the relation of the training to risk. | See the response to Panel recommendation 13 above. |
| 20. In response to comment by some SERs, the Panel recommends that OSHA consider and solicit comment on the issues of whether the additional job briefing requirements are needed and how they can be met in situations in which the employee is working at a distant location. | OSHA is proposing only one new requirement on job briefings, the requirement in 29 CFR 1910.269(c)(1)(i) and in 29 CFR 1926.952(a)(1). This provision requires that, in assigning an employee or a group of employees to perform a job, the employer provide the employee in charge of the job with available information necessary to perform the job safely. The remainder of the changes to the job briefing requirements in 29 CFR 1910.269(c) simply reorganize the existing provisions into individual paragraphs. (For additional discussion of this provision, see the summary and explanation of proposed 29 CFR 1926.952(a)(1) earlier in this preamble.)<br>The Agency believes that many employers are already providing relevant information about a job when they assign that job to a crew of employees or to an employee working alone. (For additional discussion of this provision, see the summary and explanation of proposed 29 CFR 1926.952(a)(1) earlier in this preamble.) However, to make sure that all employers do so, OSHA believes that the standard should require that the employer provide relevant hazard-related information to the employees performing the work to the extent the employer knows, or can reasonably be expected to know, that information. It should be noted that this is a requirement to communicate information, not to gather information. OSHA anticipates that employers will pass along this information when they assign jobs to employees. Where the employees are working has no effect on the employer's ability to communicate the information.<br>The Agency requests comments on whether the additional job briefing requirement is necessary and on how this provision can be met for an employee working at distant locations. |

TABLE V–22.—PANEL RECOMMENDATIONS AND OSHA RESPONSES—Continued

| Panel recommendations | OSHA responses |
| --- | --- |
| 21. All of the affected SERs felt that the provisions of the rule with respect to fall restraint systems would make it difficult for a person using a fall restraint system to perform the necessary work. The SERs also raised the possibility of safety problems associated with wearing a safety harness as opposed to a safety belt, such as an increased likelihood of the harness being snagged and as a result the employee being either pulled into a wood chipper while on the ground or pulled out of the bucket when it is lowered. The Panel recommends that OSHA consider and solicit comment on the alternative of making no changes to its existing fall protection requirements. If the provision is retained, OSHA should carefully examine the issue of whether the fall restraint system requirements in the draft make use of fall restraint systems unworkable in aerial lifts. OSHA should also consider the nonregulatory alternative of working with aerial device manufacturers and aerial device users (for example, electric and telecommunications utilities, painting and electrical contractors, tree-trimming firms) in the development of improved fall restraint systems that are more comfortable than existing systems and maintain the appropriate degree of protection for employees. | Over the course of the rulemaking, OSHA will examine the issue of whether using fall restraint systems to protect employees working from aerial lifts is workable. In this regard, the Agency requests comments on alternatives to the fall protection requirements proposed in 29 CFR 1910.269(g)(2) and 29 CFR 1926.954(b) as they relate to aerial lifts, including the alternative of making no changes to the rule. OSHA will also explore with manufacturers the nonregulatory option of improving fall protection systems for use in aerial lifts. |

*J. References*


1. CONSAD Research Corporation, ''Analytical Support and Data Gathering for a Preliminary Economic Analysis for Proposed Standards for Work on Electric Power Generation, Transmission, and Distribution Lines and Equipment (29 CFR 1910.269 and 29 CFR 1926—Subpart V),'' 2005, prepared for the U.S. Department of Labor, Occupational Safety and Health Administration, Office of Regulatory Analysis under Contract No. J9–F9–0013, Task Order Number 31, Pittsburgh, PA.

2. CONSAD Research Corporation, ''Compliance Cost and Economic Impact Estimates Including All Publicly-owned Utilities in OSHA State-plan States and Excluding Laundering Costs for Flame Resistant Apparel (FRA),'' Memorandum to the Office of Regulatory Analysis (ORA), Occupational Safety and Health Administration (OSHA), February 25, 2004.

3. OSHA Small Business Advocacy Review Panel, ''Report of the Small Business Advocacy Review Panel on the Draft OSHA Standard for Electric Power Generation, Transmission, and Distribution,'' submitted to Mr. John Henshaw, Assistant Secretary for Occupational Safety and Health, U.S. Department of Labor, Occupational Safety and Health Administration, June 27, 2003.

4. U.S. Office of Management and Budget, ''Informing Regulatory Decisions: 2004 Draft Report to Congress on the Costs and Benefits of Federal Regulations and Unfunded Mandates on State, Local, and Tribal Entities.''

5. Workers' Compensation Research Institute, ''WCRI Research Brief, Special Edition,'' Volume 9, Number 4S, Cambridge, MA, December 1993. Also available in OSHA Docket S–777, Exhibit 26–1608, and discussed in Exhibit 900, p. IV–56.

6. U.S. Environmental Protection Agency. Guidelines for Preparing Economic Analyses. EPA 240-R–00–003. September 2000. Internet address: *http://yosemite1.epa.gov/ee/epa/eed.nsf/webpages/Guidelines.html;* also available in OSHA Docket No. H–0054a, Exhibit 35–334.

7. Viscusi, Kip and Aldy, Joseph, ''The Value of a Statistical Life: A Critical Review of Market Estimates Throughout the World'', The Journal of Risk and Uncertainty, 27:1; 5–76, 2003.

8. U.S. Office of Management and Budget, Office of Information and Regulatory Affairs, ''Progress in Regulatory Reform: 2004 Report to Congress on the Costs and Benefits of Federal Regulations and Unfunded Mandates on State, Local, and Tribal Entities' December, 2004.


## VI. State Plan Standards

The 26 States or territories with OSHA-approved occupational safety and health plans must adopt an equivalent amendment or one that is at least as protective to employees within 6 months of the publication date of the final standard. These are: Alaska, Arizona, California, Connecticut (for State and local government employees only), Hawaii, Indiana, Iowa, Kentucky, Maryland, Michigan, Minnesota, Nevada, New Mexico, New Jersey (for State and local government employees only), New York (for State and local government employees only), North Carolina, Oregon, Puerto Rico, South Carolina, Tennessee, Utah, Vermont, Virginia, Virgin Islands, Washington, and Wyoming.

## VII. Environmental Impact Analysis

The provisions of this proposal have been reviewed in accordance with the requirements of the National Environmental Policy Act (NEPA) of 1969 (42 U.S.C. 4321, *et seq.*), the Council on Environmental Quality NEPA regulations (40 CFR Parts 1500–1508), and the Department of Labor's NEPA Procedures (29 CFR Part 11). As a result of this review, OSHA has determined that the proposed standards will have no significant adverse effect on air, water, or soil quality, plant or animal life, use of land, or other aspects of the environment.

## VIII. Unfunded Mandates

Section 3 of the Occupational Safety and Health Act makes clear that OSHA cannot enforce compliance with its regulations or standards on the U.S. government ''or any State or political subdivision of a State.'' Under voluntary agreement with OSHA, some States enforce compliance with their State standards on public sector entities, and these agreements specify that these State standards must be equivalent to OSHA standards. Thus, although OSHA has included compliance costs for the affected public sector entities in its analysis of the expected impacts associated with the proposal, the proposal would not involve any unfunded mandates being imposed on any State or local government entity. OSHA also concludes that the proposal would not impose an unfunded mandate on the private sector in excess of $100 million in expenditures in any one year.

## IX. Federalism

OSHA has reviewed this proposed rule in accordance with the Executive Order on Federalism (Executive Order 13132, 64 FR 43255, August 10, 1999), which requires that agencies, to the extent possible, refrain from limiting State policy options, consult with States prior to taking any actions that would restrict State policy options, and take such actions only when there is clear constitutional authority and the presence of a problem of national scope. The Order provides for preemption of State law only if there is a clear

Congressional intent for the Agency to do so. Any such preemption is to be limited to the extent possible.

Section 18 of the OSH Act expresses Congress's intent to preempt State laws where OSHA has promulgated occupational safety and health standards. A State can avoid preemption on issues covered by Federal standards only if it submits, and obtains Federal approval of, a plan for the development of such standards and their enforcement. 29 U.S.C. 667, Gade v. National Solid Wastes Management Association, 505 U.S. 88 (1992). Occupational safety and health standards developed by such Plan States must, among other things, be at least as effective in providing safe and healthful employment and places of employment as the Federal standards. Subject to the statutory limitations of the OSH Act, State-Plan States are free to develop and enforce their own requirements for occupational safety and health protections related to the maintenance and construction of electric power generation, transmission, and distribution installations. Therefore, OSHA concludes that this action does not significantly limit State policy options.

**X. OMB Review Under the Paperwork Reduction Act of 1995**

The proposed revisions of the general industry and construction standards for electric power generation, transmission, and distribution and for electrical protective equipment contain collection-of-information (paperwork) requirements that are subject to review by the Office of Management and Budget under the Paperwork Reduction Act of 1995 (PRA–95), 44 U.S.C. 3501 *et seq.*, and OMB's regulations at 5 CFR part 1320. The Paperwork Reduction Act defines ''collection of information'' as ''the obtaining, causing to be obtained, soliciting, or requiring the disclosure to third parties or the public, of facts or opinions by or for an agency, regardless of form or format * * * (44 U.S.C. 3502(3)(A)). OMB is currently reviewing OSHA's request for approval of the proposed collections.

The pending Information Collection Request (ICR) discusses the new paperwork requirements found in the proposed rule, as well as the removal of the existing collection of information for training certification in the Electric Power Generation, Transmission, and Distribution Standard (§ 1910.269(a)(2)(vii)) under OMB Control Number 1218–0190. Since this package contains a full discussion of removing the training certification, reviewers do not need to obtain ICR 1218–0190. Commenters may submit comments on the new collections, as well as the removal of the § 1910.269(a)(2)(vii) training certification requirement, under ICR number 1218–0NEW.

The title, description of the need for and proposed use of the information, summary of the collections of information, description of respondents, and frequency of response of the information collection are described below with an estimate of the annual cost and reporting burden as required by § 1320.5(a)(1)(iv). The reporting burden includes the time for reviewing instructions, gathering and maintaining the data needed, and completing and reviewing the collection of information.

OSHA invites comments on the collection-of-information requirements and the estimated burden hours associated with these collections, including comments on the following:

- Whether the proposed information-collection requirements are necessary for the proper performance of the Agency's functions, including whether the information is useful;
- The accuracy of OSHA's estimate of the burden (time and cost) of the information-collection requirements, including the validity of the methodology and assumptions used;
- The quality, utility, and clarity of the information collected; and
- Ways to minimize the burden on employers who must comply, for example, by using automated or other technological techniques for collecting and transmitting information.

*Title:* Electric Power Transmission and Distribution Standard for construction (§§ 1926.950 through 1926.968); and Electrical Protective Equipment Standard (§ 1926.97).

*Description and Proposed Use of the Collections of Information:* The proposed standards would impose new information collection requirements for purposes of the PRA and would remove one existing information collection requirement. These collection of information requirements (§§ 1926.97(c)(2)(xii), 1926.950(c)(1)(i), 1926.950(c)(1)(ii), 1926.950(c)(2)(iii), 1926.953(a), 1910.269(a)(4)(i)(A), 1910.269(a)(4)(i)(B), and 1910.269(a)(4)(ii)(C)) are being reviewed by OMB. OSHA is proposing to remove the training certification requirement contained in § 1910.269(a)(2)(vii) under control number 1218–0190.

These provisions are needed to protect employees against the electric shock hazards that might be present in the workplace and against other hazards that might be present during electric power generation, transmission, and distribution work. The new information collection requirements, including those related to certification of rubber insulated gloves and rubber blankets, the host employer informing the contract employer of any known job related hazards that might be present on the job, the contract employer communicating all the hazards to his or her employees, and the use of a permit that will control access to an enclosed space after it has been determined that the space may endanger the life of employees, are important tools for controlling or eliminating hazards faced by employees. The employer's failure to generate and disclose the information required in these standards would significantly affect OSHA's effort to reduce the number of injuries and fatalities related to hazards posed by electric power generation, transmission, and distribution work.

*Summary of the Collections of Information:* The following are new collections of information contained in the Electric Power Generation, Transmission, and Distribution Standard for general industry (§ 1910.269); the Electric Power Transmission and Distribution Standard for construction (§§ 1926.950 through 1926.968); and the Electrical Protective Equipment Standard for construction (§ 1926.97).

*Section 1926.97—Electrical Protective Equipment—Special Requirements.*

Paragraph (c)(2)(xii) of § 1926.97 requires the employer to certify that equipment has been tested in accordance with the requirements of paragraphs (c)(2)(iv), (c)(2)(vii)(C), (c)(2)(viii), (c)(2)(ix), and(c)(2)(xi) of that section. The certification must identify the equipment that passed the test and the date it was tested. Marking of equipment and entering the results of the tests and the dates of testing onto logs are two acceptable means of meeting this requirement.

*Section 1926.950, § 1910.269—Host Employer-Contract Employer Responsibilities.*

Paragraph (c)(1)(i) of § 1926.950 and paragraph (a)(4)(i)(A) of § 1910.269 require the host employer to inform the contractor of any known hazards that might be related to his work and that might not be recognized by the contractor. The host employer must also inform the contractor of any information needed to do assessments required by the standard.

Paragraph (c)(1)(ii) of § 1926.950 and paragraph (a)(4)(i)(B) of § 1910.269 require the host employer to report any observed contract-employer related violations of the standards to the contract employer.

Paragraph (c)(2)(iii) of § 1926.950 and paragraph (a)(4)(ii)(C) of § 1910.269 require the contract employer to advise the host employer of unique hazards presented by the contract employer's work, unanticipated hazards found during the contract employer's work that the host employer did not mention, and measures the contractor took to correct and prevent recurrences of violations reported by the host employer.

*Section 1926.953—Enclosed Spaces—General*

Paragraph (a) of § 1926.953 covers enclosed spaces that may be entered by employees. This paragraph applies to routine entry into enclosed spaces. If, after the precautions given in §§ 1926.953 and 1926.965 are taken, the hazards remaining in the enclosed space endanger the life of an entrant or could interfere with escape from the space, then entry into the enclosed space must meet the permit-space entry requirements of paragraphs (d) through (k) of § 1910.146, some of which involve collections of information aimed at protecting employees from the hazards of entry into confined spaces. These provisions contain practices and procedures to protect employees from the hazards of entry into permit-required confined spaces. Section 1910.146 already has a control number.

*Section 1910.269(a)(2)(vii)—Training—Certification. [Amendment]*

Paragraph (a)(2)(vii) of existing § 1910.269 requires the employer to certify that each employee has received the training required by paragraph (a)(2). This certification must be made when the employee demonstrates proficiency in the work practices involved and must be maintained for the duration of the employee's employment. OSHA is proposing to remove the certification requirement contained in § 1910.269(a)(2)(vii).

*Respondents:* Employers who construct, install, or repair electric power lines and equipment outside of or on buildings, structures, and other premises. See section V, Preliminary Regulatory Impact Analysis and Initial Regulatory Flexibility Analysis, earlier in this preamble, for the number of employers (respondents) covered by the proposed collection of information requirements.

*Frequency of Response:* On occasion. The collections of information involved include the host employer communicating the potentially known hazards to the contract employer and certifying tests performed on electrical protective equipment. This information will provide protection for employees against the electric shock hazards that might be present in the workplace.

*Average Time per Response*: Time per response ranges from 5 minutes for the host employer to inform a contract employer of the hazards to 10 minutes for the contract employer to instruct his or her employees of the potential hazards known on the jobsite.

*Total Burden Hours:* 122,276. The estimated total cost of these burden hours is approximately $4,800,000.

*Estimated Costs (Operating and Maintenance)*: 0.

In summary, the new collections of information (1218–0NEW) will add 122,276 hours, while the removal of the training certification will result in a reduction of 11,520 hours (1218–0190). The proposal will yield a net increase of 110,756 hours.

Interested parties who wish to comment on the paperwork requirements in this proposal must send their written comments to the OSHA Docket Office, Docket No. S–215, Occupational Safety and Health, Room N–2625, 200 Constitution Avenue, NW., Washington, DC 20210, and to the Office of Information and Regulatory Affairs, New Executive Office Building, Office of Management and Budget, Room 10235, 725 17th Street, NW., Washington, DC 20503, Attn: OSHA Desk Officer (RIN 1218–AB67). The Agency also encourages commenters to include their comments on paperwork requirements with their other comments on the proposed rule submitted to OSHA.

Copies of the referenced information collection request are available for inspection and copying in the OSHA Docket Office and will be provided to persons who request copies by telephoning Todd Owen at (202) 693–1941. For electronic copies of the information collection request, contact the OSHA Web page on the Internet at *http://www.osha.gov/.*

## XI. Public Participation—Comments and Hearings

OSHA encourages members of the public to participate in this rulemaking by submitting comments on the proposal, and by providing oral testimony and documentary evidence at the informal public hearing that the Agency will convene after the comment period ends. In this regard, the Agency invites interested parties having knowledge of, or experience with, safety related to working on electric power generation, transmission, or distribution installations to participate in this process, and welcomes any pertinent data and cost information that will provide it with the best available evidence on which to develop the final standard.

This section describes the procedures the public must use to submit their comments to the docket in a timely manner, and to schedule an opportunity to deliver oral testimony and provide documentary evidence at the informal public hearings. Comments, notices of intention to appear, hearing testimony, and documentary evidence will be available for inspection and copying at the OSHA Docket Office. You also should read the earlier sections titled **DATES** and **ADDRESSES** for additional information on submitting comments, documents, and requests to the Agency for consideration in this rulemaking.

*Written Comments.* OSHA invites interested parties to submit written data, views, and arguments concerning this proposal. In particular, OSHA encourages interested parties to comment on the various issues raised in the summary and explanation of the proposed rule (*see* Section IV, Summary and Explanation of Proposed Rule, earlier in this preamble). When submitting comments, parties must follow the procedures specified earlier in the sections titled DATES and **ADDRESSES.** The comments must clearly identify the provision of the proposal you are addressing, the position taken with respect to each issue, and the basis for that position. Comments, along with supporting data and references, received by the end of the specified comment period will become part of the proceedings record, and will be available for public inspection and copying at the OSHA Docket Office.

*Informal Public Hearing.* Pursuant to section 6(b)(3) of the Act, members of the public will have an opportunity at an informal public hearing to provide oral testimony concerning the issues raised in this proposal. The hearings will commence at 10 A.M. on December 6, 2005. At that time, the presiding administrative law judge (ALJ) will resolve any procedural matters relating to the proceeding. The hearings will reconvene on subsequent days at 9 A.M.

The legislative history of section 6 of the OSH Act, as well as OSHA's regulation governing public hearings (29 CFR 1911.15), establish the purpose and procedures of informal public hearings. Although the presiding officer of such hearings is an ALJ, and questioning by interested parties is allowed on crucial issues, the proceeding is informal and legislative in purpose. Therefore, the hearing provides interested parties with an opportunity to make effective and expeditious oral presentations in the absence of procedural restraints or rigid procedures that could impede or protract the rulemaking process. In addition, the hearing is an informal administrative proceeding, rather than adjudicative one in which the technical rules of evidence would apply, because its primary purpose is to gather and clarify information. The regulations that govern public hearings, and the prehearing guidelines issued for this hearing, will ensure participants fairness and due process, and also will facilitate the development of a clear, accurate, and complete record. Accordingly, application of these rules and guidelines will be such that questions of relevance, procedure, and participation generally will favor development of the record.

Conduct of the hearing will conform to the provisions of 29 CFR part 1911, ''Rules of Procedure for Promulgating, Modifying, or Revoking Occupational Safety and Health Standards.'' The regulation at 29 CFR 1911.4, ''Additional or Alternative Procedural Requirements,'' specifies that the Assistant Secretary may, on reasonable notice, issue alternative procedures to expedite proceedings or for other good cause. Although the ALJs who preside over these hearings make no decision or recommendation on the merits of OSHA's proposal, they do have the responsibility and authority to ensure that the hearing progresses at a reasonable pace and in an orderly manner.

To ensure that interested parties receive a full and fair informal hearing as specified by 29 CFR part 1911, the ALJ has the authority and power to: Regulate the course of the proceedings; dispose of procedural requests, objections, and comparable matters; confine the presentations to matters pertinent to the issues raised; use appropriate means to regulate the conduct of the parties who are present at the hearing; question witnesses, and permit others to question witnesses; and limit the time for such questioning. At the close of the hearing, the ALJ will establish a post-hearing comment period for parties who participated in the hearing. During the first part of this period, the participants may submit additional data and information to OSHA; during the second part of this period, they may submit briefs, arguments, and summations.

*Notice of Intention to Appear to Provide Testimony at the Informal Public Hearing.* Interested parties who intend to provide oral testimony at the informal public hearings must file a notice of intention to appear by using the procedures specified earlier in the sections titled **DATES** and **ADDRESSES.** This notice must provide the: Name, address, and telephone number of each individual who will provide testimony, and their preferred hearing location; capacity (for example, the name of the establishment or organization the individual is representing and the individual's occupational title and position) in which each individual will testify; approximate amount of time required for each individual's testimony; specific issues each individual will address, including a brief statement of the position that the individual will take with respect to each of these issues; and a brief summary of any documentary evidence the individual intends to present.

OSHA emphasizes that the hearings are open to the public, and that interested parties are welcome to attend. However, only a party who files a complete notice of intention to appear may ask questions and participate fully in the proceedings. While a party who did not file a notice of intention to appear may be allowed to testify at the hearing if time permits, this determination is at the discretion of the presiding ALJ.

*Hearing Testimony and Documentary Evidence.* Any party requesting more than 10 minutes to testify at the informal public hearing, or who intends to submit documentary evidence at the hearing, must provide the complete text of the testimony and the documentary evidence as specified earlier in the sections titled **DATES** and **ADDRESSES**. The Agency will review each submission and determine if the information it contains warrants the amount of time requested. If OSHA believes the requested time is excessive, it will allocate an appropriate amount of time to the presentation, and will notify the participant of this action, and the reasons for the action, before the hearing. The Agency may limit to 10 minutes the presentation of any participant who fails to comply substantially with these procedural requirements; in such instances, OSHA may request the participant to return for questioning at a later time.

*Certification of the Record and Final Determination after the Informal Public Hearing.* Following the close of the hearing and post-hearing comment period, the presiding ALJ will certify the record to the Assistant Secretary of Labor for Occupational Safety and Health; the record will consist of all of the written comments, oral testimony, and documentary evidence received during the proceeding. However, the ALJ does not make or recommend any decisions as to the content of the final standard. Following certification of the record, OSHA will review the proposed provisions in light of all the evidence received as part of the record, and then will issue the final rule based on the entire record.

## XII. List of Subjects in 29 CFR Parts 1910 and 1926

Electric power, Fire prevention, Hazardous substances, Occupational safety and health, Safety.

## XIII. Authority and Signature

This document was prepared under the direction of Jonathan L. Snare, Acting Assistant Secretary of Labor for Occupational Safety and Health, 200 Constitution Avenue, NW., Washington, DC 20210.

This action is taken pursuant to sections 4, 6, and 8 of the Occupational Safety and Health Act of 1970 (29 U.S.C. 653, 655, 657), Secretary of Labor's Order No. 5–2002 (67 FR 65008), and 29 CFR part 1911.

Signed at Washington, DC this 7th day of June, 2005.

**Jonathan L. Snare,**

*Acting Assistant Secretary of Labor.*

Accordingly, the Occupational Safety and Health Administration proposes that parts 1910 and 1926 of Title 29 of the Code of Federal Regulations be amended as follows:

## PART 1910—[AMENDED]

## Subpart I—Personal Protective Equipment

1. The authority citation for Subpart I of Part 1910 would be revised to read as follows:

**Authority:** Sections 4, 6, and 8 of the Occupational Safety and Health Act of 1970 (29 U.S.C. 653, 655, 657); Secretary of Labor's Order No. 12–71 (36 FR 8754), 8–76 (41 FR 25059), 9–83 (48 FR 35736), 1–90 (55 FR 9033), or 5–2002 (67 FR 65008) as applicable, and 29 CFR Part 1911.

Sections 29 CFR 1910.133, 1910.135, and 1910.136 also issued under 5 U.S.C. 553.

2. Paragraph (a) of § 1910.136 would be revised to read as follows:

### § 1910.136 Foot protection.

(a) *General requirements.* The employer shall ensure that each affected employee uses protective footwear when working in areas where there is a danger of foot injuries due to falling or rolling objects or due to objects piercing the sole.

* * * * *

3. Section 1910.137 would be amended as follows:

a. Paragraph (a)(1)(ii) and the note following paragraph (a)(3)(ii)(B) would be revised to read as follows:

**§ 1910.137 Electrical protective equipment.**

(a) * * *
(1) * * *
(ii) Each item shall be clearly marked as follows:
(A) Class 00 equipment shall be marked Class 00.
(B) Class 0 equipment shall be marked Class 0.
(C) Class 1 equipment shall be marked Class 1.
(D) Class 2 equipment shall be marked Class 2.
(E) Class 3 equipment shall be marked Class 3.
(F) Class 4 equipment shall be marked Class 4.
(G) Non-ozone-resistant equipment other than matting shall be marked Type I.
(H) Ozone-resistant equipment other than matting shall be marked Type II.
(I) Other relevant markings, such as the manufacturer's identification and the size of the equipment, may also be provided.

* * * * *

(3) * * *
(ii) * * *
(B) * * *

**Note to paragraph (a) of this section:** Rubber insulating equipment meeting the following national consensus standards is deemed to be in compliance with paragraph (a) of this section:

American Society for Testing and Materials (ASTM) D 120–02a, Standard Specification for Rubber Insulating Gloves.

ASTM D 178–01e1, Standard Specification for Rubber Insulating Matting.

ASTM D 1048–99, Standard Specification for Rubber Insulating Blankets.

ASTM D 1049–98e1, Standard Specification for Rubber Insulating Covers.

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

ASTM D 1051–02, Standard Specification for Rubber Insulating Sleeves.

These standards contain specifications for conducting the various tests required in paragraph (a) of this section. For example, the a-c and d-c proof tests, the breakdown test, the water soak procedure, and the ozone test mentioned in this paragraph are described in detail in the ASTM standards.

ASTM F 1236–96, Standard Guide for Visual Inspection of Electrical Protective Rubber Products, presents methods and techniques for the visual inspection of electrical protective equipment made of rubber. This guide also contains descriptions and photographs of irregularities that can be found in this equipment.

ASTM F 819–00e1, Standard Terminology Relating to Electrical Protective Equipment for Workers, sets definitions of terms relating to the electrical protective equipment covered under this section.

* * * * *

b. A new note would be added following paragraph (b)(2)(ii) to read as follows:

* * * * *

(b) * * *
(2) * * *
(ii) * * *

**Note to paragraph (b)(2)(ii) of this section:** ASTM F 1236–96, Standard Guide for Visual Inspection of Electrical Protective Rubber Products, presents methods and techniques for the visual inspection of electrical protective equipment made of rubber. This guide also contains descriptions and photographs of irregularities that can be found in this equipment.

* * * * *

c. Paragraph (b)(2)(vii) would be revised to read as follows:

* * * * *

(b) * * *
(2) * * *
(vii) Protector gloves shall be worn over insulating gloves, except as follows:
(A) Protector gloves need not be used with Class 0 or Class 00 gloves, under limited-use conditions, where small equipment and parts manipulation necessitate unusually high finger dexterity.

**Note to paragraph (b)(2)(vii)(A) of this section:** Extra care is needed in the visual examination of the glove and in the avoidance of handling sharp objects.

(B) Any other class of glove may be used for similar work without protector gloves if the employer can demonstrate that the possibility of physical damage to the gloves is small and if the class of glove is one class higher than that required for the voltage involved.
(C) Insulating gloves that have been used without protector gloves may not be reused until they have been tested under the provisions of paragraphs (b)(2)(viii) and (b)(2)(ix) of this section.

* * * * *

d. Tables I–2, I–3, I–4, and I–5 would be revised to read as follows:

* * * * *

TABLE I–2.—A–C PROOF-TEST REQUIREMENTS

| Class of equipment | Proof-test voltage rms V | Maximum proof-test current, mA (gloves only) | | | |
|---|---|---|---|---|---|
| | | 267-mm (10.5-in) glove | 356-mm (14-in) glove | 406-mm (16-in) glove | 457-mm (18-in) glove |
| 00 | 2,500 | 8 | 12 | | |
| 0 | 5,000 | 8 | 12 | 14 | 16 |
| 1 | 10,000 | | 14 | 16 | 18 |
| 2 | 20,000 | | 16 | 18 | 20 |
| 3 | 30,000 | | 18 | 20 | 22 |
| 4 | 40,000 | | | 22 | 24 |

TABLE I–3.—D–C PROOF-TEST REQUIREMENTS

| Class of equipment | Proof-test voltage |
|---|---|
| 00 | 10,000 |
| 0 | 20,000 |
| 1 | 40,000 |
| 2 | 50,000 |
| 3 | 60,000 |

TABLE I–3.—D–C PROOF-TEST REQUIREMENTS—Continued

| Class of equipment | Proof-test voltage |
|---|---|
| 4 | 70,000 |

**Note:** The d-c voltages listed in this table are not appropriate for proof testing rubber insulating line hose or covers. For this equipment, d-c proof tests shall use a voltage high enough to indicate that the equipment can be safely used at the voltages listed in Table I–5. See ASTM D 1050–90 and ASTM D 1049–98[el] for further information on proof tests for rubber insulating line hose and covers, respectively.

TABLE I–4.—GLOVE TESTS—WATER LEVEL [1, 2]

| Class of glove | A–C proof test | | D–C proof test | |
|---|---|---|---|---|
| | mm | in | mm | in |
| 00 | 38 | 1.5 | 38 | 1.5 |
| 0 | 38 | 1.5 | 38 | 1.5 |
| 1 | 38 | 1.5 | 51 | 2.0 |
| 2 | 64 | 2.5 | 76 | 3.0 |
| 3 | 89 | 3.5 | 102 | 4.0 |
| 4 | 127 | 5.0 | 153 | 6.0 |

[1] The water level is given as the clearance from the cuff of the glove to the water line, with a tolerance of ±13 mm. (±0.5 in.).
[2] If atmospheric conditions make the specified clearances impractical, the clearances may be increased by a maximum of 25 mm. (1 in.).

TABLE I–5.—RUBBER INSULATING EQUIPMENT VOLTAGE REQUIREMENTS

| Class of equipment | Maximum use voltage [1] A–C rms | Retest voltage [2] A–C rms | Retest voltage [2] D–C avg |
|---|---|---|---|
| 00 | 500 | 2,500 | 10,000 |
| 0 | 1,000 | 5,000 | 20,000 |
| 1 | 7,500 | 10,000 | 40,000 |
| 2 | 17,000 | 20,000 | 50,000 |
| 3 | 26,000 | 30,000 | 60,000 |
| 4 | 36,000 | 40,000 | 70,000 |

[1] The maximum use voltage is the A–C voltage (rms) classification of the protective equipment that designates the maximum nominal design voltage of the energized system that may be safely worked. The nominal design voltage is equal to the phase-to-phase voltage on multiphase circuits. However, the phase-to-ground potential is considered to be the nominal design voltage:
(1) If there is no multiphase exposure in a system area and if the voltage exposure is limited to the phase-to-ground potential, or
(2) If the electrical equipment and devices are insulated or isolated or both so that the multiphase exposure on a grounded wye circuit is removed.
[2] The proof-test voltage shall be applied continuously for at least 1 minute, but no more than 3 minutes.

* * * * *

e. A new paragraph (c) would be added to read as follows:

* * * * *

(c) *Requirements for other types of electrical protective equipment.* The following requirements apply to the design and manufacture of electrical protective equipment that is not covered by paragraph (a) of this section:

(1) *Voltage withstand.* Insulating equipment used for the protection of employees shall be capable of withstanding, without failure, the voltages that may be imposed upon it.

**Note to paragraph (c)(1) of this section:** Such voltages include transient overvoltages, such as switching surges, as well as nominal line voltage. See Appendix B to § 1910.269 for a discussion of transient overvoltages on electric power transmission and distribution systems.

(2) *Equipment current.* (i) Protective equipment used for the primary insulation of employees from energized circuit parts shall be capable of passing a current test when subjected to the highest nominal voltage on which the equipment is to be used.

(ii) When insulating equipment is tested in accordance with paragraph (c)(2)(i) of this section, the equipment current may not exceed 1 microampere per kilovolt of phase-to-phase applied voltage.

**Note 1 to paragraph (c)(2) of this section:** This paragraph applies to equipment that provides primary insulation of employees from energized parts. It is not intended to apply to equipment used for secondary insulation or equipment used for brush contact only.

**Note 2 to paragraph (c)(2) of this section:** For a-c excitation, this current consists of three components:

(1) Capacitive current because of the dielectric properties of the insulating material itself,

(2) Conduction current through the volume of the insulating equipment, and

(3) Leakage current along the surface of the tool or equipment.

The conduction current is normally negligible. For clean, dry insulating equipment, the leakage current is small, and the capacitive current predominates.

## Subpart R—Special Industries

4. The authority citation for Subpart R would be revised to read as follows:

**Authority:** Sections 4, 6, and 8 of the Occupational Safety and Health Act of 1970 (29 U.S.C. 653, 655, 657); Secretary of Labor's Order No. 12–71 (36 FR 8754), 8–76 (41 FR 25059), 9–83 (48 FR 35736), 1–90 (55 FR 9033), 6–96 (62 FR 111), 5–2002 (67 F.R. 65008) as applicable; 29 CFR part 1911.

Section 1910.272 also issued under 5 U.S.C. 553.

5. Section 1910.269 would be amended as follows:

a. Paragraphs (a)(2)(i) and (a)(2)(vii) would be revised and new paragraphs (a)(2)(ii)(E) and (a)(4) would be added to read as follows:

**§ 1910.269 Electric power generation, transmission, and distribution.**

* * * * *

(a) * * *

(2) *Training.* (i) All employees shall be trained as follows:

(A) Employees shall be trained in and familiar with the safety-related work practices, safety procedures, and other safety requirements in this subpart that pertain to their respective job assignments.

(B) Employees 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 this subpart but that are related to their work and are necessary for their safety.

(C) The degree of training shall be determined by the risk to the employee for the task involved.

(ii) * * *

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

* * * * *

(vii) *Demonstration of proficiency.* The employer shall determine that each employee has demonstrated proficiency in the work practices involved before that employee is considered as having completed the training required by paragraph (a)(2) of this section.

**Note 1 to paragraph (a)(2)(vii) of this section:** Though they are not required by this paragraph, 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 2 to paragraph (a)(2)(vii) of this section:** Employers may rely on an employee's previous training as long as the employer: (1) Confirms that the employee has the job experience appropriate to the work to be performed, (2) through an examination or interview, makes an initial determination that the employee is proficient in the relevant safety-related work practices before he or she performs any work covered by this subpart, and (3) supervises the employee closely until that employee has demonstrated proficiency in all the work practices he or she will employ.

* * * * *

(4) *Contractors.* (i) *Host employer responsibilities.* (A) The host employer shall inform contract employers of:

(1) Known hazards that are covered by this section, that are related to the contract employer's work, and that might not be recognized by the contract employer or its employees; and

(2) Information about the employer's installation that the contract employer needs to make the assessments required by this section.

(B) The host employer shall report observed contract-employer-related violations of this section to the contract employer.

(ii) *Contract employer responsibilities.* (A) The contract employer shall ensure that each of his or her employees is instructed in the hazards communicated to the contract employer by the host employer.

**Note to paragraph (a)(4)(ii)(A) of this section:** This instruction is in addition to the training required by paragraph (a)(2) of this section.

(B) The contract employer shall ensure that each of his or her employees follows the work practices required by this section and safety-related work rules required by the host employer.

(C) The contract employer shall advise the host employer of:

(1) Any unique hazards presented by the contract employer's work,

(2) Any unanticipated hazards found during the contract employer's work that the host employer did not mention, and

(3) The measures the contractor took to correct any violations reported by the host employer under paragraph (a)(4)(i)(B) of this section and to prevent such violations from recurring in the future.

* * * * *

b. Paragraph (c) would be revised to read as follows:

* * * * *

(c) *Job briefing.* (1) *Before each job.* (i) In assigning an employee or a group of employees to perform a job, the employer shall provide the employee in charge of the job with available information necessary to perform the job safely.

**Note to paragraph (c)(1)(i) of this section:** The information provided by the employer to the employee in charge is intended to supplement the training required under § 1910.269(a)(2). It may be provided at the beginning of the day for all jobs to be performed that day rather than at the start of each job. The information is also intended to be general in nature, with work-site specific information to be provided by the employee in charge after the crew arrives at the work site.

(ii) The employer shall ensure that the employee in charge conducts a job briefing meeting paragraphs (c)(2), (c)(3), and (c)(4) of this section with the employees involved before they start each job.

(2) *Subjects to be covered.* The briefing shall cover at least the following subjects: hazards associated with the job, work procedures involved, special precautions, energy source controls, and personal protective equipment requirements.

(3) *Number of briefings.* (i) 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.

(ii) Additional job briefings shall be held if significant changes, which might affect the safety of the employees, occur during the course of the work.

(4) *Extent of briefing.* (i) 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.

(ii) 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 to paragraph (c)(4) of this section:** The briefing must always touch on all the subjects listed in paragraph (c)(2) of this section.

(5) *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.

* * * * *

c. The note following paragraph (e)(6) would be removed and paragraphs (e)(7), (e)(8), and (e)(12) would be revised to read as follows:

* * * * *

(e) * * *

(7) *Attendants.* While work is being performed in the enclosed space, a person with first aid training meeting paragraph (b) of this section shall be immediately available outside the enclosed space to provide assistance if a hazard exists because of traffic patterns in the area of the opening used for entry. That person is not precluded from performing other duties outside the enclosed space if these duties do not distract the attendant from monitoring employees within the space.

**Note to paragraph(e)(7) of this section:** See paragraph (t)(3) of this section 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 and shall have a minimum accuracy of ±10 percent.

* * * * *

(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 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.

* * * * *

d. Paragraph (g)(2) would be revised to read as follows:

* * * * *

(g) * * *

(2) *Fall protection.* (i) Personal fall arrest systems shall meet the requirements of Subpart M of Part 1926 of this Chapter.

**Note to paragraph (g)(2)(i) of this section:** This paragraph applies to all personal fall arrest systems used in work covered by this section.

(ii) Body belts and positioning straps for work positioning shall meet the requirements of § 1926.954(b)(2) of this Chapter.

**Note to paragraph (g)(2)(ii) of this section:** This paragraph applies to all work positioning equipment used in work covered by this section.

(iii) 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. Defective equipment may not be used.

**Note to paragraph (g)(2)(iii)(A) of this section:** Appendix G to this section contains guidelines for the inspection of work positioning equipment.

(B) Personal fall arrest systems shall be used in accordance with § 1926.502(d) of this chapter. However, the attachment point need not be located as required by § 1926.502(d)(17) of this chapter if the body harness is being used as work positioning equipment and if the maximum free fall distance is limited to 0.6 m (2 ft).

(C) A personal fall arrest system or work positioning equipment shall be used by employees working at elevated locations more than 1.2 m (4 ft) 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 to paragraph (g)(2)(iii)(C) of this section:** This paragraph 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. The duty to provide fall protection associated with walking and working surfaces is contained in Subpart M of Part 1926 of this chapter; the duty to provide fall protection associated with aerial lifts is contained in § 1910.67.

**Note 2 to paragraph (g)(2)(iii)(C) of this section:** Employees who have not completed training in climbing and the use of fall protection 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 1.2 m (4 ft) above the ground.

(D) Work positioning systems shall be rigged so that an employee can free fall no more than 0.6 m (2 ft) unless no anchorage is available.

(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 kN (3,000 lbf), whichever is greater.

(F) 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 which is incompatibly shaped or dimensioned in relation to the snaphook such that unintentional disengagement could occur by the connected object being able to depress the snaphook keeper and release itself.

* * * * *

e. The heading to paragraph (h) would be revised to read as follows:

* * * * *

(h) *Ladders and platforms.* * * *

* * * * *

f. Paragraphs (l)(2)(i), (l)(3), (l)(4), and (l)(6) would be revised and a new paragraph (l)(11) would be added to read as follows:

* * * * *

(l) * * *

(2) * * *

(i) The employee is insulated from the energized part (insulating gloves or insulating gloves and sleeves worn in accordance with paragraph (l)(3) of this section are considered 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 body), or

* * * * *

(3) *Type of insulation.* (i) If the employee is to be insulated from energized parts by the use of insulating gloves (under paragraph (l)(2)(i) 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.

(ii) If the employee is to be insulated from energized parts by the use of insulating gloves or insulating gloves with sleeves:

(A) The insulating equipment shall be put on in a position where the employee cannot reach into the minimum approach distance given in paragraph (l)(2) of this section; and

(B) The insulating equipment may not be removed until the employee is in a position where he or she cannot reach into the minimum approach distance given in paragraph (l)(2) of this section.

(4) *Working position.* (i) 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.

(ii) If work is performed near exposed parts energized at more than 600 volts but not more than 72.5 kilovolts and if the employee is not insulated from the energized parts or performing live-line bare-hand work, the employee shall work from a position where the employee cannot reach into the minimum approach distance given in paragraph (l)(2) of this section.

* * * * *

(6) *Conductive articles.* 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.

* * * * *

(11) *Clothing.* (i) The employer shall assess the workplace to determine if each employee is exposed to hazards from flames or from electric arcs.

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

**Note 1 to paragraph (l)(11)(ii) of this section:** Appendix F to this section provides guidance on the estimation of available heat energy.

**Note 2 to paragraph (l)(11)(ii) of this section:** This paragraph does not require the employer to estimate the 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 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.

(iii) The employer shall ensure that each employee who is exposed to hazards from electric arcs does not wear clothing that could melt onto his or her skin or that could ignite and continue to burn when exposed to the heat energy estimated under paragraph (l)(11)(ii) of this section.

**Note to paragraph (l)(11)(iii) of this section:** Clothing made from the following types of fabrics, either alone or in blends, is prohibited by this paragraph, 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.

(iv) The employer shall ensure that an employee wears clothing that is flame resistant under any of the following conditions:

(A) The employee is subject to contact with energized circuit parts operating at more than 600 volts,

(B) The employee's clothing could be ignited by flammable material in the work area that could be ignited by an electric arc, or

(C) The employee's clothing could be ignited by molten metal or electric arcs from faulted conductors in the work area.

**Note to paragraph (l)(11)(iv)(C) of this section:** This paragraph 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.

(v) The employer shall ensure that each employee who is exposed to hazards from electric arcs wears clothing with an arc rating greater than or equal to the heat energy estimated under paragraph (l)(11)(ii) of this section.

**Note to paragraph (l)(11) of this section:** See Appendix F to this section for further information on the selection of appropriate clothing.

* * * * *

g. Table R–6 would be revised to read as follows:

* * * * *

TABLE R–6—A–C LIVE-LINE WORK MINIMUM APPROACH DISTANCE

| Nominal voltage in kilovolts phase to phase | Distance | | | |
|---|---|---|---|---|
| | Phase-to-ground exposure | | Phase-to-phase exposure | |
| | m | ft-in | m | ft-in |
| 0.051 to 0.300 [1] | Avoid Contact | | Avoid Contact | |
| 0.301 to 0.750 [1] | 0.31 | 1–0 | 0.31 | 1–0 |
| 0.751 to 15.0 | 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 |

[1] For single-phase systems, use the voltage to ground.

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

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

**Note 3:** See Appendix B to this section for information on how the mimimum approach distances listed in the tables were derived.

* * * * *

h. Paragraph (m)(3)(viii) would be revised to read as follows:

* * * * *

(m) * * *

(3) * * *

(viii) If two or more independent crews will be working on the same lines or equipment, each crew shall independently comply with the requirements in this paragraph (m)(3). The independent crews shall coordinate deenergizing and reenergizing the lines or equipment if there is no system operator in charge of the lines or equipment.

* * * * *

i. Paragraphs (n)(4), (n)(6), and (n)(7) would be revised to read as follows:

* * * * *

(n) * * *

(4) *Protective grounding equipment.* (i) 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.

(ii) If the protective grounding equipment required under paragraph (n)(4)(i) of this section would be larger than the conductor to which it is attached, this equipment may be reduced in size provided that it is sized and placed so that:

(A) The conductor being grounded will fail before the protective grounding equipment,

(B) The conductor is only considered as grounded where it is protected against failure by the protective grounding equipment, and

(C) No employees would be endangered by the failed conductor.

(iii) This equipment shall have an ampacity greater than or equal to that of No. 2 AWG copper.

(iv) 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 to paragraph (n)(4) of this section:** Guidelines for protective grounding equipment are contained in American Society for Testing and Materials Standard Specifications for Temporary Protective Grounds to Be Used on De-Energized Electric Power Lines and Equipment, ASTM F 855–03.

* * * * *

(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. For lines or equipment operating at 600 volts or less, insulating equipment other than a live-line tool may be used 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 would be 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. For lines or equipment operating at 600 volts or less, insulating equipment other than a live-line tool may be used if the employer ensures that the line or equipment is not energized at the time the ground is disconnected or if the employer can demonstrate that each employee would be protected from hazards that may develop if the line or equipment is energized.

* * * * *

j. Paragraph (p)(4)(i) would be revised to read as follows:

* * * * *

(p) * * *

(4) *Operations near energized lines or equipment.* (i) Mechanical equipment shall be operated so that the minimum approach distances of Table R–6 through Table R–10 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 at a different potential.

* * * * *

k. Paragraphs (t)(3), (t)(7), and (t)(8) would be revised to read as follows:

* * * * *

(t) * * *

(3) *Attendants for manholes and vaults.* (i) While work is being performed in a manhole or vault containing energized electric equipment, an employee with first aid and CPR training meeting paragraph (b)(1) of this section shall be available on the surface in the immediate vicinity of the manhole or vault entrance to render emergency assistance.

(ii) Occasionally, the employee on the surface may briefly enter a manhole or vault to provide assistance, other than emergency.

**Note 1 to paragraph (t)(3)(ii) of this section:** An attendant may also be required under paragraph (e)(7) of this section. One person may serve to fulfill both requirements. However, attendants required under paragraph (e)(7) of this section are not permitted to enter the manhole or vault.

**Note 2 to paragraph (t)(3)(ii) of this section:** Employees entering manholes or vaults containing unguarded, uninsulated energized lines or parts of electric equipment operating at 50 volts or more are required to be qualified under paragraph (l)(1) of this section.

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

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

* * * * *

(7) *Protection against faults.* (i) Where a cable in a manhole or vault 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 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 by shields or other devices that are capable of containing the adverse effects of a fault.

**Note to paragraph (t)(7)(i) of this section:** Abnormalities such as oil or compound leaking from cable or joints, broken cable sheaths or joint sleeves, hot localized surface temperatures of cables or joints, or joints that are swollen beyond normal tolerance are presumed to lead to or be an indication of an impending fault.

(ii) If the work being performed in a manhole or vault could cause a fault in a cable, that cable 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 by shields or other devices that are capable of containing the adverse effects of a fault.

(8) *Sheath continuity.* When work is performed on buried cable or on cable in a manhole or vault, metallic sheath continuity shall be maintained or the cable sheath shall be treated as energized.

* * * * *

l. In the Notes following paragraphs (u)(1), (u)(5)(i), (v)(3), and (v)(5)(i), ''ANSI C2–1987'' would be revised to read ''ANSI C2–2002'' wherever it appears.

m. Definitions of ''Contract employer,'' ''Entry,'' and ''Host employer'' would be added, in alphabetical order, to § 1910.269(x), to read as follows:

* * * * *

(x) * * *

*Contract employer.* An employer who performs work covered by this section for a host employer.

* * * * *

*Entry (as used in paragraph (e) of this section).* 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.

* * * * *

*Host employer.* An employer who operates and maintains an electric power generation, transmission, or distribution installation covered by this section and who hires a contract employer to perform work on that installation.

* * * * *

n. A new Appendix F would be added to § 1910.269 to read as follows:

* * * * *

## Appendix F to Section 1910.269—Clothing

### I. Introduction

Paragraph (l)(11) of § 1910.269 addresses clothing worn by an employee. This paragraph requires employers to: (1) Assess the workplace for flame and arc hazards (paragraph (l)(11)(i)); (2) estimate the available heat energy from electric arcs to which employees could be exposed (paragraph (l)(11)(ii)), (3) ensure that employees wear clothing that has an arc rating greater than or equal to the available heat energy (paragraph (l)(11)(v)), (4) ensure that employees wear clothing that could not melt or ignite and continue to burn in the presence of electric arcs to which an employee could be exposed (paragraph (l)(11)(iii)), and (5) ensure that employees wear flame-resistant clothing [1] under certain conditions (paragraph (l)(11)(iv)). This appendix contains information to help employers estimate available heat energy as required by § 1910.269(l)(11)(ii), select clothing with an arc rating suitable for the available heat energy as required by § 1910.269(l)(11)(v), and ensure that employees do not wear flammable clothing that could lead to burn injury as addressed by §§ 1910.269(l)(11)(iii) and (l)(11)(iv).

### II. Protection Against Burn Injury

*A. Estimating Available Heat Energy*

The first step in protecting employees from burn injury resulting from an electric arc is to estimate the potential heat energy if an arc does occur. There are various methods of calculating values of available heat energy from an electric circuit. These methods are listed in Table 7. 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). Some of these parameters, such as the fault current and the clearing time, are known quantities for a given system. Other parameters, such as the length of the arc and the distance between the arc and the employee, vary widely and can only be estimated.

[1] Flame-resistant clothing includes clothing that is inherently flame resistant and clothing that has been chemically treated with a flame retardant. (See ASTM F1506–02a, *Standard Performance Specification for Textile Materials for Wearing Apparel for Use by Electrical Workers Exposed to Momentary Electric Arc and Related Thermal Hazards.*)

TABLE 7.—METHODS OF CALCULATING INCIDENT HEAT ENERGY FROM AN ELECTRIC ARC

1. Standard for Electrical Safety Requirements for Employee Workplaces, NFPA 70E–2004, 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 1584–2002.
4. Heat Flux Calculator, a free software program created by Alan Privette (widely available on the Internet).
5. ARCPRO, a commercially available software program developed by Kinectrics, Toronto, ON, CA.

The amount of heat energy calculated by any of the methods is approximately directly 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 he or she 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.

In estimating available heat energy, the employer must make some reasonable assumptions about how far the employee will be from the electric arc. In some instances, such as during some work performed using live-line tools, the employee will be at least the minimum approach distance from an energized part. However, in this situation, the arc could still extend towards the employee. Thus, in this case, a reasonable estimate of the distance between the employee and the arc would be the minimum approach distance minus twice the sparkover distance.[2]

In other cases, as during rubber glove work, parts of the employee's body will be closer to an energized part than the minimum approach distance. An employee's chest will be about 380 millimeters (15 in.) from an energized conductor during rubber glove work on that conductor. Because there should not be any surfaces at a potential other than the conductor between the employee and the conductor, it is reasonable to assume that the arc will not extend towards the employee. Thus, in this situation, it would be reasonable to use 380 millimeters (15 in.) as the distance between the employee and the arc.

[2] The sparkover distance equals the shortest possible arc length.

The standard permits an employer to make broad estimates of available heat energy covering multiple system areas using reasonable assumptions about the energy exposure distribution. For example, the employer can use the maximum fault current and clearing time to cover several system areas at once. Table 8 presents estimates of available energy for different parts of an electrical system operating at 4 to 46 kV. The table is for open-air, phase-to-ground electric arc exposures typical for overhead systems operating at these voltages. The table assumes that the employee will be 380 millimeters (15 in.) from the electric arc, which is a reasonable estimate for rubber glove work. To use the table, an employer would use the voltage, maximum fault current, and maximum clearing time for a system area and select the appropriate heat energy (5, 8, or 12 calories) 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. This system falls in the 4.0-to-15.0-kV range; the fault current is less than 10 kA (the second row in that voltage range); and the clearing time is under 14.5 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 5 calories or less (from the column heading), and the employer could select clothing with a 5-calorie rating to meet § 1910.269(l)(11)(v).

Table 9 presents similar estimates for systems operating at voltages of 46.1 to 800 kV. This table is also for open-air, phase-to-ground electric arc exposures typical for overhead systems operating at these voltages. The table assumes that the arc length will be equal to the sparkover distance [3] and that the employee will be a distance from the arc equal to the minimum approach distance minus twice the arc length.

The employer will need to use other methods for estimating available heat energy in situations not addressed by Table 8 or Table 9. The calculation methods listed in Table 7 will help employers do this. In addition, employers can use Table 130.7(C)(9)(a), Table 130.7(C)(10), and Table 130.7(C)(11) of NFPA 70E–2004 to estimate the available heat energy (and to select appropriate protective clothing) for many situations not addressed in the tables in this appendix, including lower-voltage, phase-to-phase arc, and enclosed arc exposures.

[3] The dielectric strength of air is about 10 kV for every 25.4 mm (1 in.). Thus, the arc length can be estimated to be the phase-to-ground voltage divided by 10.

TABLE 8.—AVAILABLE HEAT ENERGY FOR VARIOUS FAULT CURRENTS, CLEARING TIMES, AND VOLTAGES OF 4.0 TO 46.0 KV

| Voltage range (kV) | Fault current (kV) | 5-cal maximum clearing time (cycles) | 8-cal maximum clearing time (cycles) | 12-cal maximum clearing time (cycles) |
|---|---|---|---|---|
| 4.0 to 15.0 | 5 | 37.3 | 59.6 | 89.4 |
| | 10 | 14.5 | 23.2 | 34.8 |
| | 15 | 8.0 | 12.9 | 19.3 |
| | 20 | 5.2 | 8.3 | 12.5 |
| 15.1 to 25.0 | 5 | 34.5 | 55.2 | 82.8 |
| | 10 | 14.2 | 22.7 | 34.1 |
| | 15 | 8.2 | 13.2 | 19.8 |
| | 20 | 5.5 | 8.8 | 13.2 |
| 25.1 to 36.0 | 5 | 16.9 | 27.0 | 40.4 |
| | 10 | 7.1 | 11.4 | 17.1 |
| | 15 | 4.2 | 6.8 | 10.1 |
| | 20 | 2.9 | 4.6 | 6.9 |
| 36.1 to 46.0 | 5 | 13.3 | 21.2 | 31.9 |
| | 10 | 5.7 | 9.1 | 13.7 |
| | 15 | 3.5 | 5.6 | 8.4 |
| | 20 | 2.5 | 4.0 | 6.0 |

**Notes:**
(1) This table is for open-air, phase-to-ground electric arc exposures. It is not intended for phase-to-phase arcs or enclosed arcs (arc in a box).
(2) 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 voltage 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.).

TABLE 9.—AVAILABLE HEAT ENERGY FOR VARIOUS FAULT CURRENTS, CLEARING TIMES, AND VOLTAGES OF 46.1 TO 800 KV

| Voltage range (kV) | Fault current (kV) | 5-cal maximum clearing time (cycles) | 8-cal maximum clearing time (cycles) | 12-cal maximum clearing time (cycles) |
|---|---|---|---|---|
| 46.1 to 72.5 | 20 | 10.6 | 17.0 | 25.5 |
| | 30 | 6.6 | 10.5 | 15.8 |
| | 40 | 4.6 | 7.3 | 11.0 |
| | 50 | 3.4 | 5.5 | 8.3 |
| 72.6 to 121 | 20 | 10.3 | 16.5 | 24.7 |
| | 30 | 5.9 | 9.4 | 14.1 |
| | 40 | 3.9 | 6.2 | 9.3 |
| | 50 | 2.7 | 4.4 | 6.6 |
| 138 to 145 | 20 | 12.2 | 19.5 | 29.3 |
| | 30 | 7.0 | 11.2 | 16.8 |
| | 40 | 4.6 | 7.4 | 11.1 |
| | 50 | 3.3 | 5.3 | 7.9 |
| 161 to 169 | 20 | 11.6 | 18.6 | 27.9 |
| | 30 | 7.2 | 11.5 | 17.2 |
| | 40 | 5.0 | 8.0 | 12.0 |
| | 50 | 3.8 | 6.0 | 9.0 |
| 230 to 242 | 20 | 13.0 | 20.9 | 31.3 |
| | 30 | 8.0 | 12.9 | 19.3 |
| | 40 | 5.6 | 9.0 | 13.5 |
| | 50 | 4.2 | 6.8 | 10.1 |
| 345 to 362 | 20 | 28.3 | 45.3 | 67.9 |
| | 30 | 17.5 | 28.1 | 42.1 |
| | 40 | 12.2 | 19.6 | 29.4 |
| | 50 | 9.2 | 14.7 | 22.1 |
| 500 to 550 | 20 | 23.6 | 37.8 | 56.7 |
| | 30 | 14.6 | 23.3 | 35.0 |
| | 40 | 10.2 | 16.3 | 24.4 |
| | 50 | 7.6 | 12.2 | 18.3 |
| 765 to 800 | 20 | 54.5 | 87.3 | 130.9 |
| | 30 | 33.7 | 53.9 | 80.9 |
| | 40 | 23.6 | 37.8 | 56.7 |
| | 50 | 17.8 | 28.4 | 42.6 |

**Notes:**
(1) This table is for open-air, phase-to-ground electric are exposures. It is not intended for phase-to-phase arcs or enclosed arcs (arc in a box)

(2) The table assumes that the arc length will be the phase-to-ground voltage divided by 10 and that the distance from the arc to the employee is the minumum approach distance minus twice the arc length.

*B. Selecting protective clothing*

Table 10 presents protective clothing guidelines for exposure to electric arcs. Protective clothing meeting the guidelines in this table are expected, based on extensive laboratory testing, to be capable of preventing second-degree burn injury to an employee exposed to the corresponding range of calculated incident heat energy from an electric arc. It should be noted that actual electric arc exposures may be more or less severe than the laboratory exposures because of factors such as arc movement, arc length, arcing from reclosing of the system, secondary fires or explosions, and weather conditions. Therefore, it is possible that an employee will sustain a second-degree or worse burn wearing clothing conforming to the guidelines in Table 10 under certain circumstances. Such clothing will, however, provide an appropriate degree of protection for an employee who is exposed to electric arc hazards.

TABLE 10.—PROTECTIVE CLOTHING GUIDELINES FOR ELECTRIC ARC HAZARDS

| Range of calculated incident energy cal/cm² | Clothing description (number of layers) | Clothing weight oz/yd² | Arc thermal performance value (ATPV) |
|---|---|---|---|
| 0–2 | Untreated Cotton (1) | 4.5–7 | N/A |
| 2–5 | FR Shirt (1) | 4.5–8 | 5–7 |
| 5–10 | T-Shirt plus FR Shirt and FR Pants (2) | 9–12 | 10–17 |
| 10–20 | T-Shirt plus FR Shirt plus FR Coverall (3) | 16–20 | 22–25 |
| 20–40 | T-Shirt plus FR Shirt plus Double Layer Switching Coat (4) | 24–30 | 55 |

FR—Flame resistant.
ATPV—Arc Thermal Performance Value based on ASTM F1959 test method. (The method was modified as necessary to test the performance of the three- and four-layer systems.)
Source: "Protective Clothing Guidelines for Electric Arc Exposure," Neal, T. E. Bingham, A. H., Doughty, R. L., IEEE Petroleum and Chemical Industry Conference Record, September 1996, p. 294.

It should be noted that Table 10 permits untreated cotton clothing for exposures of 2-cal/cm² or less. Cotton clothing will reduce a 2-cal/cm² exposure below the 1.6-cal/cm² level necessary to cause burn injury and is not expected to ignite at such low heat energy levels. Although untreated cotton clothing is deemed to meet the requirement for suitable arc ratings in § 1910.269(l)(11)(v) and the prohibition against clothing that could ignite and continue to burn in § 1910.269(l)(11)(iii) when the available heat energy is 2 cal/cm² or less, this type of clothing is still prohibited under certain conditions by § 1910.269(l)(11)(iv), as discussed further below.

Protective performance of any particular fabric type generally increases with fabric weight, as long as the fabric does not ignite and continue to burn. Multiple layers of clothing usually block more heat and are normally more protective than a single layer of the equivalent weight.

Exposed skin is expected to sustain a second-degree burn for incident energy levels of 1.6 cal/cm² or more. Though it is not required by the standard, if the heat energy estimated under § 1910.269(l)(11)(ii) is greater than or equal to 1.6 cal/cm², the employer should require each exposed employee to have no more than 10 percent of his or her body unprotected. Due to the unpredictable nature of electric arcs, the employer should also consider requiring the protection of bare skin from any exposure exceeding 0.8 cal/cm² so as to minimize the risk of burn injury.

**III. Protection Against Ignition**

Paragraph (l)(11)(iii) of § 1910.269 prohibits clothing that could melt onto an employee's skin or that could ignite and continue to burn when exposed to the available heat energy estimated by the employer. Meltable fabrics, such as acetate, nylon, and polyester, even in blends, must be avoided. When these fibers melt, they can adhere to the skin, transferring heat more rapidly, exacerbating any burns, and complicating treatment. This can be true even if the meltable fabric is not directly next to the skin. The remainder of this section focuses on the prevention of ignition.

Paragraph (l)(11)(v) of § 1910.269 requires clothing with an arc rating greater than or equal to the employer's estimate of available heat energy. As explained earlier, untreated cotton is acceptable for exposures of 2 cal/cm² or less. If the exposure is greater than that, the employee must wear flame-resistant clothing with a suitable arc rating. However, even though an employee is wearing a layer of flame-resistant clothing, there are circumstances under which flammable layers of clothing would be exposed and subject to ignition. For example, if the employee is wearing flammable clothing (for example, winter coveralls) over the layer of flame-resistant clothing, the outer flammable layer can ignite. Similarly, clothing ignition is possible if the employee is wearing flammable clothing under the flame-resistant clothing and the underlayer is exposed by an opening in the flame-resistant clothing. Thus, it is important for the employer to consider the possibility of clothing ignition even when an employee is wearing clothing with a suitable arc rating.

Table 11 lists the minimum heat energy under electric arc conditions that can reasonably be expected to ignite different weights and colors of cotton fabrics. The values listed, expressed in calories per square centimeter, represent a 10 percent probability of ignition with a 95 percent confidence level. If the heat energy estimated under § 1910.269(l)(11)(ii) does not exceed the values listed in Table 11 for a particular weight and color of cotton fabric, then an outer layer of that material would not be expected to ignite and would be considered as being permitted under § 1910.269(l)(11)(iii).[4] Conversely, if the heat energy estimated under § 1910.269(l)(11)(ii) exceeds the values listed in Table 11 for a particular weight and color of cotton fabric, that material may not be worn as an outer layer of garment and may not be otherwise exposed due to an opening in the flame-resistant clothing.

For white cotton fabrics of a different weight from those listed, choose the next lower weight of white cotton fabric listed in Table 11. For cotton fabrics of a different color and weight combination than those listed, select a value from the table corresponding to an equal or lesser weight of blue cotton fabric. For example, for a 6.0-oz/yd² brown twill fabric, select 4.6 cal/cm² for the ignition threshold, which corresponds to 5.2-oz/yd² blue twill. If a white garment has a silkscreen logo, insignia, or other similar design included on it, then the entire garment will be considered as being of a color other than white. (The darker portion of the garment can ignite earlier than the rest of the garment, which would cause the entire garment to burn.)

Employers may choose to test samples of genuine garments rather than rely on the values given in Table 11. The appropriate electric arc ignition test method is given in ASTM F 1958/F 1958M–99, Standard Test Method for Determining the Ignitability of Non-flame-Resistant Materials for Clothing by Electric Arc Exposure Method Using Mannequins. Using this test method, employers may substitute actual test data analysis results representing an energy level that is reasonably certain not to be capable

[4] An underlayer of clothing with an arc rating greater than or equal to the estimate of available heat energy would still be required under § 1910.269(l)(11)(v).

of igniting the fabric. For example, based on test data, the employer may select a level representing a 10 percent probability of ignition with a 95 percent confidence level, representing a 1 percent probability of ignition according to actual test results, or representing an energy level that is two standard deviations below the mean ignition threshold. The employer may also select some other comparable level.

TABLE 11.—IGNITION THRESHOLD FOR COTTON FABRICS

| Fabric description | | | Ignition threshold (cal/cm²) |
|---|---|---|---|
| Weight (oz/yd²) | Color | Weave | |
| 4.6 | White | Jersey knit | 4.3 |
| 5.2 | Blue | Twill | 4.6 |
| 6.2 | White | Fleece | 6.4 |
| 6.9 | Blue | Twill | 5.3 |
| 8.0 | Black | Twill | 6.1 |
| 8.3 | White | Sateen | 11.6 |
| 11.9 | Tan | Duck | 11.3 |
| 12.8 | Blue | Denim | 15.5 |
| 13.3 | Blue | Denim | 15.9 |

Source: "Testing Update on Protective Clothing & Equipment for Electric Arc Exposure," IEEE Paper No. PCIC–97–35.

Clothing loses weight as it wears. This can lower the ignition threshold, especially if the garment has threadbare areas or is torn.

Adding layers of clothing beneath an outer layer of flammable fabric has no significant effect on the heat energy needed to ignite the outer fabric layer. Therefore, the outer layer of clothing must be treated as if it were a single layer to determine the proper ignition threshold.

Flammable clothing worn in conjunction with flame-resistant clothing is not permitted to pose an ignition hazard.[5] Flammable clothing may not be worn as an outer layer if it could be exposed to heat energy above the ignition threshold. Outer flame-resistant layers may not have openings that expose flammable inner layers that could be ignited.

When an outer flame-resistant layer would be unable to resist breakopen,[6] the next (inner) layer should be flame-resistant.

Grounding conductors can become a source of electric arcing if they cannot carry fault current without failure. These possible sources of electric arcs [7] must be considered in determining whether the employee's clothing could ignite under § 1910.269(l)(11)(iv)(C).

Flammable clothing can also be ignited by arcing that occurs when a conductor contacts an employee or by nearby material that ignites upon exposure to an electric arc. These sources of ignition must be considered in determining whether the employee's clothing could ignite under § 1910.269(l)(11)(iv)(A) and (l)(11)(iv)(C).

o. A new Appendix G would be added to § 1910.269 to read as follows:

[5] Paragraph (l)(11)(iii) of § 1910.269 prohibits clothing that could ignite and continue to burn when exposed to the heat energy estimated under paragraph (l)(11)(ii).

[6] Breakopen is the creation of holes, tears, or cracks in the exposed fabric such that incident energy is not longer effectively blocked.

[7] Static wires and pole ground 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 need not be considered a possible electric arc souce.

Appendix G to Section 1910.269—Work Positioning Equipment Inspection Guidelines

**I. Body Belts**

Inspect body belts to ensure that:

A. 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 made of 100 percent leather;

E. No worn materials that could affect the safety of the user are present; and

F. D-rings are compatible with the snaphooks with which they will be used.

**Note:** An incompatibility between a snaphook and a D-ring may cause snaphook rollout, or unintentional disengagement of the snaphook from the D-ring. Employers should take extra precaution when determining compatibility between snaphooks and D-rings of different manufacturers.

**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 made from 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 on pole climbers are no less than 32 millimeters in length measured on the underside of the gaff;

B. Gaffs on tree climbers are no less than 51 millimeters in length measured on the underside of the gaff;

C. Gaffs and leg irons are not fractured or cracked;

D. Stirrups and leg irons are free of excessive wear;

E. Gaffs are not loose;

F. Gaffs are free of deformation that could adversely affect use;

G. Gaffs are properly sharpened; and

H. There are no broken straps or buckles.

## PART 1926—[Amended]

## Subpart E—Personal Protective and Life Saving Equipment

6. The authority citation for Subpart E of Part 1926 would be revised to read as follows:

**Authority:** Sec. 107, Contract Work Hours and Safety Standards Act (Construction Safety Act) (40 U.S.C. 333); Secs. 4, 6, and 8 of the Occupational Safety and Health Act of 1970 (29 U.S.C. 653, 655, 657); Secretary of Labor's Order No. 12–71 (36 FR 8754), 8–76 (41 FR 25059), 9–83 (48 FR 35736), 1–90 (55 FR 9033), 6–96 (62 FR 111), or 5–2002 (67 F.R. 65008) as applicable; and 29 CFR Part 1911.

7. Section 1926.97 would be added to read as follows:

### § 1926.97 Electrical protective equipment.

(a) *Design requirements.* Insulating blankets, matting, covers, line hose, gloves, and sleeves made of rubber shall meet the following requirements:

(1) *Manufacture and marking of rubber insulating equipment.* (i) Blankets, gloves, and sleeves shall be produced by a seamless process.

(ii) Each item shall be clearly marked as follows:

(A) Class 00 equipment shall be marked Class 00.

(B) Class 0 equipment shall be marked Class 0.

(C) Class 1 equipment shall be marked Class 1.

(D) Class 2 equipment shall be marked Class 2.

(E) Class 3 equipment shall be marked Class 3.

(F) Class 4 equipment shall be marked Class 4.

(G) Nonozone-resistant equipment other than matting shall be marked Type I.

(H) Ozone-resistant equipment other than matting shall be marked Type II.

(I) Other relevant markings, such as the manufacturer's identification and the size of the equipment, may also be provided.

(iii) Markings shall be nonconducting and shall be applied in such a manner as not to impair the insulating qualities of the equipment.

(iv) Markings on gloves shall be confined to the cuff portion of the glove.

(2) *Electrical requirements.* (i) Equipment shall be capable of withstanding the a-c proof-test voltage specified in Table E–1 or the d-c proof-test voltage specified in Table E–2.

(A) The proof test shall reliably indicate that the equipment can withstand the voltage involved.

(B) The test voltage shall be applied continuously for 3 minutes for equipment other than matting and shall be applied continuously for 1 minute for matting.

(C) Gloves shall also be capable of withstanding the a-c proof-test voltage specified in Table E–1 after a 16-hour water soak. (See the note following paragraph (a)(3)(ii)(B) of this section.)

(ii) When the a–c proof test is used on gloves, the 60-hertz proof-test current may not exceed the values specified in Table E–1 at any time during the test period.

(A) If the a–c proof test is made at a frequency other than 60 hertz, the permissible proof-test current shall be computed from the direct ratio of the frequencies.

(B) For the test, gloves (right side out) shall be filled with tap water and immersed in water to a depth that is in accordance with Table E–3. Water shall be added to or removed from the glove, as necessary, so that the water level is the same inside and outside the glove.

(C) After the 16-hour water soak specified in paragraph (a)(2)(i)(C) of this section, the 60-hertz proof-test current may exceed the values given in Table E–1 by not more than 2 milliamperes.

(iii) Equipment that has been subjected to a minimum breakdown voltage test may not be used for electrical protection. (See the note following paragraph (a)(3)(ii)(B) of this section.)

(iv) Material used for Type II insulating equipment shall be capable of withstanding an ozone test, with no visible effects. The ozone test shall reliably indicate that the material will resist ozone exposure in actual use. Any visible signs of ozone deterioration of the material, such as checking, cracking, breaks, or pitting, is evidence of failure to meet the requirements for ozone-resistant material. (See the note following paragraph (a)(3)(ii)(B) of this section.)

(3) *Workmanship and finish.* (i) Equipment shall be free of harmful physical irregularities that can be detected by the tests or inspections required under this section.

(ii) Surface irregularities that may be present on all rubber goods because of imperfections on forms or molds or because of inherent difficulties in the manufacturing process and that may appear as indentations, protuberances, or imbedded foreign material are acceptable under the following conditions:

(A) The indentation or protuberance blends into a smooth slope when the material is stretched.

(B) Foreign material remains in place when the insulating material is folded and stretches with the insulating material surrounding it.

**Note to paragraph (a) of this section:** Rubber insulating equipment meeting the following national consensus standards is deemed to be in compliance with paragraph (a) of this section:

American Society for Testing and Materials (ASTM) D 120–02a, Standard Specification for Rubber Insulating Gloves.

ASTM D 178–01 $^{e1}$, Standard Specification for Rubber Insulating Matting.

ASTM D 1048–99, Standard Specification for Rubber Insulating Blankets.

ASTM D 1049–98e1, Standard Specification for Rubber Insulating Covers.

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

ASTM D 1051–02, Standard Specification for Rubber Insulating Sleeves.

These standards contain specifications for conducting the various tests required in paragraph (a) of this section. For example, the a–c and d–c proof tests, the breakdown test, the water soak procedure, and the ozone test mentioned in this paragraph are described in detail in the ASTM standards.

ASTM F 1236–96, Standard Guide for Visual Inspection of Electrical Protective Rubber Products, presents methods and techniques for the visual inspection of electrical protective equipment made of rubber. This guide also contains descriptions and photographs of irregularities that can be found in this equipment.

ASTM F 819–00 $^{e1}$, Standard Terminology Relating to Electrical Protective Equipment for Workers, includes definitions of terms relating to the electrical protective equipment covered under this section.

(b) *Requirements for other types of electrical protective equipment.* The following requirements apply to the design and manufacture of electrical protective equipment that is not covered by paragraph (a) of this section:

(1) *Voltage withstand.* Insulating equipment used for the protection of employees shall be capable of withstanding, without failure, the voltages that may be imposed upon it.

**Note to paragraph (b)(1) of this section:** Such voltages include transient overvoltages, such as switching surges, as well as nominal line voltage. See Appendix B to Subpart V of this Part for a discussion of transient overvoltages on electric power transmission and distribution systems.

(2) *Equipment current.* (i) Protective equipment used for the primary insulation of employees from energized circuit parts shall be capable of passing a current test when subjected to the highest nominal voltage on which the equipment is to be used.

(ii) When insulating equipment is tested in accordance with paragraph (b)(2)(i) of this section, the equipment current may not exceed 1 microampere per kilovolt of phase-to-phase applied voltage.

**Note 1 to paragraph (b)(2) of this section:** This paragraph applies to equipment that provides primary insulation of employees from energized parts. It is not intended to apply to equipment used for secondary insulation or equipment used for brush contact only.

**Note 2 to paragraph (b)(2) of this section:** For a-c excitation, this current consists of three components:

1. Capacitive current because of the dielectric properties of the insulating material itself,
2. Conduction current through the volume of the insulating equipment, and
3. Leakage current along the surface of the tool or equipment.

The conduction current is normally negligible. For clean, dry insulating equipment, the leakage current is small, and the capacitive current predominates.

(c) *In-service care and use of rubber insulating equipment.* (1) *General.* Electrical protective equipment shall be maintained in a safe, reliable condition.

(2) *Specific requirements.* The following specific requirements apply to insulating blankets, covers, line hose, gloves, and sleeves made of rubber:

(i) Maximum use voltages shall conform to those listed in Table E–4.

(ii) Insulating equipment shall be inspected for damage before each day's use and immediately following any incident that can reasonably be suspected of having caused damage. Insulating gloves shall be given an air test, along with the inspection.

**Note to paragraph (c)(2)(ii) of this section:** ASTM F 1236–96, Standard Guide for Visual Inspection of Electrical Protective Rubber Products, presents methods and techniques for the visual inspection of electrical protective equipment made of rubber. This guide also contains descriptions and photographs of irregularities that can be found in this equipment.

(iii) Insulating equipment with any of the following defects may not be used:

(A) A hole, tear, puncture, or cut;

(B) Ozone cutting or ozone checking (the cutting action produced by ozone on rubber under mechanical stress into a series of interlacing cracks);

(C) An embedded foreign object;

(D) Any of the following texture changes: swelling, softening, hardening, or becoming sticky or inelastic.

(E) Any other defect that damages the insulating properties.

(iv) Insulating equipment found to have other defects that might affect its insulating properties shall be removed from service and returned for testing under paragraphs (c)(2)(viii) and (c)(2)(ix) of this section.

(v) Insulating equipment shall be cleaned as needed to remove foreign substances.

(vi) Insulating equipment shall be stored in such a location and in such a manner as to protect it from light, temperature extremes, excessive humidity, ozone, and other injurious substances and conditions.

(vii) Protector gloves shall be worn over insulating gloves, except as follows:

(A) Protector gloves need not be used with Class 0 or Class 00 gloves, under limited-use conditions, where small equipment and parts manipulation necessitate unusually high finger dexterity.

**Note to paragraph (c)(2)(vii)(A) of this section:** Extra care is needed in the visual examination of the glove and in the avoidance of handling sharp objects.

(B) Any other class of glove may be used for similar work without protector gloves if the employer can demonstrate that the possibility of physical damage to the gloves is small and if the class of glove is one class higher than that required for the voltage involved.

(C) Insulating gloves that have been used without protector gloves may not be reused until they have been tested under the provisions of paragraphs (c)(2)(viii) and (c)(2)(ix) of this section.

(viii) Electrical protective equipment shall be subjected to periodic electrical tests. Test voltages and the maximum intervals between tests shall be in accordance with Table E–4 and Table E–5.

(ix) The test method used under paragraphs (c)(2)(viii) and (c)(2)(xi) of this section shall reliably indicate whether the insulating equipment can withstand the voltages involved.

**Note to paragraph (c)(2)(ix) of this section:** Standard electrical test methods considered as meeting this requirement are given in the following national consensus standards:

American Society for Testing and Materials (ASTM) D 120–02a, Standard Specification for Rubber Insulating Gloves.

ASTM D 1048–99, Standard Specification for Rubber Insulating Blankets.

ASTM D 1049–98e1, Standard Specification for Rubber Insulating Covers.

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

ASTM D 1051–02, Standard Specification for Rubber Insulating Sleeves.

ASTM F 478–92, Standard Specification for In-Service Care of Insulating Line Hose and Covers.

ASTM F 479–95, Standard Specification for In-Service Care of Insulating Blankets.

ASTM F 496–02a, Standard Specification for In-Service Care of Insulating Gloves and Sleeves.

(x) Insulating equipment failing to pass inspections or electrical tests may not be used by employees, except as follows:

(A) Rubber insulating line hose may be used in shorter lengths with the defective portion cut off.

(B) Rubber insulating blankets may be salvaged by severing the defective area from the undamaged portion of the blanket. The resulting undamaged area may not be smaller than 560 mm by 560 mm (22 inches by 22 inches) for Class 1, 2, 3, and 4 blankets.

(C) Rubber insulating blankets may be repaired using a compatible patch that results in physical and electrical properties equal to those of the blanket.

(D) Rubber insulating gloves and sleeves with minor physical defects, such as small cuts, tears, or punctures, may be repaired by the application of a compatible patch. Also, rubber insulating gloves and sleeves with minor surface blemishes may be repaired with a compatible liquid compound. The repaired area shall have electrical and physical properties equal to those of the surrounding material. Repairs to gloves are permitted only in the area between the wrist and the reinforced edge of the opening.

(xi) Repaired insulating equipment shall be retested before it may be used by employees.

(xii) The employer shall certify that equipment has been tested in accordance with the requirements of paragraphs (c)(2)(iv), (c)(2)(vii)(C), (c)(2)(viii), (c)(2)(ix), and (c)(2)(xi) of this section. The certification shall identify the equipment that passed the test and the date it was tested.

**Note to paragraph (c)(2)(xii) of this section:** Marking of equipment and entering onto logs the results of the tests and the dates of testing are two acceptable means of meeting this requirement.

TABLE E–1.—A–C PROOF-TEST REQUIREMENTS

| Class of equipment | Proof-test voltage rms V | Maximum proof-test current, mA (gloves only) | | | |
|---|---|---|---|---|---|
| | | 267-mm (10.5-in) glove | 356-mm (14-in) glove | 406-mm (16-in) glove | 457-mm (18-in) glove |
| 00 | 2,500 | 8 | 12 | .................... | .................... |
| 0 | 5,000 | 8 | 12 | 14 | 16 |
| 1 | 10,000 | .................... | 14 | 16 | 18 |
| 2 | 20,000 | .................... | 16 | 18 | 20 |
| 3 | 30,000 | .................... | 18 | 20 | 22 |
| 4 | 40,000 | .................... | .................... | 22 | 24 |

TABLE E–2.—D–C PROOF-TEST REQUIREMENTS

| Class of equipment | Proof-test voltage |
|---|---|
| 00 | 10,000 |
| 0 | 20,000 |
| 1 | 40,000 |
| 2 | 50,000 |
| 3 | 60,000 |
| 4 | 70,000 |

**Note:** The d-c voltages listed in this table are not appropriate for proof testing rubber insulating line hose or covers. For this equipment, d-c proof tests shall use a voltage high enough to indicate that the equipment can be safely used at the voltages listed in Table E–4. See ASTM D 1050–90 and ASTM D 1049–98$^{e1}$ for further information on proof tests for rubber insulating line hose and covers, respectively.

TABLE E–3.—GLOVE TESTS—WATER LEVEL [1] [2]

| Class of glove | A–C proof test | | D–C proof test | |
|---|---|---|---|---|
| | mm | in | mm | in |
| 00 | 38 | 1.5 | 38 | 1.5 |
| 0 | 38 | 1.5 | 38 | 1.5 |
| 1 | 38 | 1.5 | 51 | 2.0 |
| 2 | 64 | 2.5 | 76 | 3.0 |
| 3 | 89 | 3.5 | 102 | 4.0 |
| 4 | 127 | 5.0 | 153 | 6.0 |

[1] The water level is given as the clearance from the cuff of the glove to the water line, with a tolerance of ±13 mm. (±0.5 in.).
[2] If atmospheric conditions make the specified clearances impractical, the clearances may be increased by a maximum of 25 mm. (1 in.).

TABLE E–4.—RUBBER INSULATING EQUIPMENT VOLTAGE REQUIREMENTS

| Class of equipment | Maximum use voltage [1] A–C rms | Retest voltage [2] A–C rms | Retest voltage [2] D–C avg |
|---|---|---|---|
| 00 | 500 | 2,500 | 10,000 |
| 0 | 1,000 | 5,000 | 20,000 |
| 1 | 7,500 | 10,000 | 40,000 |
| 2 | 17,000 | 20,000 | 50,000 |
| 3 | 26,000 | 30,000 | 60,000 |
| 4 | 36,000 | 40,000 | 70,000 |

[1] The maximum use voltage is the a-c voltage (rms) classification of the protective equipment that designates the maximum nominal design voltage of the energized system that may be safely worked. The nominal design voltage is equal to the phase-to-phase voltage on multiphase circuits. However, the phase-to-ground potential is considered to be the nominal design voltage:
(1) If there is no multiphase exposure in a system area and if the voltage exposure is limited to the phase-to-ground potential, or
(2) If the electrical equipment and devices are insulated or isolated or both so that the multiphase exposure on a grounded wye circuit is removed.
[2] The proof-test voltage shall be applied continuously for at least 1 minute, but no more than 3 minutes.

TABLE E–5.—RUBBER INSULATING EQUIPMENT TEST INTERVALS

| Type of equipment | When to test |
|---|---|
| Rubber insulating line hose | Upon indication that insulating value is suspect and after repair. |
| Rubber insulating covers | Upon indication that insulating value is suspect and after repair. |
| Rubber insulating blankets | Before first issue and every 12 months thereafter; [1] upon indication that insulating value is suspect; and after repair. |
| Rubber insulating gloves | Before first issue and every 6 months thereafter; [1] upon indication that insulating value is suspect; after repair; and after use without protectors. |
| Rubber insulating sleeves | Before first issue and every 12 months thereafter; [1] upon indication that insulating value is suspect; and after repair. |

[1] If the insulating equipment has been electrically tested but not issued for service, it may not be placed into service unless it has been electrically tested within the previous 12 months.

8. The authority citation for Subpart V of Part 1926 would be revised to read as follows:

**Authority:** Sec. 107, Contract Work Hours and Safety Standards Act (Construction Safety Act) (40 U.S.C. 333); Secs. 4, 6, and 8 of the Occupational Safety and Health Act of 1970 (29 U.S.C. 653, 655, 657); Secretary of Labor's Order No. 12–71 (36 FR 8754), 8–76 (41 FR 25059), 9–83 (48 FR 35736), 1–90 (55 FR 9033), 6–96 (62 FR 111), or 5–2002 (67 F.R. 65008) as applicable; and 29 CFR Part 1911.

9. Subpart V of Part 1926 would be revised to read as follows:

**Subpart V—Electric Power Transmission and Distribution**

Sec.
1926.950 General.
1926.951 Medical services and first aid.
1926.952 Job briefing.
1926.953 Enclosed spaces.
1926.954 Personal protective equipment.
1926.955 Ladders and platforms.
1926.956 Hand and portable power tools.
1926.957 Live-line tools.
1926.958 Materials handling and storage.
1926.959 Mechanical equipment.
1926.960 Working on or near exposed energized parts.
1926.961 Deenergizing lines and equipment for employee protection.
1926.962 Grounding for the protection of employees.
1926.963 Testing and test facilities.
1926.964 Overhead lines.
1926.965 Underground electrical installations.
1926.966 Substations.
1926.967 Special conditions.
1926.968 Definitions applicable to this subpart.

## Subpart V—Electric Power Transmission and Distribution

### § 1926.950 General.

(a) *Application.* (1) *Scope.* This subpart, except for paragraph (a)(3) of this section, covers the construction of electric power transmission and distribution lines and equipment. As used in this subpart 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.

(2) *Other Part 1926 standards.* This subpart applies in addition to all other applicable standards contained in this Part 1926. Employers covered under this subpart are not exempt from complying with other applicable provisions in Part 1926 by the operation of § 1910.5(c) of this chapter. Specific references in this subpart to other sections of Part 1926 are provided for emphasis only.

(3) *Applicable Part 1910 requirements.* Line-clearance tree-trimming operations and work involving electric power generation installations shall comply with § 1910.269 of this chapter.

(b) *Training.* (1) *All employees.* (i) Employees shall be trained in and familiar with the safety-related work practices, safety procedures, and other safety requirements in this subpart that pertain to their respective job assignments.

(ii) Employees 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 this subpart but that are related to their work and are necessary for their safety.

(iii) The degree of training shall be determined by the risk to the employee for the task involved.

(2) *Qualified employees.* Each qualified employee shall also be trained and competent in:

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

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

(iii) The minimum approach distances specified in this subpart corresponding to the voltages to which the qualified employee will be exposed,

(iv) 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

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

**Note to paragraph (b)(2) of this section:** For the purposes of this subpart, a person must have the training required by paragraph (b)(2) of this section in order to be considered a qualified person.

(3) *Supervision and annual inspection.* 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 subpart.

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

(i) If the supervision or annual inspections required by paragraph (b)(3) of this section indicate that the employee is not complying with the safety-related work practices required by this subpart, or

(ii) 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

(iii) If he or she must employ safety-related work practices that are not normally used during his or her regular job duties.

**Note to paragraph (b)(4)(iii) of this section:** OSHA would consider tasks that are performed less often than once per year to necessitate retraining before the performance of the work practices involved.

(5) *Type of training.* The training required by paragraph (b) of this section shall be of the classroom or on-the-job type.

(6) *Training goals.* The training shall establish employee proficiency in the work practices required by this subpart and shall introduce the procedures necessary for compliance with this subpart.

(7) *Demonstration of proficiency.* The employer shall determine that each employee has demonstrated proficiency in the work practices involved before that employee is considered as having completed the training required by paragraph (b) of this section.

**Note 1 to paragraph (b)(7) of this section:** Though they are not required by this paragraph, 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 2 to paragraph (b)(7) of this section:** Employers may rely on an employee's previous training as long as the employer: (1) Confirms that the employee has the job experience appropriate to the work to be performed, (2) through an examination or interview, makes an initial determination that the employee is proficient in the relevant safety-related work practices before he or she performs any work covered by this subpart, and (3) supervises the employee closely until that employee has demonstrated proficiency in all the work practices he or she will employ.

(c) *Contractors.* (1) *Host employer responsibilities.* (i) The host employer shall inform contract employers of:

(A) Known hazards that are covered by this section, that are related to the contract employer's work, and that might not be recognized by the contract employer or its employees; and

(B) Information about the employer's installation that the contract employer needs to make the assessments required by this subpart.

(ii) The host employer shall report observed contract-employer-related violations of this section to the contract employer.

(2) *Contract employer responsibilities.* (i) The contract employer shall ensure that each of his or her employees is instructed in the hazards communicated to the contract employer by the host employer.

**Note to paragraph (c)(2)(i) of this section:** This instruction is in addition to the training required by paragraph (b) of this section.

(ii) The contract employer shall ensure that each of his or her employees follows the work practices required by this subpart and safety-related work rules required by the host employer.

(iii) The contract employer shall advise the host employer of:

(A) Any unique hazards presented by the contract employer's work,

(B) Any unanticipated hazards found during the contract employer's work that the host employer did not mention, and

(C) The measures the contractor took to correct any violations reported by the host employer under paragraph (c)(1)(ii) of this section and to prevent such violations from recurring in the future.

(d) *Existing conditions.* 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.

### § 1926.951 Medical services and first aid.

(a) *General.* The employer shall provide medical services and first aid as required in § 1926.50.

(b) *Additional requirements.* In addition to the requirements of § 1926.50, 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:

(i) For field work involving two or more employees at a work location, at least two trained persons shall be available. However, 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.

(ii) For fixed work locations such as substations, 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 § 1926.50(d) shall be placed in weatherproof containers if the supplies could be exposed to the weather.

(3) *First aid kits.* Each first aid kit shall be maintained, shall be readily available for use, and shall be inspected frequently enough to ensure that expended items are replaced, but at least once per year.

### § 1926.952 Job briefing.

(a) *Before each job.* (1) *Initial briefing by the employer.* In assigning an employee or a group of employees to perform a job, the employer shall provide the employee in charge of the job with available information necessary to perform the job safely.

**Note to paragraph (a)(1) of this section:** The information provided by the employer to the employee in charge is intended to supplement the training required under § 1926.950(b). It may be provided at the beginning of the day for all jobs to be performed that day rather than at the start of each job. The information is also intended to be general in nature, with work-site specific information to be provided by the employee in charge after the crew arrives at the work site.

(2) *Briefing by the employee in charge.* The employer shall ensure that the employee in charge conducts a job briefing meeting paragraphs (b), (c), and (d) of this section with the employees involved before they start each job.

(b) *Subjects to be covered.* The briefing shall cover at least the following subjects: hazards associated with the job, work procedures involved, special precautions, energy source controls, and personal protective equipment requirements.

(c) *Number of briefings.* (1) *One before each shift.* 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.

(2) *Additional briefings.* Additional job briefings shall be held if significant changes, which might affect the safety of the employees, occur during the course of the work.

(d) *Extent of briefing.* (1) *Short discussion.* 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.

(2) *Detailed discussion.* A more extensive discussion shall be conducted:

(i) If the work is complicated or particularly hazardous, or

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

**Note to paragraph (d) of this section:** The briefing must always touch on all the subjects listed in paragraph (b) of this section.

(e) *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.

### § 1926.953 Enclosed spaces.

(a) *General.* This paragraph covers enclosed spaces that may be entered by employees. It does not apply to vented vaults if a determination is made that the ventilation system is operating to protect employees before they enter the space. This paragraph applies to routine entry into enclosed spaces. If, after the precautions given in this section and in § 1926.965 are taken, the hazards remaining in the enclosed space endanger the life of an entrant or could interfere with 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 of this chapter.

**Note to paragraph (a) of this section:** 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 this section.

(b) *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.

(c) *Training.* Employees who enter enclosed spaces or who serve as attendants shall be trained in the hazards of enclosed space entry, in enclosed space entry procedures, and in enclosed space rescue procedures.

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

(e) *Evaluation 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 to paragraph (e) of this section:** The evaluation called for in this paragraph may take the form of a check of the conditions expected to 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 also 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.

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

(g) *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 § 1910.146 of this chapter.

(h) *Attendants.* While work is being performed in the enclosed space, a person with first aid training meeting § 1926.951(b)(1) shall be immediately available outside the enclosed space to provide assistance if a hazard exists because of traffic patterns in the area of the opening used for entry. That person is not precluded from performing other duties outside the enclosed space if these duties do not distract the attendant from monitoring employees within the space.

**Note to paragraph (h) of this section:** See § 1926.965 for additional requirements on attendants for work in manholes and vaults.

(i) *Calibration of test instruments.* Test instruments used to monitor atmospheres in enclosed spaces shall be kept in calibration and shall have a minimum accuracy of ±10 percent.

(j) *Testing for oxygen deficiency.* Before an employee enters an enclosed space, the internal atmosphere 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.

(k) *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 paragraph (j) of this section demonstrate that there is sufficient oxygen to ensure the accuracy of the test for flammability.

(l) *Ventilation and monitoring.* 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 occurs may be followed in lieu of ventilation, if flammable gases or vapors are detected at safe levels.

**Note to paragraph (l) of this section:** See the definition of ''hazardous atmosphere'' for guidance in determining whether or not a given concentration of a substance is considered to be hazardous.

(m) *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 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.

(n) *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.

(o) *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 to paragraph (o) of this section:** See the definition of ''hazardous atmosphere'' for guidance in determining whether or not a given concentration of a substance is considered to be hazardous.

### § 1926.954 Personal protective equipment.

(a) *General.* Personal protective equipment shall meet the requirements of Subpart E of this Part.

(b) *Fall protection.* (1) *Personal fall arrest systems.* Personal fall arrest systems shall meet the requirements of Subpart M of this part.

**Note to paragraph (b)(1) of this section:** This paragraph applies to all personal fall arrest systems used in work covered by this Subpart.

(2) *Work positioning equipment.* Body belts and positioning straps for work positioning shall meet the following requirements:

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

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

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

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

(ii) Buckles shall be capable of withstanding an 8.9-kN (2,000-lbf) tension test with a maximum permanent deformation no greater than 0.4 mm (0.0156 in.).

(iii) D rings shall be capable of withstanding a 22-kN (5,000-lbf) tensile test without cracking or breaking.

(iv) Snaphooks shall be capable of withstanding a 22-kN (5,000-lbf) tension test without failure.

**Note to paragraph (b)(2)(iv) of this section:** Tensile failure of a snaphook is indicated by distortion of the snaphook sufficient to release the keeper.

(v) 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.

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

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

(A) A dielectric test of 819.7 volts, AC, per centimeter (25000 volts per foot) for 3 minutes without visible deterioration;

(B) A leakage test of 98.4 volts, AC, per centimeter (3000 volts per foot) with a leakage current of no more than 1 mA;

**Note to paragraphs (b)(2)(vii)(A) and (b)(2)(vii)(B) of this section:** Positioning straps that pass direct current tests at equivalent voltages are considered as meeting this requirement.

(C) Tension tests of 20 kN (4500 lbf) for sections free of buckle holes and of 15 kN (3500 lbf) for sections with buckle holes;

(D) A buckle tear test with a load of 4.4 kN (1000 lbf); and

(E) A flammability test in accordance with Table V–1.

TABLE V–1.—FLAMMABILITY TEST

| Test method | Criteria for passing the test |
|---|---|
| Vertically suspend a 500-mm (19.7-inch) length of strapping holding up a 100-kg (200.5-lb) weight. | Any flames on the positioning strap shall self extinguish. |
| Use a butane or propane burner with a 76-mm (3-inch) flame .............. | The positioning strap shall continue to support the 100-kg (220.5-lb) mass. |
| Direct the flame to an edge of the strapping at a distance of 25 mm (1 inch). | |
| Remove the flame after 5 seconds. | |
| Wait until any flames on the positioning strap go out. | |

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

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

(x) 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.

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

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

(B) A force in the range of 6.6 N (1.5 lbf) to 17.6 N (4 lbf) shall be required to release the locking mechanism.

(C) 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 11.0 N (2.5 lbf) or less and shall begin to open with a maximum force of 17.6 N (4 lbf).

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

(A) The test mass shall be rigidly constructed of steel or equivalent material with a mass of 100 kg (220.5 lbm).

(B) 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.

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

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

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

(F) Positioning straps shall successfully arrest the fall of the test mass without breaking and the arrest force may not exceed 17.8 kN (4000 lbf). Additionally, snaphooks on positioning straps may not have distorted sufficiently to allow the keeper to be released.

**Note 1 to paragraph (b)(2) of this section:** This paragraph applies to all work positioning equipment used in work covered by this Subpart.

**Note 2 to paragraph (b)(2) of this section:** Body belts and positioning straps that conform to American Society of Testing and Materials Standard Specifications for Personal Climbing Equipment, ASTM F 887–04, are deemed to be in compliance with the manufacturing and construction requirements of paragraph (b)(2) of this section provided that the body belt or positioning strap also conforms to paragraphs (b)(2)(iv) and (b)(2)(xi) of this section.

**Note 3 to paragraph (b)(2) of this section:** Body belts and positioning straps that conform to § 1926.502(e) on positioning device systems are deemed to be in compliance with the manufacturing and construction requirements of paragraph (b)(2) of this section provided that the positioning strap also conforms to paragraph (b)(2)(vii) of this section.

(3) *Care and use of personal fall protection equipment.* (i) Work positioning equipment shall be inspected before use each day to determine that the equipment is in safe working condition. Defective equipment may not be used.

**Note to paragraph (b)(3)(i) of this section:** Appendix G to this subpart contains guidelines for the inspection of work positioning equipment.

(ii) Personal fall arrest systems shall be used in accordance with § 1926.502(d). However, the attachment point need not be located as required by § 1926.502(d)(17) if the body harness is being used as work positioning equipment and if the maximum free fall distance is limited to 0.6 m (2 ft).

(iii) A personal fall arrest system or work positioning equipment shall be used by employees working at elevated locations more than 1.2 m (4 ft) 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 to paragraph (b)(3)(iii) of this section:** This paragraph applies to structures that support overhead electric power 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. The duty to provide fall protection associated with walking and working surfaces is contained in Subpart M of this Part; the duty to provide fall protection associated with aerial lifts is contained in § 1926.453.

**Note 2 to paragraph (b)(3)(iii) of this section:** Employees who have not completed training in climbing and the use of fall protection 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 1.2 m (4 ft) above the ground.

(iv) Work positioning systems shall be rigged so that an employee can free fall no more than 0.6 m (2 ft) unless no anchorage is available.

(v) 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 kN (3,000 lbf), whichever is greater.

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

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

(B) To each other;

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

(D) To a horizontal lifeline; or

(E) To any object which is incompatibly shaped or dimensioned in relation to the snaphook such that unintentional disengagement could occur by the connected object being able to depress the snaphook keeper and release itself.

**§ 1926.955 Ladders and platforms.**

(a) *General.* Requirements for portable ladders contained in Subpart X of this Part apply, except as specifically noted in paragraph (b) of this section. Fixed ladders shall meet Part 1910, Subpart D of this chapter.

(b) *Special ladders and platforms.* Portable ladders and platforms used on structures or conductors in conjunction with overhead line work need not meet paragraphs (b)(5)(i) and (b)(12) of § 1926.1053. However, these ladders and platforms shall meet the following requirements:

(1) *Design load.* 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.

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

(3) *Secured in place.* Ladders and platforms shall be secured to prevent their becoming accidentally dislodged.

(4) *Intended use.* Ladders and platforms may be used only in applications for which they are designed.

(c) *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 ladders shall be used where the employer can demonstrate that nonconductive ladders would present a greater hazard than conductive ladders.

**§ 1926.956 Hand and portable power tools.**

(a) *General.* Paragraph (b) of this section applies to electric equipment connected by cord and plug. Paragraph (c) of this section applies to portable and vehicle-mounted generators used to supply cord- and plug-connected equipment. Paragraph (d) of this section applies to hydraulic and pneumatic tools.

(b) *Cord- and plug-connected equipment.* (1) *Supplied by premises wiring.* Cord- and plug-connected equipment supplied by premises wiring is covered by Subpart K of this Part.

(2) *Supplied by other than premises wiring.* Any cord- and plug-connected equipment supplied by other than premises wiring shall comply with one of the following in lieu of § 1926.302(a)(1):

(i) It shall be equipped with a cord containing an equipment grounding conductor connected to the tool frame and to a means for grounding the other end (however, this option may not be used where the introduction of the ground into the work environment increases the hazard to an employee); or

(ii) It shall be of the double-insulated type conforming to Subpart K of this Part; or

(iii) It shall be connected to the power supply through an isolating transformer with an ungrounded secondary.

(c) *Portable and vehicle-mounted generators.* Portable and vehicle-mounted generators used to supply cord- and plug-connected equipment shall meet the following requirements:

(1) *Equipment to be supplied.* 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) *Equipment grounding.* The noncurrent-carrying metal parts of equipment and the equipment grounding conductor terminals of the receptacles shall be bonded to the generator frame.

(3) *Bonding the frame.* In the case of vehicle-mounted generators, the frame of the generator shall be bonded to the vehicle frame.

(4) *Bonding the neutral conductor.* Any neutral conductor shall be bonded to the generator frame.

(d) *Hydraulic and pneumatic tools.* (1) *Hydraulic fluid in insulating tools.* Paragraph (d)(1) of § 1926.302 does not apply to hydraulic fluid used in insulating sections of hydraulic tools.

(2) *Operating pressure.* Safe operating pressures for hydraulic and pneumatic tools, hoses, valves, pipes, filters, and fittings may not be exceeded.

**Note to paragraph (d)(2) of this section:** If any hazardous defects are present, no operating pressure would be 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.

(3) *Work near energized parts.* A hydraulic or pneumatic tool used where it may contact exposed energized parts shall be designed and maintained for such use.

(4) *Protection against vacuum formation.* 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 to paragraph (d)(4) of this section:** Hydraulic lines without check valves having a separation of more than 10.7 m (35 ft) between the oil reservoir and the upper end of the hydraulic system promote the formation of a partial vacuum.

(5) *Protection against the accumulation of moisture.* 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.

(6) *Breaking connections.* Pressure shall be released before connections are broken, unless quick acting, self-closing connectors are used.

(7) *Leaks.* Employees may not use any part of their bodies to locate or attempt to stop a hydraulic leak.

(8) *Hoses.* Hoses may not be kinked.

**§ 1926.957 Live-line tools.**

(a) *Design of tools.* Live-line tool rods, tubes, and poles shall be designed and constructed to withstand the following minimum tests:

(1) *Fiberglass-reinforced plastic.* If the tool is made of fiberglass-reinforced plastic (FRP), it shall withstand 328100 volts per meter (100,000 volts per foot) of length for 5 minutes, or

**Note to paragraph (a)(1) of this section:** Live-line tools using rod and tube that meet ASTM F 711–02, Standard Specification for Fiberglass-Reinforced Plastic (FRP) Rod and Tube Used in Live Line Tools, conform to paragraph (a)(1) of this section.

(2) *Wood.* If the tool is made of wood, it shall withstand 246100 volts per meter (75,000 volts per foot) of length for 3 minutes, or

(3) *Equivalent tests.* The tool shall withstand other tests that the employer can demonstrate are equivalent.

(b) *Condition of tools.* (1) *Daily inspection.* Each live-line tool shall be wiped clean and visually inspected for defects before use each day.

(2) *Defects.* 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 paragraph (b)(3) of this section before being returned to service.

(3) *Biennial* inspection and testing. Live-line tools used for primary employee protection shall be removed from service every 2 years and whenever required under paragraph (b)(2) of this 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 paragraphs (b)(3)(iv) and (b)(3)(v) of 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) 246,100 volts per meter (75,000 volts per foot) of length for 1 minute if the tool is made of fiberglass, or

(B) 164,000 volts per meter (50,000 volts per foot) of length for 1 minute if the tool is made of wood, or

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

**Note to paragraph (b) of this section:** Guidelines for the examination, cleaning, repairing, and in-service testing of live-line tools are contained in the Institute of Electrical and Electronics Engineers' IEEE Guide for Maintenance Methods on Energized Power Lines, IEEE Std. 516–2003.

### § 1926.958 Materials handling and storage.

(a) *General.* Materials handling and storage shall conform to the requirements of Subpart N of this Part.

(b) *Materials storage near energized lines or equipment.* (1) Unrestricted areas. In areas not restricted to qualified persons only, materials or equipment may not be stored closer to energized lines or exposed energized parts of equipment than the following distances plus an amount providing for the maximum sag and side swing of all conductors and providing for the height and movement of material handling equipment:

(i) For lines and equipment energized at 50 kV or less, the distance is 3.05 m (10 ft).

(ii) For lines and equipment energized at more than 50 kV, the distance is 3.05 m (10 ft) plus 0.10 m (4 in.) for every 10 kV over 50 kV.

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

**Note to paragraph (b)(2) of this section:** Requirements for the size of the working space are contained in § 1926.966(b).

### § 1926.959 Mechanical equipment.

(a) *General requirements.* (1) *Other applicable requirements.* Mechanical equipment shall be operated in accordance with Subparts N and O of this Part, except that §§ 1926.550(a)(15) and 1926.600(a)(6) do not apply to operations performed by qualified employees.

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

**Note to paragraph (a)(2) of this section:** 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.

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

(b) *Outriggers.* (1) *Extend outriggers.* 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.

(2) *Operation without outriggers.* 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.

(c) *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.

(d) *Operations near energized lines or equipment.* (1) *Minimum approach distance.* Mechanical equipment shall be operated so that the minimum approach distances of Table V–2 through Table V–6 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 at a different potential.

(2) *Observer.* 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 paragraph (d)(1) of this section is reached, unless the employer can demonstrate that the operator can accurately determine that the minimum approach distance is being maintained.

(3) *Extra precautions.* If, during operation of the mechanical equipment, the equipment could become energized, the operation shall also comply with at least one of paragraphs (d)(3)(i) through (d)(3)(iii) of this section.

(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 V–2 through Table V–6 in § 1926.960.

(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 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 to paragraph (d)(3)(iii) of this section:** Appendix C to this Subpart contains information on hazardous step and touch potentials and on methods of protecting employees from hazards resulting from such potentials.

**§ 1926.960 Working on or near exposed energized parts.**

(a) *Application.* This section applies to work on exposed live parts, or near enough to them, to expose the employee to any hazard they present.

(b) *General.* (1) *Qualified employees only.* (i) Only qualified employees may work on or with exposed energized lines or parts of equipment.

(ii) Only qualified employees may work in areas containing unguarded, uninsulated energized lines or parts of equipment operating at 50 volts or more.

(2) *Treat as energized.* Electric lines and equipment shall be considered and treated as energized unless they have been deenergized in accordance with § 1926.961.

(3) *At least two employees.* (i) Except as provided in paragraph (b)(3)(ii) of this section, at least two 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 paragraphs (b)(3)(i)(A) through (b)(3)(i)(D) of this section.

(ii) Paragraph (b)(3) of this section does not apply to the following operations:

(A) Routine switching of circuits, if the employer can demonstrate that conditions at the site allow this work to be performed safely,

(B) Work performed with live-line tools if the employee is positioned so that he or she is neither within reach of nor otherwise exposed to contact with energized parts, and

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

(c) *Live work.* (1) *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 V–2 through Table V–6, unless:

(i) The employee is insulated from the energized part (insulating gloves or insulating gloves and sleeves worn in accordance with paragraph (c)(2) of this section are considered 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 body), or

(ii) The energized part is insulated from the employee and from any other conductive object at a different potential, or

(iii) The employee is insulated from any other exposed conductive object, as during live-line bare-hand work.

**Note to paragraph (c)(1) of this section:** Paragraph (f)(1) of § 1926.966 contains requirements for the guarding and isolation of live parts. Parts of electric circuits that meet these two provisions are not considered as ''exposed'' unless a guard is removed or an employee enters the space intended to provide isolation from the live parts.

(2) *Type of insulation.* (i) If the employee is to be insulated from energized parts by the use of insulating gloves (under paragraph (c)(1)(i) 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.

(ii) If the employee is to be insulated from energized parts by the use of insulating gloves or insulating gloves with sleeves,

(A) The insulating gloves and sleeves shall be put on in a position where the employee cannot reach into the minimum approach distance given in paragraph (c)(1) of this section; and

(B) The insulating gloves and sleeves may not be removed until the employee is in a position where he or she cannot reach into the minimum approach distance given in paragraph (c)(1) of this section.

(d) *Working position.* (1) *Working from below.* 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.

(2) *Working without electrical protective equipment.* If work is performed near exposed parts energized at more than 600 volts but not more than 72.5 kilovolts and if the employee is not insulated from the energized parts or performing live-line bare-hand work, the employee shall work from a position where the employee cannot reach into the minimum approach distance given in paragraph (c)(1) of this section.

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

(1) *Connecting.* 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) *Disconnecting.* 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) *Loose conductors.* When lines or equipment are connected to or disconnected from energized circuits, loose conductors shall be kept away from exposed energized parts.

(f) *Conductive articles.* 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.

(g) *Clothing.* (1) *Hazard assessment.* The employer shall assess the workplace to determine if each employee is exposed to hazards from flames or from electric arcs.

(2) *Estimate of available heat energy.* For each employee exposed to hazards from electric arcs, the employer shall make a reasonable estimate of the maximum available heat energy to which the employee would be exposed.

**Note 1 to paragraph (g)(2) of this section:** Appendix F to this Subpart provides guidance on the estimation of available heat energy.

**Note 2 to paragraph (g)(2) of this section:** This paragraph does not require the employer to estimate the 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 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.

(3) *Prohibited clothing*. The employer shall ensure that each employee who is exposed to hazards from electric arcs does not wear clothing that could melt onto his or her skin or that could ignite and continue to burn when exposed to the heat energy estimated under paragraph (g)(2) of this section.

**Note to paragraph (g)(3) of this section:** Clothing made from the following types of fabrics, either alone or in blends, is prohibited by this paragraph, 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.

(4) *Flame-resistant clothing*. The employer shall ensure that an employee wears clothing that is flame resistant under any of the following conditions:

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

(ii) The employee's clothing could be ignited by flammable material in the work area that could be ignited by an electric arc, or

(iii) The employee's clothing could be ignited by molten metal or electric arcs from faulted conductors in the work area.

**Note to paragraph (g)(4)(iii) of this section:** This paragraph 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.

(5) *Clothing rating*. The employer shall ensure that each employee who is exposed to hazards from electric arcs wears clothing with an arc rating greater than or equal to the heat energy estimated under paragraph (g)(2) of this section.

**Note to paragraph (g) of this section:** See Appendix F to this subpart for further information on the selection of appropriate clothing.

(h) *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 Subpart E of this Part, uses a tool rated for the voltage, and is clear of the exhaust path of the fuse barrel.

(i) *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.

(j) *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.

(k) *Opening circuits under load*. Devices used to open circuits under load conditions shall be designed to interrupt the current involved.

TABLE V–2.—A–C LIVE-LINE WORK MINIMUM APPROACH DISTANCE

| Nominal voltage in kilovolts phase to phase | Distance | | | |
|---|---|---|---|---|
| | Phase-to-ground exposure | | Phase-to-phase exposure | |
| | m | ft-in | m | ft-in |
| 0.051 to 0.300 [1] | Avoid contact | | Avoid contact | |
| 0.301 to 0.750 [1] | 0.31 | 1–0 | 0.31 | 1–0 |
| 0.751 to 15.0 | 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 |

[1] For single-phase systems, use the voltage to ground.
**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 shown.
**Note 2:** The clear live-line tool distance shall equal or exceed the values for the indicated voltage ranges.
**Note 3:** See Appendix B to this subpart for information on how the minimum approach distances listed in the tables were derived.

TABLE V–3.—A–C LIVE-LINE WORK MINIMUM APPROACH DISTANCE WITH OVERVOLTAGE FACTOR PHASE-TO-GROUND EXPOSURE

| Maximum anticipated per-unit transient overvoltage | Distance in meters | | | | | | |
|---|---|---|---|---|---|---|---|
| | Maximum phase-to-phase voltage in kilovolts | | | | | | |
| | 121 | 145 | 169 | 242 | 362 | 552 | 800 |
| 1.5 | ............ | ............ | ............ | ............ | ............ | 1.82 | 2.95 |
| 1.6 | ............ | ............ | ............ | ............ | ............ | 1.97 | 3.23 |
| 1.7 | ............ | ............ | ............ | ............ | ............ | 2.13 | 3.54 |
| 1.8 | ............ | ............ | ............ | ............ | ............ | 2.29 | 3.86 |
| 1.9 | ............ | ............ | ............ | ............ | ............ | 2.47 | 4.19 |

TABLE V–3.—A–C LIVE-LINE WORK MINIMUM APPROACH DISTANCE WITH OVERVOLTAGE FACTOR PHASE-TO-GROUND EXPOSURE

| Maximum anticipated per-unit transient overvoltage | Distance in meters | | | | | | |
|---|---|---|---|---|---|---|---|
| | Maximum phase-to-phase voltage in kilovolts | | | | | | |
| | 121 | 145 | 169 | 242 | 362 | 552 | 800 |
| 2.0 | 0.74 | 0.83 | 0.92 | 1.16 | 1.59 | 2.65 | 4.53 |
| 2.1 | 0.76 | 0.85 | 0.95 | 1.21 | 1.65 | 2.83 | ............ |
| 2.2 | 0.78 | 0.88 | 0.98 | 1.25 | 1.74 | 3.01 | ............ |
| 2.3 | 0.80 | 0.91 | 1.01 | 1.29 | 1.84 | 3.20 | ............ |
| 2.4 | 0.82 | 0.93 | 1.04 | 1.33 | 1.94 | 3.42 | ............ |
| 2.5 | 0.84 | 0.96 | 1.07 | 1.38 | 2.04 | ............ | ............ |
| 2.6 | 0.86 | 0.98 | 1.10 | 1.42 | 2.14 | ............ | ............ |
| 2.7 | 0.88 | 1.01 | 1.13 | 1.45 | 2.25 | ............ | ............ |
| 2.8 | 0.91 | 1.03 | 1.16 | 1.50 | 2.36 | ............ | ............ |
| 2.9 | 0.93 | 1.06 | 1.19 | 1.54 | 2.47 | ............ | ............ |
| 3.0 | 0.95 | 1.09 | 1.22 | 1.59 | 2.59 | ............ | ............ |

**Note 1:** The distances specified in this table may be applied only where the maximum anticipated per-unit transient overvoltage has been determined by engineering analysis and has been supplied by the employer. Table V–2 applies otherwise.
**Note 2:** The distances specified in this table are the air, bare-hand, and live-line tool distances.
**Note 3:** See Appendix B to this subpart for information on how the minimum approach distances listed in the tables were derived and on how to calculate revised minimum approach distances based on the control of transient overvoltages.

TABLE V–3.—A–C LIVE-LINE WORK MINIMUM APPROACH DISTANCE WITH OVERVOLTAGE FACTOR PHASE-TO-GROUND EXPOSURE (CONTINUED)

| Maximum anticipated per-unit transient overvoltage | Distance in feet-inches | | | | | | |
|---|---|---|---|---|---|---|---|
| | Maximum phase-to-phase voltage in kilovolts | | | | | | |
| | 121 | 145 | 169 | 242 | 362 | 552 | 800 |
| 1.5 | ............ | ............ | ............ | ............ | ............ | 6–0 | 9–8 |
| 1.6 | ............ | ............ | ............ | ............ | ............ | 6–6 | 10–8 |
| 1.7 | ............ | ............ | ............ | ............ | ............ | 7–0 | 11–8 |
| 1.8 | ............ | ............ | ............ | ............ | ............ | 7–7 | 12–8 |
| 1.9 | ............ | ............ | ............ | ............ | ............ | 8–1 | 13–9 |
| 2.0 | 2–5 | 2–9 | 3–0 | 3–10 | 5–3 | 8–9 | 114–11 |
| 2.1 | 2–6 | 2–10 | 3–2 | 4–0 | 5–5 | 9–4 | ............ |
| 2.2 | 2–7 | 2–11 | 3–3 | 4–1 | 5–9 | 9–11 | ............ |
| 2.3 | 2–8 | 3–0 | 3–4 | 4–3 | 6–1 | 10–6 | ............ |
| 2.4 | 2–9 | 3–1 | 3–5 | 4–5 | 6–4 | 11–3 | ............ |
| 2.5 | 2–9 | 3–2 | 3–6 | 4–6 | 6–8 | ............ | ............ |
| 2.6 | 2–10 | 3–3 | 3–8 | 4–8 | 7–1 | ............ | ............ |
| 2.7 | 2–11 | 3–4 | 3–9 | 4–10 | 7–5 | ............ | ............ |
| 2.8 | 3–0 | 3–5 | 3–10 | 4–11 | 7–9 | ............ | ............ |
| 2.9 | 3–1 | 3–6 | 3–11 | 5–1 | 8–2 | ............ | ............ |
| 3.0 | 3–2 | 3–7 | 4–0 | 5–3 | 8–6 | ............ | ............ |

**Note 1:** The distances specified in this table may be applied only where the maximum anticipated per-unit transient overvoltage has been determined by engineering analysis and has been supplied by the employer. Table V–2 applies otherwise.
**Note 2:** The distances specified in this table are the air, bare-hand, and live-line tool distances.
**Note 3:** See Appendix B to this Subpart for information on how the minimum approach distances listed in the tables were derived and on how to calculate revised minimum approach distances based on the control of transient overvoltages.

TABLE V–4.—A–C LIVE-LINE WORK MINIMUM APPROACH DISTANCE WITH OVERVOLTAGE FACTOR PHASE-TO-PHASE EXPOSURE

| Maximum anticipated per-unit transient overvoltage | Distance in meters | | | | | | |
|---|---|---|---|---|---|---|---|
| | Maximum phase-to-phase voltage in kilovolts | | | | | | |
| | 121 | 145 | 169 | 242 | 362 | 552 | 800 |
| 1.5 | ............ | ............ | ............ | ............ | ............ | 2.24 | 3.67 |
| 1.6 | ............ | ............ | ............ | ............ | ............ | 2.65 | 4.42 |
| 1.7 | ............ | ............ | ............ | ............ | ............ | 3.08 | 5.23 |
| 1.8 | ............ | ............ | ............ | ............ | ............ | 3.53 | 6.07 |
| 1.9 | ............ | ............ | ............ | ............ | ............ | 4.01 | 6.97 |
| 2.0 | 1.08 | 1.24 | 1.41 | 1.85 | 2.61 | 4.52 | 7.91 |
| 2.1 | 1.10 | 1.27 | 1.44 | 1.89 | 2.68 | 4.75 | ............ |

TABLE V–4.—A–C LIVE-LINE WORK MINIMUM APPROACH DISTANCE WITH OVERVOLTAGE FACTOR PHASE-TO-PHASE EXPOSURE

| Maximum anticipated per-unit transient overvoltage | Distance in meters — Maximum phase-to-phase voltage in kilovolts | | | | | | |
|---|---|---|---|---|---|---|---|
| | 121 | 145 | 169 | 242 | 362 | 552 | 800 |
| 2.2 | 1.12 | 1.29 | 1.47 | 1.93 | 2.78 | 4.98 | ............ |
| 2.3 | 1.14 | 1.32 | 1.50 | 1.97 | 2.90 | 5.21 | ............ |
| 2.4 | 1.16 | 1.35 | 1.53 | 2.01 | 3.02 | 5.50 | ............ |
| 2.5 | 1.18 | 1.37 | 1.56 | 2.06 | 3.14 | ............ | ............ |
| 2.6 | 1.21 | 1.40 | 1.59 | 2.10 | 3.27 | ............ | ............ |
| 2.7 | 1.23 | 1.43 | 1.62 | 2.13 | 3.40 | ............ | ............ |
| 2.8 | 1.25 | 1.45 | 1.65 | 2.19 | 3.53 | ............ | ............ |
| 2.9 | 1.27 | 1.48 | 1.68 | 2.22 | 3.67 | ............ | ............ |
| 3.0 | 1.29 | 1.50 | 1.71 | 2.27 | 3.80 | ............ | ............ |

**Note 1:** The distances specified in this table may be applied only where the maximum anticipated per-unit transient overvoltage has been determined by engineering analysis and has been supplied by the employer. Table V–2 applies otherwise.

**Note 2:** The distances specified in this table are the air, bare-hand, and live-line tool distances.

**Note 3:** See Appendix B to this Subpart for information on how the minimum approach distances listed in the tables were derived and on how to calculate revised minimum approach distances based on the control of transient overvoltages.

TABLE V–4.—A–C LIVE-LINE WORK MINIMUM APPROACH DISTANCE WITH OVERVOLTAGE FACTOR PHASE-TO-PHASE EXPOSURE (CONTINUED)

| Maximum anticipated per-unit transient overvoltage | Distance in Meters — Maximum phase-to-phase voltage in kilovolts | | | | | | |
|---|---|---|---|---|---|---|---|
| | 121 | 145 | 169 | 242 | 362 | 552 | 800 |
| 1.5 | ............ | ............ | ............ | ............ | ............ | 7–4 | 12–1 |
| 1.6 | ............ | ............ | ............ | ............ | ............ | 8–9 | 14–6 |
| 1.7 | ............ | ............ | ............ | ............ | ............ | 10–2 | 17–2 |
| 1.8 | ............ | ............ | ............ | ............ | ............ | 11–7 | 19–11 |
| 1.9 | ............ | ............ | ............ | ............ | ............ | 13–2 | 22–11 |
| 2.0 | 3–7 | 4–1 | 4–8 | 6–1 | 8–7 | 14–10 | 26–0 |
| 2.1 | 3–7 | 4–1 | 4–9 | 6–3 | 8–10 | 15–7 | ............ |
| 2.2 | 3–8 | 4–3 | 4–10 | 6–4 | 9–2 | 16–4 | ............ |
| 2.3 | 3–9 | 4–4 | 4–11 | 6–6 | 9–6 | 17–2 | ............ |
| 2.4 | 3–10 | 4–5 | 5–0 | 6–7 | 9–11 | 18–1 | ............ |
| 2.5 | 3–11 | 4–6 | 5–2 | 6–9 | 10–4 | ............ | ............ |
| 2.6 | 4–0 | 4–7 | 5–3 | 6–11 | 10–9 | ............ | ............ |
| 2.7 | 4–1 | 4–8 | 5–4 | 7–0 | 11–2 | ............ | ............ |
| 2.8 | 4–1 | 4–9 | 5–5 | 7–2 | 11–7 | ............ | ............ |
| 2.9 | 4–2 | 4–10 | 5–6 | 7–4 | 12–1 | ............ | ............ |
| 3.0 | 4–3 | 4–11 | 5–8 | 7–6 | 12–6 | ............ | ............ |

**Note 1:** The distances specified in this table may be applied only where the maximum anticipated per-unit transient overvoltage has been determined by engineering analysis and has been supplied by the employer. Table V–2 applies otherwise.

**Note 2:** The distances specified in this table are the air, bare-hand, and live-line tool distances.

**Note 3:** See Appendix B to this Subpart for information on how the minimum approach distances listed in the tables were derived and on how to calculate revised minimum approach distances based on the control of transient overvoltages.

TABLE V–5.—D–C LIVE-LINE MINIMUM APPROACH DISTANCE WITH OVERVOLTAGE FACTOR

| Maximum anticipated per-unit transient overvoltage | Distance in meters (feet-inches) Maximum line-to-ground voltage in kilovolts | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 250 | | 400 | | 500 | | 600 | | 750 | |
| 1.5 or lower | 1.12 | (3–8) | 1.60 | (5–3) | 2.06 | (6–9) | 2.62 | (8–7) | 3.61 | (11–10) |
| 1.6 | 1.17 | (3–10) | 1.69 | (5–7) | 2.24 | (7–4) | 2.86 | (9–5) | 3.98 | (13–1) |
| 1.7 | 1.23 | (4–1) | 1.82 | (6–0) | 2.42 | (7–11) | 3.12 | (10–3) | 4.37 | (14–4) |
| 1.8 | 1.28 | (4–3) | 1.95 | (6–5) | 2.62 | (8–7) | 3.39 | (11–2) | 4.79 | (15–9) |

**Note 1:** The distance specified in this table may be applied only where the maximum anticipated per-unit transient overvoltage has been determined by engineering analysis and has been supplied by the employer. However, if the transient overvoltage factor is not known, a factor of 1.8 shall be assumed.

**Note 2:** The distances specified in this table are the air, bare-hand, and live-line tool distances.

TABLE V–6.—ALTITUDE CORRECTION FACTOR

| Altitude | | Correction factor |
|---|---|---|
| m | ft | |
| 900 | 3000 | 1.00 |
| 1200 | 4000 | 1.02 |
| 1500 | 5000 | 1.05 |
| 1800 | 6000 | 1.08 |
| 2100 | 7000 | 1.11 |
| 2400 | 8000 | 1.14 |
| 2700 | 9000 | 1.17 |
| 3000 | 10000 | 1.20 |
| 3600 | 12000 | 1.25 |
| 4200 | 14000 | 1.30 |
| 4800 | 16000 | 1.35 |
| 5400 | 18000 | 1.39 |
| 6000 | 20000 | 1.44 |

**Note:** If the work is performed at elevations greater than 900 m (3000 ft) above mean sea level, the minimum approach distance shall be determined by multiplying the distances in Table V–2 through Table V–5 by the correction factor corresponding to the altitude at which work is performed.

**§ 1926.961 Deenergizing lines and equipment for employee protection.**

(a) *Application.* This section applies to the deenergizing of transmission and distribution lines and equipment for the purpose of protecting employees. Conductors and parts of electric equipment that have been deenergized under procedures other than those required by this section shall be treated as energized.

(b) *General.* (1) *System operator.* If a system operator is in charge of the lines or equipment and their means of disconnection, all of the requirements of paragraph (c) of this section shall be observed, in the order given.

(2) *No system operator.* 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 paragraph (c) of this section apply, in the order given, except as provided in paragraph (b)(3)(i) of this section. The employee in charge of the clearance shall take the place of the system operator, as necessary.

(3) *Number of crews working.* (i) 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, paragraphs (c)(1), (c)(3), (c)(4), and (c)(11) of this section do not apply. Additionally, tags required by the remaining provisions of paragraph (c) of this section need not be used.

(ii) If two or more independent crews will be working on the same lines or equipment, each crew shall independently comply with the requirements in paragraph (c) of this section. The independent crews shall coordinate deenergizing and reenergizing the lines or equipment if there is no system operator in charge of the lines or equipment.

(4) *Disconnecting means accessible to general public.* 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.

(c) *Deenergizing lines and equipment.* (1) *Request to deenergize.* A designated employee shall make a request of the system operator to have the particular section of line or equipment deenergized. The designated employee becomes the employee in charge (as this term is used in paragraph (c) of this section) and is responsible for the clearance.

(2) *Open disconnecting means.* 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.

(3) *Automatically and remotely controlled switches.* 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.

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

(5) *Test for energized condition.* After the applicable requirements in paragraphs (c)(1) through (c)(4) 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.

(6) *Install grounds.* Protective grounds shall be installed as required by § 1926.962.

(7) *Consider lines and equipment deenergized.* After the applicable requirements of paragraphs (c)(1) through (c)(6) of this section have been followed, the lines and equipment involved may be worked as deenergized.

(8) *Transferring clearances.* 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.

(9) *Releasing clearances.* To release a clearance, the employee in charge shall:

(i) Notify each employee under his or her direction that the clearance is to be released;

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

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

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

(10) *Person releasing clearance.* The person releasing a clearance shall be the same person who requested the clearance, unless responsibility has been transferred under paragraph (c)(8) of this section.

(11) *Removal of tags.* Tags may not be removed unless the associated clearance has been released under paragraph (c)(9) of this section.

(12) *Reenergizing lines and equipment.* 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.

**§ 1926.962 Grounding for the protection of employees.**

(a) *Application.* This section applies to the grounding of transmission and distribution lines and equipment for the purpose of protecting employees. Paragraph (d) of this section also applies to the protective grounding of other equipment as required elsewhere in this Subpart.

(b) *General.* For any employee to work lines or equipment as deenergized, the lines or equipment shall be deenergized under the provisions of § 1926.961 and shall be grounded as specified in paragraphs (c) through (h) 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:

(1) *Deenergized.* The lines and equipment have been deenergized under the provisions of § 1926.961.

(2) *No possibility of contact.* There is no possibility of contact with another energized source.

(3) *No induced voltage.* The hazard of induced voltage is not present.

(c) *Equipotential zone.* Temporary protective grounds shall be placed at such locations and arranged in such a manner as to prevent each employee from being exposed to hazardous differences in electrical potential.

(d) *Protective grounding equipment.* (1) *Ampacity.* (i) 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.

(ii) If the protective grounding equipment required under paragraph (d)(1)(i) of this section would be larger than the conductor to which it is attached, this equipment may be reduced in size provided that it is sized and placed so that:

(A) The conductor being grounded will fail before the protective grounding equipment,

(B) The conductor is only considered as grounded where it is protected against failure by the protective grounding equipment, and

(C) No employees would be endangered by the failed conductor.

(iii) This equipment shall have an ampacity greater than or equal to that of No. 2 AWG copper.

(2) *Impedance.* 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 to paragraph (d) of this section:** Guidelines for protective grounding equipment are contained in American Society for Testing and Materials Standard Specifications for Temporary Protective Grounds to Be Used on De-Energized Electric Power Lines and Equipment, ASTM F 855–03.

(e) *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.

(f) *Connecting and removing grounds.* (1) *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. For lines or equipment operating at 600 volts or less, insulating equipment other than a live-line tool may be used 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 would be protected from hazards that may develop if the line or equipment is energized.

(2) *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. For lines or equipment operating at 600 volts or less, insulating equipment other than a live-line tool may be used if the employer ensures that the line or equipment is not energized at the time the ground is disconnected or if the employer can demonstrate that each employee would be protected from hazards that may develop if the line or equipment is energized.

(g) *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.

(h) *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.

**§ 1926.963 Testing and test facilities.**

(a) *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 to paragraph (a) of this section:** Routine inspection and maintenance measurements made by qualified 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 paragraphs of this section. Two typical examples of such excluded test work procedures are ''phasing-out'' testing and testing for a ''no-voltage'' condition.

(b) *General requirements.* (1) *Safe work practices.* 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. (See paragraph (f) of this section.)

(2) *Training.* 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 § 1926.950(b).

(c) *Guarding of test areas.* (1) *Guarding.* 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 coupling, in order to prevent accidental employee contact with energized parts.

(2) *Permanent test areas.* Permanent test areas shall be guarded by walls, fences, or barriers designed to keep employees out of the test areas.

(3) *Temporary test areas.* 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 paragraph (c)(3)(i) of 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.

(4) *Removal of barriers.* The barriers required by paragraph (c)(3) of this section shall be removed when the protection they provide is no longer needed.

(d) *Grounding practices.* (1) *Establish and implement practices.* 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.

(2) *Installation of grounds.* 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.

(3) *Isolated ground return.* 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 to paragraph (d)(3)(ii) of this section:** See Appendix C to this Subpart for information on measures that can be taken to protect employees from hazardous step and touch potentials.

(4) *Equipment grounding conductors.* 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.

(5) *Grounding after tests.* 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.

(6) *Grounding test vehicles.* 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.

(e) *Control and measuring circuits.* (1) *Control wiring.* 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.

(2) *Instruments.* 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.

(3) *Routing temporary wiring.* 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.

(4) *Test observer.* 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.

(f) *Safety check.* (1) *Before each test.* 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.

(2) *Conditions to be checked.* 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 as required by Subpart E of this Part and by this section; and

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

### § 1926.964 Overhead lines.

(a) *General.* (1) *Application.* This section provides additional requirements for work performed on or near overhead lines and equipment.

(2) *Checking structure before climbing.* Before elevated structures, such as poles or towers, are subjected to such stresses as climbing or the installation or removal of equipment may impose, the 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 to paragraph (a)(2) of this section:** Appendix D to this Subpart 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 also requires the employer to ascertain that the pole can sustain all other forces that will be imposed by the work to be performed.

(3) *Setting and moving poles.* (i) When poles are set, moved, or removed near exposed energized overhead conductors, the pole may not contact the conductors.

(ii) 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 body.

(iii) 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.

(b) *Installing and removing overhead lines.* The following provisions apply to the installation and removal of overhead conductors or cable.

(1) *Tension stringing method.* 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.

(2) *Conductors, cables, and pulling and tensioning equipment.* The protective measures required by § 1926.959(d)(3) 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.

(3) *Disable automatic-reclosing feature.* If the conductors being installed or removed cross over energized conductors in excess of 600 volts and if the design of the circuit-interrupting devices protecting the lines so permits, the automatic-reclosing feature of these devices shall be made inoperative.

(4) *Induced voltage.* 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 3.22 km (2 miles) from a ground.

(ii) The grounds required in paragraph (b)(4)(i) of this section shall be left in place until the conductor installation is completed between dead ends.

(iii) The grounds required in paragraph (b)(4)(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.

(5) *Safe operating condition.* Reel handling equipment, including pulling and tensioning devices, shall be in safe operating condition and shall be leveled and aligned.

(6) *Load ratings.* Load ratings of stringing lines, pulling lines, conductor grips, load-bearing hardware and accessories, rigging, and hoists may not be exceeded.

(7) *Defective pulling lines.* Pulling lines and accessories shall be repaired or replaced when defective.

(8) *Conductor grips.* Conductor grips may not be used on wire rope, unless the grip is specifically designed for this application.

(9) *Communications.* Reliable communications, through two-way radios or other equivalent means, shall be maintained between the reel tender and the pulling rig operator.

(10) *Operation of pulling rig.* The pulling rig may only be operated when it is safe to do so.

**Note to paragraph (b)(10) of this section:** Examples of unsafe conditions include: employees in locations prohibited by paragraph (b)(11) of this section, conductor and pulling line hang-ups, and slipping of the conductor grip.

(11) *Working under overhead operations.* 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.

(c) *Live-line bare-hand work.* In addition to other applicable provisions contained in this section, the following requirements apply to live-line bare-hand work:

(1) *Training.* Before using or supervising the use of the live-line bare-hand technique on energized circuits, employees shall be trained in the technique and in the safety requirements of paragraph (c) of this section. Employees shall receive refresher training as required by § 1926.950(b).

(2) *Existing conditions.* Before any employee uses the live-line bare-hand technique on energized high-voltage conductors or parts, the following information shall be ascertained:

(i) The nominal voltage rating of the circuit on which the work is to be performed,

(ii) The minimum approach distances to ground of lines and other energized parts on which work is to be performed, and

(iii) The voltage limitations of equipment to be used.

(3) *Insulated tools and equipment.* The insulated equipment, insulated tools, and aerial devices and platforms used shall be designed, tested, and intended for live-line bare-hand work. Tools and equipment shall be kept clean and dry while they are in use.

(4) *Disable automatic-reclosing feature.* The automatic-reclosing feature of circuit-interrupting devices protecting the lines shall be made inoperative, if the design of the devices permits.

(5) *Adverse weather conditions.* Work may not be performed when adverse weather conditions would make the work hazardous even after the work practices required by this section are employed. Additionally, work may not be performed when winds reduce the phase-to-phase or phase-to-ground minimum approach distances at the work location below that specified in paragraph (c)(13) of this section, unless the grounded objects and other lines and equipment are covered by insulating guards.

**Note to paragraph (c)(5) of this section:** Thunderstorms in the immediate vicinity, high winds, snow storms, and ice storms are examples of adverse weather conditions that are presumed to make live-line bare-hand work too hazardous to perform safely.

(6) *Bucket liners and electrostatic shielding.* A conductive bucket liner or other conductive device shall be provided for bonding the insulated aerial device to the energized line or equipment.

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

(ii) Where differences in potentials at the worksite pose a hazard to employees, electrostatic shielding designed for the voltage being worked shall be provided.

(7) *Bonding the employee to the energized part.* Before the employee contacts the energized part, the conductive bucket liner or other conductive device shall be bonded to the energized conductor by means of a

positive connection. This connection shall remain attached to the energized conductor until the work on the energized circuit is completed.

(8) *Aerial lift controls*. Aerial lifts to be used for live-line bare-hand work shall have dual controls (lower and upper) as follows:

(i) 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 from either bucket.

(ii) The lower set of controls shall be located near the base of the boom, and they shall be so designed that they can override operation of the equipment at any time.

(9) *Operation of lower controls*. Lower (ground-level) lift controls may not be operated with an employee in the lift, except in case of emergency.

(10) *Check controls*. Before employees are elevated into the work position, all controls (ground level and bucket) shall be checked to determine that they are in proper working condition.

(11) *Body of aerial lift truck*. Before the boom of an aerial lift is elevated, the body of the truck shall be grounded, or the body of the truck shall be barricaded and treated as energized.

(12) *Boom-current test*. A boom-current test shall be made before work is started each day, each time during the day when higher voltage is encountered, and when changed conditions indicate a need for an additional test. 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. The leakage current may not exceed 1 microampere per kilovolt of nominal phase-to-ground voltage. Work from the aerial lift shall be immediately suspended upon indication of a malfunction in the equipment.

(13) *Minimum approach distance*. The minimum approach distances specified in Table V–2 through Table V–6 in § 1926.960 shall be maintained from all grounded objects and from lines and equipment at a potential different from that to which the live-line bare-hand equipment is bonded, unless such grounded objects and other lines and equipment are covered by insulating guards.

(14) *Approaching, leaving, and bonding to energized part.* While an employee is approaching, leaving, or bonding to an energized circuit, the minimum approach distances in Table V–2 through Table V–6 shall be maintained between the employee and any grounded parts, including the lower boom and portions of the truck.

(15) *Positioning bucket near energized bushing or insulator string*. While the bucket is positioned alongside an energized bushing or insulator string, the phase-to-ground minimum approach distances of Table V–2 through Table V–6 shall be maintained between all parts of the bucket and the grounded end of the bushing or insulator string or any other grounded surface.

(16) *Hand lines*. Hand lines may not be used between the bucket and the boom or between the bucket and the ground. However, nonconductive-type hand lines may be used from conductor to ground if not supported from the bucket. Ropes used for live-line bare-hand work may not be used for other purposes.

(17) *Passing objects to employee*. Uninsulated equipment or material may not be passed between a pole or structure and an aerial lift while an employee working from the bucket is bonded to an energized part.

(18) *Table of minimum approach distances*. A minimum approach distance table reflecting the minimum approach distances listed in Table V–2 through Table V–6 shall be printed on a plate of durable nonconductive material. This table shall be mounted so as to be visible to the operator of the boom.

(19) *Nonconductive measuring device*. A nonconductive measuring device shall be readily accessible to assist employees in maintaining the required minimum approach distance.

(d) *Towers and structures*. The following requirements apply to work performed on towers or other structures that support overhead lines.

(1) *Working beneath towers and structures*. 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.

(2) *Tag lines*. 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.

(3) *Disconnecting load lines*. The loadline may not be detached from a member or section until the load is safely secured.

(4) *Adverse weather conditions*. 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 to paragraph (d)(4) of this section:** 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.

### § 1926.965 Underground electrical installations.

(a) *Application.* This section provides additional requirements for work on underground electrical installations.

(b) *Access.* A ladder or other climbing device shall be used to enter and exit a manhole or subsurface vault exceeding 1.22 m (4 feet) in depth. No employee may climb into or out of a manhole or vault by stepping on cables or hangers.

(c) *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 material 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.

(d) *Attendants for manholes and vaults.* (1) *When required.* While work is being performed in a manhole or vault containing energized electric equipment, an employee with first aid and CPR training meeting § 1926.951(b)(1) shall be available on the surface in the immediate vicinity of the manhole or vault entrance to render emergency assistance.

(2) *Brief entries allowed.* Occasionally, the employee on the surface may briefly enter a manhole or vault to provide assistance, other than emergency.

**Note 1 to paragraph (d)(2) of this section:** An attendant may also be required under § 1926.953(h). One person may serve to fulfill both requirements. However, attendants required under § 1926.953(h) are not permitted to enter the manhole or vault.

**Note 2 to paragraph (d)(2) of this section:** Employees entering manholes or vaults containing unguarded, uninsulated energized lines or parts of electric equipment operating at 50 volts or more are required to be qualified under § 1926.960(b).

(3) *Entry without attendant.* 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 the employer can demonstrate that the employee will be protected from all electrical hazards.

(4) *Communications.* Reliable communications, through two-way

radios or other equivalent means, shall be maintained among all employees involved in the job.

(e) *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.

(f) *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.

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

(h) *Protection against faults.* (1) *Defective cables.* Where a cable in a manhole or vault 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 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 by shields or other devices that are capable of containing the adverse effects of a fault.

**Note to paragraph (h)(1) of this section:** Abnormalities such as oil or compound leaking from cable or joints, broken cable sheaths or joint sleeves, hot localized surface temperatures of cables or joints, or joints that are swollen beyond normal tolerance are presumed to lead to or be an indication of an impending fault.

(2) *Work-related faults.* If the work being performed in a manhole or vault could cause a fault in a cable, that cable 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 by shields or other devices that are capable of containing the adverse effects of a fault.

(i) *Sheath continuity.* When work is performed on buried cable or on cable in a manhole or vault, metallic sheath continuity shall be maintained or the cable sheath shall be treated as energized.

### § 1926.966 Substations.

(a) *Application.* This section provides additional requirements for substations and for work performed in them.

(b) *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 to paragraph (b) of this section:** 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 C2–2002. Installations meeting the ANSI provisions comply with paragraph (b) of this section. An installation that does not conform to this ANSI standard will, nonetheless, be considered as complying with paragraph (b) of 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 § 1926.960(c)(1) while they working 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 provide by access and working space meeting ANSI C2–2002.

(c) *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.

(d) *Substation fences.* Conductive fences around substations shall be grounded. When a substation fence is expanded or a section is removed, fence grounding continuity shall be maintained, and bonding shall be used to prevent electrical discontinuity.

(e) *Guarding of rooms containing electric supply equipment.* (1) *When guarding of rooms is required.* Rooms and spaces in which electric supply lines or equipment are installed shall meet the requirements of paragraphs (e)(2) through (e)(3) 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 to ground 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 paragraph (f)(1) of this section, or

(iii) If live parts operating at more than 600 volts to ground 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 a 2.4-meter (8-foot) height at 50 volts.

(2) *Prevent access by unqualified persons.* The rooms and spaces shall be so enclosed within fences, screens, partitions, or walls as to minimize the possibility that unqualified persons will enter.

(3) *Restricted entry.* Unqualified persons may not enter the rooms or spaces while the electric supply lines or equipment are energized.

(4) *Warning signs.* Signs warning unqualified persons to keep out shall be displayed at entrances to the rooms and spaces.

(5) *Entrances to rooms.* Entrances to rooms and spaces that are not under the observation of an attendant shall be kept locked.

(f) *Guarding of energized parts.* (1) *Type of guarding.* 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 to paragraph (f)(1) of this section:** Guidelines for the dimensions of clearance distances about electric equipment in substations are contained in American National Standard National Electrical Safety Code, ANSI C2–2002. Installations meeting the ANSI provisions comply with paragraph (f)1. of this section. An installation that does not conform to this ANSI standard will, nonetheless, be considered as complying with paragraph (f)(1) of this section if the employer can demonstrate that the installation provides sufficient clearance 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 each employee is isolated from energized parts at the point of closest approach, and

3. That the precautions taken when work is performed on the installation provide protection equivalent to the protection that would be provide by horizontal and vertical clearances meeting ANSI C2–2002.

(2) *Maintaining guards during operation.* Except for fuse replacement and other necessary access by qualified persons, the guarding of energized parts within a compartment shall be maintained during operation and maintenance functions to prevent accidental contact with energized parts and to prevent tools or other equipment from being dropped on energized parts.

(3) *Temporary removal of guards.* 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.

(g) *Substation entry.* (1) *Report upon entering.* 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.

(2) *Job briefing.* The job briefing required by § 1926.952 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.

### § 1926.967 Special conditions.

(a) *Capacitors.* The following additional requirements apply to work on capacitors and on lines connected to capacitors.

**Note to paragraph (a) of this section:** See §§ 1926.961 and 1926.962 for requirements pertaining to the deenergizing and grounding of capacitor installations.

(1) *Disconnect from energized source.* Before employees work on capacitors, the capacitors shall be disconnected from energized sources and, after a wait of at least 5 minutes from the time of disconnection, short-circuited.

(2) *Short circuiting units.* Before the units are handled, each unit in series-parallel capacitor banks shall be short-circuited between all terminals and the capacitor case or its rack. If the cases of capacitors are on ungrounded substation racks, the racks shall be bonded to ground.

(3) *Short circuiting connected lines.* Any line to which capacitors are connected shall be short-circuited before it is considered deenergized.

(b) *Current transformer secondaries.* The secondary of a current transformer may not be opened while the transformer is energized. If the primary of the current transformer cannot be deenergized before work is performed on an instrument, a relay, or other section of a current transformer secondary circuit, the circuit shall be bridged so that the current transformer secondary will not be opened.

(c) *Series streetlighting.* (1) *Applicable requirements.* If the open-circuit voltage exceeds 600 volts, the series streetlighting circuit shall be worked in accordance with § 1926.964 or § 1926.965, as appropriate.

(2) *Opening a series loop.* A series loop may only be opened after the streetlighting transformer has been deenergized and isolated from the source of supply or after the loop is bridged to avoid an open-circuit condition.

(d) *Illumination.* Sufficient illumination shall be provided to enable the employee to perform the work safely.

**Note to paragraph (d) of this section:** See § 1926.56 for specific levels of illumination.

(e) *Protection against drowning.* (1) *Personal flotation devices.* Whenever an employee may be pulled or pushed or may fall into water where the danger of drowning exists, the employee shall be provided with and shall use personal flotation devices meeting § 1926.106.

(2) *Maintaining flotation devices in safe condition.* Each personal flotation device shall be maintained in safe condition and shall be inspected frequently enough to ensure that it does not have rot, mildew, water saturation, or any other condition that could render the device unsuitable for use.

(3) *Crossing bodies of water.* An employee may cross streams or other bodies of water only if a safe means of passage, such as a bridge, is provided.

(f) *Excavations.* Excavation operations shall comply with Subpart P of this Part.

(g) *Employee protection in public work areas.* (1) *Traffic control devices.* Traffic control signs and traffic control devices used for the protection of employees shall meet the requirements of § 1926.200(g)(2).

(2) *Controlling traffic.* Before work is begun in the vicinity of vehicular or pedestrian traffic that may endanger employees, warning signs or flags and other traffic control devices shall be placed in conspicuous locations to alert and channel approaching traffic.

(3) *Barricades.* Where additional employee protection is necessary, barricades shall be used.

(4) *Excavated areas.* Excavated areas shall be protected with barricades.

(5) *Warning lights.* At night, warning lights shall be prominently displayed.

(h) *Backfeed.* If there is a possibility of voltage backfeed from sources of cogeneration or from the secondary system (for example, backfeed from more than one energized phase feeding a common load), the requirements of § 1926.960 apply if the lines or equipment are to be worked as energized, and the requirements of §§ 1926.961 and 1926.962 apply if the lines or equipment are to be worked as deenergized.

(i) *Lasers.* Laser equipment shall be installed, adjusted, and operated in accordance with § 1926.54.

(j) *Hydraulic fluids.* Hydraulic fluids used for the insulated sections of equipment shall provide insulation for the voltage involved. These fluids need not meet § 1926.302(d)(1).

(k) *Communication facilities.* (1) *Microwave transmission.* (i) The employer shall ensure that no employee looks into an open waveguide or antenna that is connected to an energized microwave source.

(ii) If the electromagnetic radiation level within an accessible area associated with microwave communications systems exceeds the radiation protection guide given in § 1910.97(a)(2) of this chapter, the area shall be posted with the warning symbol described in § 1910.97(a)(3) of this chapter. The lower half of the warning symbol shall include the following statements or ones that the employer can demonstrate are equivalent:

Radiation in this area may exceed hazard limitations and special precautions are required. Obtain specific instruction before entering.

(iii) When an employee works in an area where the electromagnetic radiation could exceed the radiation protection guide, the employer shall institute measures that ensure that the employee's exposure is not greater than that permitted by that guide. Such measures may include administrative and engineering controls and personal protective equipment.

(2) *Power line carrier.* Power line carrier work, including work on equipment used for coupling carrier current to power line conductors, shall be performed in accordance with the requirements of this section pertaining to work on energized lines.

### § 1926.968 Definitions applicable to this subpart.

*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.

*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.* 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 who performs work covered by Subpart V of this Part for a host employer.

*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 different from that of the earth.

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

*Designated employee (designated person).* An employee (or person) who is assigned by the employer to perform specific duties under the terms of this section and who has sufficient knowledge of the construction and operation of the equipment and the hazards involved to perform his or her duties safely.

*Electric line truck.* A truck used to transport personnel, tools, and material for electric supply line work.

*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.

*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 § 1910.146 of this chapter, 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 § 1926.953).* 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.

*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.

*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 accidental contact by persons or objects.

**Note:** Wires that 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:

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

(2) Airborne combustible dust at a concentration that meets or exceeds its LFL;

**Note:** This concentration may be approximated as a condition in which the dust obscures vision at a distance of 1.52 m (5 feet) or less.

(3) Atmospheric oxygen concentration below 19.5 percent or above 23.5 percent;

(4) Atmospheric concentration of any substance for which a dose or a permissible exposure limit is published in Subpart G, Occupational Health and Environmental Control, or in Subpart Z, Toxic and Hazardous Substances, of this Part and which could result in employee exposure in excess of its dose or permissible exposure limit;

**Note:** An atmospheric concentration of any substance that is not capable of causing death, incapacitation, impairment of ability to self-rescue, injury, or acute illness due to its health effects is not covered by this provision.

(5) Any other atmospheric condition that is immediately dangerous to life or health.

**Note:** For air contaminants for which OSHA has not determined a dose or permissible exposure limit, other sources of information, such as Material Safety Data Sheets that comply with the Hazard Communication Standard, § 1926.1200, 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:

(1) An employee would be exposed to being blown from elevated locations, or

(2) An employee or material handling equipment could lose control of material being handled, or

(3) An employee would be exposed to other hazards not controlled by the standard involved.

**Note:** Winds exceeding 64.4 kilometers per hour (40 miles per hour), or 48.3 kilometers per hour (30 miles 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 who operates and maintains an electric power transmission or distribution installation covered by Subpart V of this Part and who hires a contract employer to perform work on that installation.

*Immediately dangerous to life or health (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.

*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.

*Line-clearance tree trimming.* The pruning, trimming, repairing, maintaining, removing, or clearing of trees or the cutting of brush that is within 3.05 m (10 feet) of electric supply lines and equipment.

*Lines.* (1) *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 to 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.

(2) *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 section, and those of less than 400 volts are considered as supply lines, if so run and operated throughout.

*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.

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

*Qualified employee (qualified person).* One knowledgeable in the construction and operation of the electric power generation, transmission, and distribution equipment involved, along with the associated hazards.

**Note 1:** An employee must have the training required by § 1926.950(b)(2) in order to be considered a qualified employee.

**Note 2:** Except under § 1926.954(b)(3)(iii), an employee 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 qualified person is considered to be a qualified person for the performance of those duties.

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

*Switch.* A device for opening and closing or for changing the connection of a circuit. In this section, a switch is understood to be manually operable, unless otherwise stated.

*System operator.* A qualified person designated to operate the system or its parts.

*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 that 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.

## Appendix A to Subpart V—Flow Charts

For information, in the form of flow charts, that helps illustrate the scope and application of subpart V of this part, see Appendix A to § 1910.269 of this chapter. That appendix addresses the interface between § 1910.269 of this chapter and subpart S of part 1910 of this chapter (Electrical), between § 1910.269 and § 1910.146 of this chapter (Permit-required confined spaces), and between § 1910.269 and § 1910.147 of this chapter (the control of hazardous energy (lockout/tagout)). The flow charts presented in that Appendix provide guidance for employers trying to implement the requirements of § 1910.269 in combination with other General Industry Standards contained in part 1910 of this chapter. Because subpart V of this part also interfaces these general industry standards, Appendix A to § 1910.269 of this chapter will assist employers in determining which of these standards applies in different situations.

## Appendix B to Subpart V—Working on Exposed Energized Parts

### I. Introduction

Electric transmission and distribution line installations have been designed to meet National Electrical Safety Code (NESC), ANSI C2, requirements and to provide the level of line outage performance required by system reliability criteria. Transmission and distribution lines are also designed to withstand the maximum overvoltages expected to be impressed on the system. Such overvoltages can be caused by such conditions as switching surges, faults, or lightning. Insulator design and lengths and the clearances to structural parts (which, for low voltage through extra-high voltage, or EHV, facilities, are generally based on the performance of the line as a result of contamination of the insulation or during storms) have, over the years, come closer to the minimum approach distances used by workers (which are generally based on non-storm conditions). Thus, as minimum approach (working) distances and structural distances (clearances) converge, it is increasingly important that basic considerations for establishing safe approach distances for performing work be understood by the designers and the operating and maintenance personnel involved.

The information in this Appendix will assist employers in complying with the minimum approach distance requirements contained in § 1926.960(c)(1) and § 1926.964(c). The technical criteria and methodology presented herein is mandatory for employers using reduced minimum approach distances as permitted in Table V–2 and Table V–3 in § 1926.960. This Appendix is intended to provide essential background information and technical criteria for the development or modification, if possible, of the safe minimum approach distances for electric transmission and distribution live-line work. The development of these safe distances must be undertaken by persons knowledgeable in the techniques discussed in this appendix and competent in the field of electric transmission and distribution system design.

### II. General

A. *Definitions.* The following definitions from § 1926.968 of this part relate to work on or near 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 accidental contact by persons or objects.

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

*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.

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.* Table V–1, Table V–2, Table V–3, and Table V–4 of § 1926.960 of this part provide minimum approach distances in the vicinity of energized electric apparatus so that work can be done safely without risk of electrical flashover.

The distance between the employee and an energized part must withstand the maximum transient overvoltage that can reach the work site under the working conditions and practices in use. Normal system design may provide or include a means to control transient overvoltages, or temporary devices may be employed to achieve the same result. The use of technically correct practices or procedures to control overvoltages (for example, portable gaps or preventing the automatic control from initiating breaker reclosing) enables line design and operation to be based on reduced transient overvoltage values. Technical information for U.S. electrical systems indicates that current design provides for the following maximum transient overvoltage values (usually produced by switching surges):

362 kV and less—3.0 per unit
552 kV—2.4 per unit
800 kV—2.0 per unit

Additional discussion of maximum transient overvoltages can be found in paragraph III.A.2, later in this Appendix.

### III. Determination of the Electrical Component of Minimum Approach Distances

A. *Voltages of 1.1 kV to 72.5 kV.* For voltages of 1.1 kV to 72.5 kV, the electrical component of minimum approach distances is based on American National Standards Institute (ANSI)/American Institute of Electrical Engineers (AIEE) Standard No.4, March 1943, Tables III and IV. (AIEE is the predecessor technical society to the Institute of Electrical and Electronic Engineers (IEEE).) These distances are represented by the following formula:

Equation (1)—For voltages of 1.1 kV to 72.5 kV:

$$D = \left(\frac{V_{max} \times pu}{95}\right)^{1.63}$$

Where: D = Electrical component of the minimum approach distance in air in feet

$V_{max}$ = Maximum rated line-to-ground rms voltage in kV

pu = Maximum transient overvoltage factor in per unit

Source: AIEE Standard No. 4, 1943.

Table 1 shows the electrical component of the minimum approach distances based on that AIEE standard.

TABLE 1.—A–C ENERGIZED LINE WORK PHASE-TO-GROUND ELECTRICAL COMPONENT OF THE MINIMUM APPROACH DISTANCE 1.1 TO 72.5 KV

| Maximum anticipated per-unit transient overvoltage | Phase-to-phase voltage | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 15,000 | | 36,000 | | 46,000 | | 72,500 | |
| | m | ft | m | ft | m | ft | m | ft |
| 3.0 | 0.04 | 0.17 | 0.16 | 0.58 | 0.23 | 0.75 | 0.39 | 1.25 |

**Note:** The distances given are for air as the insulating medium and provide no additional clearance for inadvertent movement.

B. *Voltages of 72.6 kV to 800 kV.* For voltages of 72.6 kV to 800 kV, the electrical component of minimum approach distances is based on ANSI/IEEE Standard 516–1987, ''IEEE Guide for Maintenance Methods on Energized Power Lines.'' This standard gives the electrical component of the minimum approach distance based on power frequency rod-gap data, supplemented with transient overvoltage information and a saturation factor for high voltages. The distances listed in ANSI/IEEE Standard 516 have been calculated according to the following formula:

Equation (2)—For voltages of 72.6 kV to 800 kV:

$$D = (C + a) \times pu \times V_{max}$$

Where: D = Electrical component of the minimum approach distance in air in feet

C = 0.01 to take care of correction factors associated with the variation of gap sparkover with voltage

a = A factor relating to the saturation of air at voltages of 345 kV or higher

pu = Maximum anticipated transient overvoltage, in per unit (p.u.)

$V_{max}$ = Maximum rms system line-to-ground 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)

Source: Formula developed from ANSI/IEEE Standard No. 516, 1987.

This formula is used to calculate the electrical component of the minimum approach distances in air and is used in the development of Table 2 and Table 3.

TABLE 2.—A–C ENERGIZED LINE WORK PHASE-TO-GROUND ELECTRICAL COMPONENT OF THE MINIMUM APPROACH DISTANCE 121 TO 242 KV

| Maximum anticipated per-unit transient overvoltage | Phase-to-phase voltage | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 121,000 | | 145,000 | | 169,000 | | 242,000 | |
| | m | ft | m | ft | m | ft | m | ft |
| 2.0 | 0.44 | 1.40 | 0.53 | 1.70 | 0.62 | 2.00 | 0.86 | 2.80 |
| 2.1 | 0.46 | 1.47 | 0.55 | 1.79 | 0.65 | 2.10 | 0.91 | 2.94 |
| 2.2 | 0.48 | 1.54 | 0.58 | 1.87 | 0.68 | 2.20 | 0.95 | 3.08 |
| 2.3 | 0.50 | 1.61 | 0.61 | 1.96 | 0.71 | 2.30 | 0.99 | 3.22 |
| 2.4 | 0.52 | 1.68 | 0.63 | 2.04 | 0.74 | 2.40 | 1.03 | 3.35 |
| 2.5 | 0.54 | 1.75 | 0.66 | 2.13 | 0.77 | 2.50 | 1.08 | 3.50 |
| 2.6 | 0.56 | 1.82 | 0.68 | 2.21 | 0.80 | 2.60 | 1.12 | 3.64 |
| 2.7 | 0.58 | 1.89 | 0.71 | 2.30 | 0.83 | 2.70 | 1.15 | 3.76 |
| 2.8 | 0.61 | 1.96 | 0.73 | 2.38 | 0.86 | 2.80 | 1.20 | 3.92 |
| 2.9 | 0.63 | 2.03 | 0.76 | 2.47 | 0.89 | 2.90 | 1.24 | 4.05 |
| 3.0 | 0.65 | 2.10 | 0.79 | 2.55 | 0.92 | 3.00 | 1.29 | 4.20 |

TABLE 3.—A–C ENERGIZED LINE WORK PHASE-TO-GROUND ELECTRICAL COMPONENT OF THE MINIMUM APPROACH DISTANCE 362 TO 800 KV

| Maximum anticipated per-unit transient overvoltage | Phase-to-phase voltage | | | | | |
|---|---|---|---|---|---|---|
| | 362,000 | | 552,000 | | 800,000 | |
| | m | ft | m | ft | m | ft |
| 1.5 | ............... | ............... | 1.52 | 4.97 | 2.65 | 8.66 |
| 1.6 | ............... | ............... | 1.67 | 5.46 | 2.93 | 9.60 |
| 1.7 | ............... | ............... | 1.83 | 5.98 | 3.24 | 10.60 |
| 1.8 | ............... | ............... | 1.99 | 6.51 | 3.56 | 11.64 |
| 1.9 | ............... | ............... | 2.17 | 7.08 | 3.89 | 12.73 |
| 2.0 | 1.29 | 4.20 | 2.35 | 7.68 | 4.23 | 13.86 |
| 2.1 | 1.35 | 4.41 | 2.53 | 8.27 | | |
| 2.2 | 1.44 | 4.70 | 2.71 | 8.87 | | |
| 2.3 | 1.54 | 5.01 | 2.9 | 9.49 | | |
| 2.4 | 1.64 | 5.34 | 3.12 | 10.21 | | |
| 2.5 | 1.74 | 5.67 | | | | |
| 2.6 | 1.84 | 6.01 | | | | |
| 2.7 | 1.95 | 6.36 | | | | |
| 2.8 | 2.06 | 6.73 | | | | |
| 2.9 | 2.17 | 7.10 | | | | |
| 3.0 | 2.29 | 7.48 | | | | |

**Note:** The distances given are for air as the insulating medium and provide no additional clearance for inadvertent movement.

C. *Provisions for inadvertent movement.* The minimum approach distances (working distances) 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. A certain allowance must be made to account for this possible inadvertent movement and to provide the worker with a comfortable and safe zone in which to work. A distance for inadvertent movement (called the ''ergonomic component of the minimum approach distance'') must be added to the electrical component to determine the total safe minimum approach distances used in live-line work.

One approach that can be used to estimate the ergonomic component of the minimum approach distance is response time-distance analysis. When this technique is used, the total response time to a hazardous incident is estimated and converted to 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 a distance being traveled before the car comes to a complete stop. This distance is dependent on the speed of the car at the time the stimulus appears.

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, a distance will have been traversed. It is this distance that must be added to the electrical component of the minimum approach distance to obtain the total safe minimum approach distance.

At voltages below 72.5 kV, the electrical component of the minimum approach distance is smaller than the ergonomic component. At 72.5 kV the electrical component is only a little more than 0.3 m (1 foot). An ergonomic component of the minimum approach distance is needed that will provide for all the worker's unexpected movements. The usual live-line work method for these voltages is the use of rubber insulating equipment, frequently rubber gloves. The energized object needs to be far enough away to provide the worker's face with a safe approach distance, as his or her hands and arms are insulated. In this case, 0.61 m (2 feet) has been accepted as a sufficient and practical value.

For voltages between 72.6 and 800 kV, there is a change in the work practices employed during energized line work. Generally, live-line tools (hot sticks) are employed to perform work while equipment is energized. 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 length of the ergonomic component of the minimum approach distance is also influenced by the location of the worker and by the nature of the work. In these higher voltage ranges, the employees use work methods that more tightly control their movements than when the workers perform rubber glove work. The worker is farther from energized line or equipment and needs to be more precise in his or her movements just to perform the work.

For these reasons, a smaller ergonomic component of the minimum approach distance is needed, and a distance of 0.30 m (1 foot) has been selected for voltages between 72.6 and 800 kV.

Table 4 summarizes the ergonomic component of the minimum approach distance for the two voltage ranges.

TABLE 4.—ERGONOMIC COMPONENT OF MINIMUM APPROACH DISTANCE

| Voltage range (kV) | Distance | |
|---|---|---|
| | m | ft |
| 1.1 to 72.5 | 0.61 | 2.0 |
| 72.6 to 800 | 0.30 | 1.0 |

**Note:** This distance must be added to the electrical component of the minimum approach distance to obtain the full minimum approach distance.

It must be noted that the ergonomic component of the minimum approach distance is intended to account only for unexpected movements of the employee. The working position selected must account for all the employee's anticipated movements and still enable the employee to maintain the safe minimum approach distance. (*See* Figure 1.) Anticipated movements include: An employee's adjustments to tools, equipment, and working positions; expected errors in positioning tools and equipment; 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 hard hat,
- Maneuver a tool onto an energized part with a certain amount of over or underreaching,
- Reach out for and handle tools, material, and equipment being passed to the employee in the working position, and
- Adjust tools and replace components on them, if necessary during the work procedure.

The training of qualified employees required under § 1926.950 and the job planning and briefing required under § 1926.952 must address selection of the proper working position.

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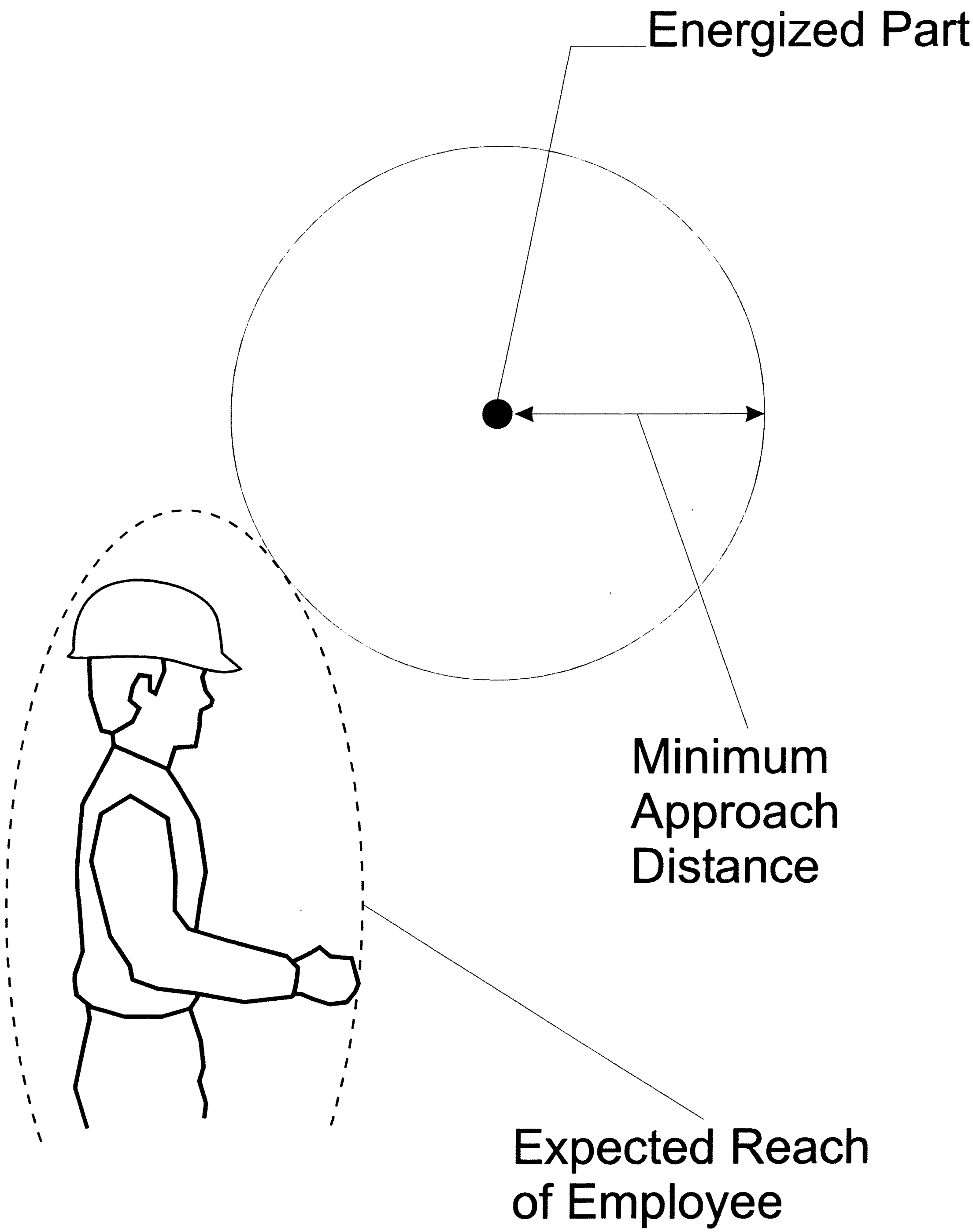


**Figure 1—Maintaining the Minimum Approach Distance**

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D. *Bare-Hand Live-Line Minimum Approach Distances.* Calculating the strength of phase-to-phase transient overvoltages is complicated by the varying time displacement between overvoltages on parallel conductors (electrodes) and by the varying ratio between the positive and negative voltages on the two electrodes. The time displacement causes the maximum voltage between phases to be less than the sum of the phase-to-ground voltages. The International Electrotechnical Commission (IEC) Technical Committee 28, Working Group 2, has developed the following formula for determining the phase-to-phase maximum transient overvoltage based on the per unit (p.u.) of the system nominal voltage phase-to-ground crest:

$pu_p = pu_g + 1.6.$

Where: $pu_g$ = p.u. phase-to-ground maximum transient overvoltage

$pu_p$ = p.u. phase-to-phase maximum transient overvoltage

This value of maximum anticipated transient overvoltage must be used in Equation (2) to calculate the phase-to-phase minimum approach distances for live-line bare-hand work.

E. *Compiling the minimum approach distance tables.* For each voltage involved, the distance in Table 4 in this appendix has been added to the distance in Table 1, Table 2, or Table 3 in this appendix to determine the resulting minimum approach distances in Table V–1, Table V–2, and Table V–3 in § 1926.960 of this part.

F. *Miscellaneous correction factors.* The strength of an air gap is influenced by the changes in the air medium that forms the insulation. A brief discussion of each factor follows, with a summary at the end.

1. *Dielectric strength of air.* The dielectric strength of air in a uniform electric field at standard atmospheric conditions is approximately 31 kV (crest) per cm at 60 Hz. The disruptive gradient is affected by the air pressure, temperature, and humidity, by the shape, dimensions, and separation of the electrodes, and by the characteristics of the applied voltage (wave shape).

2. *Atmospheric effect.* Flashover for a given air gap is inhibited by an increase in the density (humidity) of the air. The empirically determined electrical strength of a given gap is normally applicable at standard atmospheric conditions (20 C, 101.3 kPa, 11 g/cm$^3$ humidity).

The combination of temperature and air pressure that gives the lowest gap flashover voltage is high temperature and low pressure. These are conditions not likely to occur simultaneously. Low air pressure is generally associated with high humidity, and this causes increased electrical strength. An average air pressure is more likely to be associated with low humidity. Hot and dry working conditions are thus normally associated with reduced electrical strength.

The electrical component of the minimum approach distances in Table 1, Table 2, and Table 3 has been calculated using the maximum transient overvoltages to determine withstand voltages at standard atmospheric conditions.

3. *Altitude.* The electrical strength of an air gap is reduced at high altitude, due principally to the reduced air pressure. An increase of about 3 percent per 300 meters in the minimum approach distance for altitudes above 900 meters is required. Table V–5 of § 1926.960 of this Part presents this information in tabular form.

*Summary.* After taking all these correction factors into account and after considering their interrelationships relative to the air gap insulation strength and the conditions under which live work is performed, one finds that only a correction for altitude need be made. An elevation of 900 meters is established as the base elevation, and the values of the electrical component of the minimum approach distances has been derived with this correction factor in mind. Thus, the values used for elevations below 900 meters are conservative without any change; corrections have to be made only above this base elevation.

## IV. Determination of Reduced Minimum Approach Distances

### *A. Factors Affecting Voltage Stress at the Work Site*

1. *System voltage (nominal).* The nominal system voltage range sets the absolute lower limit for the minimum approach distance. The highest value within the range, as given in the relevant table, is selected and used as a reference for per unit calculations.

2. *Transient overvoltages.* Transient overvoltages may be generated on an electrical system by the operation of switches or breakers, by the occurrence of a fault on the line or circuit being worked or on an adjacent circuit, and by similar activities. Most of the overvoltages are caused by switching, and the term ''switching surge'' is often used to refer generically to all types of overvoltages. However, each overvoltage has an associated transient voltage wave shape. The wave shape arriving at the site and its magnitude vary considerably.

The information used in the development of the minimum approach distances takes into consideration the most common wave shapes; thus, the required minimum approach distances are appropriate for any transient overvoltage level usually found on electric power generation, transmission, and distribution systems. The values of the per unit (p.u.) voltage relative to the nominal maximum voltage are used in the calculation of these distances.

3. *Typical magnitude of overvoltages.* The magnitude of typical transient overvoltages is given in Table 5.

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 multi-step resistor. | 2.5 |
| Reclosed with trapped charge one-step resistor. | 2.2 |
| 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 |

Source: ANSI/IEEE Standard No. 516, 1987.

4. *Standard deviation—air-gap withstand.* For each air gap length, and under the same atmospheric conditions, there is a statistical variation in the breakdown voltage. The probability of the breakdown voltage is assumed to have 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 used in calculating the electrical component of the minimum approach distance has been set at three standard deviations ($3\sigma$[1]) below the critical flashover voltage. (The critical flashover voltage is the crest value of the impulse wave that, under specified conditions, causes flashover on 50 percent of the applications. An impulse wave of three standard deviations below this value, that is, the withstand voltage, has a probability of flashover of approximately 1 in 1000.)

5. *Broken Insulators.* Tests have shown that the insulation strength of an insulator string with broken skirts is reduced. Broken units may have lost up to 70% of their withstand capacity. Because the insulating capability of a broken unit cannot be determined without testing it, damaged units in an insulator are usually considered to have no insulating value. Additionally, the overall insulating strength of a string with broken units may be further reduced in the presence of a live-line tool alongside it. The number of good units that must be present in a string is based on the maximum overvoltage possible at the worksite.

### *B. Minimum Approach Distances Based on Known Maximum Anticipated Per-Unit Transient Overvoltages*

1. *Reduction of the minimum approach distance for AC systems.* When the transient overvoltage values are known and supplied by the employer, Table V–2 and Table V–3 of § 1926.960 of this Part allow the minimum approach distances from energized parts to be reduced. In order to determine what this maximum overvoltage is, the employer must undertake an engineering analysis of the system. As a result of this engineering study, the employer must provide new live work procedures, reflecting the new minimum approach distances, the conditions and limitations of application of the new minimum approach distances, and the specific practices to be used when these procedures are implemented.

2. *Calculation of reduced approach distance values.* The following method of calculating reduced minimum approach

[1] Sigma ($\sigma$) is the symbol for standard deviation.

distances is based on ANSI/IEEE Standard 516:

*Step 1.* Determine the maximum voltage (with respect to a given nominal voltage range) for the energized part.

*Step 2.* Determine the maximum transient overvoltage (normally a switching surge) that can be present at the work site during work operation.

*Step 3.* Determine the technique to be used to control the maximum transient overvoltage. (See paragraphs III.C and III.D of this appendix.) Determine the maximum voltage that can exist at the work site with that form of control in place and with a confidence level of 3 . This voltage is considered to be the withstand voltage for the purpose of calculating the appropriate minimum approach distance.

*Step 4.* Specify in detail the control technique to be used, and direct its implementation during the course of the work.

*Step 5.* Using the new value of transient overvoltage in per unit (p.u.), determine the required phase-to-ground minimum approach distance from Table V–2 or Table V–3 of § 1926.960 of this Part.

*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. First, the operation of circuit breakers or other switching devices may be modified to reduce switching transient overvoltages. Second, the overvoltage itself may be forcibly held to an acceptable level by means of installation of surge arresters at the specific location to be protected. Third, the transmission system may be changed to minimize the effect of switching operations.

2. *Operation of circuit breakers.*[2] The maximum transient overvoltage that can reach the work site is often due to switching on the line on which work is being performed. If the automatic-reclosing is removed during energized line work so that the line will not be reenergized after being opened for any reason, the maximum switching surge overvoltage is then limited 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. It is essential that the operating ability of such devices be assured when they are employed to limit the overvoltage level. If it is prudent not to remove 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 work is being performed. The coupling to adjacent lines must be accounted for when minimum approach distances are calculated based on the maximum transient overvoltage.

3. *Surge arresters.* The use of modern surge arresters has permitted 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 that may be caused by switching or faults.

It is possible to use properly designed arresters to control transient overvoltages along a transmission line and thereby reduce the requisite length of the insulator string. On the other hand, if the installation of arresters has not been used to reduce the length of the insulator string, it may be used to reduce the minimum approach distance instead.[3]

4. *Switching Restrictions.* Another form of overvoltage control is the establishment of switching restrictions, under which breakers are not permitted to be operated until certain system conditions are satisfied. Restriction of switching is achieved by the use of 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 are used to indicate that operation is not prevented, but only modified during the live-work activity.

*D. Minimum Approach Distance Based on Control of Voltage Stress (Overvoltages) at the Work Site*

Reduced minimum approach distances can be calculated as follows:

1. *First Method—Determining the reduced minimum approach distance from a given withstand voltage.*[4]

*Step 1.* Select the appropriate withstand voltage for the protective gap based on system requirements and an acceptable probability of actual gap flashover.

*Step 2.* Determine a gap distance that provides a withstand voltage[5] greater than or equal to the one selected in the first step.[6]

*Step 3.* Using 110 percent of the gap's critical flashover voltage, determine the electrical component of the minimum approach distance from Equation (2) or Table 6, which is a tabulation of distance vs. withstand voltage based on Equation (2).

TABLE 6.—WITHSTAND DISTANCES FOR TRANSIENT OVERVOLTAGES

| Crest voltage (kV) | Withstand distance air gap | |
|---|---|---|
| | m | ft |
| 100 | 0.22 | 0.71 |
| 150 | 0.32 | 1.06 |
| 200 | 0.43 | 1.41 |
| 250 | 0.54 | 1.77 |
| 300 | 0.65 | 2.12 |
| 350 | 0.75 | 2.47 |
| 400 | 0.86 | 2.83 |
| 450 | 0.97 | 3.18 |
| 500 | 1.08 | 3.54 |
| 550 | 1.19 | 3.89 |
| 600 | 1.29 | 4.24 |
| 650 | 1.40 | 4.60 |
| 700 | 1.58 | 5.17 |
| 750 | 1.75 | 5.73 |
| 800 | 1.92 | 6.31 |
| 850 | 2.11 | 6.91 |
| 900 | 2.31 | 7.57 |
| 950 | 2.51 | 8.23 |
| 1000 | 2.72 | 8.94 |
| 1050 | 2.94 | 9.65 |
| 1100 | 3.18 | 10.42 |
| 1150 | 3.41 | 11.18 |
| 1200 | 3.67 | 12.05 |
| 1250 | 3.93 | 12.90 |
| 1300 | 4.20 | 13.79 |
| 1350 | 4.48 | 14.70 |
| 1400 | 4.77 | 15.64 |
| 1450 | 5.06 | 16.61 |
| 1500 | 5.37 | 17.61 |
| 1550 | 5.68 | 18.63 |

**Note:** The air gap is based on the 60-Hz rod-gap withstand distance.

Source: Calculations are based on Equation (2).

*Step 4.* Add the 0.30-m (1-foot) ergonomic component to obtain the total minimum approach distance to be maintained by the employee.

2. *Second Method—Determining the necessary protective gap length from a desired (reduced) minimum approach distance.*

*Step 1.* Determine the desired minimum approach distance for the employee. Subtract the 0.30-m (1-foot) ergonomic component of the minimum approach distance.

*Step 2.* Using this distance, calculate the air gap withstand voltage from Equation (2). Alternatively, find the voltage corresponding to the distance in Table 6.[7]

*Step 3.* Select a protective gap distance corresponding to a critical flashover voltage that, when multiplied by 110 percent, is less than or equal to the withstand voltage from Step 2.

*Step 4.* Calculate the withstand voltage of the protective gap (85 percent of the critical

[2] The detailed design of a circuit interrupter, such as the design of the contacts, of resistor insertion, and of breaker timing control, are beyond the scope of this appendix. These features are routinely provided as part of the design for the system. Only features that can limit the maximum switching transient overvoltage on a system are discussed in this appendix.

[3] Surge arrester application is beyond the scope of this appendix. However, if the arrester is installed near the work site, the application would be similar to protective gaps as discussed in paragraph III.D of this appendix.

[4] Since a given rod gap of a given configuration corresponds to a certain withstand voltage, this method can also be used to determine the minimum approach distance for a known gap.

[5] The withstand voltage for the gap is equal to 85 percent of its critical flashover voltage.

[6] Switch steps 1 and 2 if the length of the protective gap is known. The withstand voltage must then be checked to ensure that it provides an acceptable probability of gap flashover. In general, it should be at least 1.25 times the maximum crest operating voltage.

[7] Since the value of the saturation factor, a, in Equation (2) is dependent on the maximum voltage, several iterative computations may be necessary to determine the correct withstand voltage using the equation. A graph of withstand voltage vs. distance is given in ANSI/IEEE Std. No. 516–1987. This graph could also be used to determine the appropriate withstand voltage for the minimum approach distance involved.

flashover voltage) to ensure that it provides an acceptable risk of flashover during the time the gap is installed.

3. *Sample protective gap calculations.*

*Problem 1:* Work is to be performed on a 500-kV transmission line that is subject to transient overvoltages of 2.4 p.u. The maximum operating voltage of the line is 552 kV. 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 line-to-ground voltage):[8]

$$552\ \text{kV} \times \frac{\sqrt{2}}{\sqrt{3}} \times 1.25 = 563\ \text{kV}$$

This will be the withstand voltage of the protective gap.

*Step 2.* Using test data for a particular protective gap, select a gap that has a critical flashover voltage greater than or equal to:

$$563\ \text{kV} \div 0.85 = 662\ \text{kV}.$$

For example, if a protective gap with a 1.22-m (4.0-foot) spacing tested to a critical flashover voltage of 665 kV, crest, select this gap spacing.

*Step 3.* This protective gap corresponds to a 110 percent of critical flashover voltage value of:

$$665\ \text{kV} \times 1.10 = 732\ \text{kV}.$$

This corresponds to the withstand voltage of the electrical component of the minimum approach distance.

*Step 4.* Using this voltage in Equation (2) results in an electrical component of the minimum approach distance of:

$$D = (0.01 + 0.0006) \times \frac{732\ \text{kV}}{\sqrt{2}} = 5.5\ \text{ft}\ (1.68\ \text{m}).$$

*Step 5.* Add 0.30 m (1 foot) to the distance calculated in Step 4, resulting in a total minimum approach distance of 1.98 m (6.5 feet).

*Problem 2:* For a line operating at a maximum voltage of 552 kV subject to a maximum transient overvoltage of 2.4 p.u., find a protective gap distance that will permit the use of a 2.74-m (9.0-foot) minimum approach distance. (A minimum approach distance of 3.42 m (11 feet, 3 inches) is normally required.)

*Step 1.* Subtracting the 0.30-m (1-foot) ergonomic component of the minimum approach distance yields an electrical component of the minimum approach distance of 2.44 m (8.0 feet).

*Step 2.* From Table 6, select the withstand voltage corresponding to a distance of 2.44 m (8.0 feet). By interpolation:

$$900\ \text{kV} + \left[50 \times \frac{(8.00 - 7.57)}{(8.23 - 7.57)}\right] = 933\ \text{kV}.$$

*Step 3.* The voltage calculated in Step 2 corresponds to 110 percent of the critical flashover voltage of the gap that should be employed. Using test data for a particular protective gap, select a gap that has a critical flashover voltage less than or equal to:

$$933\ \text{kV} \div 1.10 = 848\ \text{kV}.$$

For example, if a protective gap with a 1.77-m (5.8-foot) spacing tested to a critical flashover voltage of 820 kV, crest, select this gap spacing.

*Step 4.* The withstand voltage of this protective gap would be:

$$820\ \text{kV} \times 0.85 = 697\ \text{kV}.$$

The maximum operating crest voltage would be:

$$552\ \text{kV} \times \frac{\sqrt{2}}{\sqrt{3}} = 449\ \text{kV}.$$

The crest withstand voltage of the protective gap in per unit is thus:

$$697\ \text{kV} \div 449\ \text{kV} = 1.55\ \text{p.u.}$$

If this is acceptable, the protective gap could be installed with a 1.77-m (5.8-foot) spacing, and the minimum approach distance could then be reduced to 2.74 m (9.0 feet).

4. *Comments and variations.* The 0.30-m (1-foot) ergonomic component of the minimum approach distance must be added to the electrical component of the minimum approach distance calculated under paragraph III.D of this appendix. The calculations may be varied by starting with the protective gap distance or by starting with the minimum approach distance.

*E. Location of Protective Gaps*

1. *Adjacent structures.* Installation of the protective gap on a structure adjacent to the work site is an acceptable practice, as this does not significantly reduce the protection afforded by the gap.

2. *Terminal stations.* Gaps installed at terminal stations of lines or circuits provide a given level of protection. The level may not, however, extend throughout the length of the line to the worksite. The use of gaps at terminal stations must be studied in depth. 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 flashover. When voltage surges are initiated 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 that is installed within 0.8 km (0.5 mile) of the work site will protect against such intersecting waves. Engineering studies of a particular line or system may indicate that adequate protection can be provided by even more distant gaps.

3. *Work site.* If protective gaps are used at the work site, the work site impulse insulation strength is established by the gap setting. Lightning strikes as much as 6 miles away from the worksite may cause a voltage surge greater than the insulation withstand voltage, and a gap flashover may occur. The flashover will not occur between the employee and the line, but across the protective gap instead.

*F. Disabling Automatic Reclosing*

There are two reasons to disable the automatic-reclosing feature of circuit-interrupting devices while employees are performing live-line maintenance:

• To prevent the reenergizing of a circuit faulted by actions of a worker, which could possibly create a hazard or compound injuries or damage produced by the original fault;

• To prevent any transient overvoltage caused by the switching surge that would occur if the circuit were reenergized.

However, due to system stability considerations, it may not always be feasible to disable the automatic-reclosing feature.

## Appendix C to Subpart V—Protection From Step and Touch Potentials

### 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.

### 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 2

[8] To eliminate unwanted flashovers due to minor system disturbances, it is desirable to have the crest withstand voltage no lower than 1.25 p.u.

[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.

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.

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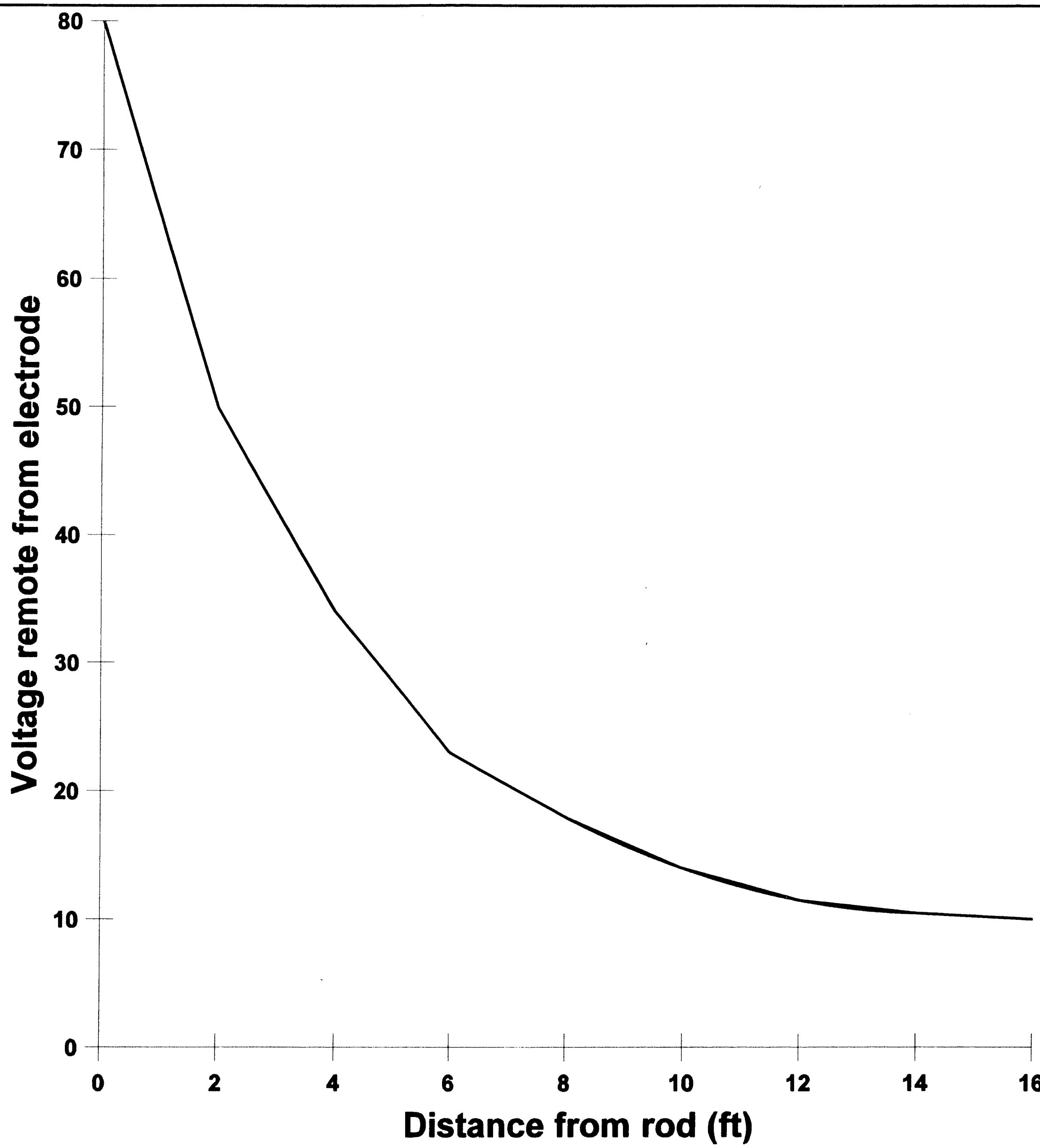


**Figure 2—Typical Voltage-Gradient Distribution Curve**

*B. Step and Touch Potentials*

"Step potential" is the voltage between the feet of a person standing near an energized grounded object. It is equal to the difference in voltage, given by the voltage distribution curve, between two points at different distances from the "electrode." A person could be at risk of injury during a fault simply by standing near the grounding point.

"Touch potential" is the voltage between the energized object and the feet of a person in contact with the object. It is equal to the difference in voltage between the object (which is at a distance of 0 feet) and a point some distance away. It should be noted that 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 that was grounded to the system neutral and that contacted an energized 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.

Step and touch potentials are illustrated in Figure 3.

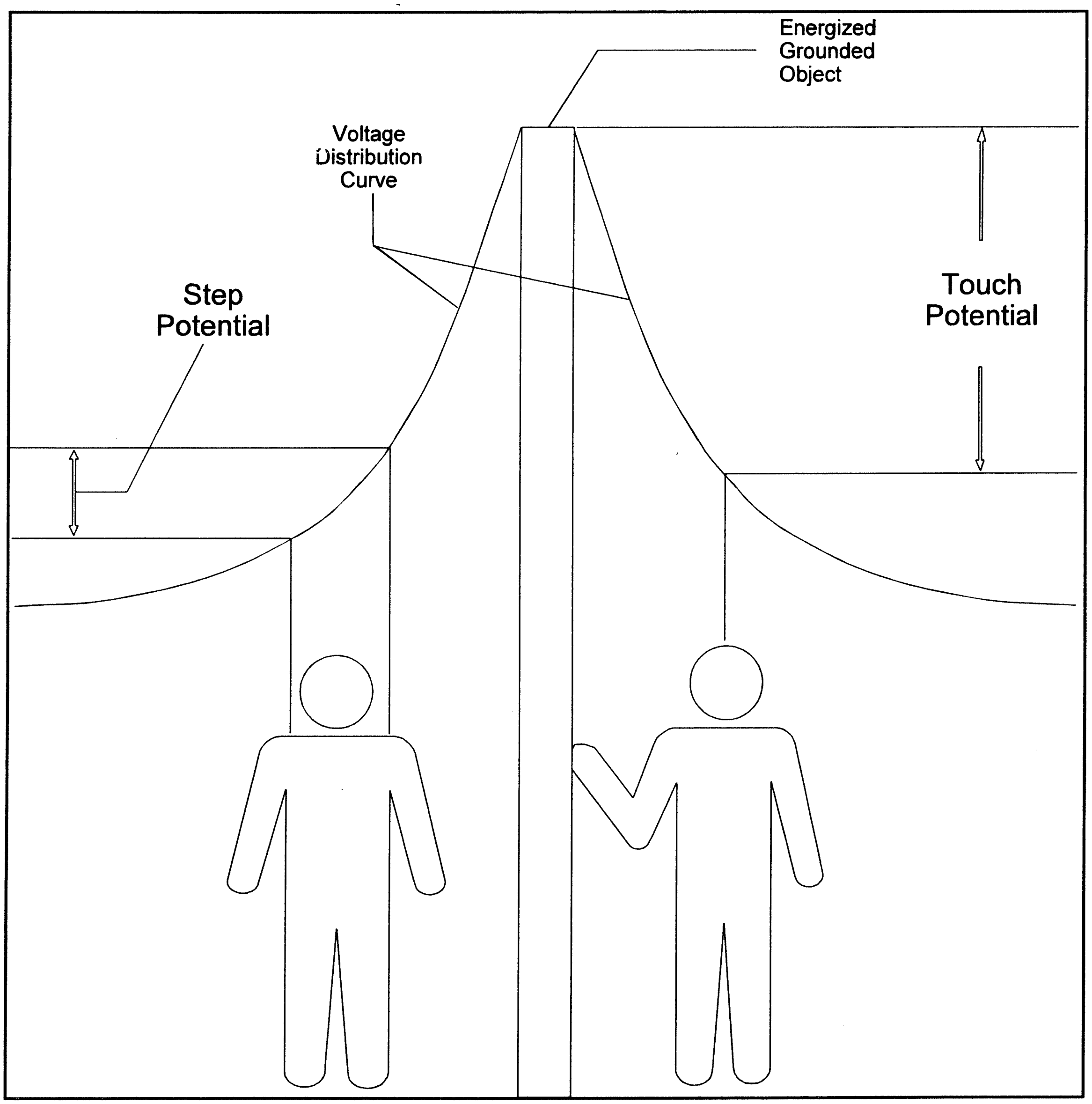


**Figure 3—Step and Touch Potentials**

*C. Protection From the Hazards of Ground-Potential Gradients*

An engineering analysis of the power system under fault conditions can be used to determine whether or not hazardous step and touch voltages will develop. The result of this analysis can ascertain the need for protective measures and can guide the selection of appropriate precautions.

Several methods may be used to protect employees from hazardous ground-potential gradients, including equipotential zones, insulating equipment, and restricted work areas.

1. The creation of an equipotential zone will protect a worker standing within it from hazardous step and touch potentials. (*See* Figure 4.) Such a zone can be produced through the use of a metal mat connected to the grounded object. In some cases, a grounding grid can be used to equalize the voltage within the grid. Equipotential zones will not, however, protect employees who are either wholly or partially outside the protected area. Bonding conductive objects in the immediate work area can also be used 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 in some cases, however.)

2. The use of 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 the operation being performed. Employees on the ground in the vicinity of transmission structures should be kept at a distance where step voltages would be insufficient to cause injury. Employees should not handle grounded conductors or equipment likely to become energized to hazardous voltages unless the employees are within an equipotential zone or are protected by insulating equipment.

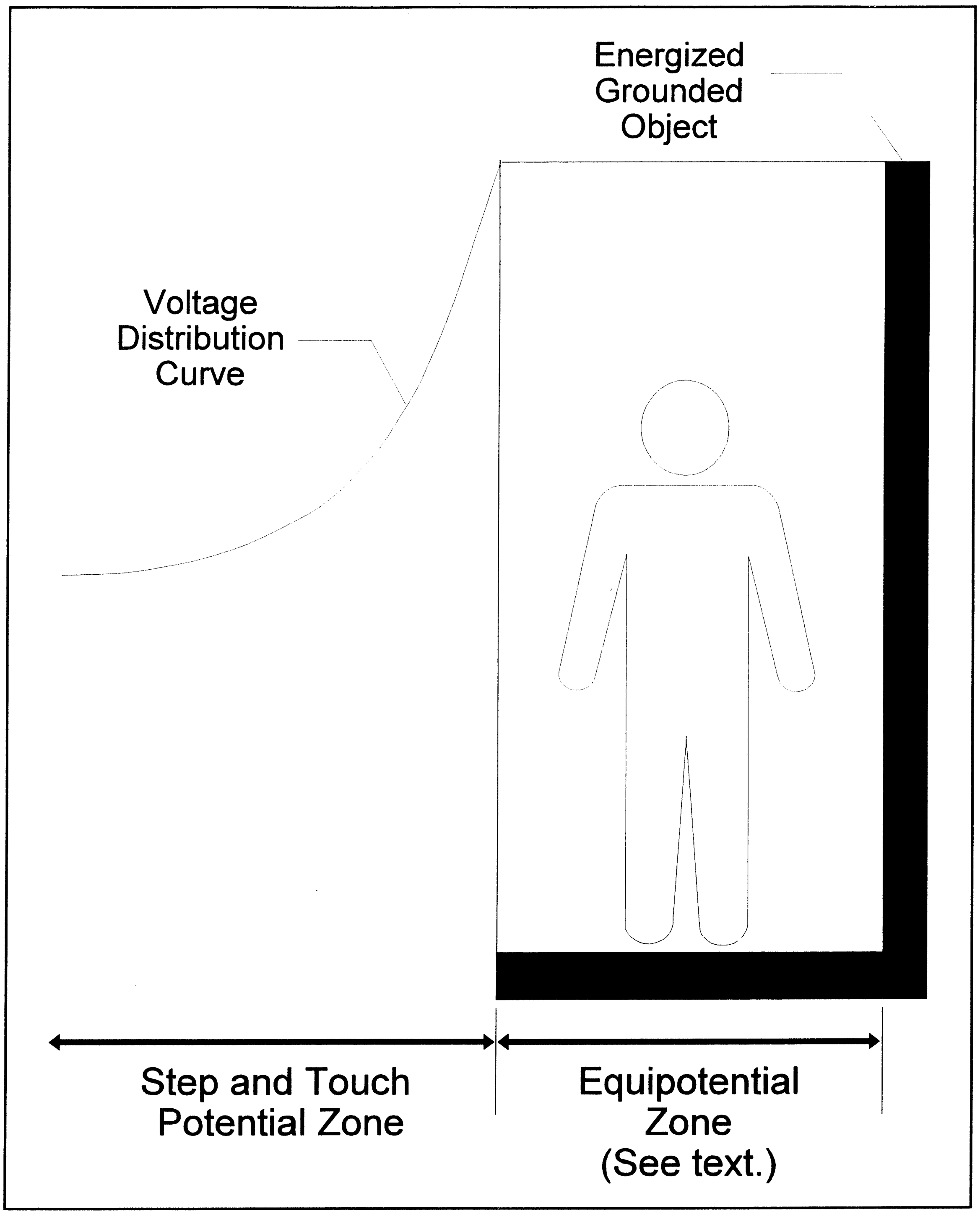


**Figure 4—Protection from Ground-Potential Gradients**

## Appendix D to Subpart V—Methods of Inspecting and Testing Wood Poles

### I. Introduction

When work is to be performed on a wood pole, it is important to determine the condition of the pole before it is climbed. The weight of the employee, the weight of equipment being installed, and other working stresses (such as the removal or retensioning of conductors) can lead to the failure of a defective pole or one 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.

If the pole is found to be unsafe to climb or to work from, it must be secured so that it does not fail while an employee is on it. 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, work should be performed from the new one.

### II. Inspection of Wood Poles

Wood poles should be inspected by a qualified employee for the following conditions:[2]

A. *General condition.* The pole should be inspected for buckling at the ground line and for 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, although not 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 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 may not support any changes of stress on the pole.

H. *Burn marks.* Burning from transformer failures or conductor faults could damage the pole so that it cannot withstand mechanical stress changes.

### III. Testing of Wood Poles

The following tests, which have been taken from § 1910.268(n)(3) of this chapter, are recognized as acceptable methods of testing wood poles:

A. *Hammer test.* Rap the pole sharply with a hammer weighing about 1.4 kg (3 pounds), starting near the ground line and continuing upwards circumferentially around the pole to a height of approximately 1.8 m (6 feet). 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 127 mm (5 inches) long. If substantial decay is encountered, 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. Caution must be exercised to avoid causing power lines to swing together. The force may be applied either by pushing with a pike pole or pulling with a rope. If the pole cracks during the test, it shall be considered unsafe.

[1] A properly guyed pole in good condition should, at a minimum, be able to handle the weight of an employee climbing it.

[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.

## Appendix E to Subpart V—Reference Documents

The references contained in this appendix provide information that can be helpful in understanding and complying with the requirements contained in subpart V of this part. The national consensus standards referenced in this appendix contain detailed specifications that employers may follow in complying with the more performance-oriented requirements of OSHA's final rule. Except as specifically noted in subpart V of this part, however, compliance with the national consensus standards is not a substitute for compliance with the provisions of the OSHA standard.

ANSI/SIA A92.2–2001, American National Standard for Vehicle-Mounted Elevating and Rotating Aerial Devices.

ANSI C2–2002, National Electrical Safety Code.

ANSI Z133.1–2000, American National Standard Safety Requirements for Pruning, Trimming, Repairing, Maintaining, and Removing Trees, and for Cutting Brush.

ANSI/ASME B20.1–2003, Safety Standard for Conveyors and Related Equipment.

ANSI/IEEE Std. 4–1995, IEEE Standard Techniques for High-Voltage Testing.

ANSI/IEEE Std. 100–2000, The Authoritative Dictionary of IEEE Standards Terms, 7th Edition.

ANSI/IEEE Std. 516–2003, IEEE Guide for Maintenance Methods on Energized Power Lines.

ANSI/IEEE Std. 935–1989, IEEE Guide on Terminology for Tools and Equipment To Be Used in Live Line Working.

ANSI/IEEE Std. 957–1995, IEEE Guide for Cleaning Insulators.

ASTM D 120–02a, Standard Specification for Rubber Insulating Gloves.

ASTM D 149–97a, Standard Test Method for Dielectric Breakdown Voltage and Dielectric Strength of Solid Electrical Insulating Materials at Commercial Power Frequencies.

ASTM D 178–01$^{e1}$, Standard Specification for Rubber Insulating Matting.

ASTM D 1048–99, Standard Specification for Rubber Insulating Blankets.

ASTM D 1049–98$^{e1}$, Standard Specification for Rubber Insulating Covers.

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

ASTM D 1051–02, Standard Specification for Rubber Insulating Sleeves.

ASTM F 478–92, Standard Specification for In-Service Care of Insulating Line Hose and Covers.

ASTM F 479–95, Standard Specification for In-Service Care of Insulating Blankets.

ASTM F 496–02a, Standard Specification for In-Service Care of Insulating Gloves and Sleeves.

ASTM F 711–02, Standard Specification for Fiberglass-Reinforced Plastic (FRP) Rod and Tube Used in Live Line Tools.

ASTM F 712–88, Standard Test Methods for Electrically Insulating Plastic Guard Equipment for Protection of Workers.

ASTM F 819–00$^{e1}$, Standard Terminology Relating to Electrical Protective Equipment for Workers.

ASTM F 855–03, Standard Specifications for Temporary Protective Grounds to Be Used on De-Energized Electric Power Lines and Equipment.

ASTM F 887–04, Standard Specifications for Personal Climbing Equipment.

ASTM F 914–03, Standard Test Method for Acoustic Emission for Insulated and Non-Insulated Aerial Personnel Devices Without Supplemental Load Handling Attachments.

ASTM F 968–93$^{e1}$, Standard Specification for Electrically Insulating Plastic Guard Equipment for Protection of Workers.

ASTM F 1116–03, Standard Test Method for Determining Dielectric Strength of Dielectric Footwear.

ASTM F 1117–03, Standard Specification for Dielectric Footwear.

ASTM F 1236–96, Standard Guide for Visual Inspection of Electrical Protective Rubber Products.

ASTM F 1430–03, Standard Test Method for Acoustic Emission Testing of Insulated and Non-Insulated Aerial Personnel Devices with Supplemental Load Handling Attachments.

ASTM F 1505–01, Standard Specification for Insulated and Insulating Hand Tools.

ASTM F 1506–02a$^{e1}$, 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.

ASTM F 1564–95, Standard Specification for Structure-Mounted Insulating Work Platforms for Electrical Workers.

ASTM F 1701–96, Standard Specification for Unused Polypropylene Rope with Special Electrical Properties.

ASTM F 1742–03, Standard Specifications for PVC Insulating Sheeting.

ASTM F 1796–97, Standard Specification for High Voltage Detectors—Part 1 Capacitive Type to be Used for Voltages Exceeding 600 Volts AC.

ASTM F 1797–98, Standard Test Method for Acoustic Emission Testing of Insulated Digger Derricks.

ASTM F1825–03, Standard Specification for Clampstick Type Live Line Tools.

ASTM F1826–00, Standard Specification for Live Line and Measuring Telescoping Tools.

ASTM F 1891–02b, Standard Specification for Arc and Flame Resistant Rainwear.

ASTM F 1958/F 1958M–99, Standard Test Method for Determining the Ignitability of Non-flame-Resistant Materials for Clothing by Electric Arc Exposure Method Using Mannequins.

ASTM F1959/F 1959M–99, Standard Test Method for Determining the Arc Thermal Performance Value of Materials for Clothing.

IEEE Std. 62–1995, IEEE Guide for Diagnostic Field Testing of Electric Power Apparatus

IEEE Std. 524–2003, IEEE Guide to the Installation of Overhead Transmission Line Conductors.

IEEE Std. 1048–2003, IEEE Guide for Protective Grounding of Power Lines.

IEEE Std. 1067–1996, IEEE Guide for the In-Service Use, Care, Maintenance, and Testing of Conductive Clothing for Use on Voltages up to 765 kV AC and ±750 kV DC.

NFPA 70E–2004, Standard for Electrical Safety in the Workplace.

## Appendix F to Subpart V—Clothing

### I. Introduction

Paragraph (g) of § 1926.960 addresses clothing worn by an employee. This paragraph requires employers to: (1) Assess the workplace for flame and arc hazards (paragraph (g)(1)); (2) estimate the available heat energy from electric arcs to which employees could be exposed (paragraph (g)(2)), (3) ensure that employees wear clothing that has an arc rating greater than or equal to the available heat energy (paragraph (g)(5)), (4) ensure that employees wear clothing that could not melt or ignite and continue to burn in the presence of electric arcs to which an employee could be exposed (paragraph (g)(3)), and (5) ensure that employees wear flame-resistant clothing [1] under certain conditions (paragraph (g)(4)). This appendix contains information to help employers estimate available heat energy as required by § 1926.960(g)(2), select clothing with an arc rating suitable for the available heat energy as required by § 1926.960(g)(5), and ensure that employees do not wear flammable clothing that could lead to burn injury as addressed by §§ 1926.960(g)(3) and (g)(4).

### II. Protection Against Burn Injury

*A. Estimating Available Heat Energy*

The first step in protecting employees from burn injury resulting from an electric arc is to estimate the potential heat energy if an arc does occur. Table 7 lists various methods of calculating values of available heat energy from an electric circuit. OSHA 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). Some of these parameters, such as the fault current and the clearing time, are known quantities for a given system. Other parameters, such as the length of the arc and the distance between the arc and the employee, vary widely and can only be estimated.

TABLE 7.—METHODS OF CALCULATING INCIDENT HEAT ENERGY FROM AN ELECTRIC ARC

1. Standard for Electrical Safety Requirements for Employee Workplaces, NFPA 70E–2004, 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, Septebmer 28–30, 1998.
3. Guide for Performing Arc Flash Hazard Calculations, IEEE 1584–2002.
4. Heat Flux Calculator, a free software program created by Alan Privette (widely available on the Internet).
5. ARCPRO, a commercially available software program developed by Kinectrics, Toronto, ON, CA.

The amount of heat energy calculated by any of the methods is approximately directly 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 he or she 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.

In estimating available heat energy, the employer must make some reasonable assumptions about how far the employee will be from the electric arc. In some instances, such as during some work performed using live-line tools, the employee will be at least the minimum approach distance from an energized part. However, in this situation, the arc could still extend towards the employee. Thus, in this case, a reasonable estimate of the distance between the employee and the arc would be the minimum approach distance minus twice the sparkover distance.[2]

In other cases, as during rubber glove work, parts of the employee's body will be closer to an energized part than the minimum approach distance. An employee's chest will be about 380 millimeters (15 in.) from an energized conductor during rubber glove work on that conductor. Because there should not be any surfaces at a potential other than the conductor between the employee and the conductor, it is reasonable to assume that the arc will not extend towards the employee. Thus, in this situation, it would be reasonable to use 380 millimeters (15 in.) as the distance between the employee and the arc.

The standard permits an employer to make broad estimates of available heat energy covering multiple system areas using reasonable assumptions about the energy exposure distribution. For example, the employer can use the maximum fault current and clearing time to cover several system areas at once. Table 8 presents estimates of available energy for different parts of an electrical system operating at 4 to 46 kV. The table is for open-air, phase-to-ground electric arc exposures typical for overhead systems operating at these voltages. The table assumes that the employee will be 380 millimeters (15 in.) from the electric arc, which is a reasonable estimate for rubber glove work. To use the table, an employer would use the voltage, maximum fault current, and maximum clearing time for a system area and select the appropriate heat energy (5, 8, or 12 calories) 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. This system falls in the 4.0-to-15.0-kV range; the fault current is less than 10 kA (the second row in that voltage range); and the clearing time is under 14.5 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 5 calories or less (from the column heading), and the employer could select clothing with a 5-calorie rating to meet § 1926.960(g)(5).

Table 9 presents similar estimates for systems operating at voltages of 46.1 to 800 kV. This table is also for open-air, phase-to-ground electric arc exposures typical for overhead systems operating at these voltages. The table assumes that the arc length will be equal to the sparkover distance [3] and that the employee will be a distance from the arc equal to the minimum approach distance minus twice the arc length.

The employer will need to use other methods for estimating available heat energy in situations not addressed by Table 8 or Table 9. The calculation methods listed in Table 7 will help employers do this. For example, employers can use Table 130.7(C)(9)(a), Table 130.7(C)(10), and Table 130.7(C)(11) of NFPA 70E–2004 to estimate

[1] Flame-resistant clothing includes clothing that is inherently flame resistant and clothing that has been chemically treated with a flame retardant. (See ASTM F1506–02a, Standard Performance Specification for Textile Materials for Wearing Apparel for Use by Electrical Workers Exposed to Momentary Electric Arc and Related Thermal Hazards.)

[2] The sparkover distance equals the shortest possible arc length.

[3] The dielectric strength of air is about 10 kV for every 25.4 mm (1 in.). Thus, the arc length can be estimated to be the phase-to-ground voltage divided by 10.

the available heat energy (and to select appropriate protective clothing) for many specific situations, including lower-voltage, phase-to-phase arc, and enclosed arc exposures.

TABLE 8.—AVAILABLE HEAT ENERGY FOR VARIATIONS FAULT CURRENTS, CLEARING TIMES, AND VOLTAGES OF 4.0 TO 46.0 KV

| Voltage range (kV) | Fault current (kA) | 5-cal maximum clearing time (cycles) | 8-cal maximum clearing time (cycles) | 12-cal maximum clearing time (cycles) |
|---|---|---|---|---|
| 4.0 to 15.0 | 5 | 37.3 | 59.6 | 89.4 |
| | 10 | 14.5 | 23.2 | 34.8 |
| | 15 | 8.0 | 12.9 | 19.3 |
| | 20 | 5.2 | 8.3 | 12.5 |
| 15.1 to 25.0 | 5 | 34.5 | 55.2 | 82.8 |
| | 10 | 14.2 | 22.7 | 34.1 |
| | 15 | 8.2 | 13.2 | 19.8 |
| | 20 | 5.5 | 8.8 | 13.2 |
| 25.1 to 36.0 | 5 | 16.9 | 27.0 | 40.4 |
| | 10 | 7.1 | 11.4 | 17.1 |
| | 15 | 4.2 | 6.8 | 10.1 |
| | 20 | 2.9 | 4.6 | 6.9 |
| 36.1 | 5 | 13.3 | 21.2 | 31.9 |
| | 10 | 5.7 | 9.1 | 13.7 |
| | 15 | 3.5 | 5.6 | 8.4 |
| | 20 | 2.5 | 4.0 | 6.0 |

**Notes:**
(1) This table is for open-air, phase-to-ground electric arc exposures. It is not intended for phase-to-phase arcs or enclosed arcs (arc in a box).
(2) 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 voltage 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.).

TABLE 9.—AVAILABLE HEAT ENERGY FOR VARIOUS FAULT CURRENTS, CLEARING TIMES, AND VOLTAGES OF 46.1 TO 800 KV

| Voltage range (kV) | Fault current (kA) | 5-cal maximum clearing time (cycles) | 8-cal maximum clearing time (cycles) | 12-cal maximum clearing time (cycles) |
|---|---|---|---|---|
| 46.1 to 72.5 | 20 | 10.6 | 17.0 | 25.5 |
| | 30 | 6.6 | 10.5 | 15.8 |
| | 40 | 4.6 | 7.3 | 11.0 |
| | 50 | 3.4 | 5.5 | 8.3 |
| 72.6 to 121 | 20 | 10.3 | 16.5 | 24.7 |
| | 30 | 5.9 | 9.4 | 14.1 |
| | 40 | 3.9 | 6.2 | 9.3 |
| | 50 | 2.7 | 4.4 | 6.6 |
| 138 to 145 | 20 | 12.2 | 19.5 | 29.3 |
| | 30 | 7.0 | 11.2 | 16.8 |
| | 40 | 4.6 | 7.4 | 11.1 |
| | 50 | 3.3 | 5.3 | 7.9 |
| 161 to 169 | 20 | 11.6 | 18.6 | 27.9 |
| | 30 | 7.2 | 11.5 | 17.2 |
| | 40 | 5.0 | 8.0 | 12.0 |
| | 50 | 3.8 | 6.0 | 9.0 |
| 230 to 242 | 20 | 13.0 | 20.9 | 31.3 |
| | 30 | 8.0 | 12.9 | 19.3 |
| | 40 | 5.6 | 9.0 | 13.5 |
| | 50 | 4.2 | 6.8 | 10.1 |
| 345 to 362 | 20 | 28.3 | 45.3 | 67.9 |
| | 30 | 17.5 | 28.1 | 42.1 |
| | 40 | 12.2 | 19.6 | 29.4 |
| | 50 | 9.2 | 14.7 | 22.1 |
| 500 to 550 | 20 | 23.6 | 37.8 | 56.7 |
| | 30 | 14.6 | 23.3 | 35.0 |
| | 40 | 10.2 | 16.3 | 24.4 |
| | 50 | 7.6 | 12.2 | 18.3 |
| 765 to 800 | 20 | 54.5 | 87.3 | 130.9 |
| | 30 | 33.7 | 53.9 | 80.9 |
| | 40 | 23.6 | 37.8 | 56.7 |

TABLE 9.—AVAILABLE HEAT ENERGY FOR VARIOUS FAULT CURRENTS, CLEARING TIMES, AND VOLTAGES OF 46.1 TO 800 KV

| Voltage range (kV) | Fault current (kA) | 5-cal maximum clearing time (cycles) | 8-cal maximum clearing time (cycles) | 12-cal maximum clearing time (cycles) |
|---|---|---|---|---|
| | 50 | 17.8 | 28.4 | 42.6 |

**Notes:**
(1) This table is for open-air, phase-to-ground electric arc exposures. It is not intended for phase-to-phase arcs or enclosed arcs (arc in a box).
(2) The table assumes that the arc length will be the phase-to-ground voltage divided by 10 and that the distance from the arc to the employee is the minimum approach distance minus twice the arc length.

*B. Selecting Protective Clothing*

Table 10 presents protective clothing guidelines for exposure to electric arcs. Protective clothing meeting the guidelines in this table are expected, based on extensive laboratory testing, to be capable of preventing second-degree burn injury to an employee exposed to the corresponding range of calculated incident heat energy from an electric arc. It should be noted that actual electric arc exposures may be more or less severe than the laboratory exposures because of factors such as arc movement, arc length, arcing from reclosing of the system, secondary fires or explosions, and weather conditions. Therefore, it is possible that an employee will sustain a second-degree or worse burn wearing clothing conforming to the guidelines in Table 10 under certain circumstances. Such clothing will, however, provide an appropriate degree of protection for an employee who is exposed to electric arc hazards.

TABLE 10.—PROTECTION CLOTHING GUIDELINES FOR ELECTRIC ARC HAZARDS

| Range of calculated incident energy cal/cm³ | Clothing description (number of layers) | Clothing weight oz/yd² | Arc thermal performance value (ATPV) |
|---|---|---|---|
| 0–2 | Untreated Cotton (1) | 4.5–7 | N/A |
| 2–5 | FR Shirt (1) | 4.5–8 | 5–7 |
| 5–10 | T-Shirt plus FR Shirt and FR Pants (2) | 9–12 | 10–17 |
| 10–20 | T-Shirt plus FR Shirt plus FR Coverall (3) | 16–20 | 22–25 |
| 20–40 | T-Shirt plus FR Shirt plus Double Layer Switching Coat (4) | 24–30 | 55 |

FR—Flame resistant.
ATPV—Arc Thermal Performance Value based on ASTM F1959 test method. (The method was modified as necessary to test the performance of the three- and four-layer systems.)
Source: "Protective Clothing Guidelines for Electric Arc Exposure," Neal, T. E., Bingham, A. H. Doughty, R. L., *IEEE Petroleum and Chemical Industry Conference Record,* September 1996, p. 294.

It should be noted that Table 10 permits untreated cotton clothing for exposures of 2 cal/cm² or less. Cotton clothing will reduce a 2-cal/cm² exposure below the 1.6-cal/cm² level necessary to cause burn injury and is not expected to ignite at such low heat energy levels. Although untreated cotton clothing is deemed to meet the requirement for suitable arc ratings in § 1926.960(g)(5) and the prohibition against clothing that could ignite and continue to burn in § 1926.960(g)(3) when the available heat energy is 2 cal/cm² or less, this type of clothing is still prohibited under certain conditions by § 1926.960(g)(4), as discussed further below.

Protective performance of any particular fabric type generally increases with fabric weight, as long as the fabric does not ignite and continue to burn. Multiple layers of clothing usually block more heat and are normally more protective than a single layer of the equivalent weight.

Exposed skin is expected to sustain a second-degree burn for incident energy levels of 1.6 cal/cm² or more. Though it is not required by the standard, if the heat energy estimated under § 1926.960(g)(2) is greater than or equal to 1.6 cal/cm², the employer should require each exposed employee to have no more than 10 percent of his or her body unprotected. Due to the unpredictable nature of electric arcs, the employer should also consider requiring the protection of bare skin from any exposure exceeding 0.8 cal/cm² so as to minimize the risk of burn injury.

**III. Protection Against Ignition**

Paragraph (g)(3) of § 1926.960 prohibits clothing that could melt onto an employee's skin or that could ignite and continue to burn when exposed to the available heat energy estimated by the employer. Meltable fabrics, such as acetate, nylon, and polyester, even in blends, must be avoided. When these fibers melt, they can adhere to the skin, transferring heat more rapidly, exacerbating any burns, and complicating treatment. This can be true even if the meltable fabric is not directly next to the skin. The remainder of this section focuses on the prevention of ignition.

Paragraph (g)(5) of § 1926.960 requires clothing with an arc rating greater than or equal to the employer's estimate of available heat energy. As explained earlier, untreated cotton is acceptable for exposures of 2 cal/cm² or less. If the exposure is greater than that, the employee must wear flame-resistant clothing with a suitable arc rating. However, even though an employee is wearing a layer of flame-resistant clothing, there are circumstances under which flammable layers of clothing would be exposed and subject to ignition. For example, if the employee is wearing flammable clothing (for example, winter coveralls) over the layer of flame-resistant clothing, the outer flammable layer can ignite. Similarly, clothing ignition is possible if the employee is wearing flammable clothing under the flame-resistant clothing and the underlayer is exposed by an opening in the flame-resistant clothing. Thus, it is important for the employer to consider the possibility of clothing ignition even when an employee is wearing clothing with a suitable arc rating.

Table 11 lists the minimum heat energy under electric arc conditions that can reasonably be expected to ignite different weights and colors of cotton fabrics. The values listed, expressed in calories per square centimeter, represent a 10 percent probability of ignition with a 95 percent confidence level. If the heat energy estimated under § 1926.960(g)(2) does not exceed the values listed in Table 11 for a particular weight and color of cotton fabric, then an outer layer of that material would not be expected to ignite and would be considered as being permitted under § 1926.960(g)(3).[4] Conversely, if the heat energy estimated under § 1926.960(g)(2) exceeds the values listed in Table 11 for a particular weight and color of cotton fabric, that material may not be worn as an outer

[4] An underlayer of clothing with an arc rating greater than or equal to the estimate of available heat energy would still be required under § 1926.960(g)(5).

layer of garment and may not be otherwise exposed due to an opening in the flame-resistant clothing.

For white cotton fabrics of a different weight from those listed, choose the next lower weight of white cotton fabric listed in Table 11. For cotton fabrics of a different color and weight combination than those listed, select a value from the table corresponding to an equal or lesser weight of blue cotton fabric. For example, for a 6.0-oz/yd² brown twill fabric, select 4.6 cal/cm² for the ignition threshold, which corresponds to 5.2-oz/yd² blue twill. If a white garment has a silkscreen logo, insignia, or other similar design included on it, then the entire garment will be considered as being of a color other than white. (The darker portion of the garment can ignite earlier than the rest of the garment, which would cause the entire garment to burn.)

Employers may choose to test samples of genuine garments rather than rely on the values given in Table 11. The appropriate electric arc ignition test method is given in ASTM F 1958/F 1958M–99, *Standard Test Method for Determining the Ignitability of Non-flame-Resistant Materials for Clothing by Electric Arc Exposure Method Using Mannequins.* Using this test method, employers may substitute actual test data analysis results representing an energy level that is reasonably certain not to be capable of igniting the fabric. For example, based on test data, the employer may select a level representing a 10 percent probability of ignition with a 95 percent confidence level, representing a 1 percent probability of ignition according to actual test results, or representing an energy level that is two standard deviations below the mean ignition threshold. The employer may also select some other comparable level.

TABLE 11.—IGNITION THRESHOLD FOR COTTON FABRICS

| Fabric description | | | Ignition threshold (cal/cm²) |
|---|---|---|---|
| Weight (oz/yd²) | Color | Weave | |
| 46 | White | Jersey Kit | 4.3 |
| 5.2 | Blue | Twill | 4.6 |
| 6.2 | White | Fleece | 6.4 |
| 6.9 | Blue | Twill | 5.3 |
| 8.0 | Black | Twill | 6.1 |
| 8.3 | White | Sateen | 11.6 |
| 11.9 | Tan | Duck | 11.3 |
| 12.8 | Blue | Denim | 15.5 |
| 13.3 | Blue | Denim | 15.9 |

Source: "Testing Update on Protective Clothing & Equipment for Electric Arc Exposure," IEEE Paper No. PCIC–97–35.

Clothing loses weight as it wears. This can lower the ignition threshold, especially if the garment has threadbare areas or is torn.

Adding layers of clothing beneath an outer layer of flammable fabric has no significant effect on the heat energy needed to ignite the outer fabric layer. Therefore, the outer layer of clothing must be treated as if it were a single layer to determine the proper ignition threshold.

Flammable clothing worn in conjunction with flame-resistant clothing is not permitted to pose an ignition hazard.[5] Flammable clothing may not be worn as an outer layer if it could be exposed to heat energy above the ignition threshold. Outer flame-resistant layers may not have openings that expose flammable inner layers that could be ignited.

When an outer flame-resistant layer would be unable to resist breakopen,[6] the next (inner) layer should be flame-resistant.

Grounding conductors can become a source of electric arcing if they cannot carry fault current without failure. These possible sources of electric arcs[7] must be considered in determining whether the employee's clothing could ignite under § 1926.960(g)(4)(iii).

Flammable clothing can also be ignited by arcing that occurs when a conductor contacts an employee or by nearby material that ignites upon exposure to an electric arc. These sources of ignition must be considered in determining whether the employee's clothing could ignite under § 1926.960(g)(4)(i) and (g)(4)(ii).

[5] Paragraph (g)(3) of § 1926.960 prohibits clothing that could ignite and continue to burn when exposed to the heat energy estimated under paragraph (g)(2).

Paragraph (g)(3) of § prohibits clothing that could ignite and continue to burn when exposed to the heat energy estimated under paragraph (g)(2).

[6] Breakopen is the creation of holes, tears, or cracks in the exposed fabric such that incident energy is no longer effectively blocked.

[7] 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 need not be considered a possible electric arc source.

## Appendix G to Subpart V—Work Positioning Equipment Inspection Guidelines

### I. Body Belts

Inspect body belts to ensure that:

A. 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 made of 100 percent leather;

E. No worn materials that could affect the safety of the user are present; and

F. D-rings are compatible with the snaphooks with which they will be used.

**Note:** An incompatibility between a snaphook and a D-ring may cause snaphook rollout, or unintentional disengagement of the snaphook from the D-ring. Employers should take extra precaution when determining compatibility between snaphooks and D-rings of different manufacturers.

### 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 made from 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 on pole climbers are no less than 32 millimeters in length measured on the underside of the gaff;

B. Gaffs on tree climbers are no less than 51 millimeters in length measured on the underside of the gaff;

C. Gaffs and leg irons are not fractured or cracked;

D. Stirrups and leg irons are free of excessive wear;

E. Gaffs are not loose;

F. Gaffs are free of deformation that could adversely affect use;

G. Gaffs are properly sharpened; and

H. There are no broken straps or buckles.

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