The True Cost of a $40 Flame Resistant Shirt

A Chicago newspaper article reported a tragic workplace fatality of a worker at an area elementary school doing electrical work who died as a result of severe burn injuries caused by an electrical incident. According to the County Medical Examiner, he was exposed to an electrical arc flash that caused his clothing to catch on fire. He died less than a week later from severe burn injuries. He left behind a spouse and children who will pay a lifetime price for an accident that lasted less than a fraction of a second. As tragic as this event was, many pieces of this story are nothing more than typical.

Electrical incidents causing severe burn injuries which can result in fatalities occur in the workplace more than 7,000 times annually of which 2,000 are severe enough to put victims in long-term burn center treatment. This means that these incidents are occurring in the workplace in the neighborhood of 5 to 10 times per day. While thermal burns are dangerous and harmful, the resulting severity and risk of fatality are more directly related to the onset of garment ignition than the exposure to heat or energy typical of this type of incident. In nearly all of these circumstances, the resulting severe burn injuries can be avoided or minimized to eliminate the potential loss of human life.

The question the author of the newspaper article does not answer is whether the worker had been wearing polyester or cotton apparel. In fact, this detail isn’t too significant to the outcome. OSHA prohibits the use of nylons, acetates, polyesters alone or in blend with cotton when work around thermal exposures could occur causing these fibers to melt and stick to the skin. Therefore, many companies require electrical workers to wear natural fiber, or all cotton clothing, while working in these situations. Cotton also presents a harmful risk because very little arc flash incident energy could cause cotton to ignite. In addition to being subjected to extreme heat of the thermal exposure, cotton and cotton blended fabrics are very likely to ignite and burn because of the molten copper and metal created from these explosions likely will cover major portions of the garments being worn. In either circumstance, burning garments, or burning and melting garments predictably increase the severity and extent of injury to the risk of fatality.

OSHA recognizes the harm of wearing improper clothing and therefore has requirements in their safety standards for electrical utilities and companies in general industry to ensure that clothing worn in these environments does not contribute to severe burn injuries or fatalities. For general industry, OSHA takes their requirements a step further to require personal protective equipment, including flame-resistant clothing, be worn to protect exposed areas of the body from electrical hazards according to the level of the potential hazard. Wearing flame-resistant clothing while working on or near energized equipment is very beneficial to the wearer in several ways; garment ignition is prevented, therefore significantly lessening severity and extent of burn injury. Further, the insulative characteristic of protective clothing defined as an arc rating, or arc thermal performance value (ATPV), can be measured so that selected flame-resistant clothing systems will have higher arc ratings that insulate from worst case exposures to minimize severity and extent of severe body burn.

OSHA references the NFPA 70E, as an acceptable means to determine what level of hazardous energy could be present were an arc flash to occur, and also what combinations of personal protective equipment would result in survivable or minimal burn related injuries. In fact, NFPA 70E provides for three different means to determine what the potential hazard level in this situation could have been and what level of protection would have prevented garment ignition, the root cause of this fatality. Though NFPA 70E provides a mathematical formula to calculate incident energy, by far the more common way it is referenced is through use of the Hazard Risk Category task tables and Typical Protective Clothing Systems table. The task tables identify common electrical tasks and assign Hazard Category numbers of 0 through 4 based on potential incident energies for these tasks. The Protective Clothing table makes recommendations for minimum arc ratings for each of the categories 0 through 4, with minimal protection levels higher than the greatest expected incident energy for each category.
Today, the third method, Simplified Two-Category, Flame-Resistant Clothing System within Annex H of the Standard is almost universal in protective clothing implementation because, as the title mentions, it's simplified and complete approach. Under this method, flame-resistant "everyday work clothing" (Hazard Risk Categories 0, 1 & 2) is utilized for systems operating at less than 1000 volts with a few exceptions. "Electrical Switching Clothing" with an ATPV greater than 40 (HRC 0, 1, 2, 3 & 4) is then utilized on operating systems greater than 1000 volts. Although the NFPA 70E Standard is the most widely recognized tool for determining hazard potentials there are a wide variety of software calculation tools also available that have been used in combination with the 70E Standard or on their own. In those circumstances where an organization has taken the steps to conduct a full hazard analysis approach using these software options, a PPE model identical to the Simplified Two Step Approach are almost without exception implemented with a daily wear of HRC 2 compliant apparel in combination with HRC 4 arc flash suits being incorporated.

We don't have an account of why this worker conducted a task while the equipment was energized, and further do not know why proper flame-resistant apparel was not being worn. We can make a few general assumptions based on typical behavior in our workplace. In this case, it is possible that this individual did not receive proper hazard awareness and safe electrical work practices training, or his employer possibly made a decision to not make a small investment above the typical costs of everyday workwear for flame-resistant clothing to protect the body from thermal burns or garment ignition.

While price points for protective apparel made from market proven branded flame-resistant fabrics are higher than all cotton industrial workwear, studies have shown that some brands of flame-resistant fabrics over the long haul are nearly as economical as everyday workwear. This is achieved where flame-resistant fabrics engineered with special fibers to enhance abrasion resistant and extend garment service life expectancy are selected for the flame-resistant daily wear requirement. Where normal cotton work apparel normally is replaced routinely because garments become worn and damaged in the workplace, the added durability of specialty flame-resistant fabrics allows multi-year use rather than an abbreviated 12-18 month period.

In this story, a relatively small investment to upgrade to flame-resistant clothing would have allowed this worker to return home to his family at the end of the workday and not become another typical, but tragic story of a preventable workplace fatality caused by an electrical incident setting clothing on fire. Positive changes are occurring as many electrical workers today are receiving the proper training to work in these conditions safely and are making the necessary investments to purchase and wear appropriate HRC2 compliant flame-resistant clothing. Hopefully, the impact will be that we see fewer stories such as this in the news in the future.

**Sights**

Mike Wright, President of 70E Solutions conducts electrical safety training for numerous Fortune 500 companies and contributed in creating the explosions for the Westex Arc Flash Video Series.

To receive a CD containing a wide range of replicated real world arc flash exposures that capture the magnitude of these incidents and the full effects on mannequins wearing non-flame-resistant or flame-resistant daily wear, please contact Westex, Inc. at (866) 493-7839 for a free copy.