

Conference Paper



"Proposed OSHA Operations and Maintenance Work Rules for Electric Utilities"

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PROPOSED OSHA OPERATIONS AND MAINTENANCE WORK RULES FOR ELECTRIC UTILITIES

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Abstract: This paper will highlight the proposed operation and maintenance work rules contained in the OSHA Section 1910.269 proposal, will provide a summary of the comments on these work rules from the American Public Power Association (APPA) (comments dated 6/1/89 and 9/29/89), and the Edison Electric Institute (EEI) (comments dated 8/1/90, 2/1/91 and 3/15/91), and will attempt to assess the impact of the rules on the electric utility industry. The scope of this paper will be limited to those portions of the Rules which cover transmission and distribution facilities, and will mention but will not discuss the portions affecting power generation facilities.

INTRODUCTION

The Occupational Safety and Health Administration (OSHA), part of the Department of Labor, promulgates work rules for employers and employees. Part 1926 of OSHA Regulation covers safety and health regulations for construction. Subpart V of Part 1926 was developed in 1972 and covers the construction of electric transmission and distribution lines and equipment. A new Section 1910.269 was proposed in the January 31, 1989 *Federal Register*. Proposed Section 1910.269 (the Rules) contains requirements for the prevention of injuries to employees performing operation and maintenance work on electric power generation, transmission and distribution installations. The Rules, as proposed, are to be included in the General Industry Standards in a new section added to Subpart R, Special Industries. Edison Electric Institute/International Brotherhood of Electrical Workers (EEI/IBEW) representatives developed a draft standard of work rules and submitted it to OSHA. OSHA accepted this draft and used it to develop the Rules.

The Rules would cover the following types of work operations.

- Inspection
- Switching - connection and disconnection of facilities
- Routine maintenance of lines and equipment
- Line clearance tree trimming
- Testing and fault locating
- Streetlight relamping
- Chemical cleaning of boilers
- Other routine operation and maintenance activities
- Other facilities involved with power plant operation such as fuel and ash handling, water and steam installations, chlorine and hydrogen systems

In addition to the Rules, the January 31, 1989 *Federal Register* Proposal also includes changes to Section 1910.137 which contains existing OSHA standards for electrical protective equipment. The original EEI/IBEW proposal included provisions related to electrical protective equipment. OSHA determined that proposed changes in electrical protective equipment should be made in 1910.137, not in 1910.269. OSHA also proposes that 1910.137 should apply to all of industry, not just electric utilities. Section 1910.137 is based on ASTM/ANSI standards on equipment such as rubber gloves, rubber matting, line hose, blankets and sleeves. The APPA submitted a comment to OSHA regarding 1910.137 in which it has indicated its objections to the requirement

for testing of Class "O" rubber gloves (for use on systems up to 1,000 volts). APPA requests that testing requirement be deleted and that the wearing of protectors and air testing before each use be required instead.

Since the purpose of the Rules is to prevent injury to employees performing operation and maintenance activities for electric utilities, the proposal contains definitions of construction activities which are not covered under 1910.269 so that the distinction can be made between operation and maintenance and construction work. Construction work is defined as "alteration and/or repair, including painting and decorating," and is further defined as "the erection of new transmission and distribution lines and equipment and the alteration, conversion, and improvement of existing transmission lines and equipment."

Although the proposed 1910.269 is written to apply strictly to electric utilities, OSHA has asked for comments regarding its application to all "power generation, transmission, and distribution systems." APPA has commented in its September 1989 response that the final rule should cover industrial owned generation, transmission and distribution facilities since 1) such systems are essentially the same as electric utilities, and 2) the EEI/IBEW original proposal, which did not include industrial systems, also did not provide the proper basis for excluding such systems. Additionally, EEI has recommended in its 8/1/90 response that the Rules "should regulate not just the investor-owned segment of the industry, but all cogenerators of electric power and other generators that provide power to electric utilities."

Subpart S of Part 1910 of OSHA Rules covers the installation and design of electrical utilization systems. OSHA is considering incorporating requirements for application to both utilization systems and systems associated with power production in 1910.269. OSHA has attempted to distinguish between systems in power plants which are directly associated with power production and systems such as lighting and power systems in portions of the plant not

directly involved with generation. OSHA asked for comments regarding this proposal. Both EEI and APPA responded that they recommend that OSHA exempt the utility industry from the requirements of Subpart S. APPA also submitted an attachment to their comments which includes proposed work rules which they would propose to add in the definition portion of 1910.269 which "would govern the performance of construction, maintenance, repair or test on electrical equipment used by the electric utility industry in place of the existing requirements in Subpart S." EEI also commented that all facilities inside generating plant boundaries should be under these Rules, including coal handling facilities not under the Mine Safety & Health Administration, as has been suggested.

General (a)

The scope of coverage of the proposed 1910.269 includes work practices, installations and equipment associated with the operation and maintenance of electric power generation, control, transformation, transmission and distribution lines and equipment. The following specific areas are covered in the Rules:

- Power generation, transmission and distribution installations accessible to qualified persons only
- Other power plant installations
- Test sites under control of electric utilities
- Line clearance tree trimming operations

Employee Training

The Rules require training for all employees falling under this scope of coverage. The Rules require additional training for "qualified" employees. A "qualified employee or person" is defined as "one knowledgeable in the construction and operation of electric power generation, transmission, and distribution equipment and the hazards involved." Included

in the required training qualifications are the following:

- Skills and techniques necessary to distinguish live parts from other parts of electric equipment
- Skills and techniques necessary to determine the nominal voltage of live parts
- Recognition of clearance distances specified in this section corresponding to the voltages to which the qualified employee will be exposed
- Proper use of special precautionary techniques, personal protective equipment, insulating and shielding materials, and insulating tools associated with working on or near exposed energized parts of electric equipment

The training required shall be of classroom or on-the-job type. The employer is to provide certification of training of employees and certification is to be maintained for the duration of employment.

Working Conditions

Existing conditions are to be determined before work is started on a project. The following existing conditions are to be identified:

- Voltages of lines and equipment including switching transients
- Induced voltages
- Integrity of grounds
- Condition of poles
- Environmental conditions relative to safety
- Locations of other circuits and equipment, both power and communication

Comments (a)

APPA has submitted the following comments on paragraph (a):

- It is assumed that the Rules will cover start-up and testing work in conjunction with new construction and betterment
- Recommends that electric utilities be exempt from Subpart S of 1910
- Regarding test sites, APPA recommends adding a sentence which excludes routine inspection and maintenance measurements, such as meter tests, relay tests and routine line and cable tests made by qualified employees
- Recommends modified wording of (a)(2) so that retraining of already qualified workers is not required and training programs already in place may be used; also recommends that wording be added which allows existing personnel records to document training and constitute certification
- Recommends easing requirements on knowledge of existing conditions and inserting the words "as are practicable" addressing such areas as determination of nominal voltages, inspection of grounds, pole conditions, environmental conditions, other utility systems, induced voltages, switching transients and grounds

Medical Services and First-Aid (b)

This paragraph states that the employer shall provide medical service and first-aid as required in 1910.151.

Specific requirements included in the Rules are as follows:

- Cardiopulmonary and first-aid training for employees working on or with energized lines or equipment

- For field work involving two or more employees, at least two trained persons must be available
- "For fixed locations such as generating stations, a number of persons shall be available to enable emergency treatment to begin within four minutes of accident"
- Training shall be equivalent to the American Red Cross Multi-media course.
- First-aid kits shall be maintained and inspected.
- First-aid supplies in weatherproof containers are required unless installed indoors.

Comments (b)

Both EEI and APPA believe that the four minute requirement is too stringent for fixed locations such as generating stations. APPA recommends that this requirement be changed to provide emergency treatment to begin as soon as practical. EEI also recommends rewriting this portion of paragraph (b) to eliminate the four minute requirement and add to the section, including the first sentence "... trained persons shall be available to render first-aid including CPR.", and "A method of communication shall be provided by the employer in order that employees working alone or with exposed energized lines or electrical equipment, are monitored and prompt emergency assistance rendered as may be required."

EEI is also concerned that the proposed paragraph (b) which addresses the sizes of crews "might be construed to require a minimum of two trained persons to be assigned to any crew performing work on or with energized lines or equipment."

Job Briefings (c)

The employer is to ensure that the employee in charge conducts job briefings with employees involved. The briefings are to address hazards

associated with the job, work procedures, special precautions, energy source controls and personal protective equipment requirements. One briefing per day is required unless work is repetitive. Additional briefings are required if there are changes in the work affecting safety. A brief discussion is satisfactory if work is routine and if employees can recognize and avoid hazards. More extensive discussions are required if work is more complicated or particularly hazardous, or if employees cannot be expected to recognize and avoid hazards.

Comments (c)

The APPA has submitted the following comments regarding the job briefings section:

- Objects to the word ensure, citing high cost of paperwork in ensuring that job briefings take place
- Recommends modifications to indicate if work or operations are repetitive and familiar, job briefings "shall be conducted to the extent necessary to maintain safety awareness" (APPA appears to believe that the need for such briefings should be left up to the supervisors)

Hazardous Energy Control (Lockout/Tagout) Procedures (d)

This section applies to the use of lockout/ tag-out procedures for the control of energy sources and installations for the purpose of electric power generation. Since the scope of this paper is to address transmission and distribution systems, no detailed discussions are included on this section. EEI and APPA have submitted extensive comments on this section.

Enclosed Spaces (e)

This section includes requirements for entry into and work in enclosed spaces, including manholes and vaults, but does not apply to vented vaults. The employer is required to

assure the use of safe work practices for entry into and work in enclosed spaces.

This section:

- Requires safe procedures for the removal of covers
- Prohibits employees from entering enclosed spaces that contain a hazardous atmosphere
- Requires attendants to be available outside of enclosed spaces to provide assistance in an emergency
- Requires test instruments used to monitor atmosphere in enclosed spaces and requires that such test instruments be calibrated for accuracy
- Requires testing for flammable gases and vapors
- Requires testing the concentration of oxygen but states that if continuous forced air ventilation is provided, oxygen deficiency testing is not required.
- If flammable gas or vapors are detected or if an oxygen deficiency is found the employer is required to provide forced air ventilation to assure safety levels of oxygen and to prevent a hazardous concentration of flammable gases and vapors - a continuous monitoring program is an alternative
- Specify requirements for forced air ventilation of enclosed spaces where used as follows:
 - shall begin before entry is made
 - shall be maintained long enough to ensure safe atmosphere before entry
 - shall be directed to ventilate immediate area where employees are present
 - shall continue until all employees leave area

- Requires air supply from clean a source
- Requires additional testing for flammable gases and vapors if open flames are used

Comments (e)

EEI recommended the addition of wording in (e)(1) Safe Work Practices to require the employer to train employees in emergency rescue procedures and to maintain the required rescue equipment.

Trenches and Excavations (f)

The Rules state that trenching and excavation operations shall comply with 1926 Subpart P. This means that electric utilities are under the same rules as other industries.

Personal Protective Equipment (g)

This paragraph proposes requirements for personal protective equipment and is based on OSHA Section 1910, Subpart I and refers to the applicable ANSI standards. The applicable portions of Section 1926 also apply, including 1926.104 ("Safety Belts, Lifelines and Lanyards") and 1926.959 ("Lineman's Body Belts, Safety Straps and Lanyards").

This section includes requirements for the following personal protective equipment:

- Eye and face
- Respiratory
- Head
- Foot
- Protective clothing
- Electric protective equipment
- Personal fall protection equipment
 - Body belts

- Life lines
- Lanyards for fall arrest
- Body belts and safety straps for work positioning
- Requires fall arresting equipment, work position equipment or travel restraining equipment by employees working more than four feet above the ground
- Requires fall arresting equipment for employees climbing wood poles without step bolts, except when climbing around obstructions

Comments (g)

APPA and EEI provided essentially similar comments regarding personal protective equipment:

- Believe that the 4 foot arrest requirement is too restrictive. APPA recommends that 15 feet should be required and EEI proposes that 10 feet should be required
- Both EEI and APPA believe that fall protective equipment should not be required for qualified employees climbing or changing location on poles, towers or similar structures

Ladders, Platforms, Step Bolts and Manhole Bolts (h)

Subpart D of 1910 would continue to apply to this section except for paragraphs (h)(2) and (h)(5). Highlights of this section which are of interest are as follows:

- Conductive ladders may not be used near exposed energized lines or equipment, except in specialized high-voltage work where non-conductive ladders would be of greater hazard
- Specific design requirements are included for manhole steps and step bolts

Comments (h)

APPA submitted the following comments on this section:

- Recommends that the design requirement for step bolts and manhole steps be deleted since these requirements are not performance oriented and incompatible with OSHA's goal. Many such steps in use will not meet the minimum width requirements but have been used safely for years
- Recommends that the section be reworded to clarify and allow discretion of the employee in charge to determine whether the use of non-conductive ladders would be appropriate in conjunction with live line bare hand work

EEI has also expressed concern about the design which is proposed for step bolts for transmission towers again, regarding the specific requirements for such step bolts. EEI also indicates that there will be significant cost in retrofitting existing transmission towers whose step bolts do not meet the new requirement.

Hand and Portable Power Tools (i)

This section applies to cord and plug connected equipment, portable and vehicle mounted generators and hydraulic and pneumatic tools. The section mainly addresses the electrical requirements of such equipment including grounding, isolating transformers and neutral connections. OSHA does not propose the use of ground fault current interrupters (GFCI) to protect employees, despite initial comments to the contrary. OSHA's position is that GFCIs would prevent electrocution but not shock leading to involuntary reaction and other injury.

Comments (i)

APPA has submitted the following comments on this section:

- Recommends that requirements be added to allow connection of power supplies either through isolating transformers for ungrounded secondary or through GFCIs
- Recommends additional requirement for the oil reservoir of a hydraulic pump to not be more than 35 feet vertically below the tool to guard against loss of insulating value due to partial vacuum in hose

Live Line Tools (j)

This section contains requirements for tests and materials handling and storage of live line tools (hot sticks).

Included are the following requirements:

- Specific design testing values for fiberglass and wood hot sticks
- Visual inspection before use each day and removal from service if a defect or contamination affecting insulating value is found

Comments (j)

APPA recommends that, in accordance with industry practice, specific allowance should be made for wiping contaminated tools or refurbishing defective tools and returning them to service after successfully passing specified test.

EEI states that electric retesting of live line tools is not required unless there is reason to suspect a problem and believes that its position is consistent with the applicable IEEE and ASTM standards. EEI proposes rewording paragraph (j)(2) which addresses the condition of tools and which provides that, if contamination exists, the tool surface be cleaned before use. Also, if any defect or contamination is found which adversely affect the insulating qualities or mechanical integrity, the tool should be removed from service. EEI proposes that the live line tools be removed from service every two years, cleaned and/or repaired by qualified

personnel, and that repaired tools be electrically tested.

Materials Handling and Storage (k)

This section is to be in accordance with 1910 Subpart N, and includes the following provisions:

- Specifies distances to energized lines in areas where storage is accessible to unqualified persons (ten feet plus adder over 50 kV)
- For qualified employees, material may not be stored in working space according to the National Electric Safety Code (NESC)
- Unqualified employees may not bring material closer than distances specified in this section, which are based on ten feet for voltages up to 50 kV

Comments (k)

APPA recommends that the entire section be deleted, and that their attachment be included which is essentially the EEI/IBEW proposal. OSHA's proposed distances for qualified employees apparently refers to Table 124-1 of the 1987 NESC, which is based on phase to phase clearances. APPA recommends that these clearances be on a phase to ground basis in accordance with section (l), of the Rules, Tables R-6 and R-7.

TABLE R-6
AC MINIMUM CLEARANCE FROM LIVE PARTS

Nominal voltage In kilovolts <u>phase to phase</u>	Distance phase to employee ¹	
	<u>feet</u>	<u>(cm)</u>
1 or less	Avoid contact	
1.1 to 15	2.00	(61)
15.1 to 35	2.33	(71)
35.1 to 46	2.50	(76)
46.1 to 72.5	3.00	(91)
72.6 to 121	3.33	(102)
138 to 145	3.50	(107)
161 to 169	3.67	(112)
230 to 242	5.00	(152)
345 to 362 ²	7.00	(213)
500 to 550 ²	11.00	(335)
700 to 765 ²	15.00	(457)

- 1 This is the minimum air gap or live-line tool distance to be maintained. The clear live-line tool distance is the distance measured longitudinally along the live-line tool from the conductive device or the working end of the tool to the employee's hand.
- 2 The minimum clearance distance may be reduced to the length of the line insulator, if a smaller clearance is needed to do the work.

TABLE R-7
DC MINIMUM CLEARANCE FROM LIVE PARTS

Maximum voltage conductor <u>to ground kilovolts</u>	Distance ^{1 2}	
	<u>feet</u>	<u>(cm)</u>
250	3.5	(107)
400	6.0	(183)
500	8.5	(259)
750	16.0	(488)

- 1 This is the minimum air gap or live-line tool distance to be maintained. The clear live-line tool distance is the distance measured longitudinally along the live-line tool from the conductive device or the working end of the tool to the employee's hand.
- 2 The minimum clearance distance may be reduced to the length of the line insulator, if a smaller clearance is needed to do the work.

Working on or Near Exposed
Energized Parts (I)

This section covers the hazards of working on or near exposed energized parts of energized lines or equipment. The requirements of this section are summarized as follows:

- Prohibits unqualified employees from working on exposed live parts of electric line or equipment
- Tables R-6 and R-7, included in the Rules, set forth clearance requirements near energized parts
- Requires a qualified employee to maintain such clearances unless:
 - the employee is insulated from the energized part - rubber gloves are allowed to meet this requirement but only from the energized part being worked
 - the energized part is isolated from the employee and any other conductive object at a different potential
 - the employee is insulated from any other conductive object, as during live line bare hand work
- Regarding working position - the employee may not work where shock or slip will tend to bring the body toward exposed parts at different potential than employee's body
- Making connections - the deenergized wire is to be connected first then the energized wire; when disconnecting, this process is reversed
- Regarding conductor apparel - requires the removal of jewelry, etc.
- When installing or removing fuses greater than 300 volts, tools or gloves rated for the voltage used are required. Safety glasses or goggles are required for installing expulsion fuses

- All requirements of this section apply in the vicinity of uninsulated but covered wires (e.g., weatherproof wires)
- Requires employees to treat ungrounded metal parts of equipment (transformer cases and breaker housing) as energized, unless known by test to be free from voltage.

Comments (l)

APPA comments that it is impossible to enforce paragraph l(3) which addresses the working position. Situations arise where it is impossible to prevent contact. APPA recommends that l(3) be reworded to add "where practicable" and comments that work should generally be done from below rather than above energized parts. APPA also recommends inclusion of reference to Tables 422-2 and 427-2 from the 1987 NESC which allows reduced clearances if switching surges are known. The comparable tables in the current 1993 NESC are 441-3 and 441-4.

EEI has expressed particular concern about the Clearance Section (l) with reference to maintenance of transmission facilities. EEI has attached an extensive proposed revision to this section which includes clearance tables which are different than the ones included in the proposed Rules. Their tables also include reduced clearances for situations where known transient overvoltage factors are present for transmission voltages 121 kV and greater. Their attachment also includes calculations and backup material from which their proposed tables were derived. This proposed attachment is in the form of a working agreement of EEI/IBEW. Portions of the attachments which do not agree with IBEW's recommendations are indicated. In a departure from the proposed Rules and the current 1993 NESC, EEI proposes that facilities 300 volts and less not require the use of insulated equipment (rubber gloves). IBEW was not in concurrence with this proposal at the time it was submitted.

Deenergizing Lines and Equipment for Employee Protection (m)

This section is analogous to section (d) which is included for power generation plants. It applies to the deenergization of transmission and distribution lines and equipment for the purpose of protecting employees. Included is a detailed procedure for deenergizing facilities if an employee must depend on others to operate switching to deenergize lines on which the employee is to work, including transfer of responsibility, tagging and grounding.

Comments (m)

Both EEI and APPA recommend that this section be revised to cover only systems 600 volts and greater. Additionally, APPA and EEI comment that lockout procedures which are included in this section and the preceding section (d) should have a provision that the utility may use its own procedures if developed, documented and implemented prior to the promulgation of these regulations.

EEI proposes a fairly extensive revision to Section (m) which includes the following major changes from the OSHA version:

- Places greater emphasis on the system operator in the lockout/tagout procedures
- Provides for record keeping of the operations by the system operator
- Places reduced emphasis on the original person requesting the clearance on the applicable lines

Grounding for the Protection of Employees (n)

This section includes requirements for the protective grounding of transmission and distribution lines and equipment for the purpose of protecting employees. For employees to work on lines which are treated as deenergized, these lines must be deenergized

according to section (m) and grounded. Under certain unusual conditions, the facilities need not to be grounded in accordance with these requirements. There must be 1) no possibility of contact with another energized source, and 2) no hazard of induced voltage.

This section:

- Requires temporary protective grounds at each work location, or on either side of the location if one location is not feasible
- Requires grounding equipment to have proper ampacity, No. 2 AWG copper minimum, and low enough impedance to permit operation of protective devices in case of accidental energization
- Requires testing before grounding to determine absence of voltage
- Requires the ground end of the protective ground to be connected first, then the line end, using an insulated device
- Requires removal first from the line end using an insulated device
- Prohibits grounding cables at a remote location if a hazardous transfer of potential could occur under fault conditions
- Allows grounds to be temporarily removed for tests, but requires previously grounded line to be considered energized during to test

Comments (n)

APPA comments that this section on grounding should apply to systems greater than 600 volts only. Additionally, both EEI and APPA submitted similar comments regarding flexibility which should be included to allow either single or dual point grounding or a combination of the two methods to allow employers to choose the method best for the particular situation. APPA recommends that grounding should be allowed on lines where nominal voltage is not found. In many cases facilities may be grounded when induced or static voltages are present. APPA

also comments that removal of grounds for cables being tested with low voltage should not require treatment of these cables as energized.

EEI believes that OSHA's requirement to require work location grounding where "feasible" is not workable, objecting to the word feasible as all encompassing.

Testing and Test Facilities (o)

This section covers the proposed safe work practices for high-voltage and high-power testing performed in laboratories, in shops, and in substations under the exclusive control of an electric utility. It does not cover routine functions for metering, relaying and normal line work.

Requirements addressed include the following:

- Guarding of test areas - walls, fences and barriers
- Grounding practices - similar to grounding requirements of other sections but requires isolated ground-return conductor system for high current testing
- Control and measuring circuits
- Safety check of test areas at beginning of each group of continuous tests

Comments (o)

APPA provided the following comments on this section:

- Recommends clarification of the wording so that there is a clear distinction between this specialized testing and routine operations such as phasing and low voltage testing
- Recommends deletion of the requirement for an isolated ground return during high current testing citing that staged fault tests often involve large areas which would not allow this requirement to be met - asks that

the rule be modified to require limitation of fault currents to ground faults currents which do not result in hazardous voltage or by limiting access to areas that may be hazardous

- Recommends that separate equipment grounds not be required for test equipment where any equipment ground is not included in the cord. Suggests that the employee be required to provide alternative protection during the test
- Separation of power cables - modify language to include "shall be made secure against damage, accident, interruptions, and other hazards"

Mechanical Equipment (p)

This section requires critical safety components of mechanical elevating and rotating equipment to be inspected on each shift in which such equipment is used.

Requirements are contained for:

- Vehicles
- Booms, winches and associated controls
- Rollover protective structures
- Outriggers
- Load limits for lifting equipment

Tables R-6 and R-7 from section (l) are referred to for clearances between equipment and live parts. If these clearances cannot be maintained and the mechanical device must come closer, then two alternatives are addressed 1) equipment and any attached load must be treated as live parts, or 2) equipment must be inspected for the voltage involved so that insulated portions observe the R-6 and R-7 clearances.

Grounding the equipment is not considered by OSHA to provide protection since the potential

of the equipment can still rise with respect to earth only a few feet from the grounding points. OSHA requested comments on this area to provide additional protection for employees.

Comments (p)

APPA provided the following comments:

- All safety equipment on mechanical elevating and rotating equipment may not be designed to allow frequent inspection. Recommends that section be modified to include "to the extent practicable" in inspecting critical safety components
- APPA believes that requirements for "the operation of mechanical equipment near energized lines or equipment is too vague" and recommends modifications to:
 - Require that Tables R-6 and R-7 are complied with for systems greater than 600 volts
 - Stipulate that the required clearances be maintained unless 1) under supervision of a qualified person responsible for maintenance of safe conditions, and 2) mechanical equipment certified for work at the applicable voltage or 3) insulated barrier is installed between the energized part and mechanical equipment or 4) mechanical equipment is insulated or 5) grounded or barricaded and considered as energized equipment

EEl objects to the use of language which includes all mechanical equipment where contact with exposed energized conductors is "possible". EEl has also submitted a complete revision of Section (p)(4) entitled *Operations Near Energized Lines or Equipment*. This revision includes elimination of the word "possible" and provides for mechanical equipment to be grounded which is a revision which is proposed by both EEl and IBEW. In accordance with OSHA's position that grounding does not provide complete protection, EEl's proposal includes stipulating methods of protection for employees on the

ground which includes establishing a perimeter or restricted area and identifying a qualified employee designated as the person in charge of the activities within the restricted area.

Overhead Lines (q)

This section provides additional requirements not covered in other portions of the Rules, for work performed on or near overhead lines and equipment.

The section contains requirements in the following areas:

- Poles and towers
 - Employees must determine that poles and towers are of adequate strength
 - Poles must be protected from contact with energized lines, and employees must be insulated from the pole
 - Employees must be protected from falling in pole holes by guarding with barriers or other employees
- Installing and removing overhead lines - these requirements were taken from the construction rules 1926.955 (Subpart V)
 - Precautions must be taken to prevent lines from contacting other energized lines
 - Barriers and tension stringing methods are stipulated
 - Lines and equipment to be installed should be treated as energized under certain conditions
 - Employees working aloft are to be protected by grounding the line being installed
 - Automatic reclosing must be disabled on any circuit greater than 600 volts which would be passed over
- Employees must be protected from induced voltages due to parallel lines
- OSHA requested comments on grounding to protect employees from hazards from induced voltages
- Precautions must be taken to prevent failure of line pulling equipment and accessories
- Communication must be maintained between reel tender and pulling rig operator and operation of pulling rig is prohibited under unsafe conditions
- Employees are prohibited from unnecessarily working directly beneath overhead operations or on the crossarm during a pulling operation
- Live line bare hand technique
 - Training and retraining of employees is required
 - Determination of the voltage of the circuit is required so that clearances will be maintained
 - Insulated tools and equipment must be designed, tested, and intended for live line work - kept clean and dry
 - Automatic reclosing must be made inoperative
 - Live line bare hand work is prohibited during thunderstorms or under conditions where clearances may be reduced (such as due to wind)
 - A conductive device (bucket liner) is required to create an area of equipotential for the worker
 - The conductive device must be bonded before the employee contacts the conductor

- Aerial lifts must have upper and lower controls - OSHA proposed that ground level controls not be operated in case of emergency - OSHA asked for comments on use of lower controls
- Checking of aerial lift controls is required
- The truck is to be grounded or treated as energized
- The aerial lift boom must have a current test made each day before beginning work
 - or when a higher voltage is encountered
 - the test to be according to ANSI applicable standard
- Related work must be suspended any time malfunction of equipment is evident
- The clearance distances specified in Table R-8 must be maintained from grounded objects, and from objects at a potential different from that at which the bucket is energized

TABLE R-8 - AC MINIMUM CLEARANCE FOR LIVE-LINE BARE-HAND WORK

Nominal voltage in kilovolts phase to phase	Distance			
	Phase to ground		Phase to phase	
	feet	(cm)	feet	(cm)
1.0 to 15.0	2.00	(61)	2.00	(61)
15.1 to 35.0	2.33	(71)	2.33	(71)
35.1 to 46.0	2.50	(76)	2.50	(76)
46.1 to 72.5	3.00	(91)	3.00	(91)
72.6 to 121	3.33	(102)	4.50	(137)
138 to 145	3.50	(107)	5.00	(152)
161 to 169	3.67	(112)	5.50	(168)
230 to 242	5.00	(152)	8.33	(254)
345 to 362 ¹	7.00	(213)	13.33	(406)
500 to 552 ¹	11.00	(335)	20.00	(610)
700 to 800 ¹	15.00	(457)	31.00	(945)

- ¹ The minimum phase-to-ground clearance distance may be reduced to the length of the line insulator, if a smaller distance is needed to do the work. The minimum phase-to-phase clearance distance may be reduced to 1.73 times the length of the line insulator, if a smaller clearance is needed to do the work.

- The use of hand lines between the bucket and boom, and between bucket and ground is prohibited
- The passing of uninsulated equipment or materials to an employee bonded to an energized part is prohibited
- A durable chart showing clearances in Table R-8 must be mounted so that it is visible to the boom operator
- Requires a non-conductive measuring device to be available to an employee in lift
- Towers and Structures - addresses hazards associated with towers and other structures supporting overhead lines
 - Standing under a tower is prohibited unless presence is necessary to assist
 - Tag lines are required for tower sections being positioned
 - Load lines must remain in place until load is secured
 - Non-emergency work from towers is prohibited in some weather
- That other protective measures are included such as rope nets, guard structures, protective coverings and isolation of workers, and
- That disabling automatic reclosing is not sufficient protection when other protections are available.
- Recommends increased emphasis on grounding
- APPA proposes the addition of new Table R-9 for DC minimum clearances for live line bare hand work extrapolated from ANSI/IEEE Standard 516-89, page 18, Table 5, State of California Work Rules and OSHA's 29 CFR 1926.956, Table V-2
- EEI proposes that this section of the proposed rules also address live line bare hand work

Line-Clearance Tree Trimming (r)

This paragraph addresses safety considerations relating to line maintenance tree trimming based in large part on ANSI Z133.1-1982, "ANSI Safety Requirements for Pruning, Trimming, Repairing, Maintaining and Removing Trees and for Cutting Brush."

A line-clearance tree trimmer is defined by the Rules as "an employee who, through related training or on-the-job experience or both, is familiar with the special techniques and hazards involved in line-clearance. An employee who is regularly assigned to a line-clearance tree trimming crew and who is undergoing on-the-job training and who, in the course of such training, has demonstrated an ability to perform duties safely at his or her level of training, and who is under the direct supervision of a line-clearance tree trimmer, is considered to be a line-clearance tree trimmer."

Included in this section is a portion entitled "Electrical Hazards" which does not apply to "qualified employees." This section contains the following requirements:

Comments (q)

EEI and APPA submitted similar comments on the overhead lines section as follows:

- Recommends the modification of (q)1 involving setting of poles to refer to circuits greater than 600 volts. APPA commented that a utility cannot guarantee that poles will not occasionally contact energized conductors
- Recommend modification of the applicable portions of (q)2 to include the EEI/IBEW proposal in its entirety covering passing over energized lines:
 - Stating that it should cover only facilities 600 volts or greater and

- Inspection of tree is required to determine whether electrical conductors are within ten feet of tree
- Employees other than line-clearance tree trimmers are required to maintain ten feet basic clearance for voltages up to 50 kV with adders for higher voltages
- Employees must be qualified as line-clearance tree trimmers if working closer than ten feet from lines of 750 volts or more
- A second line-clearance tree trimmer is required within normal voice communication if (1) he is required to approach closer than ten feet from lines of greater than 750 volts, or (2) if branches are closer than the Table R-6 and R-7 clearances, or if roping is necessary to remove branches or limbs from conductors or apparatus
- Line clearance tree trimmers must maintain the clearances indicated in Tables R-6 and R-7, excluding the notes
- Branches contacting electrical conductors within Tables R-6 and R-7 clearances may be removed only with insulated equipment
- Ladders, platforms and aerial devices may not be brought closer than Table R-6 and R-7 clearances
- Line-clearance tree trimming may not be performed during storms or under emergency conditions

Other areas which are addressed in conjunction with line-clearance tree trimming are as follows:

- Brush chippers
- Sprayers and related equipment
- Stump cutters
- Gasoline driven power saws
- Backpack power units

- Rope

Comments (r)

APPA has submitted the following comments on the line-clearance tree trimming section:

- Recommends that OSHA acknowledge that line-clearance tree trimmers are "qualified" employees
- Believes that ten foot clearance is too restrictive for 600 volt to 50 kV and proposes a new table based on six foot clearance for 600 volt to 50 kV, which is provided in an attachment to their comments
- Opposes restriction of line-clearance tree trimming during storms or emergency conditions, citing need for restoration of service and removal of safety hazards from broken trees during these situations. Recommends that this section be modified to read, "Line-clearance tree trimming operations may not be performed during storms that make the work hazardous, except for purposes related to public safety or in connection with electric system restoration."
- Recommends modification of the requirement that rope be treated as energized and recommends rewording as "care shall be taken that climbing ropes do not contact energized high voltage lines or equipment."

Communication Facilities (s)

This paragraph addresses communication facilities such as microwave and power line carrier systems.

For microwave systems, the following requirements are contained in this section:

- To protect employees' eyes, employees are prohibited from looking into an open wave guide or antenna connected to an energized microwave source

- In accordance with 1910.97 and 1910.209, warning signs are required in microwave areas

For work involving power line carrier systems, this work is to be conducted according to requirements for work on energized lines.

Comments (s)

APPA objects to the absolute requirement implied by the word "ensure" regarding exposure to microwave radiation and recommends revision of (s)(1)(iii) to read, "when an employee works in an area where electromagnetic radiation levels could exceed the levels specified in the radiation protection guide, the employer shall institute measures designed to protect employees from accidental exposure to radiation levels greater than those permitted by that guide. . ."

Underground Electrical Installations (t)

This paragraph addresses safety for underground vaults and manholes. The following requirements are contained in this section:

- Ladders must be used in manholes and vaults greater than four feet deep and climbing on cables and hangers in these vaults is prohibited
- Equipment used to lower materials and tools in manholes must be capable of supporting the weight and should be checked for defects before use
- An employee in a manhole must have an attendant in the immediate vicinity with facilities greater than 250 volts energized. An employee working alone is permitted to enter briefly for inspection, housekeeping, taking readings or similar, assuming work could be done safely
- Duct rods must be inserted in the direction presenting the least hazard to employees and

an employee must be stationed at the remote end of the rodding operation

- Before moving an energized cable, it must be inspected for defects which might lead to a fault
- To prevent accidents from working on the wrong cable, would require identification of the correct cable when multiple cables are present
- Would prohibit an employee from working in a manhole with an energized cable with a defect that could lead to a fault. However, if the cable cannot be deenergized while another cable is out, employees may enter the manhole but must protect against failure by some means, for example, using a ballistics blanket wrapped around cable
- Requires bonding around opening in metal sheath while working on cable

Comments (t)

APPA recommends that OSHA rewrite section (t)(7) regarding working with defective cables. This rewrite would include the words "shall be given a thorough inspection and a determination made as to whether they represent a hazard to personnel or representative of an impending fault."

As in Subsection (e), EEI proposes the addition of wording to cover training of employees in emergency rescue procedures and for providing and maintaining rescue equipment

Substations (u)

This paragraph covers work performed in substations and contains the following requirements:

- Requires that enough space be provided around electrical equipment to allow ready and safe access for operation and maintenance of equipment (OSHA's position

is that this requirement is sufficiently performance oriented to meet the requirements for old installations according to the 1987 NESC)

- Requires draw-out circuit breakers to be inserted and removed while in the open position and that, if the design permits, the control circuits be rendered inoperative while breakers are being inserted and removed
- Requires conductive fences around substations to be grounded
- Addresses guarding of energized parts
 - Fences, screens, partitions or walls
 - Entrances locked or attended
 - Warning signs posted
 - Live parts greater than 150 volts to be guarded or isolated by location, or be insulated
 - Enclosures are to be according to the 1987 NESC Sections 110A and 124A1 (and in 1993 NESC)
 - Requires guarding of live parts except during an operation and maintenance function, when guards are removed barriers must be installed to prevent employees in the area from contacting exposed live parts
- Requires employees who do not work regularly at the substation to report their presence
- Requires information to be communicated to employees during job briefings in accordance with Section (c) of the Rules

Comments (u)

APPA and EEI provide comments as follows:

- Both believe that some older substations (and power plants) would not meet NESC as

stated in the Rules and requests that existing installations not be required to be modified to meet NESC

- APPA recommends that Section (u)(4)(i), which includes requirements for enclosing electric conductors and equipment to minimize unauthorized access to such equipment, be modified to refer to "only those areas which are accessible to the public"

Power Generation (v)

This section provides additional requirements and related work practices for power generating plants.

Special Conditions (w)

This paragraph proposes special conditions that are encountered during electric power generation, transmission and distribution work including the following:

- Capacitors
 - Requires individual units in a rack to be short circuited and the rack grounded
 - Require lines with capacitors connected to be short circuited before being considered deenergized
- Current transformer secondaries may not be opened while energized and must be bridged if the CT circuit is opened
- Series street lighting circuits, with open circuit voltages greater than 600 volts, must be worked in accordance with Section (q) or (t) and the series loop may be opened only after the source transformer is deenergized and isolated or after the loop is bridged to avoid open circuit condition
- Sufficient artificial light must be provided where insufficient natural illumination is present to enable employee to work safely

- US Coast Guard approved personal floatation devices must be supplied and inspected where employees are engaged in work where there is danger of drowning
- Required employee protection in public work areas to include the following
 - Warning signs or flags and other traffic control devices
 - Barricades for additional protection to employees
 - Barricades around excavated areas
 - Warning lights at night prominently displayed
- Lines or equipment which may be subject to backfeed from cogeneration or other sources are to be worked as energized in accordance with the applicable paragraphs of the Rules

Comments (w)

APPA submits the following comments regarding this Special Conditions section:

- Recommends that the wording regarding capacitors be modified to include a waiting period for five minutes prior to short circuiting and grounding in accordance with industry standards for discharging of capacitors
- For series street light circuits, recommends that language be added for bridging to either install a bypass conductor or by placement of grounds so that work occurs between the grounds
- Recommends modification of the section regarding personal floatation devices to not apply to work sites near fountains, decorative ponds, swimming pools or other bodies of water on residential and commercial property

Definitions (x)

This section of the proposed Rules includes definitions of terms.

Definitions particularly pertinent to understanding the proposal and which have not previously been included are listed as follows:

- **Authorized Employee** - an employee to whom the authority and responsibility to perform a specific assignment has been given by the employer, who can demonstrate by experience or training the ability to recognize potentially hazardous energy and its potential impact on the work place conditions, and who has the knowledge to implement adequate methods and means for the control and isolation of such energy
- **Clearance (for Work)** - Authorization to perform specified work or permission to enter a restricted area
- **Clearance (from Hazard)** - Separation from energized lines or equipment

Comments (x)

The following summarizes the changes in some of the definitions which APPA recommends:

- Add to the definition for authorized employee "the authorized employee may be an employee assigned to perform the work or assigned to provide the energy control and isolation function"
- Recommends that OSHA modify the definition for a line clearance tree trimmer to add the word "qualified" resulting in the complete designation as a "qualified line clearance tree trimmer"
- Recommends that OSHA modify the definition of "qualified employee" to remove the word construction from the definition since it is felt that knowledge of construction procedures is beyond the scope of the proposed rule, resulting in APPA's new

wording as follows: "more knowledgeable in operation and hazards associated with electric power generation, transmission, and/or distribution equipment"

- Recommends that OSHA add a definition for the word "practicable" and replace the word "feasible" with practicable wherever it appears in the proposed regulations, and that practicable be further defined as "capable of being accomplished by reasonably available and economic means"

OTHER ISSUES

Clothing

OSHA requested comments on the advisability of adopting requirements regarding the clothing worn by electric utility industry employees. EEI has presented comments which indicates research is underway prior to establishing a standard for clothing to be worn by electric utility employees. However, EEI's position is that this standard has not developed to the extent that it could be included in the OSHA Rules. Both APPA and EEI state that they would support a requirement that employers train employees regarding the proper type of clothing to wear to minimize hazards when working in the vicinity of exposed energized facilities.

Grandfathering

Due to the anticipated cost impact on the utility industry of the proposed Rules requiring that existing installations be brought to the requirements of the proposed Rules, both APPA and EEI propose that the final Rules include an omnibus grandfather provision. This provision would exempt those selected types of facilities from modification to meet the new rules. EEI states that if the grandfathering concept is incorporated that electric utility employees will not be deprived of proper protection. They propose that employers be required to provide employees with a level of protection equivalent to that which the standard would require in those instances in which the utility does not

choose to modify existing facilities to comply with the final standard.

Rubber Sleeves

OSHA requests comments from the industry on whether it would be advisable to require rubber insulating sleeves when gloves are used on lines or equipment energized at more than a given voltage. EEI states its position that utilities should continue to have the option of choosing rubber gloves or gloves and sleeves, to protect employees when it is necessary to work closer to energized lines than the distances specified in the clearance tables.

Preempting State Laws

EEI requests that the final Rules be clear in their preempting state rules applicable to the operation and maintenance work rules for electric power systems. This is especially critical since some states now have existing laws which are more stringent than the proposed OSHA Rules. Examples are (1) in California and Pennsylvania where electric utility linemen are prohibited from using rubber gloves to work on lines and equipment energized at more than certain voltages, and (2) in California and Connecticut where the live line bare hand method of working on high voltage transmission systems is prohibited. One utility, Pacific Gas & Electric has obtained a variance from the California OSHA to perform live line bare-hand transmission maintenance work on an experimental basis.

Conflicts Between the Rules and Part 1926, Subpart V

Since many of the work procedures in construction work and operation and maintenance work are similar and difficult to distinguish between, EEI requests that the final order be clear in establishing which rule has jurisdiction over such similar work areas.

IMPACTS ON COSTS AND ASSOCIATED BENEFITS

In its introduction to the proposed rules, OSHA has provided an estimate of the annual cost impact on the electric utility industry for the proposed rules of approximately \$20.7 million. OSHA estimates that compliance with this proposed standard would annually prevent between 24 and 28 fatalities and 2,175 injuries per year. The utilities which have responded to this proposed standard through their respective associations have questioned the claims both of the magnitude of the cost involved and the benefit to the industry in preventing fatalities and lost-time injuries. Both EEI and APPA feel that the annual cost which OSHA estimates are significantly lower than would be realized in practice. Factors which APPA and EEI feel were not properly addressed include the following:

- OSHA has not accurately accounted for cost of potential retroactive impacts including retrofitting and modifying existing installations and equipment
- OSHA has not consistently implemented performance based provisions in proposed rules - many portions require specific approaches which would require utilities to replace procedures already in place with new procedures.
- Estimates were based on an average size investor-owned utility of 2,800 employees and an average rural cooperative of 56 employees, which are not applicable to many smaller systems such as municipal systems
- OSHA has not adequately addressed the retraining which would be necessary with modifying long-established industry practices to be in accordance with the OSHA rules

- EEI claims that OSHA's proposed clearance requirements would not allow the use of established maintenance techniques for maintaining high voltage transmission systems, and thus would require new techniques

For an example of the cost which is estimated to be experienced as a result of the new Rules, one of the EEI member companies has estimated that approximately 20,000 transmission towers would need to be modified to accommodate the required step bolts in the Rules at an estimated cost of \$6,200,000. Additionally, this same company estimates that the annual cost of retesting live line tools for its estimated 1,000 tools would be \$265,000.

Additionally, both EEI and APPA question the additional benefits which OSHA claims would result from implementation of the new Rules. APPA questions the estimates of preventing an additional 24 to 28 fatalities annually, and 2,175 injuries per year in that it fails to account for the fact that the industry has already implemented, in large part, safety measures which are incorporated in the Rules. EEI and APPA also point out that many preventable injuries cannot be eliminated despite work rules, enforcement and safety awareness campaigns since many such accidents which result in fatalities are due to employee being trained but not following the employer's training and policies.

PRESENT STATUS OF RULES

According to information received from the OSHA office in February 1993, the final Rules are to be published no later than July 1993 and possibly as soon as March 1993. OSHA closed their receipt of comments in March 1991 and no further changes in the rules are thought possible.

CONCLUSION

The OSHA 1910.269 which proposes to cover electric utility operation and maintenance work rules affects a multitude of working procedures as are summarized in this paper. It is not possible at the present time to assess the final structure of the Rules as may be proposed in 1993 or subsequent years. Since the comments from the utility associations, APPA and EEI, were made following the initial release of the proposed OSHA Rules in 1989, a significant amount of time has elapsed where other events have occurred which may affect the form of the final Rules. The 1993 NESC went into effect in August 1992, and includes some of the requirements to which the commenters objected. For example, a significant requirement in the Part 4 of the 1993 NESC requires that rubber gloves be utilized on exposed energized parts of facilities operating at 50 to 300 volts. This requirement is in conflict with EEI's proposed change to the OSHA Rules which would still allow working such secondary facilities without the use of rubber gloves.

Electric utilities are advised to review the January 31, 1989 proposed operation and maintenance Rules as summarized in this paper, and to review their procedures which would be affected by application of the Rules. Many of the procedures proposed in the Rules provide valuable guidance in electric utilities' operation and maintenance activities. Where the cost impact is not significant, it is recommended that utilities consider implementing such procedures in expectation of the Rules being published in the next few months. Also it would be appropriate for electric utilities to review the 1993 edition of the NESC since there are portions of the Rules which have resulted in changes in the NESC. These changes mainly occur in Part 4, Rules for the Operation of Electric Supply and Communications Lines and Equipment.

The concerns which the commenters have addressed regarding the cost impact and the resulting benefits experienced as a result of the promulgation of the Rules are real ones and must be addressed in the final Rules. As a result, this paper cannot present a conclusion regarding the full impact of the Rules. The development of such Rules continue to be an ongoing matter and will undoubtedly require later analysis when the final rules are published.