Electrical Safety IN THE WORKPLACE

2022

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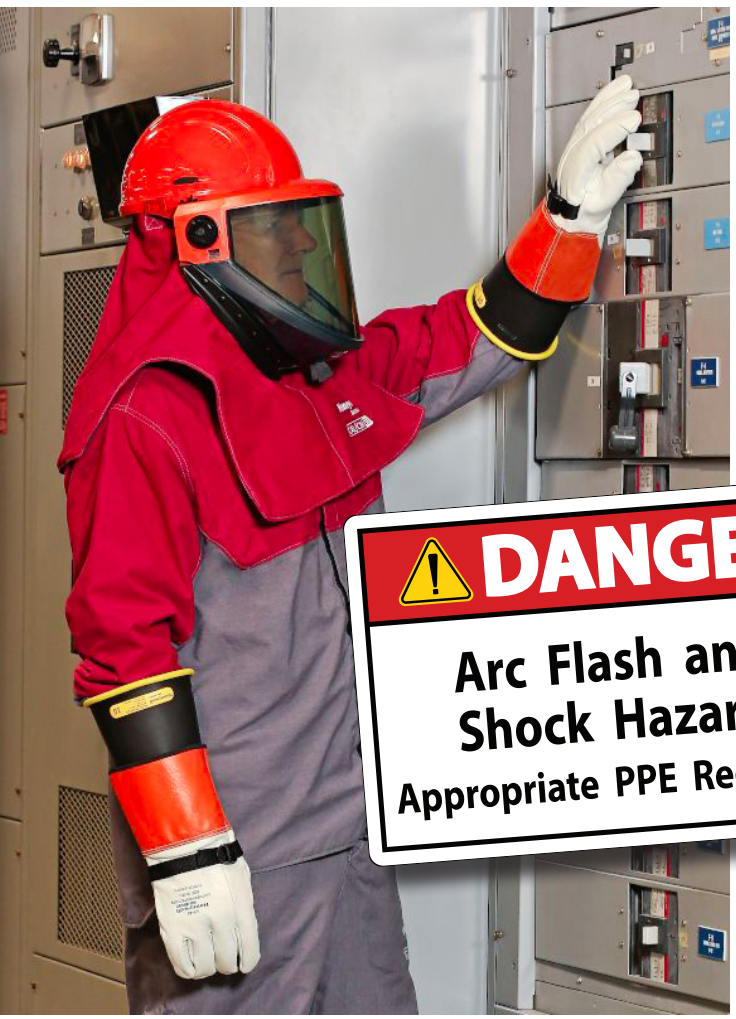

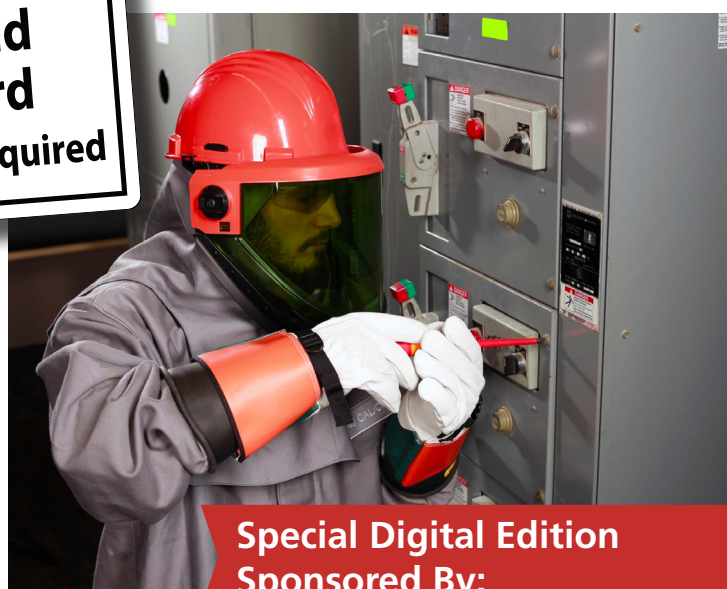

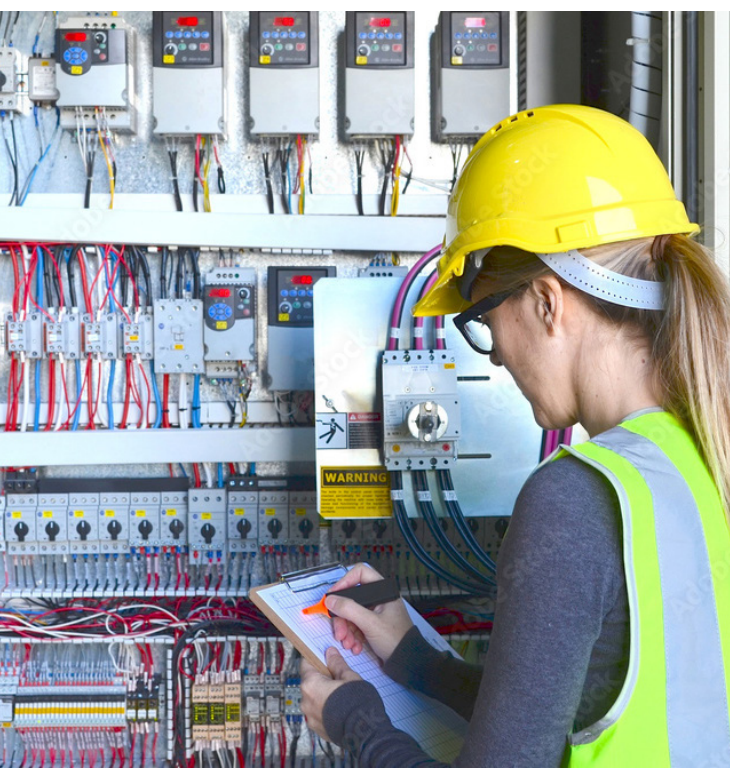

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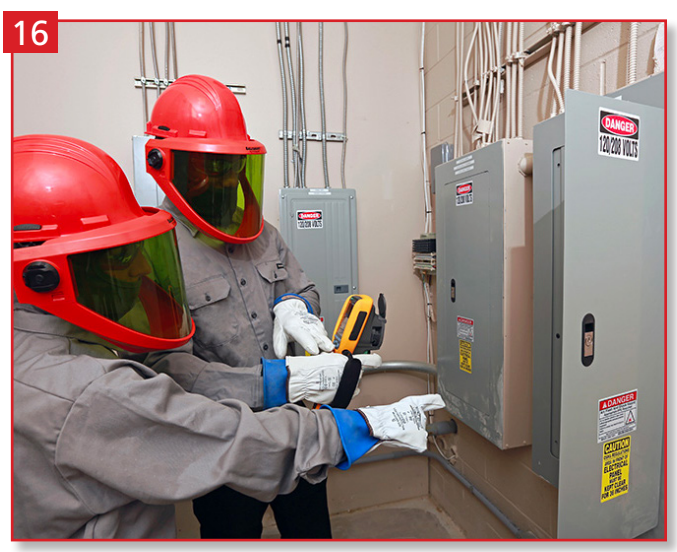

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Changes to NFPA 70E® 2021 for Electrical Safety in the Workplace®

IMPORTANT TO KNOW

Electricity has long been recognized as a serious workplace hazard, for both people who work directly with it – such as electricians and engineers – and others who may work with electricity indirectly. Potential sources of exposure are many: overhead lines, cable harnesses, circuit assemblies and more. In a fraction of an instant, an electrical incident can kill, injure, or disable a worker. Electrical injuries to workers can result from electrocution, shock, burns, or from falls caused by the worker coming into contact with electrical energy. In 2018, 160 workers were killed and 1,560 injured in U.S. workplaces, according to the Electrical Safety Foundation International (ESFI). 1 More than half of the fatal electrical injuries that year occurred in the construction industry.

NFPA 70E, which was originally developed at OSHA's request, is considered the definitive standard for electrical safety in the workplace. It includes information about arc flash incident energy, lockout-tagout procedures and personal protective equipment (PPE) that can mitigate the risk of an electrical injury.

STANDARD REQUIREMENTS

Whenever possible, turn off electrical power during the work being done and verify that it stays off until the task is completed. This can be done by: individual qualified employee control; simple lockout/tagout or complex lockout/tagout.

When it is necessary to work "live" near exposed energized parts, a live work permit that describes the work to be performed and why it must be performed should be signed by the customer, engineers or other person in charge.

For shock protection, three shock hazard boundaries should be determined: limited approach, restricted, and prohibited. These boundaries help identify who should be allowed (i.e., only qualified persons can enter the restricted approach boundary) and when workers must use voltage-rated rubber gloves and fiberglass tools.

The flash protection boundary (FPB) must also be determined. Anyone working closer than 48in to live parts must wear PPE to protect against arc flash. This may include overalls, jackets, and vests made of material that blocks heat energy and that has non-conducive hardware.

The Hazard/Risk Category (HRC) must be determined, based on tables provided by the standard. Determine Hazard/Risk Category (HRC). The HRC level helps electrical workers select the correct type of PPE to wear, based upon the task they are performing live.

Workers must wear appropriate PPE whenever they are performing tasks within the FPB, whether or not they are actually touching the live equipment.

A LOOK AT THE REVISIONS

Some of the 2021 revisions have been reorganizing. For instance, Article 110 of the standard – General Requirements for Electrical Safety-Related Work Practices — has been revised to consolidate general requirements for electrical safety-related work programs, practices and procedures from other articles. The fi rst priority in implementing these work practices is hazard elimination. Energized electrical conductors and circuit parts operating at voltages equal to or greater than 50 volts are to be put into an electrically safe condition before an employee performs work if the individual is within the limited approach boundary and/or the individual interacts with equipment where conductors or circuit parts are not exposed but an increased likelihood of injury from an exposure to an arc flash hazard exists.

Electrical safety training for employees exposed to specific hazards associated with electrical energy is to be classroom-based, on-the-job, or a combination of the two. New to the 2021 edition: classroom training can include interactive electronic or interactive web-based training components.

The 2021 70E® edition places a new emphasis on keeping on file, documenting, and following the recommendations of electrical equipment and PPE manufacturers' instructions. Manufacturers' instructions sometimes have been skipped because the information might be hard to access, forcing workers to dig through equipment packaging, or small print instructions have made readability difficult. Manufacturers must now make instructions and recommendations more readable and more accessible.

Personal protective equipment (PPE) constitutes part of NFPA 70E®. PPE includes nonconductive head protection, eye protection, hearing protection, and arc-rated clothing whenever there is possible exposure to an electric arc flash, insulating blankets, and non-melting footwear. The 2021 edition addresses the common practice of wearing high-visibility vests over arc rated clothing. In the past qualified workers that were required to wear high-visibility vests had to remove the vests if the vest did not meet the level of arc flash protection required. Now qualified workers can wear a category 1 arc rated high-visibility vests (4 cal/cm2) during the workday and not have to remove it to perform electrical troubleshooting or voltage measurements.

Acceptable electrical safety footwear has been expanded in the 2021 edition to go beyond traditional leather footwear to include other types footwear other than leather or dielectric as long as it has been tested to demonstrate no ignition, melting, or dripping at the estimated incident energy exposure or the minimum arc rating for the respective arc flash PPE category.

In addition, the definition of balaclava has been changed. The word "hood" and "sock" were removed. The new definition: an arc-rated head-protective fabric that protects the neck and head except for a small portion of the facial area.

INCREASE YOUR KNOWLEDGE

The complete standard is available online at: **https://webstore.ansi.org**. ■

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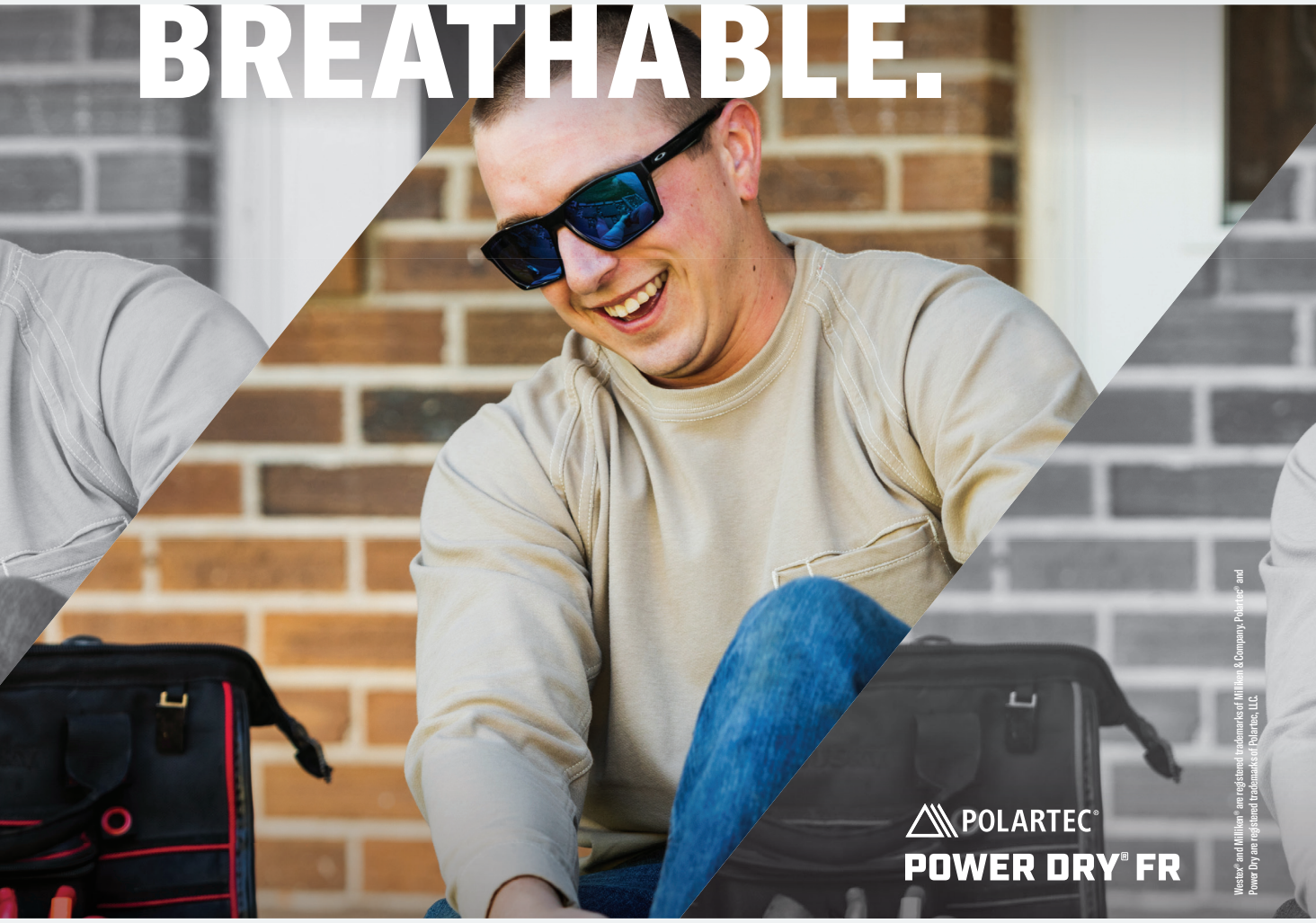

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By: **Scott Margolin**, *Co-Chairman, The Partnership for Electrical Safety*

Don't Think Your Company Needs Arc-Rated Clothing? Four Big Reasons That's Probably Wrong

If you've ever asked the question, or even just wondered "Does my company need arc-rated clothing?" chances are very high the answer is yes, even if the answer you got at the time was no. That's because many people misunderstand one or more of four major factors: the hazard, the standard, OSHA's position, or mitigation strategies. If you have any facilities which use electricity at 50 volts or greater, or work on them (and aren't an electric utility) NFPA 70E applies to you. That's pretty much everyone in the U.S.

The Hazard

Arc flashes can occur in essentially any energized equipment, including low voltage; the number one for injuries and fatalities is "only" 480V. There's no such thing as a small arc flash when you're the person in its path…3 cals is smaller than 6 cals, but they all produce extraordinary temperatures (30,000°F, four times hotter than the surface of the sun) and significant quantities of molten metal. Molten copper is >1900°F and can burn exposed skin and ignite flammable clothing. The vast majority of catastrophic injuries and fatalities are caused by the arc igniting flammable clothing, not by the arc itself. The remedy for this is simple – don't work energized if you don't have to, and don't wear fuel. All non-AR/FR clothing, including 100% cotton, is fuel. Too many people have emerged from hazard analysis specifying 100% cotton; this is worse, both with regard to safety and legally, than doing nothing. Cotton is NOT PPE – it ignites easily, burns hotter, spreads quickly, and is harder to extinguish. When someone specifies cotton, they are acknowledging a thermal hazard (by banning meltable fibers), but cotton is not protective, and is not compliant with OSHA or NFPA 70E as the outer layer.

You may be able to engineer the hazard down in frequency and down in incident energy, but it cannot be eliminated during energized work. Despite the best training, gear, and behavioral safety in the world, arc flashes continue to occur frequently. The only remedy given this fact set is arc-rated clothing and associated PPE. That's why OSHA and 70E both require it.

The Standard

NFPA 70E addressed arc flash over twenty years ago, in 2000; the standard makes it clear that anyone working on or near energized electrical gear at 50V or above must be provided with AR clothing and other PPE. 70E provides excellent hazard analysis tools, incident energy estimation tables, and risk mitigation procedures. One of those tools helps determine if an arc flash hazard exists; if the answer is yes (hint: it's almost always yes), all the appropriate PPE must be worn. 70E encourages de-energization whenever possible and allows for hot work only when de-energizing is infeasible.

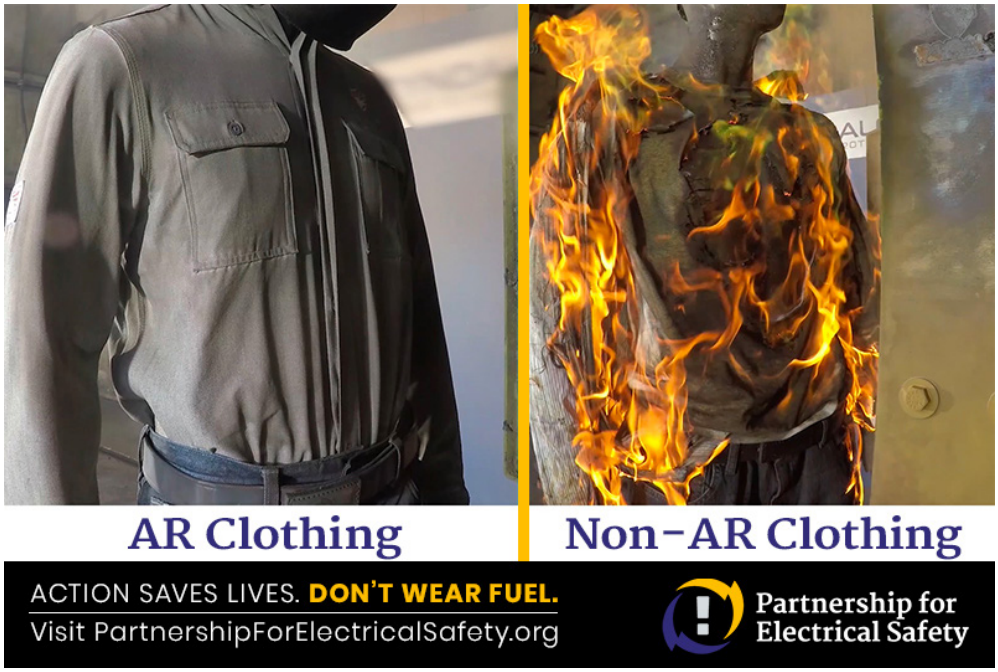
During the first several years after arc flash was added to 70E, many companies brought their electrical programs into compliance, protecting over a million workers in the process. However, in the U.S. today about 500,000 industrial electrical workers still are not being provided AR clothing, despite a clear standard and OSHA statements, enforcement, and fines. The standard has dramatically reduced serious injuries and fatalities among the protected population, but unprotected workers continue to suffer unnecessarily.

OSHA's Position

OSHA prohibits any clothing which could increase the extent or severity of injury in an arc flash; this prohibits any and all flammable clothing, including 100% cotton. They also classify AR clothing as PPE, meaning the employer is required to provide the garments, and they require that

the AR garments have an arc rating greater than the predicted incident energy exposure.

OSHA's relationship with 70E is relatively simple: OSHA tells us what we SHALL do, but not how to do it. NFPA standards (including 70E) tell us how to accomplish what OSHA requires – they gather experts in the relevant industries and create standards that instruct the industry how to protect their workers and comply with OSHA. In other words, OSHA tells us we shall provide a workplace free of recognized hazards, and where we cannot engineer the hazard out, we shall provide appropriate PPE. NFPA 70E picks up where OSHA leaves off and tells us how to conduct hazard analysis and how to protect workers. Thus, OSHA and NFPA 70E work in tandem, and have since the beginning. OSHA encouraged the NFPA 70E committee to include the arc flash hazard in the late 90s; OSHA's top electrical expert was on the 70E committee during the writing and many revision cycles since; and OSHA cites 70E regularly. OSHA has also made it quite clear that one cannot sell liability; that is, the host employer is responsible for providing incident energy information to any contractors they may employ.



Mitigation Strategies

There are several common pitfalls here: Some companies claim they do not work energized. However, there are energized work steps in every de-energization process: de-energize, confirm absence of voltage, re-energize, and confirm presence of voltage. PPE is still required. The only truly "never energized" work is pulling wire in a building not yet connected to the grid or a generator.

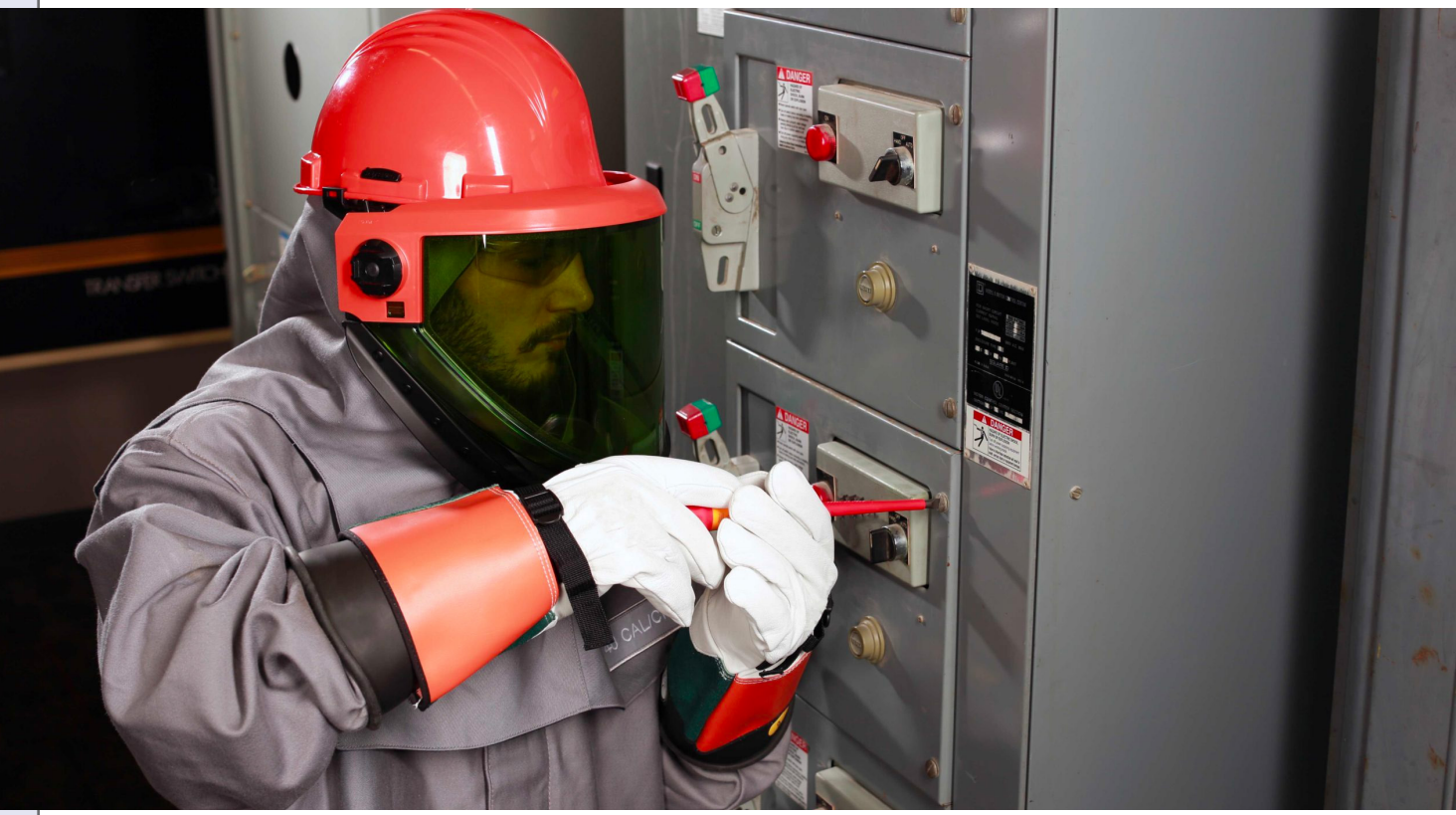
Some companies claim incident energies are too low to require PPE. This is wrong on many levels. Those calculations generally assume the worker is 18 in and that the breaker will clear as designed. However, people are often closer, and breakers often stick (require more cycles than when new). Both of these variables will cause significant increases in incident energy. Molten metal, as noted earlier, is a significant ignition hazard and is created by virtually all arcs.

Some companies continue to believe the myth that cotton is protective or compliant. It is neither.

Some companies provide a few kit bags of 25 or 40 cal suits, to be shared among dozens or hundreds of workers who are wearing flammable clothing such as 100% cotton, and then claim compliance has been achieved. This may be true in theory, but it is almost never true in reality. Kits get left at the office, in the truck, or are borrowed by someone at another job site. Workers refuse to wear shared gear due to hygiene issues, won't take the time to find and don them, or take them off too soon. The majority of serious injuries among workers who have been issued AR clothing occur in these types of task-based programs, because the injured worker was not wearing the PPE.

Some companies simply refuse to provide AR clothing based on long-outdated ideas around comfort, cost or heat stress. But today's AR pants and shirts look, feel, weigh, wash, and wear just like regular street clothing, including many of the same brands and styles, and most cost only a little more. And note that no single layer, breathable apparel is a contributor to heat stress, whether it is FR, AR, or flammable, short sleeve or long sleeve, light or normal weight; Heat stress is caused by poor hydration, lack of shade, lack of rest breaks, and some illnesses or medications. Clothing helps cause heat stress when it is non-breathable (rainwear, Tyvek, etc.) or multiple layer (40 cal suits, etc.) …not when it's breathable single layer AR or FR clothing.

Does your company need arc-rated clothing? OSHA and NFPA 70E agree – If you work on or near energized electrical gear above 50 volts, the answer is almost certainly yes. Arc flash doesn't occur as often as slips/trips/falls, but the results without PPE when it does are almost always catastrophic. Unlike many hazards, the remedy is amazingly simple: don't work energized and don't wear fuel. ■



Six "Musts" For Working on Or Near Energized Equipment

By: **David Weszley**, *Contributor*

Electricity is present in every workplace. When it is necessary to service, maintain, or modify an electrical system that is "live," here are six action items that must be addressed:

1. NFPA 70E electrical safe work practices 2021 edition must be used when working on or near energized equipment.

NFPA 70E 2021 requirements must be followed, starting with electrical safety work practices involving 50V or more. The first priority for any company is to de-energize any electrical equipment. Make sure it is in electrically safe condition before working on the equipment. There are steps when replacing a component, such as a circuit breaker or fuse. First, de-energize the equipment. The second important step is to de-energize upstream, where the energy is fed from. Turn off the power and perform lockout tagout (LOTO).

You may think you have de-energized the equipment, but importantly, you need to verify. This is huge. Check with a voltage meter if any energy is still live. This is the only official way to determine a zero-energy state. Try to turn the motor on, if it doesn't turn on, you assume it is off. But energy can be fed from multiple sources or there can be a delayed stoppage. Confirm your assumptions.

What can be done while equipment is energized, such as when troubleshooting, voltage testing, visual inspection? One, wear personal protective equipment (PPE) while doing this work, per 70E requirements. Two, set up an approach boundary surrounding the equipment that is exposed, such as when the cover is off a panel.

There are specifically designated types of boundaries, per 70E — the limited approach boundary, the restricted boundary, the arc flash boundary. To give a visual warning of the boundary's parameters, put cones, tapes, etc. around whichever boundary is furthest from the equipment.

The restricted boundary is for shock protection, where you can contact the equipment. Within the restricted boundary you need to use insulated tools.

With the limited approach boundary, you're a couple steps back from the equipment, approximately 36 to 42 inches. Bear in mind, you must wear PPE.

The arc flash boundary is decided by NFPA 70E calculation, or a qualified person comes out and does the calculation. An arc flash boundary can range from six, ten, twenty feet, or more. Completing an incident energy analysis is "boots on the ground" territory. Qualified workers are physically removing covers, looking inside, conducting visual inspection, looking at types of breakers, wire size, and logging that information. That information is compiled

and sent to an electrical engineer. He/she then calculates the incident energy number. This is an extremely important assessment, telling you how dangerous the hazard is.

Does every piece of electrical equipment have arc flash potential? No. That is why you get an incident energy analysis completed. The equipment label will tell you the voltage, the arc flash boundary and necessary level of PPE.

2. An Energized Electrical Work Permit (EEWP) is required by every company when work on or near energized equipment is deemed necessary by the company because power cannot be turned off.

An example is not being able to turn off a ventilation system in a hospital critical care unit, or perhaps an alarm system. In cases such as this you must fill out the permit. One section of the permit is called "justification." Here you explain why you are doing work on energized equipment and why it cannot be de-energized. Several signatures (by a qualified person and managers) are required on the form. You need this documentation if someone is injured while working on energized equipment and OSHA, for example, is contacted.

3. To determine if electrical equipment is energized after lockout tagout, you need to use a voltage meter to test it.

You can't rely on a visual inspection. For example, someone working on equipment may ask a co-worker to flip breaker 20 to de-energize it, but the co-worker flips breaker 21. The person working on the equipment cannot distinguish breakers 20 from 21: this is why you verify that there is no voltage on the right breaker or switch.

4. You must use insulated tools in the restricted approach boundary if you are working on energized equipment.

When you are really close to energized equipment while working, say within six inches, anything in your hands within this restricted boundary, a tool in your hand, may come in contact with the equipment. Or you might accidentally drop the tool. If it is not insulated, it will cause an arc flash, blowing up the equipment and yourself.

Here is another example of what can happen: You're tightening a component with an adjustable wrench. The equipment gets loose due to vibration, and the tool handle accidently touches the energized equipment. You get a cross connection causing an arc flash.

5. It is important to understand the types of PPE you need to wear when working on or near energized equipment.

There are two methods to determine required PPE. One, labels on equipment can tell you the results of an incident energy analysis and the distance you must maintain from the equipment. Two, if the equipment does not have a label, you need to use arc flash PPE category NFPA 70E tables (130.7c15a).

An incident energy study is conducted to determine the level of incident energy a piece of equipment has. Not everyone does an incident energy study. If you get a new piece of equipment, you need to do an incident energy analysis. It can be done in-house if you have a qualified engineer, or you can use the services of a third party.

You need to know important electrical numbers. The average person probably will not know these figures, such as available fault current and fault clearing times for breakers. Equipment labeling is extremely helpful. An equipment arc flash label is also extremely useful. Training helps you understand these numbers. If you do not understand, you're going in rather blind to work on or near energized equipment.

Sometimes your task changes while working on electrical equipment. NFPA 70E 2021 edition has been revised to state that when you turn equipment back on; when a circuit breaker has been replaced or maintenance performed, there is a chance an arc flash could occur when re-energizing equipment. The 70E 2021 edition states you should wear PPE the first time you turn equipment back on.

6. Only a qualified person can enter the restricted approach boundary.

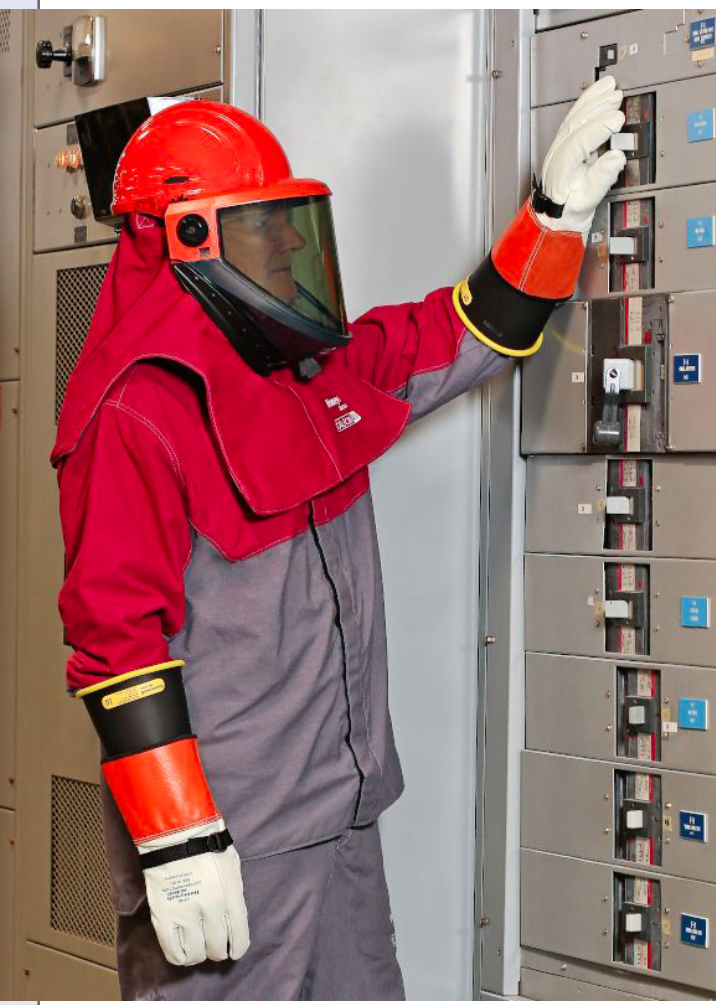
The limited approach boundary can be entered by an unqualified person for training purposes only. The unqualified person cannot touch or feel the equipment. He or she must wear PPE and have their hands to their sides, strictly visually learning.

To obtain the status of a qualified person, workers 1) need to know how to protect himself or others around them from electrical hazards and arc flash; this is a must; 2) they must have electrical safety training every three years, as NFPA 70E is revised every three years; 3) they must have knowledge of the equipment he or she is working on; and 4) they must demonstrate their skills to a designated person from the company; probably the most knowledgeable person, another qualified person. (Who the company designates to be designated person is at the discretion of the company.)

One more point to consider: OSHA inspectors use NFPA standard 70E to educate them on what to look for and to understand when conducting electrical safety enforcement inspections. Compliance officers can and do use the OSHA General Duty Cause to enforce electrical safety in the workplace — "Each employer shall furnish to each of his employees employment and a place of employment which are free from recognized hazards that are causing or are likely to cause death or serious physical harm to his employees." Arc flash or shock are recognized hazards.

Arc Flash Safety: Helping Companies Keep Workers Protected from one of the Most Dangerous Electrical Safety Hazards

By: **Kevin Pietras**, *Director of Offering Management, Honeywell Electrical Safety*



One of the most dangerous and pervasive electrical safety issues (arc flashes) occur when electrical current passes between two or more conducting surfaces or from conductors to the ground. Far from being a harmless spark, 76,000 workers each year1 are disabled because of serious shock and burn injuries caused by arc flashes.

Arc flashes can have several causes, such as gaps in insulation, corrosion, condensation, dust or other impurities on a conducting surface. Take for example the case of Graeme Edwards2, a unit controller with more than 30 years of experience who was reinstalling a high-voltage circuit breaker at an Australian power station. Edwards knew it was a potentially hazardous – though routine – procedure, so he did the work during a planned outage. Despite the outage, the electricity short circuited through a cable that was too long, causing an explosion, and leading to Edwards' death. In this situation, a trained professional passed away, leaving behind grieving family and coworkers. As shown here, arc flashes are hard to predict and difficult to prevent against. But as with many workplace safety issues, the first step to preventing serious injury is awareness, education, and having the right protective equipment.

With so much industrial and consumer equipment today relying on power-hungry electrical devices, it's more important than ever to understand the full impact of arc flashes – including safety hazards and the human and financial costs.

The Main Hazards of Arc Flashes

Electrical hazards are an all-too-common source of injury. In fact, electrical safety accidents perpetually rank as a leading cause3 of workplace deaths. Arc flashes present a significant danger and regularly cause serious injury, as electrical arcing produces temperatures as high as 35,000°F – hotter than the surface of the sun's temperature of 9,941°F. So even if the victim doesn't touch anything, he or she can be fatally injured – especially when you consider that burns can occur over a distance of 10 feet.

Burns pose a significant danger. As much as 80% of electrical injuries are burns resulting4 from an arc flash and aftereffects, such as ignition of flammable clothing. Arcs typically release five to 30 calories. Exposure to just one to two calories causes second-degree burns. In 0.1 seconds, a worker can get a third-degree burn. And the odds of someone surviving a burn decrease as age increases.

There are other debilitating effects. Hearing loss, eye injury, skin damage from blasts of molten metal, lung damage, and blast injury can all occur from an arc flash. The biggest factors in helping keep workers safe from arc flashes is awareness, education, and companies choosing and maintaining the proper protective equipment.

Take Steps to Prevent Electrical Injuries

Prevention costs less than noncompliance. The Wisconsin Safety Council estimates that for every dollar spent on training, three dollars are saved on injury costs. In one survey5 of arc flash injury victims conducted by the Fire Protection Research Foundation, 94% of respondents believed that the incident could have been prevented. In fact, the prevention method most often referred to was simply "turn the power off."

As with any sort of safety process, the best way to cope with a danger is to avoid the situation and stay out of harm's way. But when that is impossible, companies should

minimize the risk and help ensure their employees who do put themselves at risk are protected. To prevent workplace electrocutions:

- Train workers in electrical safety
- Implement and follow safe work procedures including wearing properly rated arc flash personal protective equipment (PPE)
- Follow corresponding OSHA, NEC, or NESC requirements
- Implement and follow OSHA's Lockout and Tagout (LO/TO) procedures, found here6

Training is more than an occasional talk. Improve safety training and risk awareness across the organization — and not just because OSHA requires it. For safety managers, responsibilities include raising employees' awareness of their actions and the possible results. Employees must understand the consequences of any missed protocol and understand why they should follow proper safety procedures at all times (even when nobody's looking).

Among the best guidelines to follow:

- Ensure your company has a written safety program that identifies risks, sets boundaries, and establishes the PPE needed to protect workers from arc flashes and other electrical hazards
- Document the electrical regulations and work processes
- Provide the training and tools to ensure they are understood and consistently enforced

PPE Helps Manage Arc Flash Risk

When an arc flash event occurs, it is caused by a short circuit condition where electricity travels outside of its planned path. The temperature of an arc flash can reach over three times hotter than the sun. This means workers in potential arc flash environments, such as those who operate on electrical panels in buildings, need specialized PPE to prevent them from experiencing substantial consequences.

Arc flash PPE requires head-to-toe solutions. When workers don their PPE ahead of entering an environment with the potential for an arc flash, they need to be wearing protective garments like coats, overpants, and coveralls made with arc flash resistant materials. Head, face, and neck protection is critical too. Arc flash hoods are designed to cover the head, face, and neck to protect against extreme temperatures. When considering the right face shield to use, workers should opt for selections that ensure reliable visibility even in poorly lit rooms and anti-fog and anti-scratch coatings to guarantee lens longevity.

Quite simply, no worker should get near electrical equipment without wearing the right PPE chosen by their employer. It's obvious that electrical hazards are unpredictable. A worker cannot know if the workspace had a water leak, or if the wind will whip the wires to a place where they shouldn't be. The consequences of a "minor" misjudgment are not minor when it comes to electrical power.

PPE is considered the last line of defense, after all the other steps have been taken in a safety plan. Don't treat PPE as an invincibility shield, as electrical hazards are frighteningly powerful. Everybody who gets near an industrial power plug should wear the appropriate gear. "Appropriate" is important; make sure workers have the exact PPE needed for every application.

Luckily, PPE that protects against arc flashes has come a long way – from heavy, non-breathable garments to comfortable and lightweight moisture-wicking fabric. Having modern, comfortable PPE encourages personnel to wear them more readily. After all, if employees don't wear them, they can't be protected. In addition, eye protection now features clear lenses that allow a full field of vision while protecting against arc flashes. This evolution of PPE allows users to adapt to wearing PPE more readily.

Hundreds of deaths and thousands of injuries occur7 each year due to electric shock, electrocution, and arc flash. But almost all these tragic events are preventable. A clear understanding of the dangers involved is vital to worker safety. So is a culture-driven adherence to well-vetted and correctly executed processes and procedures. PPE is the last line of defense and is crucial in the safety process, enabling organizations to protect their employees and avoid costly – and tragic – mistakes. ■

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By: **Zarheer Jooma**, *Contributor*

Utility Training & Awareness

Electrical safety-related work practices are governed by different OSHA regulations for utilities, industry, and construction companies. Utilities follow OSHA 1910.269 (Subpart R), industries follow 1910.331 (Subpart S), and construction companies follow a combination of 1926 Subpart K or 1926 Subpart V (depending on the jobsite).

Utilities spend extensive resources on training that ranges from OSHA classes, NESC installations, and company specific procedures. Some of this training spans beyond electrical training and includes non-electrical and human performance type training. In this complex array of training classes, electrical arc-flash safety training may be overlooked or inadequately covered. The lack of adequate training in this field manifests in dangerous situations as we were recently informed of a utility worker that operated a piece of equipment without wearing the proper personal protective equipment (PPE). Although this may not be a problem in certain limited cases, in this instance the label prohibited any energized work based on the (high) arc flash energy. In this case the workers at this utility failed to realize that switching off is considered energized work.

Training Operators

Switching, racking, inspecting, and cleaning are all examples of interacting with energized equipment and present an arc flash hazard. Testing, repairing (maintaining), and grounding are examples of contact (either direct or indirect) and present both a shock hazard and arc flash hazard. OSHA doesn't require that the hazard never be present, instead it requires the employer to eliminate the hazardous energy as the first option. If eliminating the hazard is not possible, only then can the employer consider the risk of injury and reduce the risk to a tolerable level. Examples of when energized work is permitted includes troubleshooting that requires voltage or when shutting down creates a greater hazard. Also take note that inconvenience or production inhibiting is NOT considered infeasible by OSHA.

Training on the Arc Flash Study

Having served as an independent safety consultant to various utilities has offered a great deal of insight into similar dangerous operating conditions but has also allowed for implementing and testing what works best in these environments. As mentioned above, training is one area that can be overlooked but it is very critical as it will not only provide the instruction and education where needed, it will also provide the awareness so employees can handle these high-risk tasks in a safe and effective manner.

Arc Flash studies are very important for overall compliance but making sure all of your workers clearly understand the results and data that come from the arc flash study is just as critical. Commercial software will assist with arc flash studies such as SKM PowerTools, ETAP, and EasyPower. These are examples that are used for systems less than 15kV, while ArcPro is used for systems above 15kV, such as HV switchyard modeling. Generating plants are fairly complex due to the multiple layers of redundancy in supply and it can be fairly common to find a circuit breaker that is capable of being supplied from four different upstream sources. Engineers undertaking the arc flash hazard analysis need to work with the plant operations and engineering departments to ensure that the correct information is provided for labeling purposes. It is critical to get the labeling correct as these labels will tell workers what PPE is necessary prior to accessing the electrical equipment.

As an example, a switchboard was calculated to be less than 8cal/cm2 when fed from the utility source and required daily wear. This scenario was common to the remaining generating units and operated regularly. In an unlikely event of a total blackout, a black start generator could be used, however, the energy then increased to above 40cal/cm2. The plant decided to utilize the 8cal/cm2 label and drafted a procedure for black start operating. In that procedure the higher arc flash energy is mentioned. In cases like these, OSHA requires emphasizing the major roles played by training. Workers must be trained, the plant must ensure that all workers understand which operating configuration is mentioned in the label, and where to obtain the correct arc flash information if the operating configuration has changed.

No matter what your role may be with a utility, training is crucial. High voltage electricians, linemen, safety directors, utility managers, meter service workers, and underground network linemen can all benefit from the various training offered. Although these are considered specialist positions, there remains areas in which even they require "specialized" training to meet the minimum requirements. Having training that focuses on key areas such as OSHA 1910.269, elements of the arc flash study, consequences of exposure, the selection, care, and application of arc flash PPE, arc flash and shock boundaries, minimum approach distance, locking, tagging, verifying, and grounding of equipment, and hazard identification and risk assessments are all critical areas for utility workers to be always fully aware of. Training will help ensure all personnel are working safe and staying fully compliant.

Zarheer Jooma conducts nationwide electrical safety training and arc flash studies. He joined e-Hazard U.S. after ten years of managing e-Hazard South Africa and many years of experience with Eskom Generation and ArcelorMittal. He has been regarded as the specialist on arc flash safety in South Africa, having convened and chaired SANS 724, the South African national standard for personal protective equipment and protective clothing against the thermal hazards of electric arc. Jooma has extensively researched and published on arc flash incident investigations and how to implement them in industry (https://e-hazard.com/).

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Congress Urges OSHA To Act on Arc Flash PPE

By: **Scott Margolin**, *Co-Chairman, The Partnership for Electrical Safety*

At least half a million industrial electrical workers STILL are not provided arc rated clothing and other PPE they need to do the job safely.

The Partnership for Electrical Safety (PES) has admirable goals, dedicated members, and bad timing. PES was founded in early 2020, with its first meeting scheduled for late March…one week after the NBA and NHL shut down along with the rest of the country. That inaugural meeting, and all following ones, have been held on Zoom. However, very significant progress has been made despite the headwinds of the pandemic and the presidential election cycle with its subsequent change of administration, policies, and focus.

If you're not familiar with PES or its work, here's a brief primer.

The Partnership for Electrical Safety firmly believes that every American working on or near energized electrical equipment deserves equal protection from arc flash, including the appropriate arc rated clothing and associated PPE (personal protective equipment). We believe that the PPE requirements of NFPA 70E: Standard for Electrical Safety in the Workplace provide the appropriate best practices to ensure industrial electrical worker and operator safety, and should be broadly adopted for substantially all live or potentially live industrial electrical work in the United States. We seek to educate those at risk and to make plain to relevant oversight entities the need for use of PPE when doing industrial electrical work, and the extreme human and financial costs of non-compliance.

Transmission and distribution utilities have provided arc flash PPE since 1994, which has dramatically reduced injuries and virtually eliminated arc flash fatalities among line workers. Despite that success, and despite the NFPA 70E standard, which has included the arc flash hazard and relevant PPE for over twenty years, at least half a million industrial electrical workers STILL are not provided arc rated clothing and other PPE they need to do the job safely. The fix for this long-standing unsafe, unequal situation is simple: OSHA must act to give industrial electrical workers the same protection their utility counterparts have long enjoyed.

OSHA action has long been a primary driver of major American workplace safety advances, including several directly relevant to this issue. OSHA was heavily involved in the Electric Utility segment move to arc flash PPE in the mid-1990s, initial industrial electrical adoptions of NFPA 70E in the early 2000s, the Oil & Gas segment move to flash fire PPE both in the late 1980s, and again with the publishing of NFPA 2112 in the early 2000s. The most recent example is also an almost perfect match and template for the current lack of industrial electrical PPE.

OSHA published a document in March of 2010 (often called the "Drilling Letter") which essentially noted that A) the drilling industry has the same flash fire hazard as the rest of the Oil & Gas Industry; B) that there are consensus standards which clearly address both the hazard and feasible means of abatement, including PPE; C) that despite these standards existing for a decade at that time, the significant majority of the drilling segment did not provide the flash fire PPE; and D) as a result, OSHA was directing the drilling industry to act. An almost identical scenario exists today, except that NPFA 70E has included arc flash for twice as long – twenty years, not ten, and the number of unprotected industrial electrical workers is substantially larger – making this situation even more urgent.

PES Progress

Since the pandemic hit, it has been essentially impossible to take the traditional approach and meet with relevant people in person to make the case. But because the situation affects so many people and the PPE/no PPE divide is so stark (an arc flash without PPE will usually result in catastrophic injury or death, whereas with the PPE there is very minor or no injury), we found many people at OSHA and within Congress were very willing to engage on the matter.

OSHA Letter

PES began by vetting our concerns and our intended approach with a gentleman recently retired from OSHA; during his 40-year tenure he was the primary author of most of OSHA's electrical standards. He also served on the NFPA 70E committee, ASTM F-18, and a myriad of other electrical safety efforts. He quickly agreed that there is a serious issue here which demands resolution and worked closely with us to draft a letter to OSHA. Despite submission of that letter during an administration which was resistant to regulatory processes, OSHA did respond positively in late 2020, concurring with the PES position: "OSHA agrees with [PES] that the hazards associated with arc-flashes are serious" but noting they were not prepared to act immediately, likely due to both the pandemic and the impending presidential election.

Congressional Engagement

PES identified key members of Congress who have oversight for the Department of Labor and OSHA as a result of committee assignments and other legislative business. Our association has held a series of meetings over several

months with more than a dozen of these Congressmen and women and their staffs, emerging with unanimous agreement that the issue is consequential, and must be rectified. We have spoken with both Republicans and Democrats, in the House and Senate, including Sen. Cindy Hyde-Smith (R-MS), Sen. Lindsey Graham (R-SC), Rep. Tom Cole (R-OK, 4th District), Rep. John Moolenaar (R-MI, 4th District), Rep. Alma Adams (D-NC, 12th District), Sen. Susan Collins (R-ME), Sen. Bob Casey (D-PA), Rep. Brian Fitzpatrick (R-PA, 1st District) and Rep. Donald Norcross (D-NJ, 1st District). Everyone was willing to help, and many have offered to take proactive steps. Rep. Norcross is the only electrician serving in Congress and has been very generous with his time and assistance; he has first-hand experience with the frequency and severity of electrical injuries in general and arc flash in particular.

Congress Urges OSHA to Act on Arc Flash PPE

Both the House and the Senate have sent bipartisan letters to OSHA. On May 14, 2021, the Chairman of the Senate Health, Education, Labor and Pensions Subcommittee on Employment and Workplace Safety Senator John Hickenlooper (D-CO) and Ranking Member Senator Mike Braun sent a letter to the OSHA Principal Deputy Assistant Secretary James Frederick urging OSHA to take a renewed approach to this standard. The House of Representatives sent a companion letter on May 17, 2021, led by Representative Donald Norcross (D-NJ) and Representative Brian Fitzpatrick (R-PA) with support from Representatives Mark Pocan (D-WI), Linda Sanchez (D-CA), and Haley Stevens (D-MI).

OSHA Secretary Doug Parker

During confirmation hearings for incoming OSHA Secretary Parker on May 27th 2021, he was asked about his awareness of and disposition toward the arc flash PPE issue by Senator Mike Braun:

"Senator Hickenlooper and I, as the Chair and Ranking Member of the Subcommittee on Employment and Workforce Safety, have already begun to work with OSHA regarding industry safety standards. This has included clarifying personal protective equipment for industrial electricians. Can you commit today to working with my office in order to shore up these standards?"

Mr. Parker responded, "If confirmed I would be happy to provide technical assistance with respect to this or other legislation. Similarly, I am willing to work with your office on improving health and safety standards, including on personal protective equipment for industrial electricians and a standard to protect workers in the tree care industry."

The three things are almost always necessary to fix a problem are now in place: knowledge among the relevant people that the issue exists, understanding of the scope, consequences and urgency, and agreement on a path to resolution. The Partnership for Electrical Safety is delighted that the United States Senate, House of Representatives, and incoming Department of Labor leadership understand the gravity of the hazard and the urgency of action to remedy the protection gap which exists today. At least 500,000 American electrical workers will continue to go to work every day without lifesaving PPE until OSHA acts.

For more information or to participate in the effort, visit www.partnershipforelectricalsafety.org.

Electrical Safety
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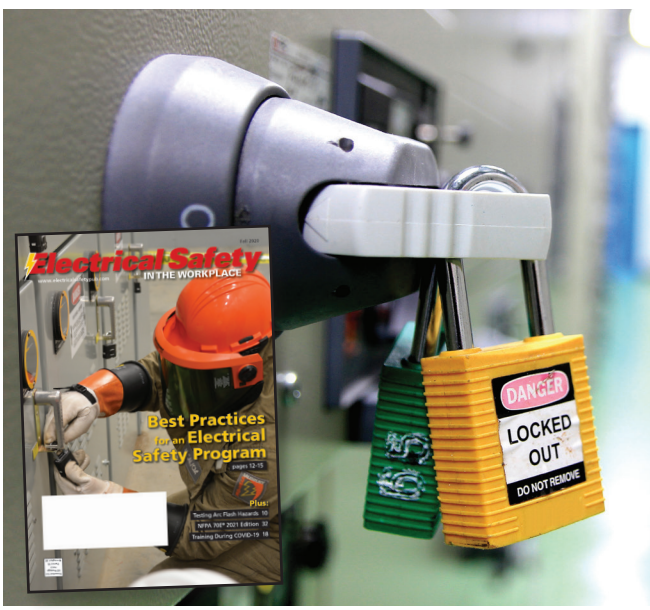

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Six Keys to NFPA 70E® Training

By: **Jay Smith**, *Contributor*

NFPA 70E® training teaches you how the standard's life-saving work practices help avoid electrical injuries, deaths, and OSHA violations. Training covers many topics, including establishing electrically safe work conditions, elements of a risk assessment, the difference between electrical hazards and risks, and the intent and limitations of personal protective equipment (PPE) required by 70E. Here are six key training considerations to address:

1. The changing workforce

A number of facility maintenance crews are bleeding knowledge—about facilities, hazards, electrical equipment—as the workforce ages with waves of retirements. This heightens the importance of NFPA 70E training for younger generations of workers who have not witnessed the evolution of electrical safety and arc flash safety in particular. Only in the past 15 years or so, since 2005-2006, when OSHA started citing companies for arc flash accidents, has arc flash knowledge and protections gained traction.

Older workers have seen an arc flash, been shocked, escaped near misses. They have decades of on-the-job knowledge, including identifying hazards and making hazard assessments.

Electrical safety training for newer workers should be led by instructors who can relate personal stories, accidents and close calls, case studies to bring 70E requirements to life. That dose of reality won't come from viewing slide in a PowerPoint or a video. It helps to be trained by someone who have been there, done that, and likely scarred along the way.

2. Arc flash causes

A key point in 70E training is explaining how an arc flash occurs, and its causes. There are usually two main contributing factors. Either equipment has failed, or there is a physical interaction with an energized piece of equipment, such as removing a panel and working with a circuit breaker. Other causes include human error, failing to use insulated tools, excessive dust, corrosion, improperly maintained or installed switches and circuit breakers, use of substandard parts, and condensation near electrical equipment. Arc flash temperatures can reach as high as 35,000°F, hotter than the surface of the sun.

3. Equipment with arc flash potential

Another key learning in 70E training cover the types of equipment with arc flash potential. Safety issues are raised whenever personnel work with an overcurrent protective device, such as circuit breakers or fuses. These devices protect against the potentially dangerous effects of overcurrents, such as an overload current or a short-circuit current, which creates a fault current. In general, an arc flash assessment or arc flash hazard study / analysis should be performed on equipment at 50 V or higher. The IEEE 1584 standard is also used for guidance on the types of equipment with arc flash potential. Opinions vary on the equipment capable of producing an arc flash, but safe to say we're not talking about a light switch or an electrical outlet.

4. Protection before an arc flash assessment has been performed

What should be done if an arc flash assessment hasn't been performed? An arc flash risk assessment is a process to determine the level of hazard that exists at each electrical enclosure, such as a control panel, panelboard, disconnect switch or switchgear. Outside providers like SEAM Group can perform Arc Flash Risk Assessments to identify and document potential arc flash hazards for all facilities with three-phase electrical power systems, which is required by NFPA 70E. This standard covers every type of commercial, industrial and institutional facility. 70E training offers guidance on recommended levels of personal protective equipment (PPE) matched to equipment types, voltages, and tasks to be performed. For example, PPE should be worn at all times when working in the facility, and 40 cal

suits should be work for higher potential exposures. A bit of guesswork is involved until the arc flash assessment has been conducted.

5. Understanding arc flash labeling

Assessment findings lead to applying arc flash labels on equipment and learning how to read data on the labels is another key point in 70E training. Labeling is required for any piece of electrical equipment that may need examination, adjustment, service or maintenance while energized, creating the potential for an arc flash incident to occur. At a minimum, NFPA 70E labels must contain the nominal system voltage, the arc flash boundary, and one of the following: the available incident energy and the corresponding working distance or the arc flash PPE category found in the NFPA 70E PPE category tables, the minimum arc rating of clothing, or the site-specific level of PPE. Electrical workers need to understand approach boundaries for both arc and shock hazards, how it affects the work of the person performing the diagnostics, as well as the risk to nearby coworkers, not only on the same level, but working above or below the task at hand.

6. Meter use documented training

One more point relating to 70E training: the standard requires qualified employees to have documented training on how to use a meter and how to interpret all indications coming from the metering device. This documentation is often overlooked in a qualified person program. Your qualified workers must be hands-on trained on using a meter and reading interpretations. Meter readings can vary greatly depending on where the meter is placed, such as if you're testing a 480 system, a phase to phase or phase to ground procedure.

These six points are often overlooked when deciphering NFPA 70E® requirements and setting the parameters for your training. The changing workforce and new adult learning styles must be taken in account. Arc flash is a lethal hazard and understanding arc flash causes should be at the forefront of training. Not often covered, though it should be, are the types of equipment that can produce an arc flash. Also often not cover in training is what to do for protection before an arc flash hazard assessment is performed. Arc flash labeling can be filled with details, small print, and deserves special attention in training because understanding labels can be a life saver. Finally, all your training should be documented. Document everything, including meter use by a qualified person.

Jay Smith is the Director – Electrical Safety Services, SEAM Group (www.seamgroup.com).

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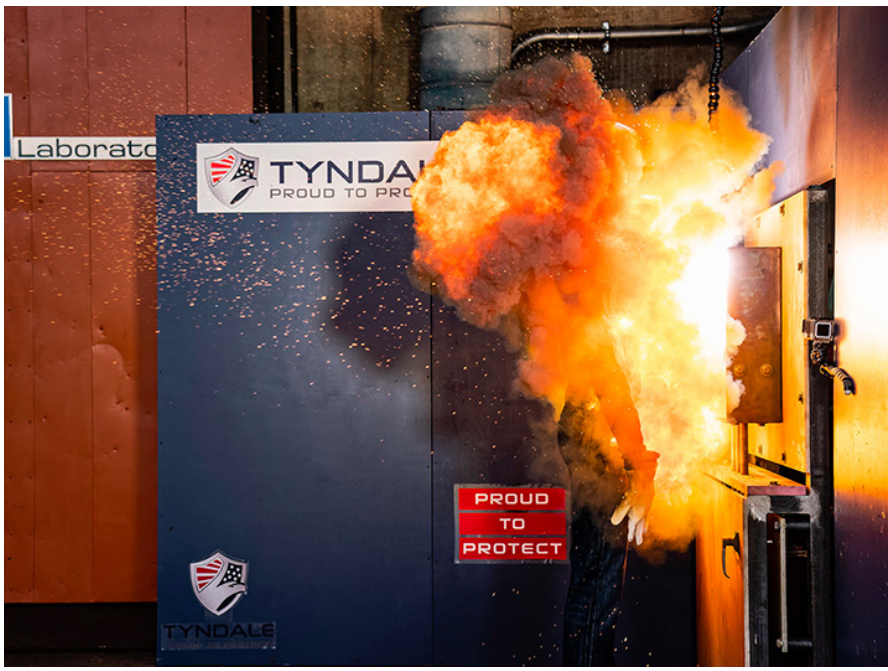
Partnership for Electrical Safety Takes Aim at Arc Flash

By: **Scott Margolin**, *Co-Chairman, The Partnership for Electrical Safety*

Ready to be shocked? More than 500,000 Americans working on or near energized electrical equipment do not currently have protection from a deadly hazard, despite standards which have been in place for over 20 years. A new organization has been formed to directly address this longstanding issue, raise awareness, and get these people the protection they deserve: The Partnership for Electrical Safety (PES).

PES is a non-profit association dedicated to improving the health and safety of unprotected electrical workers across the U.S. by ensuring that every American working on or near energized electrical equipment is provided with the appropriate arc-rated clothing and PPE. Proper AR clothing and PPE allows those whose jobs place them in a potentially hazardous situation to comfortably perform their essential work and return home safely at the end of the day.



Electric arc flash is an electrical fireball that can reach temperatures up to four times hotter than the surface of the sun.

Electric arc flash is an electrical fireball that can reach temperatures up to four times hotter than the surface of the sun. This fireball can and does ignite flammable clothing and seriously burn exposed skin, causing catastrophic or fatal injury. As a result of being improperly outfitted, many American workers suffer serious burn injuries every year. This does not need to happen. Due to the nature of electrical work, arc-flash events will occur, but the fatal and catastrophic injuries are almost always caused by clothing ignition, not the arc-flash itself. The solution is simple – **stop wearing fuel** (clothing that can burn) and start wearing arc-rated clothing.

Electrical utility workers have been protected by AR clothing since 1994. But an arc flash doesn't care who signs your paycheck, so this protection was extended to industrial electrical workers twenty years ago, when NFPA 70E first included arc flash. As a result, over a million more electrical workers have been provided protection from arc flash, dramatically reducing rates of serious injuries and fatalities. Despite this clear and compelling success, over half a million Americans continue to work energized without lifesaving PPE. This must stop, and The Partnership for Electrical Safety intends to ensure that all American electrical workers have access to and properly wear the appropriate arc-rated clothing and associated PPE.

The PES strongly believes that the PPE requirements of NFPA 70E: Standard for Electrical Safety in the Workplace provide the appropriate best practices to ensure worker safety and should be universally adopted for substantially all live or potentially live electrical work in the U.S. Two primary goals of NFPA 70E and the PES are 1) whenever possible, de-energize, and 2) when working energized, always wear arc-rated clothing appropriate to the hazard.

Arc Flash Hazard Analysis

Work de-energized whenever possible. NFPA 70E requires justification for energized work and allows it only if it is infeasible to de-energize. It also recognizes that some work must be performed energized; for instance, you cannot troubleshoot a commercial HVAC system while it is off.

70E 130.2(A)(2): Infeasibility permits energized work if it can be demonstrated that the task to be performed is **infeasible** in a de-energized state. Examples include diagnostics and testing that can only be performed while energized.

There is a big difference between inconvenient and infeasible; please be honest and accurate when making this important decision. If there is an incident, in addition to

the ethical and moral implications, you'll need to justify the position to family and friends of the injured worker, company leadership, investigators, and possibly attorneys.

The standard then requires risk assessment, even if you intend to work de-energized. That may sound odd at first, but there are energized work steps here: de-energize and confirm absence of voltage and reenergize and confirm presence of voltage. Here's the language in 70E and take note of use of the word "shall," which is proscriptive (required, not optional):

130.5 Arc Flash Risk Assessment

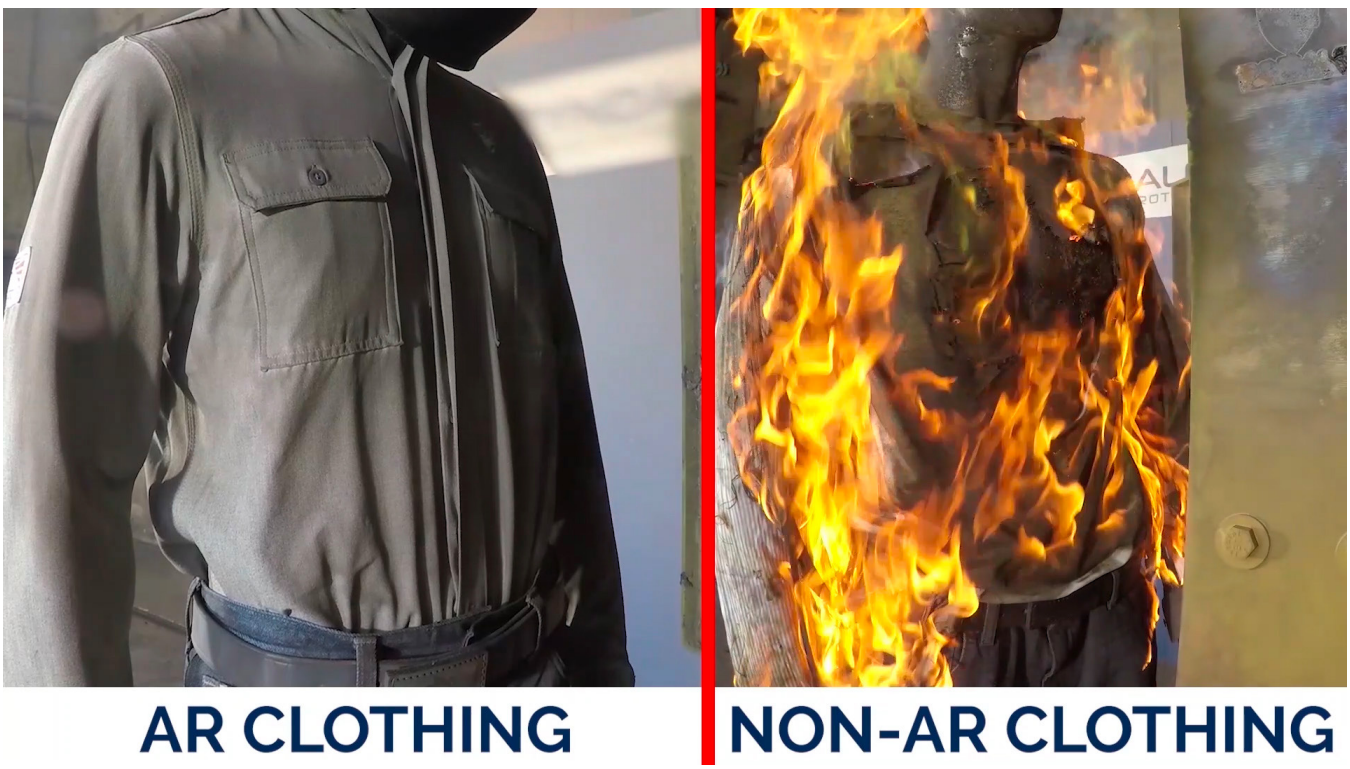
In general: arc flash risk assessment shall be performed:

- To identify arc flash hazards
- To estimate the likelihood of occurrence of injury or damage to healthy and the potential severity of injury or damage to health
- To determine if additional protective measures are required, including the use of Personal Protective Equipment (PPE)

If there is no risk of arc flash (a very high bar to clear except when working new construction not connected to the grid), AR clothing and other PPE are not required. If there is a risk of arc flash, you must document safety related work practices, arc flash boundary, incident energy at the working distance, and the PPE that people within the arc flash boundary shall use. Any equipment "likely" to require energized examination, adjustment, service or maintenance must be field marked with the appropriate label around arc flash risk, boundary, and PPE. It's important to note that one cannot "sell liability" or eliminate the need for arc flash hazard analysis by farming out work to contractors. The host employer is responsible for informing the contractor or service company of the hazards and identifying them (Section 110.3(A)).

OSHA has already begun to take a much more proactive stance, beginning with COVID-19 and worker safety and extending into other top-ten violation areas, including electrical, later this year. While OSHA does not per se enforce NFPA 70E, they have been clear in both letters and citations that if you are compliant with 70E you are compliant with OSHA, and that 70E is a primary remediation source. The law, standards, science, and data are clear: arc-rated clothing and other PPE dramatically reduce both the incidence and severity of injury and save lives.

Do not work energized unless you truly have to and recognize and dress to the arc flash hazard 100% of the time when you must work energized. Stay tuned for further exploration of arc flash risk mitigation in coming issues.



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