Implementing NFPA 70E

One Packaging Company's Experience

November 26, 2007

After attending an NFPA 70E informational seminar in early 2004, the safety manager for Company X decided that it would be in the best interest of the company and its employees to pursue compliance with NFPA 70E. After talking to some in-house electricians and trialing some software, it was determined that it would probably be best to leave the initial assessment to the experts.

The manager contacted three local electrical contractors, with varying experience dealing with NFPA 70E, to quote the project. The quotes varied widely, and are listed below.

	Experience	Cost per Box Plant
Contractor A	8 Years	$9,000
Contractor B	3 Years	$18,500
Contractor C	None	$22,000

The costs listed are the average for a corrugator plant and two sheet plants with approximately 350,000 man hours per year each with the cost estimate for the corrugator plant being slightly higher than the sheet facilities. The quotes included the costs of the study, results of the SKM software (software used to run the calculations), labels for all electrical equipment, consultation throughout the project, and initial training.

Due to the experience and cost factors, the safety manager proposed that the company use Contractor A. The proposal was presented to corporate leadership and approved in August of 2004.

The studies were completed in late 2004 / early 2005 and it was quickly determined that the cost of completing the studies was only the tip of the iceberg.

The study was broken into three sections. The first was the "Short Circuit Study." This study was done to determine the tendencies of the electrical system in the event of a short circuit. A large number of these recommendations required an upgrade to certain breakers and fuses that were not rated to handle the maximum fault current available on the circuit. In this scenario, if one of the breakers or fuses were subject to a fault current above its rating, an explosion could result causing significant equipment damage, potential downtime, and/or injury to anyone in the area. Since some of the recommendations called for changes to some larger breakers, correcting the deficiencies required significant investments at most locations that were not originally anticipated when the Arc Flash proposal was discussed. Some of the reasons for the deficiencies in the system included:

1. More short circuit current was available from the transmission grid. Due to power outages, changes in the grid had been made over the years to make them more interconnected, increasing the amount of short circuit current available.

2. The proximity of transformers to the building is a contributor to the high short circuit current. The utility moving transformers can create significant issues.

3. Changing loads in the building – adding/removing motors and equipment as well as increasing the size of motors or changing the proximity of equipment to the service all have an impact on the short circuit current. While it is rare that one change will have a major impact, over time, numerous minor changes can have a significant impact in short circuit current.

4. The short circuit calculations are very difficult to perform by hand. In recent years, software has been developed to do these calculations. Because of the long process of doing the calculations by hand, they were not always done in the past. Now with the advent of NFPA 70E, everyone is more aware of code requirements.

Basically, things change over time at most facilities, and many times outside factors change without our knowledge. Electrical infrastructure is often ignored or thought to be okay, since it was sufficient when it was installed.

The "Short Circuit Study" identified the majority of the code violations at Company X's facilities and also created the most expensive corrective actions as many breakers, including some large ones, needed to be replaced.

The second part of the study was the "Protective Device Coordination Study." The primary purpose of this section is to prioritize the order in which breakers in the system will trip in the event of overcurrent conditions. The goal is for the breaker closest to the affected piece of equipment to trip to isolate the problem, rather than first tripping an upstream breaker both taking out multiple lines and making it more difficult to isolate the cause of the trip. Many of these recommendations consisted of changing breaker settings to ensure that the protective device curves are maintained, as intended.

The third part of the study was the "Arc Flash Hazard Study." This section of the study was done to determine what level of Personal Protective Equipment (PPE) workers will be required to wear while working on electrical equipment. This section also established the boundaries for each piece of equipment. Cost recommendations for this section included installation of fused disconnect in front of certain panels. The purpose of the recommendations in this section was mostly to help facilities obtain lower hazard class levels for certain pieces of equipment. In some scenarios, Company X was able to reduce the hazard class from a "3" to a "0," reducing the risk and PPE burden to employees and contractors.

While the majority of the costs for Company X were a result of acting on the recommendations of the contractor's study, other costs to consider include:

1. Switching maintenance uniforms from polyester or blends to cotton or FR materials
2. Personal Protective Equipment (PPE)
3. Electrically Rated Tools

After all considerations, early study quotes did not even begin to estimate the cost of NFPA 70E implementation to Company X.

	Company X Average
Study	$9,000
Equipment Upgrades	$50,000
Tools	$2,000
Uniforms / PPE	$5,000
Total	**$66,000**

Bear in mind that none of these estimates include the time spent by various people including safety, plant management, or maintenance. It also assumes that much of the upgrade work can be done in-house. No labor (man-hours, overtime, etc.) costs were taken into consideration for the purpose of this paper, as they were not tracked. For the benefit of the reader, Company X implemented most of the recommendations made by the contractor including all "Short Circuit" and "Device Coordination" recommendations, as well as the majority of the "Arc Flash Hazard" study recommendations. The only recommendations not taken were a few from the "Arc Flash Hazard" study where a very expensive recommendation would make only a minor difference in risk (like bringing a hazard class from a "2" to a "1", for instance).

<u>Considerations / Lessons Learned:</u>

Considering the cost of upgrading, it was determined that purchasing everything new would be pretty difficult for some of the facilities with many recommendations. It was found that with so many people working on NFPA 70E, there are a lot of used breakers available. Company X was able to save UP TO 90% of the cost of buying new by purchasing used and refurbished breakers. Most of the best deals were found on eBay. One facility was able to complete the recommendations at 80% of the cost of new.

Be careful about the tools chosen to perform electrical work. Many insulated tools do not meet the specifications of NFPA 70E. There are some good tool vendors out there right now that meet the requirements and are labeled as such.

Try to find a contractor that uses the SKM software. This appears to be the most widely used software at this time and will ensure that you will get all three sections of the study and recommendations.

Put rules in place to ensure that breaker settings as well as breaker and fuse types remain static as outlined in your study. In times of equipment trouble, it is easy for maintenance to crank up the breaker setting so it no longer trips. It is also easy to replace fuses and breakers with a different type or brand. This is no longer acceptable. Any change in your system could create problems making your study irrelevant. Maintain a good relationship with your contractor to ensure that changes made are consistent with your system.

It is also important to stay in contact with your contractor as changes occur. If you are considering adding a piece of equipment, have your electrical contractor specify electrical requirements **BEFORE** you put it out to bid. Equipment contractors will often try to leverage quote prices by using inferior breakers and fuses. By specifying type ahead of time, you can be assured that your system will remain in compliance and also ensure that you are getting an apples-to-apples quote on your equipment installation. Company X had to learn this lesson the hard way after changing out breakers less than 6 months old.

Conclusion:

This is simply the experience of one company. You may find that your experience is much different. The biggest thing to keep in mind is that NFPA 70E compliance is a long road and will probably take more time and cost more money than you originally anticipate. You will also be surprised to find that some panels that appear to be “low risk” at first may have a high hazard class due to factors you could not reasonably consider. This information alone makes the cost of the study well worth the money.

Lastly, it is very important to note that working on live electrical equipment should be a last resort option. If the equipment can be isolated and locked out, or rescheduled to a time when it can be isolated and locked out, that needs to be the first precaution taken. De-energizing and locking out live electrical equipment is the only sure way to keep your employees safe.