

Establishing an Electrical Safety Program

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Introduction

On August 6, 1990, OSHA 29 CFR 1910.331-.335, "Electrical Safety-Related Work Practices" regulation became a Final Rule [1]. This regulation has been in force for over fifteen years and yet a surprisingly large portion of the industry still does not have a written electrical safety program, along with an electrical safe work practice procedure, in place. One question that is continually asked is: "is this a new requirement?" The answer that is given is: "no this is not a new requirement; the final rule has been around since August 6, 1990." To go back even further, on November 30, 1987, OSHA published the proposed standard on electrical safety-related work practices. This proposal was based on the 1981 edition of NFPA 70E, "*Electrical Safety Requirements for Employee Workplaces*", Part II, "Safety Related Work Practices". As can be seen, the industry has had direction on electrical safety-related work practices since 1981. So the question that must be asked is: "Why are there so many who are not even aware of these electrical safety procedure requirements?" In addition, why are there so many, who are aware of the requirements, and yet are not in compliance?

Some have actually said that they will comply when they have to. Compliance is not an option because OSHA mandates it, beside the fact that it is the right thing to do to help protect employees from the hazards of electricity. Too many have actually said that it was too expensive to write procedures, train employees, and purchase personal protective equipment (PPE). If only one major accident occurs, the costs associated with it will far exceed what it would have cost to do it right in the first place.

Before developing 29 CFR 1910.331-.335, OSHA surveyed several states, with the following results: "*For every requirement set forth in Part II of NFPA 70E, OSHA found injuries or fatalities which were directly relevant.*" [1] These work practices are not just suggestions they are mandatory requirements that have been promulgated to help prevent injuries and fatalities that are, unfortunately, happening at an alarming rate, even after more than 24 years of standard and regulation requirements for electrical safety programs and procedures.

Establishing an effective electrical safety program is vital to the safety of employees. The employer is required to develop and implement an electrical safety program that addresses employee exposure to each specific hazard that exists. This program and the related training must be appropriate for all existing conditions and is required to be written, published, and available to all employees who might be exposed to the hazards.

OSHA established the mandate for an electrical safety program in 29 CFR 1910.333(a), which states:

“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.

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.”[1]

With regard to this requirement, the OSHA Directorate of Compliance states: *“If the employer does not deenergize then suitable safe work practices for the conditions under which the work is to be performed shall be included in the written procedure and strictly enforced.”*[2]

As can be seen in this OSHA requirement there must be a written procedure. The intent of this is to establish a written electrical safety program, which must include the safe work practice procedures that are required. NFPA 70E-2004, *Standard for Electrical Safety in the Workplace*, Section 110.7 addresses the requirements for establishing an Electrical Safety Program. [3]

Since the requirements for establishing the electrical safety program are based on the hazards of electricity, this paper will address briefly these hazards along with the six topics, from NFPA 70E, Section 110.7, that must be included in the electrical safety program. [3]

Electrical Hazards

All of the studies reviewed have revealed three major hazards of electricity that must be considered. They are: 1) electrical shock, 2) electrical arc-flash and 3) electrical arc-blast. These three hazards are addressed in NFPA 70E, Annex K. [3] Each of the hazards will be briefly addressed in the following paragraphs, which include some of the physiological effects on the human body.

NFPA 70E-2004, Section 110.8(B), *Working On or Near Exposed Electrical Conductors or Circuit Parts that Are or Might Become Energized* provides the requirement to perform an electrical hazard analysis prior to employees working on or near exposed electrical conductors or circuit parts operating at 50 volts or more, that have not been deenergized. Section 130.2 provides more specific direction for the shock and flash hazard analysis process for establishing the protection

boundaries for these hazards, as well as the required personal protective equipment. This information is required as part of the electrical safety program. [3]

Electrical shock: It takes a very low value of current, flowing through the human body, to cause death or serious physical harm. There have been many studies performed in this area with different values of current causing each effect. The following chart illustrates average values of current and the effects as taken from the published studies [4]:

Current	Effect
1 mA	Barely perceptible
1-3 mA	Perception threshold (most cases)
3-9 mA	Painful sensations
9-25 mA	Muscular contractions (can't let go)
25-60 mA	Respiratory paralysis (may be fatal)
60 mA or more	Ventricular fibrillation (probably fatal)
4 A or more	Heart paralysis (fatal)
5 A or more	Tissue burning (fatal if vital organ)

Electrical arc-flash: There are two different issues with this hazard, the arc temperature and the incident energy. The main concern with the arc temperature is the flash flame and ignition of clothing. Studies have revealed that at approximately 203⁰F for one-tenth of a second (6 cycles), the skin is rendered incurable [5] or in other words onset of a third-degree burn. The main concern with the incident energy is the onset of a second-degree burn, which occurs at approximately 1.2 cal/cm². It does not take a very high temperature or very much energy to cause severe tissue damage, extreme pain and discomfort, and possible disability or death to the worker.

Electrical arc-blast: The pressures developed by an electrical arc can be extremely high. One study noted that copper, when vaporized, expands at a factor of 67,000 times [6], which one expert stated was the same expansion as dynamite. Doors or covers must be securely latched before operating a switch or circuit breaker. Technicians or operators must place their body in the safest position possible before operating the equipment. Electrical arc-flash PPE will protect against the flash/flame and incident energy hazards but may not provide complete protection against the pressures of the arc-blast.

Electrical Safety Program

Employees performing electrical work have a potential exposure to the hazards of electricity (noted above) as part of their every day work. Because of this potential exposure, the regulations and standards require a written and enforced electrical safety program along with safe work procedures. A further examination of the

standards requirements will assist in developing the required electrical safety program.

As noted above, NFPA 70E-2004, Section 110.7, *Electrical Safety Program*, provides six topics that must be included in the electrical safety program. Below are these six topics along with brief explanations of each. References will be made to the three sections of Annex E, as well as Annex F, J, and I, which provides excellent guidance for developing the electrical safety program. These Annexes will only be referenced and not quoted in this paper. [3]

Awareness and Self-Discipline - In order for a worker to avoid exposure to the hazards, they must be aware of the work environment. The electrical safety program along with required training must emphasize this, as well as self-discipline. The supervisor must also discuss all safety aspects of the tasks being performed along with examples of incidents and injuries for similar tasks to help increase employee awareness. [3]

Electrical Safety Program Principles - The electrical safety program is required to identify the principles upon which it is based.

Essentially what is needed is an assessment of the electrical equipment and systems along with a job/task and hazards analysis.

Annex E, Section E.1, *Typical Electrical Safety Program Principles*, although not part of the requirements of NFPA 70E, provides a list of principles that can be used to establish the electrical safety program. Essentially these principles amount to a job/task and hazard analysis, planning, and procedures. [3]

Electrical Safety Program Controls - An electrical safety program is also required to identify the controls by which it is measured and monitored.

Also in Annex E is Section E.2, *Typical Electrical Safety Program Controls*, which provides a list of controls that can be used in developing the Electrical Safety Program.

The equipment assessment and job/task and hazard analysis would also be needed to accomplish this requirement. [3]

Electrical Safety Program Procedures - All tasks that involve exposure to the electrical hazards must have a procedure. The procedures also define the requirements and provide guidance for workers to accomplish the job safely.

Annex E again provides additional guidance for developing these procedures as found in Section E.3, *Typical Electrical Safety Procedures*.

Another helpful reference would be the NFPA Electrical Safety Program Book, which is an excellent resource for developing the required procedures. [3]

Hazard/Risk Evaluation Procedure - The Electrical Safety Program must have a procedure that can be used by employees to assess the hazards and risks associated with each task.

Annex F, *Hazard/Risk Evaluation Procedure*, provides information to assist in developing this procedure.

Written authorization to execute work on or near live parts must also be obtained. The Energized Electrical Work Permit required by Section 130.1(A) provides the means to accomplish this. An example permit is found in Annex J, *Energized Electrical Work Permit*. [3]

Job Briefings - Another important element of the electrical safety program is a Job Briefing. The Job Briefing is a discussion of the work tasks and is required before the start of each job. The employee in charge conducts this briefing with all employees involved in the job. The job briefing should cover such things as:

- The hazards associated with the job
- Work procedures involved
- Special precautions
- Energy source controls, and
- Personal protective equipment

This briefing should also address:

- Other work in the immediate area, as well as
- Other work associated with the same electrical circuits and equipment.

If a task is routine and will be repeated several times during the day, a single job briefing would be required before the task is performed the first time.

However, if significant changes occur that may affect the safety of employees, then a new job briefing would be required before employees are exposed to any additional hazards.

A job briefing should be as extensive as necessary to ensure employees understand their exposure to electrical hazards. If the job is routine and the employees are well trained and experienced, and can recognize and avoid the hazards involved, then only a brief discussion would be required.

If the tasks are unfamiliar to the employee, or complex, a more complete briefing would be required. This would also apply for outside employees and those who are new to the area where the work is to be performed.

Annex I, *Job Briefing and Planning Checklist*, of NFPA 70E, illustrates considerations for a Job Briefing, as well as a Planning Checklist, that can be very helpful in conducting Job Briefings. [3]

Engineering Electrical Safety

Electrical safety procedures are not the complete answer to the electrical hazards problem. Several other issues must also be considered, such as incorporating electrical safety into the design of equipment and facilities. Designing in safety is generally a standard practice when dealing with the common safety concerns. However, it should be noted that the electrical safety aspects of the design are generally overlooked or are not as detailed as they should be. Without a thorough understanding of the OSHA and NFPA 70E electrical safety requirements, it would be very easy to overlook these issues in the design phase of any project. Electrical safety is not just having a procedure or donning a pair of rubber gloves or a flash suit; in fact, personal protective equipment (PPE) should be the LAST resort not the first choice. There must be more emphasis placed on designing out the electrical hazards utilizing sound engineering practices. However, when this is not possible, particularly with older, existing equipment and facilities, an electrical safety program is a must in order to help protect employees from the hazards of electricity.

References

- [1]. Occupational Safety and Health Administration (OSHA), 29 CFR 1910.331-.335, *Electrical Safety-Related Work Practices*, Final Rule, August 6, 1990.
- [2]. OSHA Instruction STD 1-16.7, July 1, 1991, Directorate of Compliance Programs.
- [3]. NFPA 70E, *Standard for Electrical Safety in the Workplace*, 2004 Edition.
- [4]. Ralph H. Lee, "Electrical Safety in Industrial Plants", IEEE Transactions on Industry and General Applications, Vol. IGA-7, p. 10-16, Jan./Feb. 1971.
- [5]. Ralph H. Lee, "The Other Electrical Hazard; Electric Arc Blast Burns", IEEE Transactions on Industry Applications, Vol. IA-18, No. 3, May/June 1982.
- [6]. Ralph H. Lee, "Pressures Developed by Arcs", IEEE Transactions on Industry Applications, Vol. IA-23, No. 4, p. 760, July/Aug. 1987.

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