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FROM: T. G. Grumbles
DATE: August 23, 1990

VISTA

Interoffice Communication

SUBJ: OSHA ELECTRICAL RELATED WORK PRACTICES

For those of you who have not requested it, attached is a copy of the final OSHA Electrical Safety Related Work Practices Rule.

The actual standard starts on Page 32014 of the attachment. The initial portion of the new requirements standard is dealing with revisions to existing standards. Beginning on Page 32016 with Section 1910.331. These requirements include items for work performed on or near exposed energized and deenergized equipment; use of electrical protective equipment; and the safe use of electric equipment.

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DEPARTMENT OF LABOR

Occupational Safety and Health Administration

29 CFR Part 1910

[Docket S-016]

RIN 1218-AA32

Electrical Safety-Related Work Practices

AGENCY: Occupational Safety and Health Administration (OSHA), U.S. Department of Labor.

ACTION: Final rule.

SUMMARY: The Occupational Safety and Health Administration (OSHA) is issuing a new standard on electrical safety-related work practices for general industry. These performance-oriented regulations complement the existing electrical installation standards. The new standard includes requirements for work performed on or near exposed energized and deenergized parts of electric equipment; use of electrical protective equipment; and the safe use of electric equipment. Compliance with these safe work practices will reduce the number of electrical accidents resulting from unsafe work practices by employees.

OSHA is also amending miscellaneous provisions in the general industry standards to: (1) Change existing regulations referring to the 1971 National Electrical Code so that they will refer instead to OSHA's electrical standards; (2) remove existing electrical work-practice requirements from other parts of the general industry standards so that all general electrical safety-related work practices will be covered in the electrical safety standards; and (3) remove an existing provision relating to construction from the general industry electrical safety standards. These changes promote uniformity and reduce redundancy among the general industry standards.

EFFECTIVE DATE: The final rule, except for § 1910.332, becomes effective on December 4, 1990. Section 1910.332 becomes effective on August 6, 1991.

FOR FURTHER INFORMATION CONTACT: Mr. James F. Foster; U.S. Department of Labor, Occupational Safety and Health Administration, room N3637; 200 Constitution Avenue, NW., Washington, DC 20210 (202-523-8148).

SUPPLEMENTARY INFORMATION:

I. Background

A. Electric Shock

It is well known that the human body will conduct electricity, and that if direct contact is made with an electrically energized part while a similar contact is made simultaneously with another conductive surface which is maintained at a different electrical potential, a current will flow, entering the body at one contact point, traversing the body and then exiting at the other contact point, usually the ground. Each year many workers suffer pain, injuries, and death from such electric shocks. OSHA estimates that there are more than 100 electrical fatalities in general industry each year.

The effects that electric shock will have on an individual will depend upon the type of circuit, its voltage, resistance, and amperage, the pathway through the body, and the duration of the contact. For example, electric shocks produced by alternating currents of power line frequency (normally 60 Hertz) passing through the body of an average adult from hand to foot for 1 second can cause various effects, starting from a condition of being barely perceptible at 1 milliampere to involuntary muscular control from 9 to 25 milliamperes. The passage of still higher currents can produce ventricular fibrillation of the heart (cessation of rhythmic pumping action) from 75 milliamperes to 4 amperes, and finally immediate cardiac arrest at over 4 amperes. Nearly instantaneous fatalities from electric shock can result from either direct paralysis of the respiratory system (at 20 milliamperes or more), failure of the heart to pump due to ventricular fibrillation (at 75 milliamperes or more), or immediate and complete heart stoppage (at 4 amperes or more). Even if the shocking current does not pass through vital organs or nerve centers, severe injuries such as deep internal burns can still occur. In some cases, injuries caused by electric shock can be a contributory cause of delayed fatalities.

Burns suffered in electrical accidents are also of great concern. These burns may be of three basic types: electrical burns, arc burns and thermal contact burns. Electrical burns are the result of the electric current flowing in the tissues and may be either skin deep or may affect deeper layers (muscles, bones, etc.) or both. Tissue damage is caused by the heat generated from the current flow; if the energy delivered by the electric shock is high, the body cannot dissipate the heat and the tissue is burned. Typically, such electrical burns are slow to heal. Arc burns, on the other hand, are the result of high temperatures produced by electric arcs or by explosions close to the body. These burns are similar to burns and blisters produced by any high temperature source. Finally, thermal contact burns are those normally experienced from the skin's contacting hot surfaces of overheated electric conductors, conduits, or other energized equipment. All types of burns may be produced simultaneously.

Electric shock currents, even at levels as low as 3 milliamperes, can also cause injuries of an indirect or secondary nature. In this case, the involuntary muscular reaction from the electric shock can cause bruises, bone fractures, and even death resulting from collisions or falls.

B. Hazards Associated With Electricity

Most electrical systems use the earth to establish a voltage reference system with respect to ground. This is done by connecting a portion of the circuit to ground. Since these systems use conductors which have voltages to ground, a shock hazard exists for persons who are in electrical contact with the earth and are exposed to the conductors. If a person comes in contact with an ungrounded conductor while that person is in contact with the ground, he or she becomes part of the circuit and current passes through his or her body.

In addition to the shock hazard, electricity poses other hazards to employees. For example, when a short circuit occurs or current flow is interrupted, hazards are created from the resultant arcs. If the current involved is great enough, these arcs can cause injury or can start a fire. Fires can also be created by overheating equipment or by conductors carrying too much current. Extremely high-energy arcs can damage equipment causing fragmented metal to fly in all directions. In atmospheres which contain explosive gases or vapors or combustible dusts, even low-energy arcs can cause violent explosions.

C. Nature of Electrical Accidents

Electrical accidents, when initially studied, often appear to be caused by circumstances which are varied and peculiar to the particular incidents involved. However, further consideration usually reveals the underlying cause to be a combination of three possible factors; i.e., work involving unsafe equipment and installations, workplaces made unsafe by the environment, and unsafe work performance (unsafe acts).

For purposes of convenience, the first and second accident-causing situations are sometimes combined and simply referred to as unsafe conditions. Thus, electrical accidents can be generally

considered as being caused by unsafe conditions, unsafe acts, or, in what is usually the case, combinations of the two. It should also be noted that inadequate maintenance can cause equipment or installations which were originally considered safe to deteriorate, resulting in an unsafe condition.

Some unsafe electric equipment and installations can be identified, for example, by the presence of faulty insulation, improper grounding, loose connections, defective parts, ground faults in equipment, or unguarded live parts. The environment can also be a contributory factor to electrical accidents in a number of ways. For example, environments containing flammable vapors, liquids or gases, areas containing corrosive atmospheres, and wet and damp locations are some unsafe environments affecting electrical safety. Finally, some unsafe acts can be recognized as, typically, the failure to deenergize electric equipment when it is being repaired or inspected, the intentional use of obviously defective and unsafe tools, or the use of tools or equipment too close to energized parts.

D. Protective Measures

There are various general ways of protecting employees from the hazards of electric shock, including insulation and guarding of live parts. Insulation provides an electrical barrier to the flow of current. To be effective, the insulation must be appropriate for the voltage, and the insulating material must be undamaged, clean, and dry. Guarding prevents the employee from coming too close to energized parts. It can be in the form of a physical barricade, or it can be provided by installing the live parts out of reach from the working surface. (This technique is known as "guarding by location.")

Grounding is another method of protecting employees from electric shock; however, it is normally a secondary protective measure. To keep guards or enclosures at a common potential with earth, they are connected, by means of a grounding conductor, to ground. In addition, grounding also provides a path of low impedance and of ample capacity back to the source to pass enough current to operate the overcurrent devices in the circuit. If a live part accidentally comes in contact with a grounded enclosure, current flow is directed back to earth, and the circuit protective devices (e.g., fuses and circuit breakers) can interrupt the circuit.

These protective measures help ensure the safe installation of electric equipment and are prescribed by the regulations presently contained in 29 CFR part 1910, subpart S. Addressing common unsafe conditions, these rules cover such safety considerations as guarding and insulation of live parts, grounding of equipment enclosures, and protection of circuits from overcurrent.

However, even though equipment may be in compliance with the installation requirements in subpart S, the employee is still exposed to electrical hazards. An unsafe work practice can increase the gravity of the hazards, which under normal conditions would be controlled and would pose no serious risk to the worker. For example, an employee carrying a ladder could approach exposed live parts that are guarded by installation beyond normal reaching distance. The employee's bringing the ladder close to the live parts exposes the worker to hazards much greater than those present under usual working conditions.

When employees are working with electric equipment, they must use safe work practices. Such safety-related work practices include keeping a prescribed distance from exposed energized lines, avoiding the use of electric equipment when the employee or the equipment is wet, and locking-out and tagging equipment which is deenergized for maintenance.

Another important safety practice involves the use of electrical protective devices, such as rubber gloves and rubber mats for the purpose of insulation against live parts, or live-line tools for purposes of both insulation and manipulation of energized parts from a distance. However, to assure the protection of the employee, this equipment must be properly manufactured and maintained. Regular maintenance is an important consideration in order to keep this equipment from deteriorating into an unsafe condition.

E. Need for Final Regulation

The current electrical safety standards contained in subpart S of part 1910 provide employees with protection from hazards posed by electrical installations. By requiring such protective measures as guarding of live parts and grounding of equipment enclosures, the current regulations make most types of electric equipment reasonably safe under normal conditions.

However, even normally safe equipment can pose hazards under certain conditions. A few illustrations may help to underscore this point. To guard overhead power lines from contact by the public, electric utility companies install the lines at heights which cannot be reached by persons standing on the ground. This protective measure serves its purpose well, until someone approaches a power line with a long ladder or a crane. Since the overhead power lines were not designed to provide complete protection under such circumstances, safe work practices [e.g., maintaining a safe distance] must be used to minimize the hazards involved.

Another common example of a normally safe installation posing hazards is equipment undergoing maintenance. Under normal operating conditions, live parts of equipment are required to be guarded from contact by employees. However, when the equipment must be disassembled for maintenance or repair, the normally enclosed electrical parts become exposed. Therefore, during maintenance, certain work practices must be used to prevent contact with the necessarily exposed parts while they are energized. Typical safety-related work practices used in such situations include equipment deenergizing, lockout and tagging procedures, and the use of personal protective equipment.

Electric equipment can also be used under circumstances that pose unexpected hazards. For example, using an ordinary portable electric drill, a worker can ignite flammable vapors from paint thinner being used nearby. The existing electrical safety standards contain provisions dealing with electrical installations in hazardous locations. However, they do not directly address the hazards involved with the use of electric equipment in areas in which hazardous concentrations of flammable gases or vapors may accumulate temporarily and infrequently. In such circumstances, safety-related work practices must be used to control the hazards involved. With respect to the electrical hazards, such practices could include the use of additional ventilation or the shutdown of electric equipment while hazardous quantities of the vapors are present.

As previously noted, the current electrical standards in subpart S of the General Industry Standards cover electrical installations rather than work practices; the few safety-related work practice standards that do exist are distributed in other subparts of 29 CFR part 1910. However, although unsafe work practices appear to be involved in most workplace electrocutions, OSHA has very few regulations addressing work practices necessary for electrical safety.

Unsafe work practices appeared to be a factor in about three-fourths of the electrocutions included in Exhibit 8 (which is discussed in the next section

of the preamble). Because of this, OSHA has concluded that standards are needed to minimize these hazards.

On September 1, 1989, OSHA promulgated a standard on the control of hazardous energy sources (lockout/tagout). This new standard addresses practices and procedures that are necessary to disable machinery or equipment and to prevent the release of potentially hazardous energy while maintenance and servicing activities are being performed. Although this rule covers electrical energy sources, it specifically excludes "exposure to electrical hazards from work on, near, or with conductors or equipment in electric utilization installations, which is covered by subpart S of this part." Thus, the generic lockout/tagout standard does not cover electrical hazards, and there is a gap in protection for electrical workers. The final electrical safety-related work practices standard will fill that gap with provisions that specifically pertain to electrical hazards of equipment maintenance and servicing.

Various national consensus standards, such as American National Standards Institute (ANSI) standards, address electrical safety-related work practices for particular types of equipment and operations. For example, American National Standard for Personnel Protection—Lockout/Tagout of Energy Sources—Minimum Safety Requirements (ANSI Z244.1-1982) addresses the electrical and other hazards of servicing and maintaining equipment. Also, American National Safety Code for Crawler, Locomotive, and Truck Cranes, ANSI B30.5, requires a minimum clearance of 10 feet for cranes operated near overhead power lines. Similarly, ANSI Z49.1, Safety in Welding and Cutting, contains electrical work practice requirements for the use of welders. OSHA previously adopted these last two consensus standards (in 29 CFR 1910.180 and 1910.252, respectively) under section 6(a) of the OSH Act (29 U.S.C. 655(a)); and, in some part, they have helped reduce electrical accidents. However, these "specialized" standards are limited in their areas of concern and do not address safe electrical work practices generally. Within the last 10 years, though, the National Fire Protection Association (NFPA) recognized the need for a general electrical safety-related work practice standard and adopted part II of NFPA 70E, Electrical Safety Requirements for Employee Workplaces.

Based on the considerable number of electrocutions occurring in situations for which no OSHA safety standards exist, OSHA has determined that a significant risk of death or serious injury exists (even in workplaces in compliance with existing OSHA standards), and the Agency has decided that a comprehensive electrical safety-related work practice standard is necessary for the protection of employees.

F. Accident Patterns

During this rulemaking, OSHA collected accident summaries (Exhibit 8) from the Agency's Integrated Management Information System (IMIS). These accident summaries were analyzed, and the results were compared to the survey of OSHA preliminary fatality/catastrophe event reports used in the development of the proposal. The new data covered the period of approximately April 1984 to December 1986. However, for various reasons, the OSHA fatality reports did not record all occupational electrocutions occurring in this period. For example, despite reporting requirements, some fatalities are simply never reported to OSHA. There has also been evidence that, in the past, some electrocutions have been mistakenly identified as heart attacks. (See, for example, the preamble to the final ground-fault protection standard at 41 FR 55697.) Presumably, this could have occurred during the period in question. Additionally, some accident reports submitted for this period were not reviewed in time to be entered into the database. Further, the IMIS data base does not include reports from all states with their own approved OSHA programs. Despite this underreporting, the available fatality information indicates that there is a serious problem.

In reviewing the data, OSHA divided the accidents into industry groups, as given in Table 1.

The Agency is limiting this rulemaking to the prevention of accidents in general industry and maritime (which has even fewer electrical safety requirements than general industry) because to include other industrial sectors (such as construction) would seriously impede the rulemaking process. Inclusion of other industries in the scope of the standard would require the Agency to consider many possible diverse situations requiring safety-related work practices that are likely to be germane only to these industries. The construction industry, for example, is an extensive user of temporary wiring, which is frequently moved and is often used under a wide range of environmental conditions. Such situations often affect the type of electrical safety-related work practices recommended for use. Within the past few years, OSHA revised its electrical standards for construction, subpart K of part 1926, which incorporate various electrical safety-related work practices that address the particular electrical hazards present in the construction industry (51 FR 25294). Additionally, under the Construction Safety Act and 29 CFR 1911.12, OSHA is required to consult with the Advisory Committee for Construction Safety and Health before issuing proposed rules affecting construction, to assure that the unique aspects of construction work are taken into consideration by the Agency.

Reasons for excluding work on telecommunications installations and work on electric power generation, transmission, and distribution installations are given in section III of this preamble. A proposed standard for the protection of employees engaged in electric power generation, transmission, and distribution work (only for electric utilities and their contractors) was published in the **Federal Register** on January 31, 1989 (54 FR 4974).

Therefore, of particular interest at this time are the 128 fatalities and 98 injuries occurring in general industry. A general breakdown of the accidents, by type, is given in Table 2. A review of the circumstances surrounding the accidents appears to indicate that an unsafe work practice, or a combination of unsafe work practices, was involved in about three fourths of the electrical fatalities.

TABLE 1—ELECTRICAL FATALITIES BY INDUSTRY—APRIL 1984 TO DECEMBER 1986 [1]

Industry	Applicable standard (29 CFR)	No. of fatalities	No. of hospitalized injuries	No. of non-hospitalized injuries
General Industry [2]	Part 1910, Subpart S	128	78	20
Construction [2]	Part 1926, Subpart K	127	46	16
Telecommunications	§ 1910.268	7	3	0

TABLE 1—ELECTRICAL FATALITIES BY INDUSTRY—APRIL 1984 TO DECEMBER 1986 [1]—Continued

Industry	Applicable standard (29 CFR)	No. of fatalities	No. of hospitalized injuries	No. of non-hospitalized injuries
Power Transmission and Distribution	Construction—Part 1926, Subpart V; Operation and Maintenance—Separate Rulemaking (Proposed § 1910.269).	59	34	3
Maritime	Parts 1915–1918 and Part 1910, Subpart S	1	0	0

[1] Only accidents reviewed for this period are included. Some accidents that occurred during this period were not reviewed at the time the exhibit was entered into the record. (Most of the records for 1984 and 1985 were reviewed; few from 1986 were reviewed.)
[2] Excluding Telecommunications and Power Transmission and Distribution.

TABLE 2—ELECTRICAL ACCIDENTS BY UNSAFE ACT—APRIL 1984 TO DECEMBER 1986

Category No. and Unsafe Event	No. of fatal.	No. of hosp. inj.	No. of non-hosp. inj.
i. Use of equipment or material too close to exposed energized lines:—Total	47	17	8
a Vehicles (e.g., cranes and dump trucks)	27	14	6
b Other mechanical equipment (e.g., augers and derricks)	8	0	1
c Tools and materials (e.g., ladders and tree limbs) [1]	12	3	1
ii. Failure to use electrical protective equipment [1]	5	3	0
iii. Assuming an unsafe position [1]	20	4	4
iv. Failure to deenergize (and lockout/tag) equipment [1]	13	3	1
v. Use of visibly defective electric equipment [1]	12	6	3
vi. Blind reaching, drilling, digging, etc	3	0	0
vii. No unsafe work practice or not enough information to classify properly	28	45	4
Total	126	78	20

[1] These categories contain common elements and therefore overlap. For illustration, the electrocution of an employee who contacted an overhead power line while working from a ladder could be placed into category (a), no protective equipment, or in category (iii), unsafe working position. The accident would be placed into one of these categories depending on whether he or she was qualified to use protective equipment and work very close to the power lines.

Unsafe work practices may result from such factors as inattentiveness, lack of training, or poor supervision. From the aforementioned reports, it is not always possible to determine the level of training involved, the employers' work rules, or other secondary factors which may have contributed to the accidents. Additionally, even though unsafe work practices were involved in many accidents, unsafe conditions were sometimes present at the same time. (For example, see category (v).) The data presented here are merely being used to demonstrate that unsafe work practices are significant contributors to electrical accidents and that they should be addressed in OSHA's regulations. It should be noted that, even with 100 percent compliance with OSHA's current General Industry Standards, most of the accidents (67 percent) given in categories (i) through (vi) in Table 2 would still have occurred.

Within each category in Table 2, the accidents are very similar in nature. From the fatality reports, OSHA can describe a typical accident for each of the first six categories (with the provision of the standard which most directly addresses the hazard in parentheses) as follows:

(i) *Use of equipment or material too close to exposed energized lines.* (a) *Vehicles.* An employee was operating a hydraulic tilt-frame hoist beneath overhead power lines, trying to pick up a dumpster that was filled with hazardous chemical waste. The overhead line was 24 feet, 4 inches above the ground. The operation was located at the approximate midpoint between two utility poles. The first employee was operating the controls, which were located on the driver's side of the trailer. He was standing on the ground, which was semisoft because the air temperature was 40 degrees, F. (There was light snow on the ground, and the sun was shining.) A second employee attached the cable from the hoist to the dumpster. The second employee and two others were standing at the rear of the trailer, where it made contact with the dumpster. The truck and trailer were about 56 feet long, and the dumpster about 35 feet long. The operator had the tilt frame about 4 to 5 inches away and tried to pull up the dumpster. The strain on the trailer lifted the mast into the overhead line (34 kilovolts phase to phase, 19.9 kilovolts phase to ground). The second employee saw the operator being shocked and ran to aid him with the other two employees right behind. The second employee threw himself at the operator to knock him off the controls. He then received an electric shock and burns. The other two employees tried to grab the operator, but were knocked down by the current. Eventually, they pulled the operator away, but too late to save him from electrocution. (§ 1910.333(c)(3)(iii))

(b) *Other mechanical equipment.* An employer assigned two employees to drill soil samples at a worksite. The drill rig was set up at the site, and four holes were drilled. During the process of drilling a fifth hole, the rig was set near an overhead power line. When the boom was raised, contact was made with the 12-kilovolt overhead power line (7200 volts phase to ground), electrocuting one employee and shocking the other. (§ 1910.333(c)(3)(iii))

(c) *Tools and materials.* A maintenance crew leader was using an iron measuring rod to check the level of a storage tank. When he pulled the rod out, it struck an overhead power line. He died from pulmonary emboli due to electric shock. (§ 1910.333(c)(3)(i)(B) and (c)(6))

(ii) *Failure to use electrical protective equipment.* An electrician was working without rubber insulating gloves, even though protective gloves had been provided. He was changing an electric cable in a panel board energized at 480 volts. As he was trying to pass the cable between the vertical bars, his arm touched the cable. He was electrocuted. (§§ 1910.333(c)(2) and 1910.335(a)(1)(i))

(iii) *Assuming an unsafe position.* Two employees of a trucking firm were delivering a 10-kilovolt-ampere transformer to a substation. A 19.5-kilovolt overhead power line was located about 20 feet from the ground, 6 feet from the top of the transformer. One of the employees climbed the transformer to remove the chain binders. Bending over, he loosened a clevis and, as he stood up, contacted the power line. He was electrocuted; and the other employee, who was holding onto the chain, received an electric shock, which caused second and third degree burns. (§ 1910.333(c)(3)(i)(A))

(iv) *Failure to deenergize (and lockout/tag) equipment.* While an employee was operating a gang-nail-plate press machine, the shop foreman brought a loose cable connection to his attention. The employee subsequently opened a junction box mounted on the machine and attempted to tighten the nut holding the cable. The nut was on the inside of the box, but the employee did not deenergize the circuit to the junction box. He made contact with energized parts within the box and was electrocuted. (§ 1910.333(b)(2))

(v) *Use of visibly defective electric equipment.* An employee was installing equipment in an area between a temperature control unit and an injection molding machine. The keyed prong for the grounded conductor of the portable temperature control unit had been modified so that the plug could be inserted into the receptacle in any position. At the time of the accident, the plug was inserted so that the prong for the grounded conductor was in the slot intended for the ungrounded conductor. When the employee contacted the energized frame of the temperature control unit and the grounded injection molding machine, he was electrocuted. (§ 1910.334(a)(2))

(vi) *Blind reaching, drilling, digging, etc.* A printing machine operator was having problems restarting the motor on a gilder machine. He opened the right door on the 480-volt gilder relay control panel. With the left door closed and the disconnect handle in the "on" position, he tried to reset the relays. When he could not find the tripped relay on the right side, he reached behind the closed left door. He made contact with live parts energized at 480 volts and was electrocuted. (§ 1910.333(c)(4)(ii))

G. Significant Risk

In order to promulgate safety regulations, OSHA must show that the hazard the Agency proposes to address presents a significant risk to employee safety. As part of the preliminary analysis for the electrical safety-related work practices proposal, OSHA determined the population at risk, the industries and occupations presenting major risks, and the incidence and severity of injuries attributable to the failure to establish safe work practices. Finally, in keeping with the purpose of safety standards to prevent accidental injuries and deaths, OSHA estimated the number of accidents that would be prevented by the regulation.

Although nearly every worker in general industry is exposed to electrical hazards, some are at much greater risk than others. Employees at appreciably greater risk include, (a) those in industries that have the highest incidence rates of electrical accidents and (b) those in occupations considered high risk for electrical hazards. JACA Corporation, in their "Regulatory Assessment of the Impact of the Proposed Electrical Safety-Related Work Practices Standard" (Exhibit No. 1), characterized the frequency at which electrical accidents occur and tabulated the relative risk between industries. Among industries covered by the standard, the highest relative risks are encountered in the following industries: Lumber and wood products; rubber and miscellaneous plastics products; stone, clay, and glass products; primary metal; and miscellaneous repair services. Industries with a relatively low risk are concentrated in the finance, insurance, and real estate industries. According to the JACA report and excluding jobs not addressed by the proposal (such as electric distribution and transmission line workers), the highest electrical accident rates are faced by electricians and apprentices, stationary engineers, mechanics and repairmen, structural metal craftsmen, and welders. Low rates are encountered by personnel in the sales and clerical fields.

OSHA has estimated that more than 3,100 injuries and 69 fatalities (concentrated within a high risk group of about 2.1 million workers) could be prevented each year through compliance with the safety-related work practices contained in the final standard. (A detailed analysis of the benefits of the standard and a description of the methodology used can be found in chapter V of OSHA's final regulatory analysis, which is available for inspection and copying in Docket S-016 in the Docket Office.)

The particular injuries that the safe work practices standard will prevent include electric shocks, burns, and the indirect injuries that result when electric shocks occur. (Indirect injuries are typically bruises, bone fractures, and even deaths that occur due to the involuntary muscular reactions that follow electric shocks.) Although some injuries only involve minor shocks and burns, many victims suffer disabling effects, some are killed by electrocution and still others die from indirect injuries, such as those incurred in falls. Therefore, the frequency and seriousness of injuries to be prevented clearly demonstrate a significant risk that is being addressed by this final standard.

II. Development of the Final Standard

A. Present Electrical Standards

In 1976, the National Fire Protection Association (NFPA) created the "70E Committee" to prepare a consensus standard for possible use by OSHA in developing a proposed revision of the Agency's electrical safety standards. The 70E Committee visualized a standard consisting of four major parts:

Part I—Installation Safety Requirements
Part II—Safety-Related Work Practices
Part III—Safety-Related Maintenance Requirements
Part IV—Safety Requirements for Special Equipment

The name given to this new document became NFPA 70E, "Electrical Safety Requirements for Employee Workplaces."

The NFPA 70E Committee derived part I from the National Electrical Code (NEC). OSHA reviewed the 70E document, which the NFPA approved, and used it as the foundation for proposing a revision (44 FR 552744) to 29 CFR part 1910, subpart S—the electrical standards for General Industry. After a public comment period and an informal hearing, the revised subpart S was published as a final rule in the Federal Register (46 FR 4034) on January 16, 1981. The standard covers the safe installation of electric utilization equipment.

While OSHA was revising its standards using NFPA 70E, part I, the 70E Committee was completing its work on part II.

After considering the views and recommendations of the experts on the committee and comments from the public, NFPA approved the 70E Committee's standard on electrical safety-related work practices. Thus, NFPA 70E, part II, "Safety-Related Work Practices," became a national consensus standard.

B. Use of NFPA 70E, Part II, as a Base Standard

In the development of the proposal, OSHA evaluated NFPA's electrical safety-related work practice standard. In areas which overlapped other

consensus standards not presently adopted by OSHA, the NFPA document was compared with those other standards with respect to consistency and with respect to effectiveness in providing employee safety. For example, the NFPA requirements on lockout of equipment were compared to ANSI Z244.1, Lockout/Tagout of Energy Sources, so that OSHA could determine which requirements could most effectively protect employees from electrical hazards. In this case, as in most others, the NFPA standard more directly addressed electrical hazards than did the ANSI document, although OSHA believes that NFPA 70E was sometimes overly detailed or too specification-oriented. In comparison to other national consensus standards, NFPA's electrical safety-related work practices appeared to be more effective in providing employee safety for work performed on, near, or with electric components, equipment, or circuits and appeared to be consistent with current industry practice.

OSHA also examined provisions of NFPA 70E which were comparable to existing OSHA regulations. For example, OSHA compared § 1910.180(j), dealing with the operation of cranes near overhead lines, with similar requirements in the NFPA standard. As a result, OSHA discovered that, while the 70E committee referred to OSHA's regulations in § 1910.180(j) in providing for a 10-foot minimum clearance, they provided smaller clearance distances in NFPA 70E for other types of equipment used near overhead power lines. In this area, NFPA 70E seemed to be less effective in protecting employees. In most other areas, however, the 70E requirements were at least as protective as OSHA's.

Finally, OSHA evaluated whether the requirements of NFPA 70E, part II, were directed towards the apparent causes of electrical accidents. In addition to the previously mentioned OSHA survey, the Agency also reviewed electrical accident data provided by California, Florida, and other States. For every requirement set forth in part II of NFPA 70E, OSHA found injuries or fatalities which were directly relevant. For instance, the lockout/tagout requirements of Chapter 4 were found to relate specifically to accidents in category (iv) presented previously in Table 2. However, it was not always possible to relate every specification in the 70E provisions on lockout of equipment to a particular causative factor presented in the accident descriptions.

OSHA thoroughly reviewed NFPA's consensus standard on Electrical Safety-Related Work Practices and determined that it was an appropriate document on which to base a proposed rule. Although the format and outline of the NFPA standard were not entirely suitable, the basic requirements were generally valid and related well to causes of electrical accidents. Where necessary, in developing its proposed rule, OSHA reorganized and edited the national consensus standard to fit the Agency's regulatory needs. For the most part, however, the final standard, as did the proposal, contains the same requirements as part II of NFPA 70E. A performance-oriented approach addressing the causes of these accidents is thus maintained. As a consequence, the methods of compliance remain flexible.

Whenever a rule promulgated by OSHA differs substantially from an existing national consensus standard, section 6(b)(8) of the Occupational Safety and Health Act (29 U.S.C. 655(b)(8)) requires the Agency to state the reasons why the rule as adopted will better effectuate the purposes of the Act than the national consensus standard. Toward this end, OSHA conducted a detailed comparative analysis of NFPA 70E, part II and OSHA's final regulations. This analysis, in the form of a paragraph-by-paragraph comparison, is available for inspection and copying in Docket S–016 in the Docket Office. Individual provisions of the final rule are discussed in greater detail in Section III of this preamble. The relatively few significant differences exist because of OSHA's expectation that overall employee safety will be improved.

C. History of the Regulation

On November 30, 1987, OSHA published the proposed standard on electrical safety-related work practices (52 FR 45530; correction notice: 53 FR 2047). This proposal was intended to supplement the existing electrical installation requirements contained in 29 CFR part 1910, subpart S, and were based on the provisions of NFPA 70E, part II. Interested parties were given until February 29,1988, to submit written comments on the proposal, to file objections, and to request a hearing.

OSHA received 45 comments on the proposal, including 6 requests for a hearing. In response to the hearing requests and in accordance with section 6(b)(3) of the Occupational Safety and Health Act, OSHA published a notice announcing an informal public hearing and listing the issues to be discussed at the hearing (53 FR 21694). The hearing was held on August 9 and 10, 1988, in Washington, DC.

At the close of the public hearing, Administrative Law Judge Aaron Silverman set the deadlines for the submission of additional information and for the filing of briefs by the participants to be September 12 and November 21, 1988, respectively. At the request of one of the hearing participants, Judge Silverman subsequently extended the deadline for receipt of additional information to October 11, 1988. Judge Silverman issued an order receiving the post-hearing comments and closing the record on November 3, 1989. At the same time, he certified the record to the Assistant Secretary of Labor for OSHA.

The comments received in response to the notices of proposed rulemaking and of public hearing, the written transcript of the hearing, and the exhibits submitted at the hearing and during the post-hearing period allowed for such submissions constitute the rulemaking record for this proceeding. The entire record was carefully considered in the preparation of this final rule.

III. Summary and Explanation of Final Standard

This section discusses the important elements of the final standard and explains any significant differences between it and the source document, NFPA 70E, part II. This section also discusses and resolves issues that were raised at the public hearing, significant comments received as part of the rulemaking record, and substantive changes from the language of the proposed rule. References in parentheses are to exhibits and transcript pages in the rulemaking record.

A. § 1910.331

Section 1910.331 sets forth the scope of the regulations. According to this section, the standard covers electrical safety-related work practices of employees who work on, near, or with electric circuits and equipment. Types of work performed by qualified persons which are not covered by the regulations are also listed. Although the scope is similar to that of NFPA 70E and to existing § 1910.302(a), there is a key difference. Briefly, the NFPA standard and § 1910.302(a) state that certain installations,[1] rather than types of work, are not covered.

[1] Namely: Installations in mines; in ships and other watercraft; in aircraft; in automotive vehicles, except for mobile homes and recreational vehicles; in railway rolling stock, including railway facilities

Continued

The work practice standard does not apply to "qualified persons" (as defined in § 1910.399 and discussed later in this preamble) performing work on or directly associated with these same types of installations because the work practices in this standard do not address the types of electrical hazards faced by such workers performing this type of work. However, employees who are working at these installations but who are not "qualified" are covered by §§ 1910.331 through 1910.335. Safety-related work practices used by qualified employees who are performing work not covered in this regulation are addressed in other standards, such as 29 CFR part 1926, subpart V (power transmission and distribution); 29 CFR 1910.268 (telecommunications); and ANSI C2 (electric supply). This last standard has not been adopted by OSHA, but the Agency has proposed a separate standard, based in part on ANSI C2, for work practices to be used with electric power generation, transmission, and distribution systems (54 FR 4974, January 31, 1989).

Noting that work by qualified persons on these special installations was not covered by the proposal, several commenters questioned the adequacy of the definition of "qualified person" (Ex. 4–9, 4–13, 4–20, 4–26, 4–29). "Qualified person" is currently defined in § 1910.399 as: "One familiar with the construction and operation of the equipment and the hazards involved." "Qualified persons" are intended to be only those who are well acquainted with and thoroughly conversant in the electric equipment and electrical hazards involved with the work being performed. As used in the standard, the term connotes different qualifications for different tasks. For example, with respect to § 1910.331(c)(1), which exempts qualified linemen working on transmission lines, a qualified person would be one who understands the construction and operating characteristics of the transmission line and who has a thorough knowledge of the hazards involved in the type of work being performed on the line. On the other hand, this provision would not ordinarily exempt a transportation worker using a boom mounted on a flat bed truck to unload concrete blocks at a site near overhead distribution lines. This type of employee would not normally be expected to understand the construction and operation of the lines, nor would this person likely be completely knowledgeable in the hazards involved.

One hearing participant suggested that the definition of "qualified person" be clarified to rest upon one's competence to perform a task safely, such as trimming trees near overhead lines (Ex. 26). The commenter claimed that the proposal required tree trimmers to have a lineman's knowledge of electric utility generation equipment. The definition does require a qualified person to be "familiar with construction and operation of the equipment * * * involved." However, a detailed knowledge of power generation equipment is not relevant to the task of trimming trees near overhead power lines, nor is it required by the definition. The only equipment involved would be power lines themselves, and certainly a person would need some knowledge of the construction and operation of power lines in order to distinguish them from telephone and cable television lines. Also, a person would need to be familiar with the construction and operation of power lines in order to make some determination of the voltage levels involved. According to the National Arborist Association (Ex. 30), "qualified line-clearance tree trimmers" are "familiar with the special techniques and hazards involved in line clearance." These workers are expected to maintain clearances from overhead lines based on the voltage of the lines, so they must be able to determine approximate voltage levels from the configuration of the lines. Therefore, OSHA believes that line-clearance tree trimmers have sufficient knowledge of the construction and operation of overhead power lines (though not to the same degree as an electric power lineman) and that these employees would be "qualified" under the definition contained in § 1910.399. Therefore, OSHA has not changed the definition of "qualified person" as suggested by this hearing participant.

With respect to companies that own and operate the types of installations listed in paragraph (c)(1) of § 1910.331 (for example, an electric utility), it is assumed that all employees whose work is on or is directly related to these installations are "qualified." OSHA has found it to be a very rare practice for an employer to allow an unqualified worker to perform work on one of these types of installations. However, it is common for an unqualified employee, such as a painter, to be engaged in unrelated work near an overhead electric power line. Because, by definition, an unqualified employee lacks sufficient training and experience, he or she faces a greater risk of electric shock while working near an electric power line than a qualified employee.

Whether an employee is considered to be a "qualified person" will depend upon various circumstances in the workplace. It is possible and, in fact, likely for an individual to be considered "qualified" with regard to certain equipment in the workplace, but "unqualified" as to other equipment. For example, an employee may have received the necessary training to be considered qualified to work on a particular piece of equipment. However, if that same employee were to work on other types of equipment for which he or she had not received the necessary training, he or she would be considered unqualified for that other equipment.

The foregoing discussion of how OSHA expects to apply the regulations to work performed by qualified persons was also given in the preamble to the proposal. Most of the commenters who questioned the definition of "qualified person" did not object to the explanation in the preamble. Two specifically supported this discussion and suggested incorporating some of its language into the text of the definition (Ex. 4–9 and 4–13). (In response to these comments, OSHA has clarified the existing definition. This is discussed later in this section of the preamble, under § 1910.399.)

Work performed by other than qualified persons on, near, or with electrical installations is covered by the work practices contained in the standard, even if the electrical installations involved are not covered by the installation safety requirements of subpart S. This is because unqualified persons, by definition, do not have the training nor the skills necessary to perform work safely very close to electrical installations. Additionally, there are no standards, other than the 10–foot clearance rule for cranes and similar equipment, to cover these situations at present. Work performed by other than qualified persons near these "exempted" installations (e.g., near an electric transmission line) is covered by the new requirements. Thus, for example, a painter carrying a ladder near electric transmission or distribution lines would have to comply with the provisions of § 1910.333(c)(3)(i), but a qualified lineman working on the lines would not be covered.

The present installation safety requirements in subpart S do not cover "installations under the exclusive control of electric utilities * * * for the generation, control, transformation,

for generation, transformation, transmission and distribution of power used for rolling stock signaling and operation; in communication facilities; and for electric energy generation, control, transformation, transmission and distribution located outdoors or in building spaces used exclusively for such purposes.

transmission, and distribution of electric energy" (§ 1910.302(a)(2)(v)). This exclusion, which reflects the unique hazards and work practices involved in generation, transmission, and distribution of electric energy, mirrors the language contained in the scopes of the National Electrical Code and of NFPA 70E. The work practices in this standard are designed to complement the installation safety provisions in subpart S and are not intended to cover work practices for qualified persons who work on or near electric generation, transmission, or distribution installations. Therefore, paragraph (c)(1) of final § 1910.331 provides that qualified persons working on or near these installations are not covered by the new regulations. (As noted previously, OSHA has proposed a separate rule on electric power generation and related areas.) Additionally, because electric power generation, transmission, and distribution installations involve similar hazards and work practices whether or not they are controlled by electric utilities, OSHA has determined that the standard should not apply to qualified persons who work on or near any such installation, regardless of who owns or controls the installation.

A note is provided at the end of paragraph (c)(1) of § 1910.331 to emphasize that this exclusion is limited to qualified persons whose work is on or directly associated with these installations. The note states that, for other than excluded installations, where work is to be performed on or near exposed energized parts, even qualified persons must comply with the work practices contained in §§ 1910.331 through 1910.335. In these cases, the standard covers qualified persons who work near the energized parts as well as those qualified to work on the energized parts.

The extent to which the final standard should cover power generating stations was the subject of many of the comments and much of the testimony at the hearing. In general, the electric utilities want to be covered by one standard (at least as far as electrical requirements are concerned) and do not want to be covered by subpart S within the confines of an electric generating station (Tr. 1-110, 2-47 to 2-48, 2-155).

Edison Electric Institute (EEI) argued, in their posthearing brief, that OSHA has not shown the standard to be reasonably necessary to protect electric utility power generating station employees (Ex. 30). They supported this argument by pointing out that installations within an electric supply station for power generation posed the same hazards as installations supplying utilization equipment within the station (Ex. 30). Further, they claimed that they were unable to distinguish between the two types of installations within a generating station (Tr. 1-109, 2-88 to 2-100, Ex. 30). They also submitted evidence indicating that much of the supply wiring for the two systems was intermingled (Tr. 2-90, 2-92). In his testimony on this point, Mr. Malcolm Thaden, Jr., stated:

> Exhibit 2 [a part of Ex. 6-3] describes a 480 volt motor control center with 37 break positions that supplies electricity to equipment associated with the production of power in a 650 megawatt generating station. This is Chalk Point Unit 3, which was built in 1975.
>
> Examples of loads supplied from this motor control center include air heater drives, boiler drain sump pumps, igniter fans, boiler feed pump turbine, and auxiliary steam fans.
>
> Breakers in this motor control center also supply power to the service breaker panels. The lighting panel in the cable spreading room is shown in photograph 2-D, the service breaker that supplies loads that might be defined by OSHA under the proposed regulation as utilization equipment not used for generation, such as the control room lights, lavatories, office, service, and such.
>
> This exhibit demonstrates that the breaker supplying the service breaker is intermingled among all the other breakers in the motor control center, and that the power leads from the breaker share common raceways with power cables for many types of loads in the power plant. (Tr. 2-91 to 2-92)
>
> * * * * *
>
> Where the power goes and what equipment it ultimately drives is irrelevant to the risk which the employee faces when he works on these electrical systems. (Tr. 2-91)

In any plant or building (electric utility plants included), the circuits for various portions of the installation branch off the main supply of electricity, as limbs and branches fork off the main trunk of a tree. Each "fork" in the wiring is represented by a switchboard or panelboard containing the circuit breakers that supply feeders (limbs) and branch circuits (branches).

OSHA realizes that all circuits for utilization equipment installed in generating stations must originate in the same area as the circuits for the generating installation. However, at some point, circuits that are not an integral part of the generating installation must become independent of the generating circuits, except to the extent that they may share common cable trays or perhaps raceways. Otherwise, it would be impossible to control the lighting, for example, independently of the generator itself. With respect to the existing requirements of part I of subpart S, OSHA considers the "covered" installation to begin where it becomes electrically independent of conductors and equipment used for the generation of electric power. (Whether the circuit conductors share common raceways or cable trays is largely irrelevant from an electrical standpoint. Any direct connection between circuits is at a remote location, where the circuit protective devices and disconnecting means are located.) In most cases, it is a simple matter of tracing the wiring back from the utilization equipment itself until a point is reached where generation circuits are also supplied. Generally, branch circuits supplying utilization equipment (other than that used for the generation process) are covered: feeders supplying only "utilization" branch circuits are covered; feeders supplying "generation" circuits, alone or in combination with "utilization" circuits are not covered.

Exhibit 18 (recreated in Figure 1) clearly shows where each circuit in a utility plant is covered under existing subpart S. Each lighting circuit has its own breaker that is independent of (does not control) other loads in the generating station. If any of the other loads supplied by the panelboard or switchboard containing such a breaker is used in the generation of power, the panelboard or switchboard and its supply wiring are not covered. Nowhere, in this exhibit, does a branch circuit (i.e., the circuit conductors between the final overcurrent device protecting the circuit and the outlet for electric current) supply both "utilization" and "generation" loads. Branch circuits that supply "utilization" loads are not installations * * * for the generation * * * of electric energy" and are thus covered under the existing subpart S requirements and under the new regulations being promulgated here. Branch circuits that supply "generation" loads are "installations * * * for the generation * * * of electric energy" and are thus not covered under the two subpart S standards.

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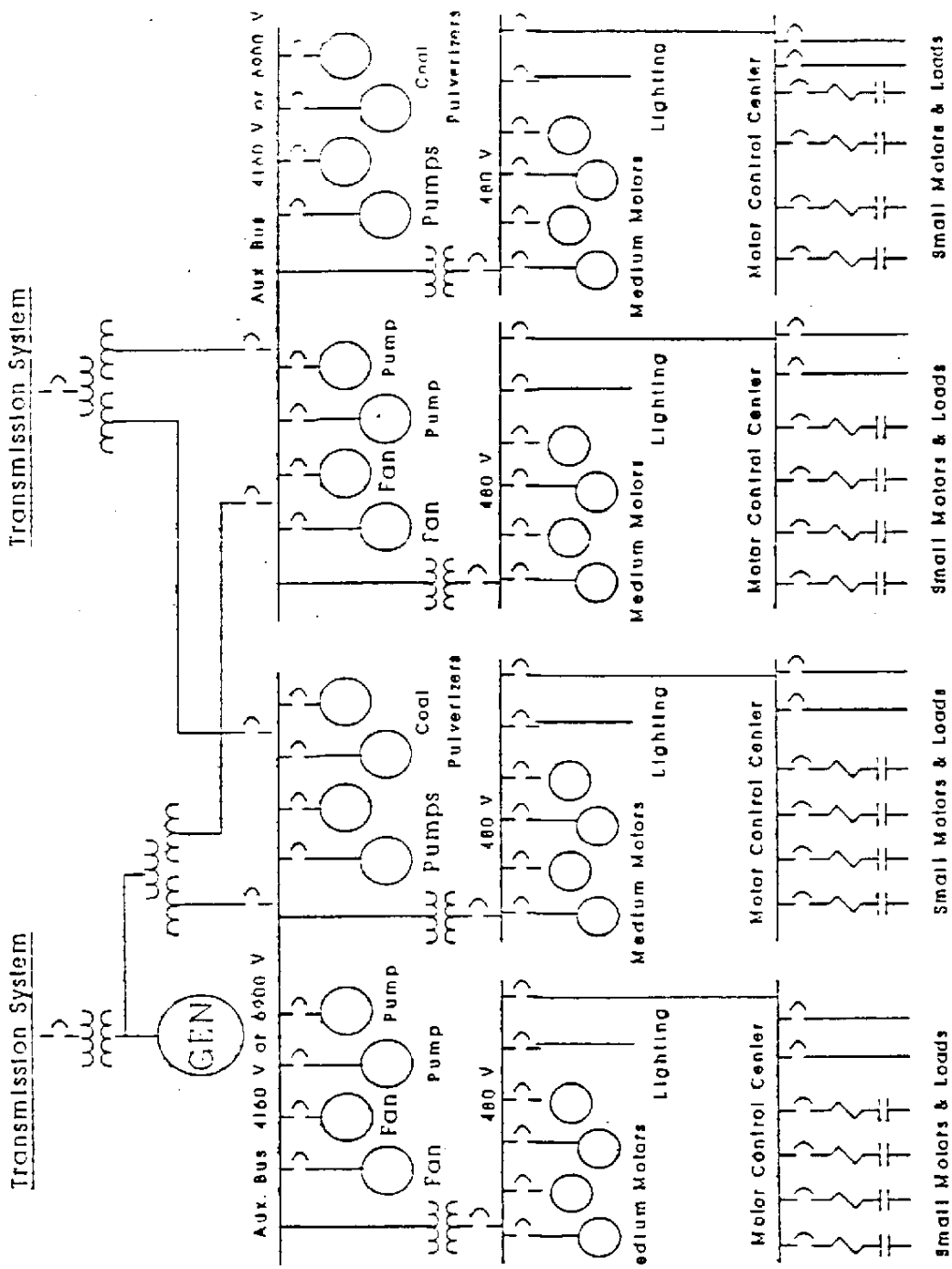

Figure 1 -- ONE-LINE DIAGRAM OF A COAL-FIRED GENERATING UNIT

Source: Electric Utility Systems and Practices, 4th. Ed., Homer M. Rustebakke (G. E. Wiley, 1983). (Ex. 18)

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Feeders (i.e., all circuit conductors between the service equipment or other source of supply and the final branch-circuit overcurrent device) sometimes serve both types of loads. Those that do and those that supply only "generation" branch circuits are considered to be installations for the generation of power and are not covered. Feeders that supply only utilization branch circuits are covered because they are not used for power generation.

For example, the lighting installation is covered as follows: the lighting fixtures, branch circuit wiring, and overcurrent protection are covered; the panelboard and its supply wiring are covered if they supply no conductors or equipment used for generation; if the panelboard that supplies the lighting circuit also supplies generation loads, it is not covered.

Historically, the Agency has followed this reasoning in applying its electrical standards. Existing § 1910.302(a)(2)(v), which relates to the scope of the installation requirements currently contained in subpart S, reads as follows:

§ 1910.302 Electric utilization systems.

* * * * *

(a) *Scope.* * * *

(2) *Not covered.* * * *

(v) Installations under the exclusive control of electric utilities for the purpose of communication or metering; or for the generation, control, transformation, transmission, and distribution of electrical energy located in buildings used exclusively by utilities for such purposes or located outdoors on property owned or leased by the utility or on public highways, streets, roads, etc., or outdoors by established rights on private property.

The plain language of this regulation excludes, from the scope of existing subpart S, only "installations . . . for the generation, control, transformation, transmission, and distribution of electric energy." Installations for other purposes are covered by the existing requirements of subpart S.

EEI has interpreted this exclusion in a manner that is not consistent with its plain language. Because the wording was taken from NFPA 70E and the NEC, EEI presented several witnesses supporting an interpretation of the NEC language that would exclude electric utility power generating stations in their entirety. These witnesses pointed to a fine print note that was added to the NEC in the 1981 edition of the Code. The fine print note states that the NEC covers "installations in buildings used by the utility . . . such as office buildings, warehouses, garages, machine shops, and recreational buildings which are not an integral part of a generating plant, substation, or control center." For example, Mr. Wilfred Summers, who serves as a member of the NEC code-making panel responsible for the scope of the NFPA standard (CMP 1), stated:

When I voted to include the fine print note in the 1984, 1981 and 1987 NEC's, I intended the note to make it clear that every electrical installation in an electric power generating plant owned and operated by the electric utility is not subject to the NEC. This was and remains so, regardless of whether a particular electric installation is considered to be used to generate electric power. (Tr. 2–68 to 2–69.)

Also testifying in regard to the scope of the NEC, Mr. Charles J. Hart, who represents the National Electrical Contractors Association and who is likewise a member of CMP 1, stated:

When I proposed the fine print note and when I agreed to the version that was adopted, it was my intent and understanding that section 90–2(b)(5) and the fine print note taken together, it would be clear that the NEC, the National Electrical Code, does not apply to any electrical system or equipment in a power generation plant owned and operated by an electric utility. (Tr. 2–73 to 2–74.)

Mr. Melvin Borleis, a consultant for EEI and a third member of CMP 1, also supported this interpretation of the NEC.

OSHA does not dispute this interpretation of the scope of the 1987 NEC by these experts. However, OSHA does not and has never interpreted the language of existing § 1910.302(a)(2)(v) or its predecessor, former § 1910.308(c)(2)(v), in this manner.

Shortly after the OSH Act was adopted, OSHA promulgated three standards governing occupational exposure to electrical hazards in a variety of workplaces: 29 CFR part 1926, subpart V, governing occupational safety in the construction of electric transmission and distribution lines and equipment (37 FR 24880, November 23, 1972); 29 CFR part 1926, subpart K, governing electrical safety in construction (36 FR 7370 and 36 FR 23232, April 17, 1971, and December 30, 1971); and 29 CFR part 1910, subpart S, governing electrical safety in general industry (36 FR 10466 and 37 FR 3431, May 29, 1971, and February 16, 1972). The latter two standards incorporated the 1971 NEC by reference. Subpart S, at former § 1910.308(c)(2)(v), provided:

(c) *Scope.* * * *

(2) *Not covered.* The provisions of this subpart do not cover:

* * * * *

(v) Installations under the exclusive control of electric utilities for the purpose of communication, metering; or for the generation, control, transformation, transmission, and distribution of electric energy, located in buildings used exclusively by the utilities for such purposes or located outdoors on property owned or leased by the utilities or on public highways, streets, roads, etc., or outdoors by established rights on private property.

In 1981, OSHA revised 29 CFR part 1910, subpart S, its standard for electrical safety in general industry, in large part to incorporate relevant provisions of the NEC in the body of the standard rather than incorporating any specific year's edition of the NEC by reference. In proposing to do so, the Agency specifically requested comment on "whether the scope of the standard is clear with respect to its coverage of public utilities" (45 FR 10375). As proposed and as adopted, revised subpart S, in § 1910.302(a)(2)(v), codified the utility exclusion as it was stated in the 1971 NEC. In adopting this provision, OSHA made it clear, both through statements of its officials at the hearing (May 6, 1980, Transcript p. 25) and in the Preamble to the subpart S revision, that it considered the NEC exclusion to be limited to "installations either for the generation, control, transformation and distribution of electric energy or for the purpose of communication or metering" (46 FR 4038). Otherwise, the OSHA standards applied.

From the inception of subpart S, OSHA read its standards to be fully applicable to electric utility generating stations, with the sole exception that generation installations were not subject to the provisions incorporated from the NEC. This followed from the plain language contained in former § 1910.308(c)(2)(v). OSHA has utilized the same approach in enforcing the revision of subpart S published on January 16, 1981 (46 FR 4034).

OSHA began enforcing subpart S against utilities within months of its adoption. Computerized OSHA citation records begin in July 1972, and show that OSHA first cited a utility for violation of subpart S in August 1972 (Ex. 25). OSHA has continued to inspect and cite utilities for violations of its electrical safety standards in subpart S. Thus, OSHA records (Ex. 25) show a total of 2,762 inspections of utilities between July 1972 and June 1987. Of these, over 340 were inspections resulting in citations for violations of subpart S, including 13 fatality/catastrophe inspections involving 7 deaths and 16 hospitalized injuries (not including 1 fatality which was apparently caused by a nonelectrical hazard). Nor were there inspections limited to outlying buildings in utility facilities; OSHA has cited main plant buildings where appropriate (Ex. 25).

Where citations were contested, OSHA asserted its jurisdiction in

enforcement litigation before the Occupational Safety and Health Review Commission (for example, *Northern States Power Company*, 1975 Occup. Safety & Health Dec. (CCH) Para. 20,366—subpart S NEC citation of coal conveyor upheld [Ex. 25]). Additionally, in an April 1980 memorandum, OSHA's Director of Federal Compliance and State Programs confirmed to a regional official that (in the subpart S context) OSHA considered NEC requirements to be applicable to an electric utility's premises wiring for power and light (Ex. 25). It is clear, then, that OSHA has uniformly construed the NEC provisions to apply to a utility's utilization installations and has applied other subpart S standards to utilities throughout the Agency's existence.

OSHA faced the same argument from EEI over the scope of the electrical standards for construction, which are contained in 29 CFR part 1926, subpart K. Like former subpart S of the General Industry Standards, the original subpart K of the Construction Standards adopted the NEC by reference, including its scope. When subpart K was revised in 1986 (51 FR 25294, July 11, 1986), OSHA adopted a slightly revised scope for the electrical installation requirements contained in that subpart. The scope of these requirements, as they relate to installations in generating stations, is contained in § 1926.402(b), which reads as follows:

(b) *Not covered.* Sections 1926.402 through 1926.408 do not cover installations used for the generation, transmission, and distribution of electric energy, including related communication, metering, control, and transformation installations. (However, these regulations do cover portable and vehicle-mounted generators used to provide power for equipment used at the jobsite.) See subpart V of this part for the construction of power distribution and transmission lines.

EEI challenged the subpart K final rule in the United States Court of Appeals for the D.C. Circuit, in part over OSHA's adoption of this language. EEI argued before the court that the revised scope, for the first time, extended some provisions of the standard to electrical installations in utility power generation plants (Ex. 9). EEI contended that, prior to this revision, these generating plants were completely exempt from regulation under subpart K by virtue of the "utility exemption" contained in section 40-2(b)(5) of the 1971 NEC incorporated by reference in the former subpart K (Ex. 9). This is virtually the same argument that the utility industry is using in the present rulemaking effort.

However, in *Edison Electric Institute v. Occupational Safety and Health Administration*, 849 F.2d 611 (D.C. Cir. 1988), the Court of Appeals ruled against EEI, finding as follows:

> In order to resolve this dispute, we must turn to the language of the 1971 NEC utility exclusion that was incorporated by reference in original subpart K. The relevant provision is Art. 90-2(b)(5) of the 1971 NEC, which provides that the following installations are not covered:
>
> Installations under the exclusive control of electric utilities for the purpose of communication, metering or for the *generation*, transmission and distribution of electric energy located in buildings used exclusively by utilities for such purposes or located outdoors on property owned or leased by the utility or on public highways, streets, roads, etc., or outdoors by established rights on private property. (Emphasis added.)
>
> Petitioner would have the court read this provision as if it said: "All installations under the exclusive control of electric utilities located in buildings used exclusively by such utilities for the generation of electric energy." But it is apparent that the provision is phrased in a different fashion. In fact, Art. 90-2(b)(5) purports to exclude only those "installations" that are "for the generation * * * of electric energy" *and* that are "located in buildings used exclusively by utilities for such purpose[]." The provision does not purport to exclude *all* installations that are located in buildings used for the generation of electricity.
>
> We therefore find that the interpretation adopted by the agency is supported by the language of the regulation itself. In light of this conclusion, petitioner bears a heavy burden in seeking to persuade the court that the agency's interpretation is erroneous.[2] We find nothing in the record before us that is sufficient to meet that burden.
>
> First, petitioner can point to no enforcement pattern that supports its claim that premises wiring was excluded under the original subpart K. To the contrary, the agency urges that it began enforcing subpart K against utilities within months of its adoption and has continued to do so on a regular basis. As evidence of these enforcement decisions, OSHA has attached as an appendix to its brief (1) a 1981 citation for a violation of a NEC provision that, according to OSHA was issued to a utility's main generating plant; [3] and (2) a memorandum dated April 1, 1980, from OSHA's Director of Federal Compliance and State Programs to a Regional Administrator that states that "the National Electric Code 1981 is applicable to power stations with regard to their premise's [sic] wiring for power and light."
>
> * * * * *
>
> Instead of producing evidence regarding the agency's enforcement history, EEI supports its interpretation of the NEC exclusion by pointing to the affidavits of two members of the committee that drafted the exclusion.[4] The opinions of these members were elicited during the subpart S rulemaking in response to OSHA's request for comments on whether "the scope of the standard is clear with respect to its coverage of public utilities." Notice of Informal Public Hearing, 45 FR 10375, 10376 (1980).[5] Two affidavits introduced by EEI, those of Mr. E.A. Brand and of Mr. H.P. Michener, support its interpretation of the NEC utility exclusion.[6] Other testimony, such as that of Mr. Richard Lloyd, a member of the 1971 Correlating Committee, is ambiguous at best.[7]

[2] EEI suggests that the deference usually accorded to an agency's interpretation of its own regulations, *see, e.g., United Steelworkers of American v. Marshall*, 647 F.2d 1189, 1223 (D.C. Cir. 1980), may be inappropriate when the regulation at issue is adopted from a national consensus standard, citing *Marshall v. Anaconda Co.*, 596 F.2d 370, 374 (9th Cir. 1979) and *Bethlehem Steel Corp. v. OSHRC*, 573 F.2d 157, 160 (3d Cir. 1978). We need not decide this issue because we find that the Secretary's interpretation is the most logical construction of the NEC utility exclusion. No deference is necessary except that due to the plain meaning of the regulation. In fact, as the agency notes, "it is Edison, not the Secretary, which attempts to read the plain language of the 1971 NEC exclusion to mean something other than what it actually says."

[3] The citation was issued for a violation of subpart S rather than subpart K. Nonetheless, since the 1971 NEC utility exclusion was incorporated into both standards, a citation issued under the one standard is probative of how the exclusion was interpreted under the other.

[4] The individual articles of the NEC are drafted by separate panels. A Correlating Committee oversees the work of these panels and is responsible for approving the complete text of the NEC. *See, e.g.*, 1971 NEC at 70v (NFPA), reprinted in J.A. at 58.

[5] At EEI's request, the entire rulemaking record of the subpart S revision was included in the record of the subpart K revision.

[6] Mr. Michener, the 1971 Chairman of Code Panel No. 1, which was responsible for drafting the utility exclusion, stated that:

> The wording of [the utility exclusion] has been prepared by a special Technical Subcommittee for the 1968 edition. That subcommittee, however, has also proposed a note that read: "Nothing contained in part (b) of this section is to be construed to exempt any electrical wiring which is used for building lighting or general power purposes."
>
> The panel did not accept this modifying note for the 1968 edition or in its review of the 1971 edition. I, therefore, understand that the intent of the Code Committee was to exclude from the scope of the 1971 National Electrical Code all the conductors and equipment on the premises of an electric power generating plant under the exclusive control of an electric utility used exclusively by the utility for such purpose, whether or not the particular conductors or equipment were in the generation-transmission distribution network.

J.A. at 237,238.

The statements in Mr. Michener's affidavit were confirmed by Mr. Brand, who served as a member of the Correlating Committee for the 1971 Code and was also a member of Code Panel No. 1. J.A. at 235, 236; *see also* J.A. at 132-34 (Affidavit of E.A. Brand dated April 18, 1980.)

[7] Mr. Lloyd noted his "understanding" that the members of Code Panel 1 had "rather lengthy discussions" on the scope of the utility exclusion and stated that the panel's work was accepted by the Correlating Committee. *See* J.A. at 370-72; *see also* Testimony of Dr. Jerry L. Purswell, Director of OSHA's Safety Standards Programs, J.A. at 332, 343, noting that the NEC covers "the utilization systems or premises wiring found in buildings used by the electric utilities."

We do not find compelling evidence of the scope of the utility exclusion in the statements of two members of the drafting committee rendered almost ten years after the enactment of the 1971 NEC. Both the Supreme Court and this court have repeatedly emphasized that postenactment statements by legislators or indeed by legislatures are not entitled to great weight in interpreting the meaning of legislation. *See, e.g., CPSC* v. *GTE Sylvania, Inc.*, 447 U.S. 102, 117–18 (1980); *Democratic Congressional Campaign Committee* v. *FEC*, 831 F.2d 1131, 1134 (D.C. Cir. 1987) (citing cases). A similar approach is appropriate when interpreting a national consensus standard. Petitioner has presented no contemporaneous interpretation of the 1971 code to support its unnatural construction of the utility exclusion. We therefore discern no evidence in the "legislative history" that would require us to overturn the agency's interpretation.

Petitioner also points to a "fine print note" or interpretation adopted during the 1981 revision of the NEC. The fine print note states:

It is the intent of this section that this Code covers all premises' wiring or wiring other than utility owned metering equipment, on the load side of the service point of the buildings, structures, or any other premises not owned or leased by the utility. Also, it is the intent that this Code cover installations in buildings used by the utility for purposes other than listed in (b)(5) above, such as office buildings, warehouses, garages, machine shops, recreational buildings which are not an integral part of a generating plant, substation, or control center. 1981 NEC Art. 90–2 (FPN) (NFPA), reprinted in J.A. at 184.

EEI argues that the second sentence of this fine print note, by listing affirmatively the utility facilities covered by the Code, underscores those that are not covered, and therefore supports EEI's position that all installations in buildings that are an "integral part of a generating plant" are not covered by the Code. This interpretation of the note gains some support from the rejection, by the most recent Code Panel 1, of a proposal to delete from the note the words "which are not an integral part of a generating plant, substation or control center." The panel explained the decision to reject this amendment to the note on the following ground: "It is not the intent to cover office buildings, warehouses, etc., that are an integral part of a generating plant, substation, or control center." *See* 1986 NEC Technical Committee Report at 11, reprinted in Pet. App. at 9.

Assuming that we accept the interpretation of the note advanced by the petitioner, however, we do not find it to be dispositive on the meaning of the exclusion included in the original subpart K. The note was adopted by the drafters of the NEC fully nine years after OSHA incorporated the 1971 NEC into subpart K. The same factors that counsel against according substantial weight to the *post hoc* affidavits that EEI introduced into the subpart S rulemaking also militate against relying on this gloss added in a later draft of the code. We therefore find that the agency's position, that it has not altered the scope of the utility exclusion to include premises wiring for the first time, is reasonable.

The Court of Appeals has, therefore, upheld OSHA's interpretation of the electrical installation requirements of Subpart K and, by implication, subpart S. Installations within a generating plant that are not used for the generation of power (for example, lighting circuits, branch circuits supplying convenience outlets, and the heating, ventilation, and air-conditioning installations) are already covered by the existing provisions of subpart S. Conductors and equipment that are used in the generation of power (such as the generator itself, boiler feedwater pumps, and control circuits for the generator) are not covered. A distinction has been made (long before the start of this rulemaking effort) between the two types of installations within a generating station, with one being subject to OSHA electrical installation requirements and the other being exempt.

With the possibility of such a distinction in mind, EEI argued that there is nothing special about employee exposure to electrical installations not used as opposed to used for generation which justifies separate work practice standards (Ex. 30). In their post-hearing brief, EEI stated:

The conclusion is that there is literally no evidence in the record which supports the view that the hazards presented to utility workers when working in [sic] power plant electrical equipment not used for generation are so unusual or unique that they should be regulated any differently than all other electrical work in a power plant. (Ex. 30)

However, within an electric utility power plant, there is one distinction affecting employee safety that can be made between installations used for power generation and those not used for this purpose. This distinction is that installations not used for power generation are currently regulated under existing subpart S, whereas conductors and equipment used for power generation are regulated by no OSHA standards.

The conductors and equipment covered by subpart S can be expected to present a minimum level of safety, under normal operating conditions, that protects employees to the extent that only a few basic safety-related work practices are necessary (basically, those contained in final § 1910.334). Usually, live parts of electric circuits are not exposed to contact by employees (especially unqualified employees), so that employees can perform their jobs without consideration of touching an energized part. Also, metal frames of electric equipment are grounded if employees would likely be in contact with a grounded surface when touching the equipment. In this way, employees are protected from ground faults. To protect employees from fire and ground-fault hazards, conductors and equipment are provided with overcurrent protection. Thus, the installation safety requirements contained in subpart S protect employees to a great degree already (and this is the preferred method of protection given the inevitability of human error if work practices are used as the primary means of protection). The safe work practices to be used when work is performed on, near, or with electric circuits and equipment are dependent upon the design of the electrical installation and the standards it must meet.

On the other hand, installations used for power generation, which are not covered by the existing design requirements of subpart S, need follow no rigid rules. Equipment grounding, guarding of live parts, and overcurrent protection are not required for power generation equipment under OSHA standards, and the Agency has no assurance that these safety features have been provided. Even if electric utilities "generally" comply with the National Electrical Safety Code (ANSI C2), as asserted by EEI (Ex. 30), their generation installations do not necessarily provide these safety features. For example, ANSI C2–1984, section 124.A, requires the guarding of circuit parts operating at more than 150 volts to ground. Existing OSHA § 1910.303 requires guarding of circuit parts operating at 50 volts or more. In a generating station, electric utilities must currently follow the OSHA rule for conductors and equipment that are not used for generation, but not for the generation system conductors and equipment. Clearly, safe work practices for the two types of installations would vary, even with similar 120-volt motors, if one has live parts guarded and the other does not.

Edison Electric Institute also suggested that OSHA adopt (as part of a separate vertical standard) requirements contained in a joint EEI/IBEW draft standard on the maintenance of electric power generation, transmission, and distribution installations (Tr. 2–47 to 2–49; Ex. 30). Some of the requirements of this draft standard (Ex. 6) contained electrical requirements for generating facilities, which EEI claimed "reflects . . . what is regarded in the industry as enlightened minimum safe work practices." (Ex. 30) It is these

requirements, EEI states, that OSHA should apply to electric utilities in place of the work practices proposed for subpart S (Tr. 2–138).

OSHA used the EEI/IBEW draft standard as a base document in developing proposed § 1910.269 on electric power generation, transmission, and distribution. However, the paragraph on work practices on or near equipment energized at 100 to 2000 volts within generating plants (EEI/IBEW draft § 1910.269(v)(16), Ex. 6) was not carried forward into the OSHA proposal on generating plants. OSHA does not believe that the three enforceable work practices (dealing only with the use of protective equipment and test equipment) contained in the EEI/IBEW draft standard are an adequate substitute for the many safe work practices contained in this final rule, even for installations meeting existing subpart S requirements.[8]

Edison Electric Institute also argued that OSHA did not demonstrate significant risk to employees in the electric utility industry (Ex. 30). They claimed that the accident information (Ex. 8) and the citation data (Ex. 25) that OSHA submitted failed to relate to electrical hazards covered by the proposal (Ex. 3). However, both of these exhibits contain evidence of electrical injuries to employees in generating plants. In the printout of citation data (Ex. 25BB), wherever a fatality or serious injury is accompanied, in the report, by a related violation of OSHA's existing or former electrical standards in subpart S, the accident obviously involved "non-exempt" wiring.

In the ten-year period covered by the first printout in Ex. 25BB, electric utilities had 7 fatalities and 16 hospitalized injuries. (These accidents are due to faulty installations. Accidents involving "non-exempt" installations caused by unsafe work practices alone are not included in this data base.) This translates to 0.6 deaths per year associated with "non-exempt" installations in electric power generation plants.[9]

Exhibit 8 also contains information on electrical fatalities in the electric utility segment of general industry. The data in Table 2 include the following:

(a) 3 electrocutions of employees in SIC 4911 that would be covered under subpart S (existing and new standard).

(b) 2 electrocutions of employees of contractors working at generating stations.

These data cover the period of April 1984 to December 1986; and, as stated earlier, do not include all fatal accidents occurring during this time. Even so, from these data, OSHA can estimate the minimum number of relevant electrocutions occurring in the electric utility industry as being (3 electrocutions)/(2.75 years), or 1.1 deaths per year.

Thus, there are between 0.6 and 1.1 deaths per year in the electric utility industry that are addressed by OSHA's electrical standards in subpart S. The final Regulatory Impact Assessment (RIA) estimates that there are 108 relevant deaths per year in all of General Industry. The Preliminary Regulatory Impact Assessment (Ex. 2) lists total general industry employment as about 66 million. Exhibit 25Z gives employment in the electric utility industry as about 0.45 million, or about 0.7 percent of the general industry total. The number of relevant electrical fatalities per year is between 0.6 and 1.0 percent of the general industry total. Therefore, the risk of electrocution caused by a hazard covered by the final standard is about the same as or slightly higher in the electric utility industry in comparison to the risk faced by general industry employees as a whole.

Even in the absence of injury data, OSHA must consider whether the hazards to which employees working in electric utility plants are the same as those faced by employees working in other general industry workplaces. Assuming that installations in generating plants that are covered by existing subpart S actually meet those regulations, OSHA believes that the hazards faced by electric utility employees are identical to that faced by other general industry employees. (In fact, the work practices standard makes allowances for common types of non-compliance with the existing electrical standard.) There is nothing special about a lighting installation, for example, in a generating plant that would make the hazards here any different from those in other workplaces.

One of OSHA's expert witnesses, Mr. Jay Stewart, testified about the hazards of various electrical installations and their associated work practices. He said:

> Most employees will be provided protection from electrical hazards by the provisions of this standard for training, deenergizing, lockout and tagging, restricted distance from overhead lines and use of portable equipment.
>
> In some unusual work places, employees may have exposure to some unique hazards that require other provisions. However, OSHA should not exempt any industries from this standard for those reasons.
>
> • • •
>
> Where the hazards are the same among industries, the work practices and standards involved . . . should be basically the same.
>
> With respect to electrical safety, the hazards faced by an electrician working on a lighting or air conditioning system, for example, would be the same no matter what industry employs him or her.
>
> If the hazards are the same, then the work practices to be used by electricians working on lighting and air conditioning systems should be uniform among all industries.
>
> Separate standards would be warranted only if the system itself presented unique hazards. (Tr. 1–151 to 1–152)

OSHA agrees with Mr. Stewart and finds no evidence in the record that utilization equipment and its supply wiring pose unique hazards in the electric utility industry. Edison Electric Institute offered no evidence that utilization equipment and circuits in power generation facilities posed unique hazards, except where the circuits are commingled with power generation circuits. EEI did claim that electric utilities were unique because of their highly trained work force (Tr. 2–60) and the need to maintain reliable and continuous service to their customers (Tr. 2–102). However, the training received by an employee does not change the hazards posed by the equipment to which he or she is exposed; training is simply one means of controlling the hazards. Also, installations covered by the work practices standard are not (by definition) "an integral part of the generating installation" and thus cannot possibly affect the reliability of the generation system significantly. Therefore, OSHA has concluded that electric utility employees do face a significant risk of injury from hazards addressed by the final standard.

For the foregoing reasons, OSHA has not accepted EEI's arguments for excluding the electric utility industry, in general, and their electric generating stations, in particular, from the scope of the final electrical safety-related work practices standard. Employees in that industry face a significant risk of injury from hazards addressed by the final rule. OSHA has always interpreted the existing electrical installation requirements in subpart S as applying to

[8] During the comment period and at the hearing, EEI submitted a new paragraph on electrical safety-related work practices in generating plants for inclusion in final § 1910.269. The suggested requirements, which were more substantive than their earlier submission, were never submitted to the subpart S rulemaking record, so OSHA could not consider them in the promulgation of the subpart S standard. The merit and appropriateness of including them in § 1910.269, as well as any effect they might have on enforcement of subpart S in electric generating plants, will be carefully considered by the Agency when final § 1910.269 is developed.

[9] The fact that these are generating plants can be seen by checking the address from the associated field in the individual record.

utilization installations in electric utility power generating stations, and the hazards presented by these installations are different from those in a generating station that are not covered by existing subpart S. Therefore, OSHA has adopted a scope to the final standard that covers work on or near installations that are in power generating stations but that are not used for power generation.

The Agency has, however, added a second note to § 1910.331(c)(1) that gives examples of work on or directly associated with electric power generation, transmission, or distribution installations. One of the examples of work performed by a qualified person that would not be covered by the standard is work on electric utilization circuits in a generating plant provided that:

(A) Such circuits are commingled with installations of power generation equipment or circuits, and

(B) The generation equipment or circuits present greater electrical hazards than those posed by the utilization equipment or circuits (such as exposure to higher voltages or lack of overcurrent protection).

These examples are consistent with the statements concerning the interpretation of the scope of the standard made by OSHA at the hearing. (See, for example, Tr. 1–14, 1–19 to 1–23, 1–53 to 1–54, 1–56 to 1–58, and 1–60 to 1–62.)

Another interest group, tree-trimming contractors, also commented on the scope of the standard. The National Arborist Association (NAA) argued that line-clearance tree trimming (the trimming of trees to provide clearance from overhead power lines) should not be covered under the subpart S standard (Ex. 24). They noted that, in the preamble to the proposal (52 FR 45534) and at the public hearing (Tr. 1–19 to 1–23), OSHA's expressed intent was to exempt tree trimming performed near overhead lines by qualified people. However, NAA was concerned that the standard itself did not specifically exclude such work from coverage and that the regulation would be misinterpreted in the field (Ex. 24). The language proposed in § 1910.331(c)(1) exempting "work performed by qualified persons on or *directly associated* with" power transmission and distribution installations (emphasis added) particularly bothered the arborist. They felt that this wording exempted only work performed on behalf of the owner or operator of the overhead lines (Ex. 24).

It is OSHA's intent, as noted earlier, that the standard not apply to tree-trimming operations performed near overhead power lines as long as qualified employees are performing the work. (OSHA has proposed, instead, to cover line-clearance tree-trimming operations performed by line-clearance tree trimmers in the forthcoming electric power generation, transmission, and distribution standard mentioned previously.) The owner of the power lines and the company or individual for whom the work is being performed are not relevant factors. In order to clarify this in the final standard, the Agency has added a note to § 1910.331(c)(1) and a definition of "line-clearance tree trimming." The note reads, in part, as follows:

> **Note 2:** Work on or directly associated with generation, transmission, or distribution installations includes:
>
> * * * * *
>
> (2) Work directly associated with such installations, such as line-clearance tree trimming and replacing utility poles.

The definition reads as follows:

> *Line-clearance tree trimming.* The pruning, trimming, repairing, maintaining, removing, or clearing of trees or cutting of brush that is within 10 feet (305 cm) of electric supply lines and equipment.

OSHA believes that these additions in the final rule will clarify the standard and allay the National Arborist Association's stated concern. In practice, line-clearance tree-trimming contractors (who typically use qualified line-clearance tree trimmers to perform the work) will be covered under the electric power generation, transmission, and distribution standard (proposed § 1910.269, noted previously). Residential contractors (who use regular tree workers that are not considered "qualified persons" under subpart S) would normally be covered under the electrical safety-related work practice requirements of subpart S being promulgated here.

Under § 1910.331(c)(2), qualified persons engaged in telecommunications work are not covered by the standard to the extent that the work is covered by § 1910.268. That section applies to employers providing telecommunication service, including but not limited to communications utilities. Since the final rule would not apply to work covered by § 1910.268, there would be no overlap between the new regulations and the present telecommunications standard.

The installations listed in paragraphs (c)(3) and (c)(4) of final § 1910.331 are provided for consistency with the coverage of the installation safety requirements of subpart S, as set forth in existing § 1910.302(a)(2) (i) and (iii), respectively. For example, under § 1910.331(c)(3), automotive repair work involving electric conductors and equipment installed on self-propelled vehicles performed by qualified employees would not be covered by the final rule. As explained previously, whether an employee is considered to be qualified depends upon various circumstances in the workplace. For an automobile mechanic or other employee to be considered qualified (and thereby not covered under § 1910.331(c)(3)), he or she would have to understand the construction and operating characteristics of automotive electrical systems and would have to have a thorough knowledge of the hazards they present. It should be noted that the recently promulgated standard for the control of hazardous energy sources excludes "[e]xposure to electrical hazards from work on, near, or with conductors or equipment in electric utilization installations, which is covered by subpart S of this part" (§ 1910.147(a)(1)(ii)(C), 54 FR 36687). This exclusion applies only to work that is within the scope of the new electrical safety-related work practices standard. Work that is outside the scope of the electrical standard is covered by the generic lockout standard unless otherwise noted in § 1910.147.

B. § 1910.332

This section sets forth training requirements. Employees are required to be trained in the safety-related work practices of the standard, as well as any other practices necessary for safety from electrical hazards. Inasmuch as the application of the standard to work performed on or directly associated with exposed energized parts of certain installations (for example, power generation, transmission, and distribution installations) depends upon whether or not the work is performed by a qualified person, appropriate training is required for these individuals. Paragraph (b)(3) of final § 1910.332 explicitly states what OSHA intends as a basic training requirement for such qualified persons.

In order to be as flexible as possible, the OSHA final rule accepts both classroom and on-the-job training. The NFPA 70E standard is silent on the method by which training is to be provided.

The economic impact of the final standard is limited, and the expected benefits are optimized, because the training requirements apply primarily to employees in occupations that traditionally carry relatively high risk of injury due to electrical hazards. A review of the accidents indicates that the greatest impact on reduction of accidents would result from training

employees who work in jobs which expose them to electrical hazards to a greater degree than the average worker.[10] Upon searching the available accident data, OSHA has determined that employees in the occupations listed in Table 3 are more likely to face a higher than normal risk of electrical accidents. (The occupations listed in Table 3 are general categories taken from the specific occupational groups given in Table 7, in section IV of this preamble, which lists the electrical injury incidence rate for each group.) The occupational groupings listed include any qualified person who performs work covered by this proposed standard, as well as unqualified persons who also face a high risk. It is primarily these employees who would be subject to the training requirements. However, in some cases, employees in other occupational groupings may also face a relatively high risk of injury due to electric shock, and these employees would also require training. For example, a production employee may work in an area containing exposed live parts that are guarded only by location (such as overhead lines). If this worker could come in contact with these lines in the course of his or her work, then he or she would have to be trained. Training in the basic areas of hazard recognition, proper work practices, and knowledge of the working environment can reduce the frequency of accidents involving employees in these categories, whereas training employees who face a minimal exposure to electrical hazards would result in a negligible increase in benefits. Therefore, OSHA is requiring that training be provided only for employees who face the greatest risk of injury due to electric shock or other electrical hazards.

The training requirements contained in the proposal were addressed by many of the commenters and hearing participants. Three of the six hearing requests cited the training provisions as the basis of their objections. The hearing requests claimed that the proposal's training provisions were inadequate and would not provide sufficient protection from electrical hazards. The AFL-CIO (Exhibit 4-32) suggested that the requirements be expanded to cover the qualifications of the trainer, duration of the training, and demonstration of effectiveness of the training. The United Steelworkers of America (Exhibit 4-45) suggested that all workers be required to receive training and that the amount of required training be increased. The International Brotherhood of Teamsters (Exhibit 4-28) objected to OSHA's failure to provide a description, in objective terms, of what exposure to electrical hazards would trigger the training provisions. In response to these objections, OSHA listed the adequacy of these requirements as an issue to be addressed at the public hearing (55 FR 21695).

TABLE 3.—TYPICAL OCCUPATIONAL CATEGORIES OF EMPLOYEES FACING A HIGHER THAN NORMAL RISK OF ELECTRICAL ACCIDENTS

Occupation
Electricians.
Mechanics and repairers.
Electrical and electronic technicians.
Electrical and electronic equipment assemblers.
Stationary engineers.
Material handling equipment operators.
Electrical and electronic engineers.
Blue collar supervisors.
Welders.
Riggers and roustabouts.

No evidence was received with respect to the qualifications of the trainer or with respect to demonstration of the effectiveness of training. The AFL-CIO, which proposed expanding the requirements to address these criteria, did not provide language or guidance as to what should be required. OSHA believes that employers generally will blend any additional training imposed by the final rule into their existing programs or will use existing training programs offered by outside sources. Additionally, OSHA has no evidence that existing programs use unqualified trainers or have not been successful in reducing the number of accidents. In fact, Jay Stewart, one of OSHA's expert witnesses, stated:

> There are many aids available for training in the form of written materials, video tapes and lectures. The most sophisticated programs often include all of these. These are also available as complete programs. (Tr. 1-155)

Therefore, the final rule does not contain provisions addressing the qualifications of trainers or the demonstration of effectiveness of the training. OSHA believes that there is presently insufficient information in the record to support specific provisions in these areas. Once the standard has been in effect for some time, the Agency can evaluate whether the training programs being used are effective.

Many commenters and some of the hearing participants addressed the duration of training, especially with respect to the times given in OSHA's regulatory assessment of the impact of the proposal. The comments and evidence generally agreed that times listed in Table 4 in the preamble to the proposal were not adequate to fully train employees in electrical safety (Ex. 4-1, 4-8, 4-16, 4-29, 4-45, 15; Tr. 2-124). However, some of these commenters were using the times listed in the preamble as being requirements of the standard and as representing the total time taken to train an employee in his or her occupation (Ex. 4-1, 4-8, 4-29, 4-45). OSHA does not intend the times given in the regulatory analysis (Table 7) as the amount of training time required by the standard or as being representative of the total amount of time spent training an employee in his or her occupation. (An electrician, for example, takes years to learn the trade, and much of what is learned relates directly to electrical safety.) The times given in Table 7 in the preamble are simply OSHA's estimates of the average additional amount of training that would be required under the standard. However, on the basis of information in the rulemaking record, the Agency has adjusted the amount of training estimated to result from the final standard. (For further discussion of this issue, see section IV of this preamble.)

The final question relating to the proposed training requirements dealt with who should receive training under the standard. Some commenters and witnesses felt that all employees should receive instruction in electrical safety (Ex. 4-29, 4-32, 4-45; Tr. 2-13 to 2-15). For example, the United Steelworkers of America (USWA) stated:

> The USWA proposes that *all* workers be trained in electrical safety because *all* workers, during the course of performing their normal job duties daily, are exposed to routine electrical hazards. (Ex. 4-45)

Mr. James Sharp of the International Brotherhood of Electrical Workers (IBEW) supported this view, stating:

> Every employee should be trained on the . . . electrical hazards involved in his workplace, be it a five minute training session or a week training session, if needed. (Tr. 2-15)

In support of his position, Mr. Sharp cited NFPA 70E:

> 70E, again, was written to protect all employees, and in part II, as proposed in the rulemaking, only those who are exposed—and I don't know who is going to determine

[10] For a more thorough discussion of the relative risk of electrical accidents among various categories of employees and of how training reduces this risk, see chapter IV of OSHA's final Regulatory Impact and Regulatory Flexibility Analysis of the Electrical Safety-Related Work Practices Standard for General Industry. This document is available for inspection and copying in Docket S-016 in the Docket Office.

that magic number of where training is required and where it is not required in the document. (Tr. 2–14)

The provision in NFPA 70E to which Mr. Sharp was referring is contained in section 1.A and reads as follows:

A. *Safety Training.* Employees shall be trained in the safety related work practices, safety procedures, and other personnel safety requirements in this standard that pertain to their respective job assignments.

Employees shall not be permitted to work in an area where they are likely to encounter electrical hazards unless they have been trained to recognize and avoid the electrical hazards to which they will be exposed.

Note: For the purposes of this standard an electrical hazard is a recognizable dangerous electrical condition. Electrical conditions such as exposed energized parts and unguarded electric equipment which may become energized unexpectedly are examples of electrical hazards. (Ex. 35A)

The first paragraph of this requirement is nearly the same as final § 1910.332(b)(1), which reads as follows:

(b) *Content of training.* (1) *Practices addressed in this standard.* Employees shall be trained in and familiar with the safety-related work practices required by §§ 1910.331 through 1910.335 that pertain to their respective job assignments.

The only difference between the two provisions is that final § 1910.332(a) limits the application to employees who are not fully protected from electrical hazards by the requirements of existing §§ 1910.303 through 1910.308, whereas NFPA 70E does not limit the application of the requirement at all. However, the only employees not required to be trained under the final OSHA standard are those that are already sufficiently protected by the Agency's electrical installation standard. Additionally, NFPA limits the required training to provisions that pertain to an employee's job assignments. The employees not covered under the OSHA training requirements are those whose job assignments relate to none of the work practice requirements in the final rule. Therefore, under both the consensus standard and OSHA's final rule, all employees would be required to know (and use) the work practices that are contained in the standard and that are relevant to the employees' work.

The second paragraph of NFPA 70E section 1.A is a general paragraph that applies only to employees working in areas that contain electrical hazards. Mr. Sharp of the IBEW expressed the view that this required janitors and secretaries to be trained (Tr. 2–13 to 2–14). However, OSHA believes that few janitors and very few secretaries face electrical hazards as defined in the Note to NFPA 70E section 1.A. In fact, in the JACA report mentioned previously, clerical workers had one of the lowest electrical injury incidence rates of any occupation listed.[11] Additionally, Mr. Bernard W. Whittington, who was one of the OSHA expert witnesses and who is a past and current member of the NFPA 70E committee, argued that the proposed OSHA and NFPA 70E training requirement would achieve equal degrees of safety (Tr. 1–176 to 1–177). Under questioning by Mr. Sharp, he stated:

Mr. Sharp: Since you were involved in the development of the training provision of NFPA 70E and you're familiar with it, in your opinion how does the proposed rule better carry out your statement here of properly training the employee for the electrical hazards in his workplace?

Mr. Whittington: I can't say that it does it better, Mr. Sharp. I can say that it parallels and does it as well. It's just stated in a slightly different manner.

I come back to some of my original statements because endorsing performance oriented standards versus specification oriented standards and saying that OSHA has now with this type of standard allowed the flexibility of the employer and the employee in the workplace to draft their own required training requirements.

I view that as being a good thing.

Mr. Sharp: I agree that they have done this but wherein is the proposal more flexible than what we had in [70E].

Mr. Whittington: I don't say that it is. I say they achieved equal objectives. Just using a slightly different set of words. (Tr. 1–176 to 1–177)

OSHA's other expert witness at the hearing, Mr. Jay A. Stewart, also supported the proposed training requirements stating:

The training requirements will provide adequate protection from electrical hazards. (Tr. 1–152) He goes on to note that the vast majority of employees should not be exposed to electrical hazards and would not need any training. The employer provides protection for these employees by ensuring that the electrical installation meets the requirements contained in sections 1910.302 through 1910.308 of the existing general industry standards. (Tr. 1–154)

OSHA agrees with this argument. The Agency firmly believes that many employees, such as office workers, are fully protected by the electrical installation requirements contained in existing §§ 1910.302 through 1910.308. It is only when an employee performs job tasks which these existing requirements do not take into consideration that an employee faces a significant risk of injury from an electrical hazard. The injury data and accident descriptions corroborate this.

[11] Regulatory Assessment of the Impact of the Proposed Electrical Safety-Related Work Practices Standard", JACA Corp., pp. 4–8 to 4–9 (Ex. 1).

In fact, in the final rule, OSHA has altered the language of proposed § 1910.332(a) to stress this point in the regulation itself. Final § 1910.332(a) applies the training requirements "to employees who face a risk of electric shock that is not reduced to a safe level by the electrical installation requirements of §§ 1910.303 through 1910.308." The table of occupations to be trained has been retained, but is now referenced in a note to § 1910.332(a) rather than by the language of the scope itself. The new note to this paragraph reads as follows:

Note: Employees in occupations listed in Table S–4 face such a risk and are required to be trained. Other employees who also may reasonably be expected to face a comparable risk of injury due to electric shock or other electrical hazards must also be trained.

The basic intent of the scope provision, including the note, remains the same.

Table 4 lists the occupations identified in the accident descriptions contained in Exhibits 4–14 and 10, taken from the National Institute of Occupational Safety and Health (NIOSH) Fatal Accident Circumstances Epidemiology (FACE) reports. Nearly all of the listed occupations in Table 4 are also covered by Table S–4 in the final rule. The exceptions, such as restaurant workers, would still be covered because of exposure to electrical hazards despite not being explicitly mentioned in the regulations.

TABLE 4.—ELECTRICAL FATALITIES BY OCCUPATION

Job title	Number of fatalities
Laborer	28
Lineman	20
Electrician	16
Painter	13
Truck driver	7
Machine operator	6
Groundman	6
Maintenance man	5
Technician	5
Crew leader/foreman	4
Construction worker	4
Carpenter	3
Iron worker	3
Brick layer	3
Bill poster	3
Welders	2
Restaurant worker	2
Firemen	2

Source: NIOSH reports from their Fatal Accident Circumstances Epidemiology (FACE) Program (Ex. 4–14).

For example, the two restaurant workers mentioned in the NIOSH reports were both electrocuted immediately after wet mopping floors where electric equipment was present.

Employees assigned to mop work areas where the cleaning liquids may enter electric equipment designed for dry locations only face a risk of electric shock that is not reduced to a safe level by the existing Subpart S installation requirements. As the hazard of using electricity under wet conditions is widely recognized, OSHA expects that such employees would be trained as required by final § 1910.332.

On the other hand, the vast majority of all restaurant workers do not face such a high risk of injury from electric shock. Only one or two workers at any given location are usually assigned the task of mopping floors. Additionally, some portion of all restaurants are set up so that electric equipment is not exposed to splashing water during moping operations. Lastly, in one of the two accidents in the NIOSH report, violations of the installation requirements of existing Subpart S rather than improper work practices were the major causative factors.

Three commenters suggested adding occupations to the list proposed in Table S–4 (Ex. 4–12, 4–14, 4–33). E. I. du Pont de Nemours and Company cited painters and industrial machine operators as groups with sufficient exposure to electrical hazards to warrant training (Ex. 4–12). Painters were also mentioned in the comments of the Alliance of American Insurers as an occupational group with exposure to overhead power lines (Ex. 4–33). In Table 4, taken from the NIOSH FACE data (Ex. 4–14), painters and industrial machine operators were the groups with the fourth- and sixth-highest number of fatalities, respectively. Therefore, OSHA has added painters and industrial machine operators to the occupations listed Table S–4 of the final standard.

Another three commenters argued that employees in some of the occupations listed in proposed Table S–4 had very limited or no exposure to electrical hazards (Ex. 4–16, 4–23, 4–34). The Boeing Company cited electrical and electronic engineers as an example of an occupational group having few members exposed to injury from electric shock (Ex. 4–16). OSHA agrees with these comments and in response to them, has added a note to final Table S–4. This note exempts employees in certain listed occupations if they (or, for supervisors, the employees they supervise) do not come close to exposed parts of electric circuits operating at 50 volts or more to ground. Occupations to which the note does not apply (such as electricians) are expected to have an exposure to electrical hazards due to the nature of their work. This exemption should free employers from training employees who are not exposed to electrical hazards and should minimize the cost of the final standard without reducing benefits.

On the basis of information placed in the record, in the form of accident data and recommendations from industrial safety experts, OSHA has retained the training requirements contained in the proposal. Notes clarifying the intent of the standard, as described previously, have been added in the final rule, and two occupations have been added to Table S–4. OSHA believes that final § 1910.332 provides the greatest possible protection for employees without imposing unnecessary training costs on employers.

C. § 1910.333

The basic intent of § 1910.333 is to require employers to take one of three options to protect employees working on electric circuits and equipment: (1) Deenergize the equipment involved and lock out its disconnecting means (§ 1910.333(b)); or (2) deenergize the equipment and tag disconnecting means, if the employer can demonstrate that tagging is as safe as locking (§ 1910.333(b)); or (3) work the equipment energized if the employer can demonstrate that it is not feasible to deenergize it (see discussion of § 1910.333(a) for permissible applications of this option and § 1910.333(c) for precautions to be taken when work is performed on or near energized parts). These are the same options allowed under NFPA 70E.

Paragraph (a) of § 1910.333 sets forth general requirements on the selection and use of work practices. The requirements of this paragraph mainly address accidents which involve the hazards of exposure to live parts of electric equipment. A deenergized part is obviously safer than an energized one. Because the next best method of protecting an employee working on exposed parts of electric equipment (the use of personal protective equipment) would continue to expose that employee to a risk of injury from electric shock, § 1910.333(a) makes equipment deenergizing the primary method of protecting employees.

Under certain conditions, however, deenergizing need not be employed. Employees may be allowed to work on or near exposed energized parts, if the employer can demonstrate that deenergizing: (1) Would be infeasible or (2) would introduce additional or increased hazards, e.g., interruption of life-support equipment, shutdown of hazardous location ventilation systems, or complete removal of illumination. In any case, employees working on or near energized parts must use safe work practices as required by the standard.

Some of the commenters addressed the proposal's preference for deenergizing electric circuits when work is to be performed on them (Ex. 4–5, 4–10, 4–22). These commenters argued that it is as safe for qualified employees to work on energized parts as it is for them to work on deenergized parts. For example, the Aerojet Solid Propulsion Company stated: "We believe that it is equally safe to work systems energized or deenergized provided qualified persons are used and responsible supervision make a determination of the method to be used prior to proceeding with work." (Ex. 5) Supporting this view to a lesser extent, Mr. C. Richard Chapin, testified:

> [I]n the electric utility industry, while we deenergize to the extent practical, the need to maintain reliable and continuous service to the customer means that often electrical equipment and systems are worked energized, operating with well trained workers and proper procedures.
>
> Whatever the extent of application of this standard to utility power plants, utilities cannot operate with a regulatory preference for deenergization or with a requirement which places the burden of proof on the utility to show for each occurrence that deenergizing either introduces additional hazards or is virtually impossible. (Tr. 2–102 to 2–103)

The proposal's preference for deenergizing electric equipment is based on NFPA 70E and on accident data in the record. Section 1.B of NFPA 70E requires electric circuits to be deenergized unless it is not feasible to do so (Ex. 25A). More than ten percent of the fatalities listed in Table 2 were attributable to the employer's failure to deenergize and lockout electric circuits or equipment (Ex. 8). Of these 13 workers killed, 9 appeared to be qualified for the task being performed. Obviously, none of the fatalities was caused by a deenergized circuit (though some fatalities involved circuits that were thought to be deenergized). For this reason, OSHA has not accepted the argument that a qualified employee can work on energized circuits as safely as he or she can work on deenergized circuits. Therefore, OSHA is not leaving it to the employer's discretion as to whether or not to deenergize electric circuits on the basis of convenience, custom, or expediency.

On the other hand, the Agency realizes that there are times when it is necessary to work on or near exposed parts of electric circuits or equipment while the circuit or equipment remains energized. The proposal cited two

conditions under which the electric circuits and equipment could remain energized: (1) If the employer could demonstrate that deenergizing would create additional or increased hazards or (2) if the employer could demonstrate that deenergizing is infeasible due to equipment design or operational considerations.

Several comments addressed the circumstances under which work on energized parts would be permitted (Ex. 4–9, 4–12, 4–13, 4–17, 4–18, 4–21). Three of these comments specifically cited trouble shooting as an operation that had to be performed with circuits energized and requested that the standard specifically permit this (Ex. 4–9, 4–18, 4–21). Noting that examples of equipment not required to be deenergized due to the creation of additional hazards were given in a note in the proposed rule, the other three commenters suggested that the standard also include a note listing examples of equipment that would not be required to be deenergized because of infeasibility due to design or equipment limitations (Ex. 4–12, 4–13, 4–17). The Monsanto Company recommended the following note, which would permit most trouble shooting:

> An example of infeasibility due to equipment design or operational limitations is the making of required tests and adjustments which can only be made with the circuit or equipment energized. (Ex. 4–17)

Questioning the OSHA witnesses on behalf of the Edison Electric Institute (EEI), Mr. Stephen C. Yohay inquired as to the meaning of the word "infeasible" in proposed § 1910.333(a)(1). The Agency witness explained that, under the proposal, it would be considered to be "infeasible" to shut down a process in a chemical plant, an entire plant, or even a portion of a plant depending on the installation (Tr. 1–84).

On the basis of these comments and the questions posed by EEI, OSHA has determined that it is appropriate to list examples of situations in which "deenergizing ... is infeasible due to design or operational limitations." These examples are given, in the final standard, in a new Note 2 to § 1910.333(a)(1). (Proposed Note 2 has been renumbered as Note 3 in the final rule.) The language for the note has been taken, in part, from Monsanto's recommendation. The examples include testing (i.e., trouble shooting) that cannot be performed with the equipment deenergized, and work on circuits that form an integral part of a continuous industrial process in a chemical plant. The first example should satisfy the concerns of commenters who wanted the standard to permit trouble shooting and should permit necessary work that could not be performed under deenergized conditions. The second example was noted at the public hearing and is an example of a situation in which it is highly impractical to deenergize a circuit.

Paragraph (b) of § 1910.333 covers work on or near exposed deenergized electric parts and includes requirements for lockout and tagging of equipment disconnecting means. The need for adequate lockout and tagging procedures for electric equipment is widely recognized, as demonstrated by the ANSI and NFPA standards in this area. The accidents in the rulemaking record which involved work on electric equipment also indicate a need for proper work practices in this area. Although the lockout and tagging requirements of NFPA 70E are used as a basis, the OSHA standard clarifies and simplifies the requirements of the NFPA standard by directing the coverage to the prevention of employee contact with energized equipment or circuits. While the NFPA 70E requirements for lockout and tagging are highly detailed, the final regulations are general and more performance oriented in nature.

Additionally, the NFPA requirements were intended to apply any time work is performed on or near deenergized circuit parts or equipment in any situation which presents a danger that the circuit parts or equipment might become unexpectedly energized. Thus, the NFPA provisions not only address the hazard of contact with energized parts, but also cover other hazards which are presented by unexpected start-up of equipment during maintenance operations. This is expressed in NFPA 70E, part II, section 1.B, second paragraph, which states:

> Where the work to be performed requires employees to work on or near exposed circuit parts or equipment, and there is danger of injury due to electric shock, *unexpected movement of equipment, or other electrical hazards*, the circuit parts and equipment that endanger the employees shall be deenergized and locked out or tagged out in accordance with the policies and procedures specified in Paragraph B(1) and chapter 4 through subparagraph B(7)(b). [Emphasis added.] (Ex. 25A)

In contrast to this, the OSHA Subpart S standard is intended to cover employee exposure to electrical hazards which might occur from the unexpected energizing of circuit parts and does not cover other equipment-related hazards which do not involve exposed live parts. Thus, the subpart S standard will protect an electrician working on a circuit but does not address a mechanic working on the mechanical parts of an electrically powered machine. (The recently issued generic lockout standard, § 1910.147, covers the hazards of unexpected activation or energization of machinery or equipment during servicing or maintenance activities. See final rule at 54 FR 36644, September 1, 1989.)

One of the hearing requests (Ex. 4–29) specifically suggested that the lockout and tagging provisions be expanded to require the release of stored mechanical energy before circuits or equipment are deenergized. The unanticipated release of this stored mechanical energy could, in fact, injure employees. OSHA recognizes that equipment maintenance and repair present significant hazards to employees. As noted earlier, these hazards, which are different from those addressed by the electrical work-practices standard, are covered by OSHA's standard on the control of hazardous energy sources (lockout/tagout). OSHA has written these two standards so that they complement one another.

Two commenters specifically addressed the issue of compatibility of the lockout and tagging provisions in the two OSHA standards. The Motor Vehicle Manufacturers Association (Ex. 4–48) suggested that the lockout and tagging requirements in the electrical safety-related work practices standard be removed and that OSHA apply the generic standard (§ 1910.147) to electrical lockout. The National Electrical Manufacturers (Ex. 4–8) expressed the view that the two standards be compatible. They specifically cited areas that were not addressed in the electrical lockout and tagging proposal but that are covered under NFPA 70E and in the generic lockout standard, such as provisions for removal of locks and tags by the person who applied them and written procedures. The National Fire Protection Association also cited OSHA's lockout and tagging provisions in the proposed electrical standard as one area where the OSHA proposal was not as effective as NFPA 70E in protecting employees, because the OSHA proposal depended upon the generic lockout standard to provide protection from non-electrical hazards (Ex. 29). They stated that this "bifurcated approach to lockout/tagout regulation is a dangerous one." (Ex. 29)

In response to these comments, OSHA again reviewed the electrical lockout and tagging requirements of the proposed electrical work practices standard for consistency with the generic lockout standard and for effectiveness equivalent to NFPA 70E. The Agency has determined that the

omission from the proposal of a requirement addressing responsibility for removal of locks and tags would render OSHA's standard less effective than NFPA 70E. Therefore, a requirement equivalent to NFPA 70E section 4.B(6)(c), Lockout-Tagout Device Removal, has been incorporated into the final rule. This provision, which has been codified as § 1910.333(b)(2)(v)(C), reads as follows:

Each lock and tag shall be removed by the employee who applied it or under his or her direct supervision. However, if this employee is absent from the workplace, then the lock or tag may be removed by a qualified person designated to perform this task provided that:

(1) The employer ensures that the employee who applied the lock or tag is not available at the workplace, and

(2) The employer ensures that the employee is aware that the lock or tag has been removed before he or she resumes work at that workplace.

This requirement ensures that locks and tags are removed with the full knowledge of the employee who applied them. Without such a requirement, it is likely that a lock or a tag could be removed by persons who are not responsible for the lockout, endangering employees working on the "deenergized parts." This provision also allows for removal of locks and tags if the employee who applied them is absent from the workplace, under conditions like those in the exception to § 1910.147(e)(3).

Additionally, the generic lockout standard and NFPA 70E's lockout provisions contain requirements for lockout procedures to be in writing. In the preamble to the final generic lockout standard, OSHA strongly defended that standard's requirement for written procedures (54 FR 36670). The Agency believes that written procedures are an important part of a successful lockout and tagging program and that they should, therefore, be required. However, the final electrical standard's lockout provisions are themselves a step-by-step procedure for safely deenergizing electrical circuits. For this reason, the final electrical work practices standard incorporates a requirement (§ 1910.333(b)(2)(i)) for employers to maintain a copy of the lockout procedures outlined in § 1910.333(b)(2) and to make it available for inspection by employees and by OSHA. The procedures can be in the form of a copy of the regulation itself or can be the employer's documentation of his or her lockout program. In fact, if the employer's written procedures compiled under § 1910.147(c)(4) contain all the procedures required by paragraph (b)(2) of final § 1910.333, the employer's documentation of his or her generic lockout program could also be used to fulfill the obligation imposed by § 1910.333(b)(2)(i) of the electrical work practices standard.

In comparing proposed § 1910.333(b)(2) with final § 1910.147, OSHA determined that the new generic lockout standard encompassed all the lockout and tagging requirements contained in the electrical work practices proposal with two exceptions. First, the proposed electrical standard more tightly restricted the use of tags without locks (see the discussion of final § 1910.333 (b)(2)(iii)(C) and (b)(2)(iii)(D), below) and called for additional protection when tags were permitted. Secondly, the electrical work practices proposal contained specific requirements for testing circuit parts for voltage before they could be considered as deenergized (see discussion of final § 1910.333(b)(2)(iv)(B), below). OSHA believes that a lockout and tagging program which meets § 1910.147 will, with these two exceptions, provide protection for servicing and maintenance involving electrical work and live parts. Accordingly, the final rule on electrical safety-related work practices incorporates this finding. OSHA has decided to accept (by means of a note added to final § 1910.333(b)(2)) any lockout and tagging program that conforms to § 1910.147 if it also meets paragraphs (b)(2)(iii)(D) and (b)(2)(iv)(B) of final § 1910.333. This will enable employers to use a single lockout and tagout program to cover all hazards addressed by these two standards, as long as that program includes procedures that meet the two additional paragraphs when exposure to electric shock is involved.

OSHA believes that these changes make the final electrical lockout and tagging provisions equivalent to those in NFPA 70E and compatible with § 1910.147.

The application of the final standard's lockout and tagging requirements is set forth in § 1910.333(b)(2), reading, in part, as follows:

(2) *Lockout and tagging.* While any employee is exposed to contact with parts of fixed electric equipment or circuits which have been deenergized, the circuits energizing the parts shall be locked out or tagged or both in accordance with the requirements of this paragraph.

OSHA has drafted its electrical lockout and tagging provisions to be more performance oriented than are the corresponding provisions of NFPA 70E. Within the range of hazards covered by the final standard, OSHA believes that the final lockout and tagging provisions will provide employees with electrical safety which is equivalent to that which would be afforded by NFPA 70E, part II.

OSHA has limited the application of the lockout and tagging provisions to fixed equipment. (It is not clear whether the NFPA standard would apply to other than fixed equipment.) Employees can safely work on cord- and plug-connected, portable and stationary equipment which is disconnected from the circuit. Generally, such equipment is returned to a maintenance shop for repair, and the danger of accidental energizing of equipment parts is eliminated in most cases.

Paragraph (b)(2)(i) of final § 1910.333 requires an employer to maintain a copy of the procedures outlined in § 1910.333(b)(2) and to make it available to employees and to OSHA. The explanation and rationale for this paragraph was presented earlier in this section of the preamble.

Paragraph (b)(2)(ii) addresses the deenergizing of equipment within the lockout and tagging process. After a procedure is set for safe deenergizing, the circuits and equipment on which work is to be performed are then required to be disconnected from all energy sources. This ensures that the circuits are completely disabled. Because they do not completely deenergize entire circuits, control devices are not permitted to be used as the only disconnecting means. Lastly, capacitive elements in the circuit are required to be relieved of their stored energy and are required to be short-circuited and grounded if necessary. These requirements will protect employees from the release of electrical energy during their work on the circuits or equipment.

Some commenters expressed the concern that stored non-electrical energy could also pose electrical hazards (Exs. 4–8, 4–29, 4–32). Mr. Jay Stewart, one of OSHA's expert witnesses, testified in support of these comments as follows:

One commenter suggested that in deenergizing electrical equipment procedures be required to deactivate or release mechanical or pneumatic energy that may be involved in the mechanism of the electrical equipment. Some contactors and circuit breakers have very large operating springs or pneumatic or even hydraulic operating mechanisms.

OSHA should consider as a part of the deenergizing requirement a new paragraph (D) in paragraph (b)(2)(i) of § 1910.333 to state:

"(D) Stored mechanical energy such as in a spring or stored pneumatic or hydraulic energy that is present in electrical equipment

and that might endanger personnel shall be released." (Tr. 1-159)

OSHA has accepted Mr. Stewart's recommendation and has included a new § 1910.333(b)(2)(ii)(D). This paragraph requires the blocking or relieving of stored non-electrical energy that could energize an electric circuit.

Paragraph (b)(2)(iii) sets forth requirements on the application of locks and tags to circuit disconnecting means. To prevent the unauthorized reenergizing of a circuit on which work is being performed, the final standard, in general, requires a lock and a tag to be placed on each disconnecting means that could supply power to the circuit. The final rule also requires the tags used to contain a statement prohibiting unauthorized operation of the disconnecting means and prohibiting removal of the tag. This requirement will ensure that employees are informed of the purpose of the lock and tag.

To permit maximum flexibility, the requirements permit the use of locks alone or tags alone under certain conditions. Tags are permitted to be used without locks if locks cannot be applied to a given installation or if the employer demonstrates that tagging procedures will provide safety equivalent to that of a lock. However, because a person could operate the disconnecting means before reading or recognizing the tag, the standard also requires that, where tags only are used, one or more additional safety measures be taken to provide added safety. The additional measures used must either: (1) Ensure that the closing of the tagged single switch would not reenergize the circuit on which employees are working or (2) virtually prevent the accidental closing of the disconnecting means. The following examples from the record illustrate protective techniques that are commonly used to supplement tags and protect workers:

(1) The removal of a fuse or fuses for a circuit (Tr. 2-104).

(2) The retraction of a draw-out circuit breaker from a switchboard (i.e., racking out the breaker; Ex. 6).

(3) The placement of a blocking mechanism over the operating handle of a disconnecting means so that the handle is blocked from being placed in the closed position (proposed § 1910.333(b)(2)(ii)(C)(2)).

(4) The opening of a switch (other than the disconnecting means) which also opens the circuit between the source of power and the exposed parts on which work is to be performed (proposed § 1910.333(b)(2)(ii)(C)(2)).

(5) The opening of a switch for a control circuit that operates a disconnect that is itself open and disconnected from the control circuit or is otherwise disabled (Tr. 2-170).

(6) Grounding the circuit upon which work is to be performed (Tr. 2-167).

The additional safety measure is necessary because, at least for electrical disconnecting means, tagging alone is significantly less safe than locking out. A disconnecting means could be closed by an employee who has failed to recognize the purpose of the tag. The disconnect could also be closed accidentally.

Public comment was requested on whether the additional safety measure is necessary when a disconnecting means is tagged and on what measures could be taken to protect employees from the accidental closing of a tagged switch. OSHA also requested public comment on situations in which tagging procedures may provide safety equivalent to that provided by locks.

A few commenters supported the use of tags alone, without an additional measure taken to protect employees (Ex. 4-17, 4-18, 6; Tr. 2-103 to 2-106). For example, Mr. Richard Chapin, representing the Edison Electric Institute, stated:

> The standard would require that where the circuit is open and tagged, the employee would, in addition, have to open the panel box and either lift wires or remove the breaker from its position, to establish a second break. This would create the additional hazard of exposing employees to energized equipment which would far exceed the risk if a properly trained electric utility power plant employee might disregard a tag and flip a switch which had been tagged out." (Tr. 2-104) He further stated: ". . . the tagging system in use in the electric utility industry provides protection to workers which is equivalent to locks in other industries. (Tr. 2-103)

However, as documented in two of the computer printouts in Exhibit 8, the electric utility industry had 14 fatalities and 17 injuries recorded in OSHA files that were directly caused by a failure of the lockout/tagout procedure in use.[12] (These accidents occurred during the period of July 1, 1972, to June 30, 1988, but do not represent all accidents during this period. Most injuries in all States and most fatalities in States with approved OSHA plans are not included.)

Although many of these accidents occurred while work was being performed on installations not covered by the standard (in fact, in most cases the type of installation was not listed), the number of fatalities and injuries does indicate that there is a risk of serious injury under the electric utility industry's current tagging system. Their tagging system does not differentiate between electric power generation, transmission, or distribution installations and electric utilization installations (Ex. 30; Tr. 2-84 to 2-100, 2-105 to 2-106, 2-137), and it is relatively uniform across the entire electric utility industry (Ex. 10; across the entire electric utility industry (Ex. 10; Tr. 2-144 to 2-146, 2-160 to 2-162).

In light of this evidence, OSHA believes that some form of protection in addition to the simple opening of a disconnect and the placement of a tag on the disconnect is necessary and appropriate even for electric utilities, which claim to have an industry-wide tagging system that provides safety equivalent to a lock. On the other hand, the Agency recognizes the safety record of many individual electric utility companies, as well as companies in other industries, who have never had a lockout- or tagging-related injury in decades through the use of a successful tagging system, which provides supplemental protection in addition to that provided by a simple tag. Therefore, OSHA is retaining the requirement for a measure of protection in addition to the use of tags alone, but is clarifying the language of § 1910.333(b)(2)(iii)(D) to read as follows:

> A tag used without a lock, as permitted by paragraph (b)(2)(iii)(C) of this section, shall be supplemented by one or more additional safety measures that provide a level of safety equivalent to that obtained by the use of a lock. Examples of additional safety measures include the removal of an isolating circuit element, blocking of a controlling switch, or opening of an extra disconnecting device.

In the final rule, OSHA is not strictly requiring the opening of an additional disconnect or the removal of a circuit element if tags are used as an equivalent to locks. Any measure or combination of measures that will protect employees as well as the application of a lock can be used to supplement the tagging of disconnecting means. In determining whether an individual employer's "tagging-only" program provides safety

[12] The number of fatalities and injuries were determined by adding the injury data for every accident that was coded with "lockout/tagout procedure malfunction" as the corresponding human factor associated with the accident. Due to the presence of this code, this analysis could include accidents for which there was no description, or abstract, of how it occurred. (The accident descriptions were generally not available before April 1984.) For incidents with associated abstracts, the total was adjusted to account for cases in which a utility tagging procedure malfunction was noted in the accident description, but the accident was not correspondingly coded. Because this could not be done for injuries and fatalities that occurred before April 1984, it is likely that the totals associated with lockout/tagout procedure malfunctions are understated.

equivalent to a lock, the Agency will consider factors such as:

(1) The safety record under the employer's tagging program.

(2) Whether the tagged disconnecting means are accessible to qualified persons only.

(3) Whether the tag and its attachment mechanism clearly identify the disconnecting means that is open and effectively inhibit reenergizing the electric circuit (for example, when a tag is used on an energy isolating device that is capable being locked out, the tag must be attached at the same location that the lock would have been attached), and

(4) Whether employees are thoroughly familiar with tagging procedures, especially their duties and responsibilities with respect to the procedures and the meaning and significance of the tags used with the procedures.

One commenter noted that proposed paragraphs (b)(2)(ii)(C) (*1*) and (*3*) are basic requirements that should apply regardless of whether the employer uses tags alone or in conjunction with locks (Ex. 4–8). The first paragraph proposed a requirement for tags to prohibit removal and unauthorized operation, while the second covered training of employees in the employer's tagging system. These requirements are already addressed in final §§ 1910.333(b)(2)(iii)(B), on tags, and 1910.332(b)(1), on training. Therefore, OSHA has not included paragraphs (b)(2)(ii)(C) (*1*) and (*3*) of proposed § 1910.333 in the final standard and has incorporated remaining proposed subparagraph (C)(*2*) into final § 1910.333(b)(2)(iii)(D).

When the work to be performed involves only a simple circuit and can be completed in a short time, a lock can be used safely without a tag. The final rule limits the use of this procedure to any situation that involves one circuit or a single piece of equipment and that involves a lockout period of no more than one work shift. Additionally, affected employees would be required to be trained in and familiar with this procedure to avoid any possible confusion over the purpose of the lock on the disconnecting means.

Final § 1910.333(b)(2)(iv) contains requirements for verifying that the correct circuits have, in fact, been deenergized. The requirement for determining whether a circuit has been opened can be satisfied by operating the controls for the equipment supplied by the circuit. This method has the advantage of not exposing employees to possibly energized parts. Therefore, the standard makes this the first step in verifying the condition of the circuit.

Of course, operating the equipment controls is not a completely reliable indication that the circuit has been deenergized. It is possible to interrupt a portion of the circuit so that the equipment will not operate even though the rest of the circuit is still alive. Therefore, the standard requires a qualified person to use test equipment to ensure that all parts of the circuit to which employees will be exposed are deenergized. Because it is also possible, under certain conditions, to feed circuits from the "load" side, the test is required to check for any voltage backfeed which might be present.

Voltages over 600 volts are more likely than lower voltages to cause test equipment itself to fail, leading to false indications of no-voltage conditions. To prevent accidents resulting from such failure of test equipment, the final standard requires checking operation of the test equipment immediately before and after use, if voltages over 600 volts are involved.

Once work has been completed, it will be necessary to reenergize the circuit. Paragraph (b)(2)(v) of final § 1910.333 addresses the procedure to be used for this task. The first step that must be taken is an inspection or test (or both) of the circuits and work areas to ensure that all tools, jumpers, grounds, and other devices have been removed. Otherwise, energizing the circuits involved could result in a short-circuit condition that injures employees. The standard requires such inspection and tests, if necessary, to be performed by a qualified person.

To protect employees from contact with reenergized circuit parts, the final rule requires affected employees (those who are exposed to the hazards of reenergizing the electric circuits) to be warned to stay clear. The locks and tags must then be removed by the employees who placed them under paragraph (b)(2)(v)(C) (discussed previously in this section of the preamble.) After all locks and tags are removed, a visual determination that employees are clear of danger is required. Once these procedures have been followed, it is safe to reenergize the circuits.

Paragraph (c) of final § 1910.333 applies to work on or near exposed energized parts. This paragraph contains requirements intended to prevent accidents due to the presence of exposed live parts. Requirements are given pertaining to work near overhead lines, illumination, confined work areas, conductive materials and equipment, portable ladders, conductive apparel, and housekeeping duties.

Paragraph (c)(2) of final § 1910.333 requires employees working on electric circuit parts or on electric equipment that has not been deenergized under the procedures set forth in final § 1910.333(b) to be qualified persons. These employees must be capable of working safely on energized circuits and must be familiar with the protective work method and tools that are necessary for this type of work. This provision will prevent injuries to unqualified employees, who are not capable of working safely on energized electric circuits.

Since overhead lines are a major source of occupational electrocutions (47 of 128 electrocutions in general industry as reflected by the OSHA fatality/catastrophic abstracts), regulations dealing with work near such lines are stressed. A number of these accidents involve employees engaged in non-electrical activities which place them near electric power conductors installed above ground (e.g., a painter moving a ladder). The requirements of final § 1910.333(c)(3) have expanded those found in the NFPA 70E section on overhead lines and are more stringent. According to § 1910.333(c)(3)(i), other than qualified persons would be required to maintain a 10-foot (305-cm) minimum clearance from unguarded energized overhead lines. This clearance distance is based on the 10-foot (305-cm) clearance rules presently contained in §§ 1910.67(b)(4), 1910.180(j), 1910.266(c)(6)(xxii), 1926.550(a)(15), and 1926.600(a)(6), which apply to the use of various mechanical equipment near electric power lines.

OSHA realizes that it is sometimes necessary for work to be performed closer to the lines than 10 feet (305 cm) when it is infeasible or impossible to deenergize them. However, since unqualified persons are not fully aware of the danger involved, such work may be performed only by qualified personnel. Therefore, for qualified persons, the final standard allows smaller clearances, as given in Table S–5. These clearances are the same as those given in Table R–2 of § 1910.268, "Telecommunications." The smaller clearances allow qualified persons to perform tasks which require close approach to overhead lines. At the same time, the smaller clearances provide protection from arc-over with a sufficient safety factor for employees who are familiar with the construction and operation of overhead electric power lines and with the hazards involved. Additionally, if the work requires closer approach than even these smaller clearances allow, qualified persons would be permitted to approach

the lines as close as necessary if insulation or guarding is provided.

Without differentiating between qualified and unqualified workers, the NFPA standard requires a "safe distance" to be maintained for any employee working in elevated positions near unguarded, energized lines but does not specify what this distance is. For employees on the ground, the consensus standard requires deenergizing or guarding any overhead line that might be contacted.

The Edison Electric Institute (which represents electric utilities) was very concerned about OSHA's approach to the hazards of overhead lines for "qualified" employees. In their comments, they stated:

> Proposed § 1910.333(c)(3)(ii) pertaining to work by "qualified" persons in the vicinity of overhead lines, genuinely frightens EEI and its members, because we believe that OSHA has no appreciation of the risks the standard would create. By definition [through language contained in the scope of the standard], such persons will not be doing work on or directly associated with those lines. Therefore, these are likely to be employees of contractors having no relationship with an electric utility. Rather, they will simply be workers whose work happens to take them in proximity to overhead utility lines. An example might be a carpenter contractor whose employees are working on a scaffold near overhead lines, or a tree trimmer working for a private homeowner trimming trees near a live power line.
>
> Among the precautions which would license such employees to approach within two feet of a 7.2kV line, for example, would be insulating the energized line, i.e., by applying a rubber line hose or blanket. Section 1910.333(c)(ii)(B) [sic]. There is no suggestion, however, that such equipment would be applied to the utility's lines by utility employees; rather, it appears that the so-called "qualified" carpenter or tree trimmer would be the one actually working on high voltage lines to apply this equipment.
>
> This is nothing short of an OSHA invitation to kill workers who have nothing approaching the skill and experience needed to come as close to, and work on, energized overhead conductors as utility linemen. Moreover, allowing such workers to rely on devices such as rubber line hose to protect themselves from high voltage lines is well understood by utilities to invite those employees to have a false, and deadly, sense of security about their safety. Simply stated, whether OSHA misguidedly believes them to be "qualified" or not, persons other than trained and experienced utility linemen should be prohibited from installing protective equipment on utility lines and equipment. All others, except those who have a recognized need to work closer than ten (10) feet to energized lines, such as line clearance tree trimmers and communications workers, must be required to keep ten (10) feet from energized power lines, period. (Ex. 4–10)

EEI further stated, through one of its witnesses at the hearing, Mr. C. Richard Chapin:

> . . . it would be contrary to public safety and would create unacceptable risks to both utility and nonutility employees, as well as electric utility systems, for the final rule to suggest that employers not working for electric utilities could take it upon themselves to apply protective coverings to overhead power lines.
>
> In this connection, EEI wishes to express its very deep concern about the minimal requirements which this standard would seem to propose in order for persons to be considered qualified for work on or associated with energized lines or equipment.
>
> As we read the standard, if a person received an hour of training as to the hazards of working on such equipment, he would be considered qualified within the meaning of the proposal.
>
> Just as an aside here, a qualified lineman, first class lineman, probably has three years of training, just as an example. (Tr. 2–107)

OSHA agrees with EEI that carpenters should not come closer than 10 feet to an overhead power line. The Agency does not intend to allow carpenters to approach as close as 2 feet to an overhead power line or to allow any employee with only 1 hour of training to install protective equipment on such lines.

As noted earlier, the training times listed in the preamble to the proposal were estimates of additional training beyond that already provided by employers to "qualified" employees. These estimates were not intended to provide a training criterion against which to measure an employee's qualifications. Clearly, the additional training alone would not be adequate to make an employee "qualified" if that employee has not already had the training necessary for his or her trade. OSHA expects employers to ensure that any employees they consider "qualified" under these provisions receive training similar (in degree) to that provided to electric power line installers, telephone line installers, or line-clearance tree trimmers, depending on the type of work being performed. An employee who receives this type of training would be qualified to work close to overhead power lines. For example, an electrician working in a substation for a commercial establishment would be permitted to work on electric equipment that is installed less than 10 feet from the overhead power lines feeding the substation. Assuming the electrician is qualified to perform work in such a substation, OSHA sees no safety-oriented reason to require the work to be performed by an electric utility employee whether or not the incoming lines are owned and operated by a utility.

The installation by "qualified persons" of protective equipment, such as rubber insulating line hose or electrically insulating plastic guard equipment, on electric power transmission or distribution is not covered under the final electrical safety-related work practices standard. OSHA considers this type of work to be work on electric power transmission and distribution installations; therefore, when such work is performed by "qualified persons", it is exempt from final §§ 1910.332 through 1910.335, as noted in § 1910.331(c)(1). A note to this effect has been added to § 1910.333(c)(3). Unqualified employees are prohibited from performing this type of work by final § 1910.333(c)(2). The installation of insulation on electric power lines would require the employee to work closer than 10 feet from the lines, and only qualified persons are permitted to work that close to the lines.

For vehicular and mechanical equipment (§ 1910.333(c)(3)(iii)), OSHA is requiring a minimum clearance of 10 feet (305 cm), while NFPA 70E allows equipment other than aerial lifts, mobile cranes, and derrick trucks [13] to come as close as 4 feet to exposed, energized overhead lines. In the final OSHA standard, approaches closer than 10 feet are allowed for: (1) Vehicles in transit; (2) lines protected by insulating barriers; and (3) insulated aerial lifts operated by qualified persons. These closer approach distances are based on exceptions to the 10-foot (305-cm) clearance rules presently contained in the existing OSHA standards noted previously. All of OSHA's existing standards (e.g., § 1910.180(j)(1)) require a basic 10-foot clearance for the specific equipment covered. Additionally, § 1926.600(a)(6) of the Construction Standards requires all mechanical equipment to keep 10 feet away from power lines. Therefore, the new regulations are consistent with OSHA's existing requirements and minimize the confusion as to what clearances are required.

The clearance distances listed in NFPA 70E, as well as those in OSHA's final standard, protect against arc-over of current from the lines to the equipment. Assuming that the equipment would never come any closer than permitted by either standard, both would theoretically provide employees with protection. However, the main

[13] For these types of equipment only, NFPA refers to OSHA's existing standards, which require a minimum clearance of 10 feet.

concern involved in operating mechanical equipment near exposed power lines is unintended movement of the equipment which may bring the equipment too close to the lines. A 10-foot clearance provides a more reasonable margin of error compared to the distances given in NFPA 70E.

Additionally, the clearance distances in NFPA 70E vary according to the type of equipment in use and the voltage of the power lines. Mr. James Sharp of the International Brotherhood of Electrical Workers supported the NFPA approach, stating:

> Ever since I have been in the electrical business, for some 50 years, it has been taught me that distance is a prime factor in consideration when you are dealing with varying voltages. Distance, protection, voltage, you can t separate them. (Tr. 2-17)

OSHA has not accepted this argument. Most employees operating mechanical equipment will not be able to determine the voltage on the power lines and, therefore, will not know the clearance to be maintained. Also, because existing § 1926.600(a)(6) already requires a 10-foot clearance for all types of mechanical equipment used in construction, varying the clearance distance based on voltage (below 50kV) would cause a conflict between the two OSHA standards.

With respect to the hazards of overhead power lines, OSHA feels that its standard provides greater safety than the national consensus standard. In view of the fact that 47 of the 123 electrocutions studied were due to the use of equipment or material too close to exposed energized overhead lines, OSHA believes that requirements to prevent such electrocutions are of the highest priority and should provide as much safety as possible. For these reasons, and in order to promote consistency within the OSHA standards, the final regulations contain a basic 10-foot (305-cm) clearance rule, with certain exceptions. No information was provided during the rulemaking period demonstrating ways in which specific operations could be performed safely with clearances less than 10 feet. Therefore, OSHA made no changes to the basic 10-foot clearance contained in the proposal.

As noted previously, the standard permits approaches closer than 10 feet for: (1) Vehicles in transit; (2) lines protected by insulating barriers; and (3) insulated aerial lifts operated by qualified persons. The 4-foot clearance for vehicles in transit is based on existing §§ 1910.180(j)(1)(iii) and 1926.550(a)(15)(iii). This exception, which requires the boom or other structure to be lowered, allows truck-mounted mechanical equipment to travel safely under power lines that cross streets and highways. On the issue of the 4-foot clearance permitted for vehicles in transit, EEI suggested that OSHA increase the clearance to 4 feet plus 4 inches for every 10 kilovolts over 50 kilovolts (Ex. 4-10). They argued that, while 4 feet was an adequate clearance for voltages under 50 kilovolts, higher voltages necessitate greater clearances for safety's sake. OSHA has accepted this comment and has added the following language in final § 1910.333(c)(3)(iii)(A)(*1*):

> If the voltage is higher than 50 kV, the clearance shall be increased 4 in. (10 cm) for every 10 kV over that voltage.

The National Arborist Association (NAA) expressed concern with proposed § 1910.333(c)(3)(iii)(B), which prohibited employees on the ground from contacting a vehicle or mechanical equipment if it could, in turn, contact an overhead power line (Ex. 4-30). They argued that the use of insulated aerial lifts protected employees on the ground. Under questioning by the attorney representing NAA, an OSHA witness explained that, if an insulated aerial lift is positioned so that the uninsulated portion of the lift cannot come closer to any overhead power line than the distances proposed in Table S-5 (for a qualified person operating the lift), the employees on the ground would be permitted to contact the aerial lift truck and any of its attachments (Tr. 1-32 to 1-34). To clarify the rule, the Agency has revised § 1910.333(c)(3)(iii)(B)(*2*) to read as follows:

§ 1910.333 Selection and use of work practices.

* * * * * * *

(c) * * *

(3) * * *

(iii) * * *

(B) Employees standing on the ground may not contact the vehicle or mechanical equipment or any of its attachments, unless:

* * * * * *

(*2*) The equipment is located so that no uninsulated part of its structure (that portion of the structure that provides a conductive path to employees on the ground) can come closer to the line than permitted in paragraph (c)(3)(iii) of this section.

This language should make it clear that only the uninsulated portion of insulated aerial lifts are used to determine where the aerial lift truck may be located so that employees on the ground may contact the truck.

Paragraph (c)(4) of final § 1910.333 addresses the hazards associated with working near exposed live parts where visibility is impaired. Adequate illumination is required by paragraph (c)(4)(i) to ensure that employees can see well enough to avoid contacting exposed live parts. Specific guidance was not provided in the proposal. Although OSHA requested comments and supporting data with respect to levels of illumination, the only specific levels suggested in the rulemaking record were in the form of appendix guidance and were not supported by any evidence that they were necessary or adequate (Ex. 4-8, 4-25). In enforcing this provision, OSHA will use applicable national consensus standards as guidelines, such as ANSI A11.1, American National Standard Practice for Industrial Lighting. OSHA presently uses this document in enforcing § 1926.56, which addresses illumination in the construction industry.

Paragraph (c)(4)(ii) prohibits the act of blind reaching into areas containing exposed live parts. Obviously, if the live parts cannot be seen, it would be difficult to avoid contact with them. Therefore, the standard does not permit employees to work near exposed live parts that cannot be seen because of obstructions or poor lighting.

Some installations of electric equipment provide little working space for maintenance employees. Such cramped conditions can lead to employees' backing or moving into exposed live parts. To prevent this from occurring, paragraph (c)(5) of final § 1910.333 requires precautions to be taken to assure that accidental contact with the parts does not occur. For example, protective blankets could be used to shield some of the live parts, or portions of the electrical installation could be deenergized. (Of course, there is a regulatory preference for deenergizing the equipment. The conditions specified in § 1910.333(a)(1) would have to be met before the employee could work so close to exposed energized parts.) Also, doors and panels are required to be secured if they could knock into employees and cause them to contact exposed energized parts.

Handling metal ladders and other conductive materials in the vicinity of overhead lines is a leading cause of occupational electrocutions. (See category (i)(c) in Table 2 of this preamble.) Paragraphs (c)(6) and (c)(7) of final § 1910.333 address the hazards associated with such material handling operations. To protect employees handling conductive tools or materials near exposed live parts, paragraph (c)(6) requires conductive materials or equipment to be handled in a manner that will prevent their contacting the

energized parts. Because moving such long metal objects as pipes and ducts can be particularly hazardous in areas containing exposed energized conductors or circuit parts, the final standard also requires employers to institute work practices that minimize the hazards associated with handling these objects. For example, an employer could require employees to handle metal irrigation pipes so that the pipes are always in a horizontal plane. This practice would prevent the material from contacting overhead power lines.

Metal ladders can also provide a path to ground for workers who directly contact live parts. In final § 1910.333(c)(7), OSHA requires portable ladders to have nonconductive siderails if used by employees who would be working where they might contact exposed energized circuit parts. This should protect these workers from electric shock.

In view of the number of accidents that have occurred when metal ladders contacted overhead lines, the Agency requested comments on whether metal ladders should also be prohibited from being used where they might contact energized overhead electric power lines. Three commenters supported a prohibition of metal ladders near exposed, energized overhead power lines (Ex. 4–8, 4–12, 4–29). One commenter stated that the proposal was adequate with regard to the use of metal ladders (Ex. 4–25).

The Agency reviewed the accident information in Exhibits 8 (the OSHA fatality/catastrophe reports) and 4–14 (the NIOSH FACE data) for fatalities and injuries involving the use of metal ladders. There were 24 incidents involving the contact of a metal ladder with an overhead power line. In several cases, multiple fatalities occurred. Although 20 of the 24 cases were categorized under "construction" (Ex. 8), many of the "construction" accidents involved painters, who may or may not have been performing construction work. (Reports were placed in the "construction" category based solely on the SIC classification of the contractor involved.)

Paragraph (a)(11) of existing § 1926.450 addresses the use of ladders near electric circuits in construction. This provision currently prohibits the use of portable metal ladders for electrical work or where the ladders may contact electric conductors. OSHA believes that, where the hazards are the same for work in construction and in general industry, the standards should be essentially the same. This is especially important if employers, such as painting contractors, may have jobs to perform that sometimes fall under the Construction Standards and sometimes fall under the General Industry Standards. Therefore, in final § 1910.333(c)(7), OSHA is adopting a rule that incorporates the construction standard's prohibition on the use of metal ladders where they may contact electric conductors. The language of the final § 1910.333(c)(7) has been taken partly from proposed § 1910.333(c)(7) and partly from the proposed revision of existing § 1926.450(a)(11) (proposed § 1926.1053(b)(12), 51 FR 42765, November 25, 1986). The final rule reads as follows:

> Portable ladders shall have nonconductive siderails if they are used where the employee or the ladder could contact exposed energized parts.

Final § 1910.333(c)(8) prohibits employees from wearing conductive objects, such as metallic jewelry, in a manner presenting an electrical contact hazard. Typical accident descriptions indicate that these metal objects short circuit live parts; and, as current flows through the objects, the employees wearing them are severely burned. Protective methods include wrapping the conductive apparel with nonconductive tape, the use of rubber gloves, and the use of insulation on the live part, as well as the removal of the conductive item. OSHA understands that compliance may present difficulties as many employees may not want to remove or cover certain articles of jewelry. However, given the severity of the possible consequences (e.g., loss of a finger, arm burns, or injury to adjacent coworkers), OSHA believes that some means of protecting the employee, as well as others nearby, must be provided.

Paragraph (c)(9) of final § 1910.333 addresses hazards related to housekeeping duties (such as electric equipment cleaning or vegetation spraying, clipping, or trimming) performed near exposed energized circuit parts. This provision requires the employer to adopt safeguards that prevent *employees* performing such duties from contacting energized parts, either directly or through conductive cleaning aids. Examples of protective measures include the use of protective insulating equipment or the provision of guards to prevent contact.

Paragraph (c)(10) of § 1910.333 contains requirements that restrict the manner in which interlocks may be defeated. Interlocks deenergize circuits to prevent electric shock to persons using equipment or performing minor maintenance or adjustments. However, under some maintenance conditions, the interlocks must be rendered inoperative so that tests or adjustments can be made. To prevent injury to employees who may not realize the hazards involved (both to the person defeating the interlock and to others who may be exposed), paragraph (c)(10) permits only qualified persons to defeat interlocks while they work on the equipment. Also, when the qualified person's work is completed, the interlock system would be required to be put back into an operative condition.

This paragraph was originally proposed as § 1910.333(b)(3), under requirements for work on or near deenergized parts. However, as suggested by one commenter (Ex. 4–8), OSHA has moved the paragraph under § 1910.333(c), which covers work on or near energized parts. OSHA believes that such placement is more appropriate, as interlocks are normally by-passed during work on or near energized parts. In fact, the requirement is only necessary when the equipment protected by the interlock is energized. Additionally, the language of the requirement has been clarified in the final rule to indicate that it applies only to electrical safety interlocks—those that deenergize circuits to prevent electric shock to persons using electric equipment. Interlocks used for equipment control purposes are not included in this requirement. This change was in response to comments that suggested a clarification of the rule (Ex. 4–8, 4–11).

D. § 1910.334

Requirements in this section address the hazards of using electric equipment. Although hazards common to the installation of electric equipment are covered in the existing subpart S regulations, the accidents in OSHA's survey show that equipment is often used improperly or is damaged in use. (See category (v) in Table 2.) Such misuse and abuse of equipment creates hazards which the existing installation standards address only indirectly. The requirements of final § 1910.334 cover these hazards more directly.

Paragraph (a) of final § 1910.334 sets forth requirements on the use of cord- and plug-connected equipment, including extension cords, and addresses common hazards associated with their use. Paragraph (a)(1) requires portable equipment to be handled in a manner which will not cause damage. Paragraph (a)(2)(i) requires visual inspection of cords, plugs, and receptacles, and paragraph (a)(2)(ii) prohibits the use of defective equipment. These requirements protect employees from electric shocks caused by damaged

equipment. Such defects as missing grounding prongs on attachment plugs and poor insulation on conductors have caused injuries to employees.

To prevent the connection of mismatched or misaligned plugs and receptacles, paragraph (a)(2)(iii) requires these devices to be checked to ensure that they are of compatible configurations and are in alignment. If this is not done, an employee might force a plug of one rating into a receptacle of a different rating, leading to a lack of proper overcurrent protection. Other, even worse possibilities include the application of a higher than intended voltage on connected equipment or the impression of voltage on the frame of the equipment through the equipment grounding conductor.

Rules ensuring the continuity of grounding conductors for cord- and plug-connected equipment are set forth in paragraph (a)(3) of final § 1910.334. Paragraph (a)(3)(i) requires power supply and extension cords used with grounding-type equipment to contain an equipment grounding conductor. Paragraph (a)(3)(ii) prohibits alteration of plugs and receptacles to ensure that grounding continuity is maintained across the connection. For example, clipping the grounding prong from a plug is prohibited. Adapters that interrupt grounding continuity are prohibited by paragraph (a)(3)(iii).

Paragraph (a)(4) of final § 1910.334 requires portable electric equipment used in highly conductive locations (e.g., those inundated with water) to be approved for the use. This requirement ensures that the equipment is appropriate for the serious hazards presented by the use of electric equipment in these areas.

Paragraph (a)(5) of final § 1910.334 imposes regulations on the connection of attachment plugs. In the final rule, employees are prohibited from plugging and unplugging energized plugs and receptacles while their hands are wet (paragraph (a)(5)(i)). (The final rule makes it clear that only energized equipment is affected. For example, plugging a deenergized cord into an energized receptacle is covered, as the receptacle is energized equipment.)

The Edison Electric Institute argued that there is a greater hazard if the condition of the plug itself provides a conductive path to the employee's hand (Ex. 4–10). They suggested a prohibition against connecting or disconnecting cords if the plugs are so dirty or wet that a conductive path to the employee's hand is present. OSHA has accepted this comment and has included the following requirement in final § 1910.334(a)(5)(ii):

(ii) Energized plug and receptacle connections may be handled only with insulating protective equipment if the condition of the connection could provide a conducting path to the employee's hand.

Paragraph (a)(5)(ii) of final § 1910.334 (redesignated from proposed paragraph (a)(5)(ii)) requires locking-type connectors to be secured after connection. This rule will prevent this type of connector from separating partially, thus avoiding exposure of the live connector blades (prongs).

The requirements in final § 1910.334(a) ensure that cord- and plug-connected equipment continues to meet the installation requirements currently contained in Subpart S and is used in its intended manner.

Final § 1910.334(b) deals with electric circuits. To protect the operator of a disconnect from its failure, paragraph (b)(1) requires devices used for opening circuits under load to be designed for the purpose.

Circuits deenergized by the operation of a protective device (such as a fuse or circuit breaker) have to be checked to ensure that they can be safely reenergized, as required under paragraph (b)(2). Without such a check, it is possible for an employee to be injured in case of failure of the protective device. Several commenters stated that overcurrent devices on certain circuits are designed to open under overload conditions (Ex. 4–17, 4–43, 27). Under fault conditions (which are the ones that generally make it hazardous to reset circuit breakers or replace fuses manually), other protective elements are designed to operate and open the circuit. The commenters claimed that it would be safe to reset these overload protective devices and suggested that OSHA specifically permit this without a determination of exactly what condition caused the devices to open. Although the Agency agrees with these comments, OSHA notes that the proposal (and the final rule) simply required the employer to determine if it is safe to reenergize the circuit, not to determine the specific cause of the outage. To clarify this provision in the final rule, OSHA has added a note to § 1910.334(b)(2), reading as follows:

Note: When it can be determined from the design of the circuit and the overcurrent devices involved that the automatic operation of a device was caused by an overload rather than a fault condition, no examination of the circuit or connected equipment is needed before the circuit is reenergized.

Paragraph (b)(3) of final § 1910.334 prohibits changing (for maintenance or other purposes) overcurrent protective devices in any manner which would violate § 1910.304(e), the installation safety requirements for overcurrent protection. This provision will prevent the use of a fuse or circuit breaker with a rating too high to protect the equipment or conductors involved. This provision is also intended to prevent the temporary bypassing of protective devices, which could lead to shock and fire hazards.

Paragraph (c) of final § 1910.334 sets forth requirements on the use, rating, and inspection of electrical test instruments and equipment. Because the use of test instruments can expose employees to live parts of electric circuits, paragraph (c)(1) requires testing work on electric circuits or equipment to be performed by qualified persons.

To prevent injuries to employees resulting from exposed conductors or other defects in the test equipment, paragraph (c)(2) requires the visual inspection of such equipment before use. Of course, employees would not be permitted to use defective or damaged equipment until it has been repaired.

Using test equipment in improper environments or on circuits with voltages or currents higher than the rating of the equipment can cause the equipment's failure. Since employees can be injured as a result of this failure, paragraph (c)(3) requires test equipment to be used within its rating and to be suitable for the environment in which it is to be used.

Paragraph (d) of final § 1910.334 requires suitable protective measures to be taken to protect against the hazards of using flammable and ignitible materials occasionally in ordinary locations (those which are not covered by existing § 1910.307). While storage, manufacture, and other on-going presence of flammables are covered under the installation requirements for hazardous locations contained in subpart S, temporary uses are not covered. The final standard prohibits energizing electric equipment where it might ignite flammable or ignitible materials, unless suitable protective measures are taken. Protective measures could include ventilation and clearing accumulations of combustible dusts, as appropriate.

E. § 1910.335

The requirements of this section address accidents involving the failure to use protective equipment. Paragraph (a) of final § 1910.335 addresses the proper use of protective equipment. Requirements include those on inspection, protection, and situations

demanding the use of personal protective equipment. These regulations are intended to ensure that the equipment will actually provide insulation of and safety to the employee.

OSHA's existing regulations [14] on the design of insulating protective equipment are contained in § 1910.137, in subpart I of 29 CFR part 1910, which references various American National Standards Institute (ANSI) standards.

NFPA 70E refers to more recent (but not the most recent) editions [15] of the same ANSI standards. Although OSHA is not making changes to § 1910.137 in the present rulemaking, the Agency has proposed to revise this section in connection with its rulemaking on electric power generation, transmission, and distribution. (A notice of proposed rulemaking was published on January 31, 1989 (54 FR 4974).) The proposed revision of § 1910.137 would replace the incorporation of the out-of-date consensus standards with a set of performance-oriented requirements that are consistent with the latest revisions of these consensus standards. Additionally, the protective equipment proposal includes requirements for the safe use and care of electrical protective equipment to complement the equipment design provisions.

Paragraph (a) of final § 1910.335 also addresses the use of other types of protective equipment not specifically covered in subpart I, such as fuse handling devices, nonconductive rope, and protective shields and barriers. Requirements are included for the use of equipment that is appropriate for the parts of the body to be protected and for the work being performed; for the maintenance of protective equipment; and for the protection of this equipment during use. These requirements are unchanged from the proposal; there were no significant comments received on these provisions.

Paragraph (b) of final § 1910.335 applies to alerting techniques. To inform employees about electrical hazards to which they are exposed, safety signs and symbols are required by paragraph (b)(1). (Requirements for safety signs, symbols, and tags are contained in existing § 1910.145. The subpart S requirement for safety signs, symbols, and tags does not increase the burden imposed by this existing standard. This provision is included in the final rule because the following two paragraphs are dependent upon the requirement for safety signs and tags.) Paragraph (b)(2) requires the use of barricades to limit access to areas containing exposed, energized electric parts. If signs and barricades alone will not adequately protect employees, an attendant to guard the area and warn other employees is required by paragraph (b)(3).

F. § 1910.399

OSHA is applying the definitions in existing § 1910.399 to the entire subpart S and is removing the paragraph designations from the section.

It is OSHA's intent, as noted earlier, that the standard not apply to tree-trimming operations performed near overhead power lines as long as qualified employees are performing the work. (OSHA has proposed, instead, to cover line-clearance tree-trimming operations performed by line-clearance tree trimmers in the forthcoming electric power generation, transmission, and distribution standard mentioned previously.) In order to clarify this in the final standard, the Agency has added a note to § 1910.331(c)(1) and a definition of "line-clearance tree trimming." The addition of this term, the definition of which was not included in the proposal, and of the note, which was discussed under § 1910.331 in this section of the preamble, should help clarify the intent of the standard.

The final standard adds an explanation of the use of the word "may" to the definitions already contained in § 1910.399. Conforming to correct grammar and to existing usage in subpart S, OSHA has used the words "may" and "shall" as follows:

A. If a discretionary right, privilege, or power is conferred, the word "may" has been used. (For example: the employer may restrict access to equipment; i.e., it is permissible for the employer to do this.) Such rules are permissive in nature and are usually used as exceptions to requirements.

B. If a right, privilege, or power is abridged, or if an obligation to abstain from acting is imposed, the word "may" has been used with a restrictive "no," "not," or "only." (For example: (1) No unqualified person may enter restricted areas; (2) unqualified persons may not enter restricted areas; or (3) only qualified persons may enter restricted areas. For all three cases, persons who are not qualified are prohibited from restricted areas). These requirements are mandatory.

C. If an obligation to act is imposed, the word "shall" has been used. (For example: employers shall restrict access to areas containing live parts.) These rules are mandatory upon the employer to act.

The use of these terms in the final standard is consistent with their use in the existing subpart S. The definition of "may" is unchanged from the proposal.

OSHA received numerous comments on the definition and use of the term "qualified person" in the proposal (Ex. 4–9, 4–10, 4–13, 4–16, 4–20, 4–25, 4–26, 4–20, 4–29, 4–30). Many of them argued that the definition contained in existing § 1910.399 was inadequate (Ex. 4–10, 4–16, 4–20, 4–25, 4–26). These commenters again cited the short training times they mistakenly believe OSHA is requiring. (See the discussion of § 1910.332, earlier in this section of the preamble.)

As stated previously, OSHA realizes that different types of work demand different levels of training. In fact, it can take many years for certain types of employees to become fully qualified for the demanding type of work they do (Tr. 2–107). (This training is provided, in large part, in the absence of regulation; therefore, the Agency did not include this in its determination of costs imposed by the standard.) The discussions earlier in this preamble and in the preamble to the proposal make this clear. The definition of "qualified person" in the existing regulation is identical to the definition of the same term in the National Electrical Code, and the Agency has been using it (or one virtually identical to it) for over 17 years without problems. Therefore, OSHA has determined that it is not necessary to revise the wording of the existing definition.

[14] *§ 1910.137 Electrical protective devices.* Rubber protective equipment for electrical workers shall conform to the requirements established in the American National Standards Institute Standards as specified in the following list:

Item	Standard
Rubber insulating gloves	J6.6—1967
Rubber matting for use around electric apparatus.	J6.7—1935 (R 1962)
Rubber insulating blankets.	J6.4—1970
Rubber insulating hoods	J6.2—1950 (R 1962)
Rubber insulating line hose.	J6.1—1950 (R 1962)
Rubber insulating sleeves.	J6.5—1962

[15] Blankets—ANSI/ASTM D1048–1977, Specifications for Rubber Insulating Blankets
Hoods—ANSI/ASTM D1049–1977, Specifications for Rubber Insulating Covers
Line Hose—ANSI/ASTM D1050–1977, Specifications for Rubber Insulating Line Hoses
Sleeves—ANSI/ASTM D1051–1977, Specifications for Rubber Insulating Sleeves
Gloves—ANSI/ASTM D120–1977, Specifications for Rubber Insulating Gloves
Mats—ANSI/ASTM D178–1977, Specifications for Rubber Insulating Matting
ANSI—American National Standards Institute
ASTM—American Society for Testing and Materials

On the other hand, several commenters argued that the definition could be clarified (Ex. 4–9, 4–13, 4–28, 4–30). Two of them pointed to the discussion of § 1910.331(c) in the preamble to the proposal, which provided guidance on whether a person should be considered "qualified," and suggested that it might be added as a note to the definition of "qualified person" (Ex. 4–9, 4–13). OSHA has accepted this comment, and the final rule amends the existing definition with the addition of the following note:

Note 1: Whether an employee is considered to be a "qualified person" will depend upon various circumstances in the workplace. It is possible and, in fact, likely for an individual to be considered "qualified" with regard to certain equipment in the workplace, but "unqualified" as to other equipment. (See § 1910.332(b)(3) for training requirements that specifically apply to qualified persons.)

The National Arborist Association was concerned that the definition of "qualified person" did not adequately address employees who are in training to become qualified (Ex. 4–30). In their comment, they quoted the definition of "qualified line-clearance tree-trimmer trainee" from the American National Standard for Tree Care Operations—Pruning, Trimming, Repairing, Maintaining, and Removing Trees, and Cutting Bush—Safety Requirements, ANSI Z133.1, as follows:

Qualified line-clearance tree-trimmer trainee. Any worker regularly assigned to a line-clearance tree-trimming crew and undergoing on-the-job training who, in the course of such training, has demonstrated his ability to perform his duties safely at his level of training.

They further stated:

The long standing proven technique for employee learning of line clearance tree trimming is for the trainee to receive on-the-job training under the careful eye of an experienced employee. The central tenet of this training process is that the trainee is not permitted to do more than the level of his safety training permits him to do. This is reflected in the above quoted ANSI trainee definition. The problem with the proposed § 1910.399 definition therefore is that it fails to account for the special status of trainees—it does not treat trainees as qualified. As a result, members of the same crew, under the proposal, untenably would be subject to different OSHA standards depending on the level of the same job they were performing! The suggested solution is to adopt the ANSI definitions and exempt both qualified employees and qualified trainees (short of exempting the tree industry altogether). (Ex. 4–30)

OSHA does not, however, consider trainees as being unqualified persons. This question was addressed at the hearing during the following exchange between OSHA (Mr. Wallis) and the attorney representing the National Arborist Association (Mr. Semler):

Mr. Semler: What is OSHA's intent . . . with respect to a line clearance tree-trimmer trainee who is part of a crew that would otherwise be exempt?

That person typically in the industry is allowed to do work commensurate with his training and experience but the standard doesn't particularly address the trainee issue.

Would the trainee share the exemption otherwise available to the crew?

Mr. Wallis: Yes, but only up to a point. Obviously the first time he comes onto the job we don't expect a trainee to be able to just go up and trim the overhead line. He wouldn't really have the knowledge or the skills and I think you would admit that.

As he progresses in his training, he is going to be held more and more qualified . . . He has to be qualified for the task he's doing in other words.

Mr. Semler: And if he qualified for the task he's doing, he would share the exemption?

Mr. Wallis: Yes. (Tr. 1–27 to 1–28)

The Agency realizes that this concept is not readily apparent from the text of the existing definition. Therefore, OSHA is adding a second note to the definition explaining its application to trainees. The basic thrust of the note has been taken from the ANSI Z133.1 definition of "line-clearance tree-trimmer trainee" and from the National Arborist Association's comment that trainees are carefully supervised. The language of the note is general, however, so that it applies to any employees who are undergoing on-the-job training to become qualified employees, rather than restricted to tree trimmers only. (Line-clearance tree-trimmer trainees, like line-clearance tree trimmers and qualified power line workers, would be covered under proposed § 1910.269 (54 FR 4974).) New note 2 to the existing definition reads as follows:

Note 2: 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.

G. Miscellaneous

Various general industry standards have continued to reference the 1971 NEC, even though the latest revision of subpart S makes such references unnecessary. Therefore, a number of miscellaneous amendments were proposed to substitute references to subpart S for the current references to the NEC [§§ 1910.68 (b)(4) and (c)(5)(iv)(*c*), 1910.94(a)(2)(iii), 1910.103(b)(3)(iii)(*e*), 1910.106 Tables H–18 and H–19, 1910.110 Table H–28, and 1910.178(c)(2)). In five other places in part 1910 (§§ 1910.106(b)(7)(iii)(*a*), 1910.179(g)(1)(i), 1910.252(a)(6)(iv)(*d*)(*2*), and 1910.261 (g)(1)(iv) and (k)(16)), the regulations contain inaccurate references to the electrical standards. OSHA proposed to revise these provisions so that they refer to subpart S. No objections were made to these proposed revisions, and the final rule adopts the revisions as proposed.

Other changes were proposed to consolidate electrical safety-related work practices in subpart S and, where possible, eliminate them from other subparts of part 1910 (§§ 1910.26(c)(3)(viii), 1910.67(b)(4), 1910.180(j), 1910.181(j)(5), 1910.265(c)(12), and 1910.266(c)(6)(xxii)). The United Steelworkers of America (USWA) objected to the proposed elimination of §§ 1910.26(c)(3)(viii), 1910.265(c)(12), and 1910.266(c)(6)(xxii) (Ex. 4–45).

Existing § 1910.26(c)(3)(viii), in subpart D of part 1910, reads as follows:

(viii) Users are cautioned to take proper safety measures when metal ladders are used in areas containing electric circuits to prevent short circuits or electrical shock.

The USWA believes that this regulation should not be eliminated because it is the only reference in the ladder standards to the hazard of using ladders near electric circuits.

Final § 1910.333 (c)(6) and (c)(7), in subpart S of part 1910, contain requirements for handling portable ladders near energized conductors, including a prohibition against using portable ladders with conductive side rails where an employee or the ladder might contact energized parts. The new subpart S requirements clearly provide better protection of employees than the existing subpart D provision. Therefore, the removal of existing § 1910.26(c)(3)(viii) is justified. However, rather than eliminate this paragraph entirely, the final rule has replaced this provision with a reference to the provisions of subpart S dealing with work performed on or near exposed energized electric circuit parts (which includes the requirement pertaining to the use of ladders). A reference to electrical hazards will thus be retained within the ladder standards themselves.

With respect to the removal of § 1910.265(c)(12), the USWA argued that paragraphs (c)(12) (iv), (vii), and (ix) are not specifically covered elsewhere. These three provisions read as follows:

§ 1910.265 Sawmills.

* * * * *

(c) * * *

(12) * * *

(iv) *Protective equipment.* Rubber protective equipment shall be provided as required by § 1910.137.

* * * * *

(vii) *Overload relays.* Overload relays shall be reset by authorized qualified personnel only.

* * * * *

(xi) *Bridging fuses.* Doubling or bridging fuses shall be prohibited.

Paragraph (c)(12)(iv) is simply a reference to § 1910.137, and the hazards addressed by this paragraph are clearly covered in § 1910.137.

The hazard addressed by paragraph (c)(12)(vii) is covered by new § 1910.334(b)(2), which requires a determination of the safety involved in resetting circuit protective devices. The existing regulation requires authorized qualified personnel to perform the resetting only; it does not require any determination of the safety of doing so. The new provision more directly addresses the hazard of resetting an overcurrent protective device when it is not safe to do so than the existing regulation.

Bridging fuses, the subject of § 1910.265(c)(12)(ix), is covered by new § 1910.334(b)(3). In fact, the new regulation prohibits any modification of overcurrent protection that would cause the protection to be inadequate. The old provision only prohibits bridging and doubling fuses. Clearly, the new requirement more effectively protects employees than existing § 1910.265(c)(12)(ix).

Existing § 1910.266(c)(6)(xxii) reads as follows:

§ 1910.266 Pulpwood logging.

* * * * *

(c) * * *

(6) * * *

(xxii) When any equipment is being moved or operated in the vicinity of an electric distribution line a minimum clearance of ten feet shall be maintained between the electric distribution line and all elements of the machine.

The hazard covered in this provision is better addressed by new § 1910.333(c)(3)(iii). The existing regulation only provides for a 10-foot clearance, without regard to the voltage on the line. The new requirement includes considerations, such as voltages greater than 50 kilovolts, deenergizing and guarding the power lines, and additional protective measures for personnel on the ground. Thus, the new rule provides far better protection for employees than the old one.

For these reasons, OSHA has decided to remove the existing provisions as proposed except that § 1910.26(c)(3)(viii) is revised to refer to new § 1910.333(c). The following regulations in the existing General Industry Standard are removed: §§ 1910.67(b)(4), 1910.180(j), 1910.181(j)(5), 1910.265(c)(12), and 1910.266(c)(6)(xxii).

The last proposed miscellaneous revision was to remove existing paragraph (b)(1) from § 1910.304. Since this provision relates only to construction work, its inclusion in the General Industry Standard is unnecessary. The same requirement is appropriately contained in § 1926.404(b)(1) of subpart K of part 1926, the Construction Safety and Health Standards. OSHA received no substantive objection to the removal of this provision; therefore, the final rule deletes paragraph (b)(1) of § 1910.304 from the General Industry Standards.

IV. Regulatory Impact Assessment

The final Regulatory Impact and Flexibility Analysis for the standard on electrical safety-related work practices for general industry was prepared in accordance with the requirements of Executive Order 12291 and the Regulatory Flexibility Act of 1980 (5 U.S.C. 601 *et seq.*). Since the standard is not likely: (1) To have an annual effect on the economy of $100 million; (2) to result in a major increase in costs or prices for consumers, industries, government agencies or geographic regions; or (3) to have significant adverse effects on competition, employment, investment, productivity, innovation, or the ability of United States-based enterprises to compete with foreign-based enterprises, the standard does not constitute a major rule under the cost criteria of Executive Order 12291. However, because of the wide ranging impact, OSHA is treating this standard as if it were a major rule.

A. Affected Industries

The standard will apply to every major standard industrial code (SIC) economic division with the exception of Agriculture, Construction and parts of Mining, Transportation, Communication and Public Utilities. Based on 1983–1987 data, covered industries accounted for about 4.6 million establishments.[18]

B. Benefits

The analysis of the benefits of the standard was based on annual data averaged from 1983 to 1987. OSHA found that under existing practices an average 92 deaths and 3,996 disabling and nondisabling injuries covered by this standard occurred annually between 1983 and 1987.

To estimate potential benefits of the standard or its probable effectiveness in preventing electrical contact injuries (e.g. shock, electrocution), an analysis of differential risk was performed. The analysis revealed that approximately 3,400 disabling and nondisabling injuries and 78 fatalities (at the 85 percent effectiveness level for this regulation) should be avoided each year after the rule is promulgated (see Table 5). In addition to the estimated 85 percent effectiveness level, a sensitivity analysis using 75 percent and 95 percent effectiveness rates is also presented.

[18] From this data, there are 1,005,558 "affected" establishments. See Table II-1 in the final Regulatory Impact Analysis, which is available to the public in the OSHA Docket Office.

TABLE 5.—REDUCTION IN INJURIES

Type of injury	Average annual elec. injuries in industries covered by the standard, 83–87	Average No. of electrical injuries caused by work practices (.75 fatal/.50 nonfatal)	Injuries averted		
			(0.75)	(0.85)	(0.95)
Nondisabling	4,320	2,160	1,620	1,836	2,052
Disabling	3,671	1,836	1,377	1,560	1,744
Fatal	122	92	69	78	87
Total Injuries	8,113	4,088	3,066	3,474	3,883

Source: U.S. Department of Labor, OSHA, Office of Regulatory Analysis.

C. Technical Feasibility and Costs

OSHA has determined that the standard is technologically feasible, as all of the provisions can be met by using currently available equipment.

Current practices are used for the cost analysis baseline. In estimating the industrywide costs of complying with the standard, it was assumed that workplaces would incur costs relating to:

—Providing appropriate training to employees, and
—Meeting the requirements of the lockout and tagging provision.

The first-year cost of the standard is estimated at $74.6 million (in 1989 dollars), with recurring annual costs totaling $20.3 million per year (in 1989 dollars) (see Table 6).

TABLE 6—COSTS OF TRAINING AND LOCKOUT/TAGOUT[a] (1989 DOLLARS)

Costs	First year ($000)	Annual recurring ($000)
Training	$71,520	$17,880
Lockout/tagout	3,092	2,454
Total	74,613	20,334

[a] Numbers may not add exactly due to rounding.
Source: U.S. Department of Labor, OSHA, Office of Regulatory Analysis.

TABLE 7.—OCCUPATIONS REQUIRING TRAINING

Training category—Estimated time required	Occupation	Population to be trained [1]
High level training	Electrical Assemblers [2]	124,250
	Machine Assemblers	49,224
	Electricians	165,669
	Stationary Engineers [2]	13,956
	AC/Heating/Refrig Mech/Install	67,028
	Industrial Machinery Mechanics	342,453
	Precision Instrument Repairers	42,239
	Maintenance Repairers, Gen Util	817,232
1½ hours	All Other Elec Mech/Install/Rep	33,095
	Radio Mechanics	4,047
	Electronic Home Enter Equip Rep	36,690
	Electronic Rep, Com/Ind Equip	34,914
	Electronic Technician [2]	147,613
	Crane and Tower Operators	45,929
Subtotal		1,924,392
Average level training	Home Appl and Power Tool Rep	66,220
	Office Machine Servicers	52,520
	Blue Collar Worker Supervisors [3]	294,150
	Gas and Petroleum Plant Occup [3]	7,538
1 hour	Subtotal	420,427
Minimal level training	Welders and Cutters [3]	56,194
	Roustabouts [3]	23,681
	Truck Drivers—Light & Heavy [3]	459,842
	Painters and Paper Hangers [3]	34,268
	Industrial Machine Operators [3]	190,349
½ hour	Riggers [3]	2,416
	Electrical Engineers [3]	170,960
Subtotal		937,610
Total		3,282,429

[1] U.S. Department of Labor, Bureau of Labor Statistics, *National OES Survey-Based Matrix, Industry-Occupation Employment*, for the years 1984, 1986, and 1988.
[2] Population to be trained represents 50 percent of all employees in this occupation.
[3] Population to be trained represents 25 percent of all employees in this occupation.

The allocation of training costs for OSHA's electrical safety work practices standard is based on the categorization of occupations according to the actual or potential risk of injury associated with working on or near exposed live electrical circuitry. Occupations were grouped into high, average, and minimal level training categories based on the level of worker exposure to electrical hazards and on the incidence rate of electrical injuries per occupation (see Table 7).

Populations to be trained were taken from the BLS *National OES Survey-Based Matrix, Industry-Occupation Employment*, for the years 1984, 1986, and 1988. Incidence rates were derived from Bureau of Labor Statistics Supplementary Data System data, Department of Labor Fatality/Catastrophe and Underwriters Laboratories (UL) electrical injury reports were also used to determine, quantitatively, occupations with high electrical hazard exposures. For example, of 208 serious electrical injury and death reports, Electricians accounted for 47; these occupations were placed in the high level training category. In the minimal level training category, Welders and Cutters accounted for 12 injuries and deaths and Truck Drivers accounted for 15. The UL and Fatality/Catastrophe data sets were generally consistent with the SDS-generated injury incidence rates; occupations with a high incidence rate of electrical injury accounted for a relatively large proportion of the Fatality/Catastrophe and UL reports, and occupations with a low SDS incidence rate generally accounted for fewer injuries.

Occupations were placed in the three categories (high, average, and minimal level training) based largely on their electrical injury incidence rates. However, some occupations with relatively low incidence rates were placed in a higher category because of the degree of their exposure to electrical hazards. For example, electronic technicians and radio mechanics had an incidence rate that would have placed them in the minimal level training group, but their high exposure to electrical

hazards prompted OSHA to place them in the high level training category for the purposes of the regulatory analysis.[17]

Based on this categorization scheme, one and a half hours of training would be needed for the 1,924,392 employees in the high level training category, one hour of training for the 420,431 employees in average level training jobs, and one-half hour of training for the 937,610 employees in the minimal level training category (Table 7). This training will be in addition to that already received under current practices for each of the listed occupations. For example, electricians currently receive extensive training, usually requiring an apprenticeship during the first years of work. This occupational group would require an hour and a half of additional training pertaining to electrical work practices covered under this standard.

Paragraph (b) of section 1910.333 establishes requirements pertaining to work performed on or near deenergized electrical circuits. Costs will be incurred in the purchase of locks and tags and also from the execution of the lockout/tagout procedure. The sum of the industrywide costs for locks and tags and for the execution of the procedure yields a total first year lockout/tagout cost of $3,092,470.

OSHA did not calculate the cost of procuring electrical protective equipment for compliance with the standard. Employers are already required to have adequate supplies of rubber insulating equipment by Section 1910.132.[18] Therefore, OSHA has concluded that the standard will not result in a significant purchase of additional protective equipment.

D. Economic Feasibility and Impacts

OSHA has also determined that the standard will be economically feasible. The potential impacts of compliance on individual firms were evaluated by using financial models of firms in two industries. Industries selected represented a range of diversity with respect to the degree of electrical hazards present and the amount of effort required to comply with the standard. The first-year model firm costs ranged from $37 to $82 for small firms and from $451 to $1,825 for large firms. The analysis revealed that even if the entire cost of compliance were passed forward, the impact on prices would be extremely small. With respect to the standard's potential impact on the profitability of firms, the analysis showed that even if the compliance costs were fully absorbed, profitability as measured by return on assets and profit margin would not be significantly reduced. None of the reductions would exceed 0.70 percent.

E. Regulatory Flexibility Certification

Pursuant to the Regulatory Flexibility Act of 1980 (5 U.S.C. 601 *et seq.*), OSHA has assessed the impact of the standard and certifies that it will not have a significant impact on a substantial number of small entities. The majority of the firms subject to the standard are small. Using a definition of a small firm as one that employs fewer than 20 workers, about 84 percent of all the covered firms fall into the "small" category. The estimated cost of compliance with the standard, however, would result in less than a 0.20 percent decrease in profitability. OSHA has determined that, although many small firms will be affected by the standard, the costs will be easily absorbed and there will be no significant or disproportionate impact on small entities.

F. Environmental Effects

The standard's provisions 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 regulations of the Council on Environmental Quality (40 CFR parts 1500–1517), and the Department of Labor's NEPA Procedures (29 CFR part 11). As a result of this review, OSHA has determined that these provisions will have no significant effect on air, water or soil quality, plant or animal life, on the use of land, or other aspects of the environment.

G. Regulatory Impact Analysis

The preceding discussion summarizes the key findings of the final Regulatory Impact Analysis (RIA) of the amendment to subpart S, part 1910, prepared by the Office of Regulatory Analysis of the Occupational Safety and Health Administration. The RIA includes assessments of estimated compliance costs, estimated benefits, risks, small business impact, alternative regulatory and nonregulatory options and a profile of the industry. The RIA is based on contract work performed for OSHA by JACA Corp. Their report (Ex. 1), "Regulatory Assessment of the Impact of the Proposed Electrical Safety-Related Work Practices Standard, Final Report", January 20, 1984, and OSHA's final Regulatory Impact Analysis are available to the public in the OSHA Docket Office.

V. International Trade

Increases in the price of domestically manufactured goods in general result in an increase in the demand for imports, and a decrease in the demand for exports. The magnitude of this impact depends on the relevant demand elasticities and the magnitude of the price changes. While the final standard may result in slightly higher prices of manufactured goods, the estimated magnitude of this increase is so small that the Agency has concluded that any resultant impact on foreign trade will be negligible.

VI. Recordkeeping

The standard references the requirements for safety signs and tags contained in existing § 1910.145. The paperwork requirements of § 1910.145 are currently approved by the Office of Management and Budget in accordance with the Paperwork Reduction Act of 1980 under OMB control number 1218–0132.

VII. Effective Date

In developing the Final Rule, OSHA has considered whether a delayed effective date is necessary for any of the provisions of the standard. Employers will need adequate time to integrate their procedures for complying with the lockout and tagging provisions in this standard into the procedures used under the generic lockout standard, § 1910.147, published on September 1, 1989 (54 FR 36644). The generic lockout standard became effective on January 2, 1990. A period of 120 days should be adequate for this purpose, since the Final Rule does not require extensive retrofitting or major modifications of existing equipment. The Agency believes that 120 days is also adequate time for employers to obtain the necessary hardware needed for compliance with the new standard (primarily locks and tags). Lastly, this amount of time should be adequate for employers to ensure that their work practices conform to the requirements of the new standard.

However, OSHA received some evidence during the rulemaking that it could take some employers a year or more to incorporate the training required by the standard into their existing training programs. For example, Mr. Lamont Turner, testifying on behalf of Edison Electric Institute, stated that it took his company 15 months to restructure their training program in

[17] See the final Regulatory Impact Analysis, which is available to the public in the Docket Office, for a complete discussion of the placement of occupations into each category and for a listing of the actual electrical injury incidence rates for those occupations.

[18] The rulemaking record contained no evidence indicating that employers had insufficient supplies of protective equipment to meet the standard.

order to meet regulations on hazardous waste (Tr. 2–178). Therefore, OSHA is making the requirements on training contained in § 1910.332 effective one year from the date of publication of the standard.

VIII. List of Index Terms

Electric power; fire prevention; flammable materials; occupational safety and health; Occupational Safety and Health Administration; safety; signs and symbols; and tools.

IX. Federalism

This Final Rule has been reviewed in accordance with Executive Order 12612 (52 FR 41685, October 30, 1987), regarding Federalism. This Order requires that agencies, to the extent possible, refrain from limiting state policy options, consult with states before taking any actions which would restrict state policy options, and take such actions only if 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 Occupational Safety and Health Act (OSH Act) expresses Congress' clear intent to preempt state laws relating to issues on which Federal OSHA has promulgated occupational safety and health standards. Under the OSH Act, a state can avoid preemption only if it submits, and obtains Federal approval of, a plan for the development of such standards and their enforcement. 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. Where such standards are applicable to products distributed or used in interstate commerce, they may not unduly burden commerce and must be justified by compelling local conditions. (See section 18(c)(2) of the OSH Act.)

The Federal standard on electrical safety-related work practices addresses hazards which are not unique to any one state or region of the country. Nonetheless, states with occupational safety and health plans approved under section 18 of the OSH Act will be able to develop their own state standards to deal with any special problems which might be encountered in a particular state. Moreover, because this standard is written in general, performance-oriented terms, there is considerable flexibility for state plans to require, and for affected employers to use, methods of compliance which are appropriate to the working conditions covered by the standard.

In brief, this Final Rule addresses a clear national problem related to occupational safety and health in general industry. States which have elected to participate under section 18 of the OSH Act are not preempted by this standard and will be able to address any special conditions within the framework of the Federal Act, while ensuring that the state standards are at least as effective as this standard.

X. State Plan Standards

The 23 states and 2 territories with their own OSHA approved occupational safety and health plans must adopt a comparable standard within 6 months of the publication date of the final standard. These states and territories are: Alaska, Arizona, California, Connecticut,[19] Hawaii, Indiana, Iowa, Kentucky, Maryland, Michigan, Minnesota, Nevada, New Mexico, New York,[20] North Carolina, Oregon, Puerto Rico, South Carolina, Tennessee, Utah, Vermont, Virginia, Virgin Islands, Washington, and Wyoming. Until such time as a state standard is promulgated, Federal OSHA will provide interim enforcement assistance, as appropriate, in these states.

XI. Authority

This document was prepared under the direction of G.F. Scannell, Assistant Secretary of Labor for Occupational Safety and Health, U.S. Department of Labor, 200 Constitution Avenue NW., Washington, DC 20210.

Accordingly, 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. 9–83 (48 FR 35736), and 29 CFR part 1911, 29 CFR part 1910 is amended as set forth below.

Signed at Washington, DC, this 27th day of July 1990.

G.F. Scannell,

Assistant Secretary of Labor.

Part 1910 of title 29 of the Code of Federal Regulations is amended as follows:

PART 1910—[AMENDED]

1. The authority citation for subpart D of part 1910 continues to read as follows:

Authority: Secs. 4, 6, 8, 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), or 9–83 (48 FR 35736), as applicable. Sections 1910.23, 1910.24, 1910.25, 1910.26, and 1910.28 also issued under 29 CFR part 1911.

2. Paragraph (c)(3)(viii) of § 1910.26 is revised to read as follows:

§ 19.10.26 Portable metal ladders.

* * * * *

(c) * * *

(3) * * *

(viii) See § 1910.333(c) for work practices to be used when work is performed on or near electric circuits.

Subpart F—Authority [Amended]

3. The authority citation for subpart F of part 1910 continues to read as follows:

Authority: Secs. 4, 6, 8, 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), or 9–83 (48 FR 35736), as applicable. Sections 1910.66, 1910.67, 1910.68, and 1910.70 also issued under 29 CFR part 1911.

4. Entire paragraph (b)(4) of § 1910.67 is revised to read as follows:

§ 1910.67 Vehicle-mounted elevating and rotating work platforms.

* * * * *

(b) * * *

(4) For operations near overhead electric lines, see § 1910.333(c)(3).

* * * * *

5. Paragraphs (b)(4) and (c)(5)(iv)(c) of § 1910.68 are revised to read as follows:

§ 1910.68 Manlifts.

* * * * *

(b) * * *

(4) *Reference to other codes and subparts.* The following codes, and subparts of this part, are applicable to this section: Safety Code for Mechanical Power Transmission Apparatus, ANSI B15.1–1953 (R 1953), and subpart O; subpart S; Safety Code for Fixed Ladders, ANSI A14.3–1956, and Safety Requirements for Floor and Wall Openings, Railings and Toeboards, ANSI A12.1–1967, and subpart D.

* * * * *

(c) * * *

(5) * * *

(iv) * * *

(c) Where flammable vapors or combustible dusts may be present, electrical installations shall be in accordance with the requirements of subpart S of this part for such locations.

* * * * *

[19] Plan covers only State and local government employees.

[20] Plan covers only State and local government employees.

Subpart G—Authority [Amended]

6. The authority citation for subpart G of part 1910 continues to read as follows:

Authority: Secs. 4, 6, 8, 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), or 9–83 (48 FR 35736), as applicable. Sections 1910.94 and 1910.99 also issued under 29 CFR part 1911.

§ 1910.94 [Amended]

7. The words: "the National Electrical Code, NFPA 70–1971; ANSI C1–1971 (Rev. of C1–1968)" are removed from paragraph (a)(2)(iii) of § 1910.94 and are replaced with: "Subpart S of this part."

Subpart H—Authority [Amended]

8. The authority citation for subpart H of part 1910 is revised to read as follows:

Authority: Secs. 4, 6, 8, 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), or 9–83 (48 FR 35736), as applicable. Sections 1910.103, 1910.106, 1910.107, 1910.108, 1910.109, and 1910.110 also issued under 29 CFR part 1911.

Section 1910.120 issued under the authority of section 126 of the Superfund Amendments and Reauthorization Act of 1986 as amended (29 U.S.C. 655 note), secs. 6 and 8 of the Occupational Safety and Health Act of 1970 (29 U.S.C. 655, 657), secs. 4 of the Administrative Procedure Act (5 U.S.C. 553), 29 CFR part 1911, and Secretary of Labor's Order 9–83 (48 FR 35736).

9. Paragraph (b)(3)(iii)(*e*) of § 1910.103 is revised to read as follows:

§ 1910.103 Hydrogen.

* * * * *

(b) * * *

(3) * * *

(iii) * * *

(*e*) Electric equipment shall be in accordance with the requirements of subpart S of this part for Class I, Division 2 locations.

* * * * *

10. Section 1910.106 is amended to remove the acronym "NEC" from the boxheads in Tables H–18 and H–19, and paragraph (h)(7)(iii)(*a*) is revised to read as follows:

§ 1910.106 Flammable and combustible liquids.

* * * * *

(h) * * *

(7) * * *

(iii) *Electrical.* (*a*) All electric wiring and equipment shall be installed in accordance with subpart S of this part.

* * * *

§ 1910.110 [Amended]

11. The words "National Electrical Code" are removed from the boxhead in Table H–28 in § 1910.110.

Subpart N—Authority [Amended]

12. The authority citation for subpart N of part 1910 continues to read as follows:

Authority: Secs. 4, 6, 8, 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), or 9–83 (48 FR 35736), as applicable. Sections 1910.177, 1910.178, 1910.179, 1910.183, 1910.184, 1910.189, and 1910.190 also issued under 29 CFR part 1911.

13. The introductory text of paragraph (c)(2) of § 1910.178 is revised to read as follows:

§ 1910.178 Powered industrial trucks.

* * * * *

(c) * * *

(2) For specific areas of use, see Table N–1 which tabulates the information contained in this section. References are to the corresponding classification as used in subpart S of this part.

* * * * *

14. Paragraph (g)(1)(i) of § 1910.179 is revised to read as follows:

§ 1910.179 Overhead and gantry cranes.

* * * * *

(g) *Electric equipment*—(1) *General.* (i) Wiring and equipment shall comply with subpart S of this part.

* * * * *

15. Paragraph (j) of § 1910.180 is revised to read as follows:

§ 1910.180 Crawler, locomotive, and truck cranes.

* * * * *

(j) *Operations near overhead lines.* For operations near overhead electric lines, see § 1910.333(c)(3).

16. Entire paragraph (j)(5) of § 1910.181 is revised to read as follows:

§ 1910.181 Derricks.

* * * * *

(j) * * *

(5) *Operations near overhead lines.* For operations near overhead electric lines, see § 1910.333(c)(3).

* * * * *

Subpart Q—Authority [Amended]

17. The authority citation for subpart Q of part 1910 continues to read as follows:

Authority: Secs. 4, 6, 8, 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), or 1–90 (55 FR 9033), as applicable; 5 U.S.C. 553; 29 CFR part 1911.

18. Paragraph (f)(4)(iv)(B) of § 1910.252 is revised to read as follows:

§ 1910.252 Welding cutting, and brazing.

(f) * * *

(4) * * *

(iv) * * *

(B) Wiring and electric equipment in compressor or booster pump rooms or enclosures shall conform to the provisions of subpart S of this part for Class I, Division 2 locations.

* * * * *

Subpart R—Authority [Amended]

19. The authority citation for Subpart R of part 1910 is revised to read as follows:

Authority: Secs. 4, 6, 8, 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), or 9–83 (48 FR 35736), as applicable. Sections 1910.261, 1910.262, 1910.265, 1910.266, 1910.267, 1910.268, 1910.272, 1910.274, and 1910.275 also issued under 29 CFR part 1911.

20. Paragraphs (g)(1)(iv) and (k)(16) of § 1910.261 are revised to read as follows:

§ 1910.261 Pulp, paper, and paperboard mills.

* * * * *

(g) * * *

(1) * * *

(iv) Electric equipment shall be of the explosion-proof type, in accordance with the requirements of subpart S of this part.

* * * * *

(k) * * *

(16) *Grounding.* All calender stacks and spreader bars shall be grounded in accordance with subpart S of this Part as protection against shock induced by static electricity.

* * * * *

§ 1910.265 [Amended]

21. Paragraph (c)(12) of § 1910.265 is removed and reserved.

§ 1910.266 [Amended]

22. Paragraph (c)(6)(xxii) of § 1910.266 is removed.

Subpart S—Authority [Amended]

23. The Authority Citation for subpart S of part 1910 is revised to read as follows:

Authority: Secs. 4, 6, 8, Occupational Safety and Health Act of 1970 (29 U.S.C. 653, 655, 657); Secretary of Labor's Order No. 8–76 (41 FR 25059) or 9–83 (48 FR 35736), as applicable; 29 CFR part 1911.

§ 1910.304 [Amended]

24. Entire paragraph (b)(1) of § 1910.304 is removed and reserved.

25. Sections 1910.331 through 1910.335 are added to Subpart S to read as follows:

Safety-Related Work Practices

§ 1910.331 Scope.

(a) *Covered work by both qualified and unqualified persons.* The provisions of §§ 1910.331 through 1910.335 cover electrical safety-related work practices for both qualified persons (those who have training in avoiding the electrical hazards of working on or near exposed energized parts) and unqualified persons (those with little or no such training) working on, near, or with the following installations:

(1) *Premises wiring.* Installations of electric conductors and equipment within or on buildings or other structures, and on other premises such as yards, carnival, parking, and other lots, and industrial substations;

(2) *Wiring for connection to supply.* Installations of conductors that connect to the supply of electricity; and

(3) *Other wiring.* Installations of other outside conductors on the premises.

(4) *Optical fiber cable.* Installations of optical fiber cable where such installations are made along with electric conductors.

Note: See § 1910.399 for the definition of "qualified person." See § 1910.332 for training requirements that apply to qualified and unqualified persons.

(b) *Other covered work by unqualified persons.* The provisions of §§ 1910.331 through 1910.335 also cover work performed by unqualified persons on, near, or with the installations listed in paragraphs (c)(1) through (c)(4) of this section.

(c) *Excluded work by qualified persons.* The provisions of §§ 1910.331 through 1910.335 do not apply to work performed by qualified persons on or directly associated with the following installations:

(1) *Generation, transmission, and distribution installations.* Installations for the generation, control, transformation, transmission, and distribution of electric energy (including communication and metering) located in buildings used for such purposes or located outdoors.

Note 1: Work on or directly associated with installations of utilization equipment used for purposes other than generating, transmitting, or distributing electric energy (such as installations which are in office buildings, warehouses, garages, machine shops, or recreational buildings, or other utilization installations which are not an integral part of a generating installation, substation, or control center) is covered under paragraph (a)(1) of this section.

Note 2: Work on or directly associated with generation, transmission, or distribution installations includes:

(1) Work performed directly on such installations, such as repairing overhead or underground distribution lines or repairing a feed-water pump for the boiler in a generating plant.

(2) Work directly associated with such installations, such as line-clearance tree trimming and replacing utility poles.

(3) Work on electric utilization circuits in a generating plant provided that:

(A) Such circuits are commingled with installations of power generation equipment or circuits, and

(B) The generation equipment or circuits present greater electrical hazards than those posed by the utilization equipment or circuits (such as exposure to higher voltages or lack of overcurrent protection).

(2) *Communications installations.* Installations of communication equipment to the extent that the work is covered under § 1910.268.

(3) *Installations in vehicles.* Installations in ships, watercraft, railway rolling stock, aircraft, or automotive vehicles other than mobile homes and recreational vehicles.

(4) *Railway installations.* Installations of railways for generation, transformation, transmission, or distribution of power used exclusively for operation of rolling stock or installations of railways used exclusively for signaling and communication purposes.

§ 1910.332 Training.

(a) *Scope.* The training requirements contained in this section apply to employees who face a risk of electric shock that is not reduced to a safe level by the electrical installation requirements of §§ 1910.303 through 1910.308.

Note: Employees in occupations listed in Table S–4 face such a risk and are required to be trained. Other employees who also may reasonably be expected to face a comparable risk of injury due to electric shock or other electrical hazards must also be trained.

(b) *Content of training.* (1) *Practices addressed in this standard.* Employees shall be trained in and familiar with the safety-related work practices required by §§ 1910.331 through 1910.335 that pertain to their respective job assignments.

(2) *Additional requirements for unqualified persons.* Employees who are covered by paragraph (a) of this section but who are not qualified persons shall also be trained in and familiar with any electrically related safety practices not specifically addressed by §§ 1910.331 through 1910.335 but which are necessary for their safety.

(3) *Additional requirements for qualified persons.* Qualified persons (i.e., those permitted to work on or near exposed energized parts) shall, at a minimum, be trained in and familiar with the following:

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

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

(iii) The clearance distances specified in § 1910.333(c) and the corresponding voltages to which the qualified person will be exposed.

Note 1: For the purposes of §§ 1910.331 through 1910.335, a person must have the training required by paragraph (b)(3) of this section in order to be considered a qualified person.

Note 2: Qualified persons whose work on energized equipment involves either direct contact or contact by means of tools or materials must also have the training needed to meet § 1910.333(c)(2).

(c) *Type of training.* The training required by this section shall be of the classroom or on-the-job type. The degree of training provided shall be determined by the risk to the employee.

TABLE S–4.—TYPICAL OCCUPATIONAL CATEGORIES OF EMPLOYEES FACING A HIGHER THAN NORMAL RISK OF ELECTRICAL ACCIDENT

Occupation
Blue collar supervisors.[1]
Electrical and electronic engineers.[1]
Electrical and electronic equipment assemblers.[1]
Electrical and electronic technicians.[1]
Electricians.
Industrial machine operators.[1]
Material handling equipment operators.[1]
Mechanics and repairers.[1]
Painters.[1]
Riggers and roustabouts.[1]
Stationary engineers.[1]
Welders.

[1] Workers in these groups do not need to be trained if their work or the work of those they supervise does not bring them or the employees they supervise close enough to exposed parts of electric circuits operating at 50 volts or more to ground for a hazard to exist.

§ 1910.333 Selection and use of work practices.

(a) *General.* Safety-related work practices shall be employed to prevent electric shock or other injuries resulting from either direct or indirect electrical contacts, when work is performed near or on equipment or circuits which are or may be energized. The specific safety-related work practices shall be

consistent with the nature and extent of the associated electrical hazards.

(1) *Deenergized parts.* Live parts to which an employee may be exposed shall be deenergized before the employee works on or near them, unless the employer can demonstrate that deenergizing introduces additional or increased hazards or is infeasible due to equipment design or operational limitations. Live parts that operate at less than 50 volts to ground need not be deenergized if there will be no increased exposure to electrical burns or to explosion due to electric arcs.

Note 1: Examples of increased or additional hazards include interruption of life support equipment, deactivation of emergency alarm systems, shutdown of hazardous location ventilation equipment, or removal of illumination for an area.

Note 2: Examples of work that may be performed on or near energized circuit parts because of infeasibility due to equipment design or operational limitations include testing of electric circuits that can only be performed with the circuit energized and work on circuits that form an integral part of a continuous industrial process in a chemical plant that would otherwise need to be completely shut down in order to permit work on one circuit or piece of equipment.

Note 3: Work on or near deenergized parts is covered by paragraph (b) of this section.

(2) *Energized parts.* If the exposed live parts are not deenergized (i.e., for reasons of increased or additional hazards or infeasibility), other safety-related work practices shall be used to protect employees who may be exposed to the electrical hazards involved. Such work practices shall protect employees against contact with energized circuit parts directly with any part of their body or indirectly through some other conductive object. The work practices that are used shall be suitable for the conditions under which the work is to be performed and for the voltage level of the exposed electric conductors or circuit parts. Specific work practice requirements are detailed in paragraph (c) of this section.

(b) *Working on or near exposed deenergized parts.* (1) *Application.* This paragraph applies to work on exposed deenergized parts or near enough to them to expose the employee to any electrical hazard they present. Conductors and parts of electric equipment that have been deenergized but have not been locked out or tagged in accordance with paragraph (b) of this section shall be treated as energized parts, and paragraph (c) of this section applies to work on or near them.

(2) *Lockout and tagging.* While any employee is exposed to contact with parts of fixed electric equipment or circuits which have been deenergized, the circuits energizing the parts shall be locked out or tagged or both in accordance with the requirements of this paragraph. The requirements shall be followed in the order in which they are presented (i.e., paragraph (b)(2)(i) first, then paragraph (b)(2)(ii), etc.).

Note 1: As used in this section, fixed equipment refers to equipment fastened in place or connected by permanent wiring methods.

Note 2: Lockout and tagging procedures that comply with paragraphs (c) through (f) of § 1910.147 will also be deemed to comply with paragraph (b)(2) of this section provided that:

(1) The procedures address the electrical safety hazards covered by this Subpart; and

(2) The procedures also incorporate the requirements of paragraphs (b)(2)(iii)(D) and (b)(2)(iv)(B) of this section.

(i) *Procedures.* The employer shall maintain a copy of the procedures outlined in paragraph (b)(2) and shall make it available for inspection by employees and by the Assistant Secretary of Labor and his or her authorized representatives.

Note: The written procedures may be in the form of a copy of paragraph (b) of this section.

(ii) *Deenergizing equipment.* (A) Safe procedures for deenergizing circuits and equipment shall be determined before circuits or equipment are deenergized.

(B) The circuits and equipment to be worked on shall be disconnected from all electric energy sources. Control circuit devices, such as push buttons, selector switches, and interlocks, may not be used as the sole means for deenergizing circuits or equipment. Interlocks for electric equipment may not be used as a substitute for lockout and tagging procedures.

(C) Stored electric energy which might endanger personnel shall be released. Capacitors shall be discharged and high capacitance elements shall be short-circuited and grounded, if the stored electric energy might endanger personnel.

Note: If the capacitors or associated equipment are handled in meeting this requirement, they shall be treated as energized.

(D) Stored non-electrical energy in devices that could reenergize electric circuit parts shall be blocked or relieved to the extent that the circuit parts could not be accidentally energized by the device.

(iii) *Application of locks and tags.* (A) A lock and a tag shall be placed on each disconnecting means used to deenergize circuits and equipment on which work is to be performed, except as provided in paragraphs (b)(2)(iii)(C) and (b)(2)(iii)(E) of this section. The lock shall be attached so as to prevent persons from operating the disconnecting means unless they resort to undue force or the use of tools.

(B) Each tag shall contain a statement prohibiting unauthorized operation of the disconnecting means and removal of the tag.

(C) If a lock cannot be applied, or if the employer can demonstrate that tagging procedures will provide a level of safety equivalent to that obtained by the use of a lock, a tag may be used without a lock.

(D) A tag used without a lock, as permitted by paragraph (b)(2)(iii)(C) of this section, shall be supplemented by at least one additional safety measure that provides a level of safety equivalent to that obtained by the use of a lock. Examples of additional safety measures include the removal of an isolating circuit element, blocking of a controlling switch, or opening of an extra disconnecting device.

(E) A lock may be placed without a tag only under the following conditions:

(*1*) Only one circuit or piece of equipment is deenergized, and

(*2*) The lockout period does not extend beyond the work shift, and

(*3*) Employees exposed to the hazards associated with reenergizing the circuit or equipment are familiar with this procedure.

(iv) Verification of deenergized condition. The requirements of this paragraph shall be met before any circuits or equipment can be considered and worked as deenergized.

(A) A qualified person shall operate the equipment operating controls or otherwise verify that the equipment cannot be restarted.

(B) A qualified person shall use test equipment to test the circuit elements and electrical parts of equipment to which employees will be exposed and shall verify that the circuit elements and equipment parts are deenergized. The test shall also determine if any energized condition exists as a result of inadvertently induced voltage or unrelated voltage backfeed even though specific parts of the circuit have been deenergized and presumed to be safe. If the circuit to be tested is over 600 volts, nominal, the test equipment shall be checked for proper operation immediately before and immediately after this test.

(v) Reenergizing equipment. These requirements shall be met, in the order given, before circuits or equipment are re-energized, even temporarily.

(A) A qualified person shall conduct tests and visual inspections, as

necessary, to verify that all tools, electrical jumpers, shorts, grounds, and other such devices have been removed, so that the circuits and equipment can be safely energized.

(B) Employees exposed to the hazards associated with reenergizing the circuit or equipment shall be warned to stay clear of circuits and equipment.

(C) Each lock and tag shall be removed by the employee who applied it or under his or her direct supervision. However, if this employee is absent from the workplace, then the lock or tag may be removed by a qualified person designated to perform this task provided that:

(*1*) The employer ensures that the employee who applied the lock or tag is not available at the workplace, and

(*2*) The employer ensures that the employee is aware that the lock or tag has been removed before he or she resumes work at that workplace.

(D) There shall be a visual determination that all employees are clear of the circuits and equipment.

(c) *Working on or near exposed energized parts. (1) Application.* This paragraph applies to work performed on exposed live parts (involving either direct contact or contact by means of tools or materials) or near enough to them for employees to be exposed to any hazard they present.

(2) *Work on energized equipment.* Only qualified persons may work on electric circuit parts or equipment that have not been deenergized under the procedures of paragraph (b) of this section. Such persons shall be capable of working safely on energized circuits and shall be familiar with the proper use of special precautionary techniques, personal protective equipment, insulating and shielding materials, and insulated tools.

(3) *Overhead lines.* If work is to be performed near overhead lines, the lines shall be deenergized and grounded, or other protective measures shall be provided before work is started. If the lines are to be deenergized, arrangements shall be made with the person or organization that operates or controls the electric circuits involved to deenergize and ground them. If protective measures are provided such as guarding, isolating, or insulating, these precautions shall prevent employees from contacting such lines directly with any part of their body or indirectly through conductive materials, tools, or equipment.

Note: The work practices used by qualified persons installing insulating devices on overhead power transmission or distribution lines are not covered by §§ 1910.332 through 1910.335. Under paragraph (c)(2) of this section, unqualified persons are prohibited from performing this type of work.

(i) *Unqualified persons.* (A) When an unqualified person is working in an elevated position near overhead lines, the location shall be such that the person and the longest conductive object he or she may contact cannot come closer to any unguarded, energized overhead line than the following distances:

(*1*) For voltages to ground 50kV or below—10 ft. (305 cm);

(*2*) For voltages to ground over 50kV—10 ft. (305 cm) plus 4 in. (10 cm) for every 10kV over 50kV.

(B) When an unqualified person is working on the ground in the vicinity of overhead lines, the person may not bring any conductive object closer to unguarded, energized overhead lines than the distances given in paragraph (c)(3)(i)(A) of this section.

Note: For voltages normally encountered with overhead power lines, objects which do not have an insulating rating for the voltage involved are considered to be conductive.

(ii) *Qualified persons.* When a qualified person is working in the vicinity of overhead lines, whether in an elevated position or on the ground, the person may not approach or take any conductive object without an approved insulating handle closer to exposed energized parts than shown in Table S–5 unless:

(A) The person is insulated from the energized part (gloves, with sleeves if necessary, rated for the voltage involved are considered to be insulation of the person from the energized part on which work is performed), or

(B) The energized part is insulated both from all other conductive objects at a different potential and from the person, or

(C) The person is insulated from all conductive objects at a potential different from that of the energized part.

TABLE S–5.—APPROACH DISTANCES FOR QUALIFIED EMPLOYEES ALTERNATING CURRENT

Voltage range (phase to phase)	Minimum approach distance
300V and less	Avoid contact.
Over 300V, not over 750V.	1 ft. 0 in. (30.5 cm).
Over 750V, not over 2kV	1 ft. 6 in. (46 cm).
Over 2kV, not over 15kV	2 ft. 0 in. (61 cm).
Over 15kV, not over 37kV.	3 ft. 0 in. (91 cm).
Over 37kV, not over 87.5kV.	3 ft. 6 in. (107 cm).
Over 87.5kV, not over 121kV.	4 ft. 0 in. (122 cm).
Over 121kV, not over 140kV.	4 ft. 6 in. (137 cm).

(iii) *Vehicular and mechanical equipment.* (A) Any vehicle or mechanical equipment capable of having parts of its structure elevated near energized overhead lines shall be operated so that a clearance of 10 ft. (305 cm) is maintained. If the voltage is higher than 50kV, the clearance shall be increased 4 in. (10 cm) for every 10kV over that voltage. However, under any of the following conditions, the clearance may be reduced:

(*1*) If the vehicle is in transit with its structure lowered, the clearance may be reduced to 4 ft. (122 cm). If the voltage is higher than 50kV, the clearance shall be increased 4 in. (10 cm) for every 10kV over that voltage.

(*2*) If insulating barriers are installed to prevent contact with the lines, and if the barriers are rated for the voltage of the line being guarded and are not a part of or an attachment to the vehicle or its raised structure, the clearance may be reduced to a distance within the designed working dimensions of the insulating barrier.

(*3*) If the equipment is an aerial lift insulated for the voltage involved, and if the work is performed by a qualified person, the clearance (between the uninsulated portion of the aerial lift and the power line) may be reduced to the distance given in Table S–5.

(B) Employees standing on the ground may not contact the vehicle or mechanical equipment or any of its attachments, unless:

(*1*) The employee is using protective equipment rated for the voltage; or

(*2*) The equipment is located so that no uninsulated part of its structure (that portion of the structure that provides a conductive path to employees on the ground) can come closer to the line than permitted in paragraph (c)(3)(iii) of this section.

(C) If any vehicle or mechanical equipment capable of having parts of its structure elevated near energized overhead lines is intentionally grounded, employees working on the ground near the point of grounding may not stand at the grounding location whenever there is a possibility of overhead line contact. Additional precautions, such as the use of barricades or insulation, shall be taken to protect employees from

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

(4) *Illumination.* (i) Employees may not enter spaces containing exposed energized parts, unless illumination is provided that enables the employees to perform the work safely.

(ii) Where lack of illumination or an obstruction precludes observation of the work to be performed, employees may not perform tasks near exposed energized parts. Employees may not reach blindly into areas which may contain energized parts.

(5) *Confined or enclosed work spaces.* When an employee works in a confined or enclosed space (such as a manhole or vault) that contains exposed energized parts, the employer shall provide, and the employee shall use, protective shields, protective barriers, or insulating materials as necessary to avoid inadvertent contact with these parts. Doors, hinged panels, and the like shall be secured to prevent their swinging into an employee and causing the employee to contact exposed energized parts.

(6) *Conductive materials and equipment.* Conductive materials and equipment that are in contact with any part of an employee's body shall be handled in a manner that will prevent them from contacting exposed energized conductors or circuit parts. If an employee must handle long dimensional conductive objects (such as ducts and pipes) in areas with exposed live parts, the employer shall institute work practices (such as the use of insulation, guarding, and material handling techniques) which will minimize the hazard.

(7) *Portable ladders.* Portable ladders shall have nonconductive siderails if they are used where the employee or the ladder could contact exposed energized parts.

(8) *Conductive apparel.* Conductive articles of jewelry and clothing (such as watch bands, bracelets, rings, key chains, necklaces, metalized aprons, cloth with conductive thread, or metal headgear) may not be worn if they might contact exposed energized parts. However, such articles may be worn if they are rendered nonconductive by covering, wrapping, or other insulating means.

(9) *Housekeeping duties.* Where live parts present an electrical contact hazard, employees may not perform housekeeping duties at such close distances to the parts that there is a possibility of contact, unless adequate safeguards (such as insulating equipment or barriers) are provided. Electrically conductive cleaning materials (including conductive solids such as steel wool, metalized cloth, and silicon carbide, as well as conductive liquid solutions) may not be used in proximity to energized parts unless procedures are followed which will prevent electrical contact.

(10) *Interlocks.* Only a qualified person following the requirements of paragraph (c) of this section may defeat an electrical safety interlock, and then only temporarily while he or she is working on the equipment. The interlock system shall be returned to its operable condition when this work is completed.

§ 1910.334 Use of equipment.

(a) *Portable electric equipment.* This paragraph applies to the use of cord- and plug-connected equipment, including flexible cord sets (extension cords).

(1) *Handling.* Portable equipment shall be handled in a manner which will not cause damage. Flexible electric cords connected to equipment may not be used for raising or lowering the equipment. Flexible cords may not be fastened with staples or otherwise hung in such a fashion as could damage the outer jacket or insulation.

(2) *Visual inspection.* (i) Portable cord- and plug-connected equipment and flexible cord sets (extension cords) shall be visually inspected before use on any shift for external defects (such as loose parts, deformed and missing pins, or damage to outer jacket or insulation) and for evidence of possible internal damage (such as pinched or crushed outer jacket). Cord- and plug-connected equipment and flexible cord sets (extension cords) which remain connected once they are put in place and are not exposed to damage need not be visually inspected until they are relocated.

(ii) If there is a defect or evidence of damage that might expose an employee to injury, the defective or damaged item shall be removed from service, and no employee may use it until necessary repairs and tests to render the equipment safe have been made.

(iii) When an attachment plug is to be connected to a receptacle (including any on a cord set), the relationship of the plug and receptacle contacts shall first be checked to ensure that they are of proper mating configurations.

(3) *Grounding-type equipment.* (i) A flexible cord used with grounding-type equipment shall contain an equipment grounding conductor.

(ii) Attachment plugs and receptacles may not be connected or altered in a manner which would prevent proper continuity of the equipment grounding conductor at the point where plugs are attached to receptacles. Additionally, these devices may not be altered to allow the grounding pole of a plug to be inserted into slots intended for connection to the current-carrying conductors.

(iii) Adapters which interrupt the continuity of the equipment grounding connection may not be used.

(4) *Conductive work locations.* Portable electric equipment and flexible cords used in highly conductive work locations (such as those inundated with water or other conductive liquids), or in job locations where employees are likely to contact water or conductive liquids, shall be approved for those locations.

(5) *Connecting attachment plugs.* (i) Employees' hands may not be wet when plugging and unplugging flexible cords and cord- and plug-connected equipment, if energized equipment is involved.

(ii) Energized plug and receptacle connections may be handled only with insulating protective equipment if the condition of the connection could provide a conducting path to the employee's hand (if, for example, a cord connector is wet from being immersed in water).

(iii) Locking-type connectors shall be properly secured after connection.

(b) *Electric power and lighting circuits.* (1) *Routine opening and closing of circuits.* Load rated switches, circuit breakers, or other devices specifically designed as disconnecting means shall be used for the opening, reversing, or closing of circuits under load conditions. Cable connectors not of the load-break type, fuses, terminal lugs, and cable splice connections may not be used for such purposes, except in an emergency.

(2) *Reclosing circuits after protective device operation.* After a circuit is deenergized by a circuit protective device, the circuit may not be manually reenergized until it has been determined that the equipment and circuit can be safely energized. The repetitive manual reclosing of circuit breakers or reenergizing circuits through replaced fuses is prohibited.

Note: When it can be determined from the design of the circuit and the overcurrent devices involved that the automatic operation of a device was caused by an overload rather than a fault condition, no examination of the circuit or connected equipment is needed before the circuit is reenergized.

(3) *Overcurrent protection modification.* Overcurrent protection of circuits and conductors may not be modified, even on a temporary basis, beyond that allowed by § 1910.304(e).

the installation safety requirements for overcurrent protection.

(c) *Test instruments and equipment.* (1) *Use.* Only qualified persons may perform testing work on electric circuits or equipment.

(2) *Visual inspection.* Test instruments and equipment and all associated test leads, cables, power cords, probes, and connectors shall be visually inspected for external defects and damage before the equipment is used. If there is a defect or evidence of damage that might expose an employee to injury, the defective or damaged item shall be removed from service, and no employee may use it until necessary repairs and tests to render the equipment safe have been made.

(3) *Rating of equipment.* Test instruments and equipment and their accessories shall be rated for the circuits and equipment to which they will be connected and shall be designed for the environment in which they will be used.

(d) *Occasional use of flammable or ignitible materials.* Where flammable materials are present only occasionally, electric equipment capable of igniting them shall not be used, unless measures are taken to prevent hazardous conditions from developing. Such materials include, but are not limited to: flammable gases, vapors, or liquids; combustible dust; and ignitible fibers or flyings.

Note: Electrical installation requirements for locations where flammable materials are present on a regular basis are contained in § 1910.307.

§ 1910.335 Safeguards for personnel protection.

(a) *Use of protective equipment.* (1) *Personal protective equipment.* (i) Employees working in areas where there are potential electrical hazards shall be provided with, and shall use, electrical protective equipment that is appropriate for the specific parts of the body to be protected and for the work to be performed.

Note: Personal protective equipment requirements are contained in subpart I of this part.

(ii) Protective equipment shall be maintained in a safe, reliable condition and shall be periodically inspected or tested, as required by § 1910.137.

(iii) If the insulating capability of protective equipment may be subject to damage during use, the insulating material shall be protected. (For example, an outer covering of leather is sometimes used for the protection of rubber insulating material.)

(iv) Employees shall wear nonconductive head protection wherever there is a danger of head injury from electric shock or burns due to contact with exposed energized parts.

(v) Employees shall wear protective equipment for the eyes or face wherever there is danger of injury to the eyes or face from electric arcs or flashes or from flying objects resulting from electrical explosion.

(2) *General protective equipment and tools.* (i) When working near exposed energized conductors or circuit parts, each employee shall use insulated tools or handling equipment if the tools or handling equipment might make contact with such conductors or parts. If the insulating capability of insulated tools or handling equipment is subject to damage, the insulating material shall be protected.

(A) Fuse handling equipment, insulated for the circuit voltage, shall be used to remove or install fuses when the fuse terminals are energized.

(B) Ropes and handlines used near exposed energized parts shall be nonconductive.

(ii) Protective shields, protective barriers, or insulating materials shall be used to protect each employee from shock, burns, or other electrically related injuries while that employee is working near exposed energized parts which might be accidentally contacted or where dangerous electric heating or arcing might occur. When normally enclosed live parts are exposed for maintenance or repair, they shall be guarded to protect unqualified persons from contact with the live parts.

(b) *Alerting techniques.* The following alerting techniques shall be used to warn and protect employees from hazards which could cause injury due to electric shock, burns, or failure of electric equipment parts:

(1) *Safety signs and tags.* Safety signs, safety symbols, or accident prevention tags shall be used where necessary to warn employees about electrical hazards which may endanger them, as required by § 1910.145.

(2) *Barricades.* Barricades shall be used in conjunction with safety signs where it is necessary to prevent or limit employee access to work areas exposing employees to uninsulated energized conductors or circuit parts. Conductive barricades may not be used where they might cause an electrical contact hazard.

(3) *Attendants.* If signs and barricades do not provide sufficient warning and protection from electrical hazards, an attendant shall be stationed to warn and protect employees.

§ 1910.399 [Amended]

26. The numbered paragraph designations (1) through (137) are removed from the definitions in paragraph (a) of § 1910.399.

27. Reserved paragraphs (b), (c), and (d) of § 1910.399 are removed, and both the paragraph (a) designation and the heading "Definitions applicable to §§ 1910.302 through 1910.330" are removed from paragraph (a) of § 1910.399.

28. A definition of "Line-clearance tree trimming" is added between the definitions of "Lighting outlet" and "Listed"; a definition of "May" is added between the definitions of "Location" and "Medium voltage cable"; and two notes are added to the definition of "Qualified person" in § 1910.399. The new definitions and the notes read as follows:

§ 1910.399 Definitions applicable to this subpart.

* * * * *

Lighting outlet. * * *

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

* * * * *

Location. * * *

May. If a discretionary right, privilege, or power is conferred, the word "may" is used. If a right, privilege, or power is abridged or if an obligation to abstain from acting is imposed, the word "may" is used with a restrictive "no," "not," or "only." (E.g., no employer may . . .; an employer may not . . .; only qualified persons may. . . .)

* * * * *

Qualified person. * * *

Note 1: Whether an employee is considered to be a "qualified person" will depend upon various circumstances in the workplace. It is possible and, in fact, likely for an individual to be considered "qualified" with regard to certain equipment in the workplace, but "unqualified" as to other equipment. (See § 1910.332(b)(3) for training requirements that specifically apply to qualified persons.)

Note 2: 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.

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