Session No. 795

Implementing an Electrical Safety Program Using NFPA 70E

Drake A. Drobnick, CSP, OHST
Saline, Michigan

Introduction

The goal of any safety program should be zero incidents and injuries. Adhering to the National Fire Protection Association's Standard for Electrical Safety in the Workplace (NFPA 70E) can help take that goal from concept to reality. This paper will provide ways for complying with the requirements of the 70E standard. It will also offer suggestions for establishing and implementing a comprehensive electrical safety program.

History

The 70E standard was created in 1979 at the request of The Occupational Safety and Health Administration (OSHA) to assist in the enforcement of electrical workplace safety. A major change to the standard was introduced in 2004 when safe work practice elements were introduced. The standard is currently "in cycle" with the next publication date being 2009. While not directly citable under the OSHA act NFPA 70E is enforced mainly through the use of the General Duty clause.

Application

NFPA 70E applies to most workplace environments. Understanding the requirements of Chapter 1 is essential for employees who are exposed to "live parts" over 50 volts or where an electrical arc flash hazard exists. This includes the hazardous daily activity of diagnostic testing and troubleshooting.

Recommendation

The 70E standard should be used as a reference when conducting shock and arc flash hazard assessments, when reviewing specific work tasks using the hazard/risk category tables, and for making personal protective equipment selections.

Due Diligence

Commission

Employers are responsible for creating and maintaining a safe workplace environment and for providing and enforcing written safety procedures. This would include establishing an electrical safety program. An electrical safety program is an organized approach that prevents injuries and equipment damage by eliminating hazards, exposures, and by using personal protective equipment. Employers are required to create policies and procedures for working on or near live components, provide training for both qualified and unqualified employees, establish safe work

practices, and develop lockout/tagout policies. Once these programs are established they must be audited to ensure compliance which includes a process for correcting deficiencies and investigating incidents.

Omission

Implementing an electrical safety program can prevent injuries. Creating and maintaining this program will increase spending. However, not protecting your employees from electrical hazards can cause skyrocketing costs such as increases in insurance or workers' compensation premiums, catastrophic medical payments, large litigation settlements, equipment damage, and production down-time, impugning your corporate reputation, possible bankruptcy, and even criminal prosecution. Your implementation of the 70E standard's requirements within your safety program is evidence that you have acted reasonably should litigation occur. Simply stated, implementing an effective electrical safety program is "good business".

Program Development

Your first decision should include your program's goal based on your organization's risk tolerance. Assessing your current state to find where deficiencies exist is the next step. Finally, planning and correcting those defiencies will create a successful program.

Using a hierarchy of controls to mitigate or eliminate incident occurrences is critical. Eliminating hazards primarily by de-energizing equipment wherever possible is the first step. Second performing an incident energy analysis helps to determine which controls will reduce the hazard potential. An engineering analysis of your system can be provided by various vendors or you can purchase available software and perform your own survey. Administrative controls like training, safe work practices and equipment labeling follow. Finally, selecting the appropriate personal protective equipment will help reduce hazard exposures. These four steps will provide a solid foundation for your program. The 70E standard provides some guidance for developing an Electrical Safety Program in Annex E. Reference publications like "The Electrical Safety Program Book" published by the National Fire Protection Association can provide valuable information to assist you in creating your program.

At this point, you should update your electrical system drawings. Having documents that are current and available is essential to your program. You should be aware that any survey completed will become inaccurate if preventative maintenance requirements are not practiced.

Deenergize

The most important element in preventing unnecessary incidents and injuries is to de-energize equipment. In most instances this can be accomplished with forward planning. Should the decision to work on live equipment be made an authorized permit to work must be issued. Working live is limited to life safety or continuous process operations not employer convenience.

Permit to Work System

A sample permit to work is included in the 70E standard Annex J. The permit helps discourage live work by requiring signatures of all parties involved. This may include signatures from the

plant manager or other levels of management to insure that everyone has an understanding of the potential hazards. The permit requires the employees to review and document the task to be completed and initiate all precautionary measures before the work commences. Part of this review is the selection of the proper personal protective equipment required to safely perform the work. Additionally, other permit procedures may influence the task such as confined space entry, circuit re-closing, and test before touch policies.

Shock and Flash Hazard Analysis

A shock and arc flash hazard analysis increases safety by notifying the employee of the magnitude of the hazards associated with the task. It also helps to insure that the proper personal protective equipment is specified.

Shock Hazards

Shock hazard approach distance boundaries are a function of the voltage level and working clearance distances. Table 130.2 (C) of the 70 E standard provides those distances and combined with the boundary definitions are fairly straightforward. Additional shock protection can be provided by installing "finger safe" (no contact) devices.

Arc Flash Hazards

Hazard/risk category classifications can either be obtained from the task specific requirements of the 70E standard's Table 130.7(C)(9)(a) or by calculating the flash protection boundary (FPB) and incident energy at a distance reference point using the formulas provided in Annex D. The dilemma when using the tables as well as the 70E formulas is that the fault current magnitude and clearing time of the overcurrent device must be known. This becomes evident when the table notes for tasks at 600 volts and below are properly applied. In either example you can then determine the personal protective equipment requirements from the standard's look-up tables 130.7 (C) (10) and (11). Because of the trauma caused by the blast effects of an arc flash event "DO NOT ATTEMPT" to perform the work in an energized condition if your calculations reveal incident energies above the 40 cal/cm^2 maximum threshold.

Current Limitation

The effect of an arc flash can be reduced significantly by installing current limiting technologies. The most popular method of accomplishing current limitation is the installation of fuses or circuit breakers. These devices limit the amount of incident energy magnitude by shortening the fault clearing time to one cycle or less. Other methods such as installing isolation transformers can also accomplish a degree of protection by limiting the amount of available short circuit current.

Safe Work Practices

Your organization should have a policy for conducting job briefings before and after each job. A sample job briefing form is located in Annex I of the 70E standard. This review can help to ensure a safe efficient task completion and further reduce any unanticipated situations that may develop during the task's performance. Other safe work practices should include policies on Lockout, employee training, emergency procedures, equipment labeling, personal protective equipment, and in the use of Ground Fault Circuit Interrupters (GFCI). These devices prevent

injuries by opening the circuit if a leakage current is detected. To be effective GFCI's should be tested according to the manufacturers' recommendations and always before use.

Employee Training

Your program should define training requirements for both "qualified" and unqualified employees. The method for qualifying your employees should be part of your program. Unqualified employees should be instructed in understanding their role in your electrical safety program. My experience suggests that many unqualified employees reset electrical devices rather than wait for the proper tradespersons to respond. This type of activity can only be condoned if the employee is properly trained and equipped to perform the task. Written training records are required to be kept and should be reviewed as part of the auditing process. Qualified employees should be trained in emergency response procedures including first aid, CPR, AED use, and the removal of victims from energized equipment.

Labeling

Equipment labels are required by the National Electrical Code article 110.16. You should use an ANSI Z535 style label that includes the following information: Flash Protection Boundary distance, incident energy in cal/cm^2 at a reference distance, shock hazard voltage level, and all personal protective equipment required.

Personal Protective Equipment

Hand Protection

Personal protective equipment is your "last line" of defense. Protection is required against shock hazards at and above 50 volts. You should also consider the use of gloves on high current systems at fewer than 50 volts if a burn or shock hazard exists. This will necessitate the use of insulating gloves and leather protectors in most instances including performing diagnostic testing and troubleshooting activities. Once the gloves are placed into service they must be re-certified every six months and inspected before each use. Although not rated for this purpose, insulated gloves and their leather protectors will provide a degree of thermal protection from arching faults.

Fire Resistant (FR) Clothing

Burn injuries are caused when clothing is ignited in an arc flash incident. In many instances, clothing burns long after the arc is extinguished. For this reason, I recommend you invest in fire resistant (FR) clothing for your employees. FR clothing can help mitigate the extent of burn injuries because of its self extinguishing nature. This clothing should be used as "everyday wear" and should consist of a long sleeve shirt and trousers rated for the incident energy exposures encountered.

Fire resistant garments can either be purchased or rented through a laundry supplier. They typically have an Arc Thermal Performance Value (ATPV) of approximately 4-8 cal/cm^2. When warranted by higher incident energy levels, ATPV garments rated from 25-40 cal/cm^2 should be readily available and used. Garment suppliers can provide the expertise to clean and repair the garments as required. Additionally, any outerwear worn as thermal insulation or for protection from the rain must also be arc rated.

When ordering FR clothing ask to see the ASTM 1506 certification label attached to the garment. This label assures the wearer that the garment will perform as intended during an arc flash incident.

Head and Face Protection

Head and face protection like hardhat/face shield combinations and arc hoods are required to reduce thermal burns, protect against flying particles, and filter out ultraviolet radiation produced in an arc flash. These devices are designed as secondary eye protection, so safety glasses must be worn beneath. Hearing protection is also required for exposures at 8 cal/cm^2 and above.

Test Instruments

Employers should review their test instruments to ensure compliance with the IEC 61010 safety requirements. Meters compliant with this standard help reduce injuries by assuring that over voltages due to line transients do not destroy the meter. To help reduce the possibility of misuse, employees should be trained in proper meter application.

Auditing

A systematic auditing process should be established to measure effectiveness and insure program compliance. Ultimately, policy enforcement is a clear signal to your employees that you are serious about electrical safety.

Pitfalls

The greatest pitfall you will encounter in setting up your program is employee attitude. The vast majority of employees who work with electricity have never worn any type of personal protective equipment. This experience tends to foster the belief in the "it can't happen to me" syndrome and the resentment of being "told what to do". I believe that reasonable employees will agree that protecting their well being is the "right thing to do" but they will freely admit that they believe all the policies and protective methods required by the standard are burdensome. To counter these beliefs I suggest that you involve your employees in the creation and implementation of your program.

Conclusion

NFPA 70E is a "how to" guide for implementing the electrical safety requirements of OSHA. It is a current "best practice" of how employees can be protected from electrical hazards. I suggest that you use the standard as a minimum requirement when establishing your program. I wish you every success.