Electrical Safety
IN THE WORKPLACE

WINTER 2021

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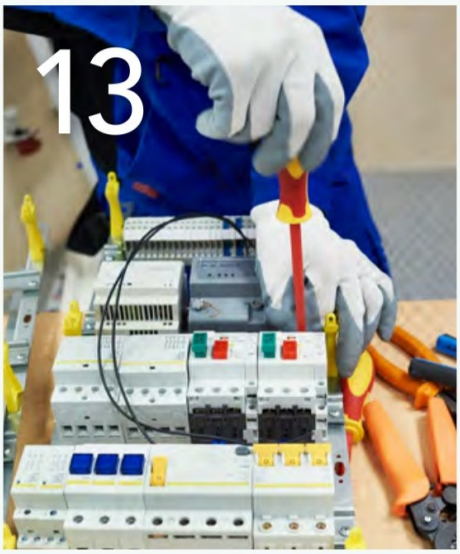

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PUBLISHER'S NOTE

Welcome to our winter issue. This is technically the third issue of *Electrical Safety in the Workplace*. In case you missed it, our team published a digital edition after our fall launch issue since we had so much content and advertisers wanted the visibility sooner than later. I am very humbled and grateful for everyone who has contributed to the early success of this publication – old friends, colleagues, and industry leaders, along with manufacturers and suppliers of electrical safety solutions have contributed and to them I say "thank you." This issue is full of great content from lots of thought leaders and industry experts. My hope is you will read, learn, and apply what is in these pages, keeping your team safe. As always, your feedback is welcome.

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AD INDEX

Electrical Safety IN THE WORKPLACE

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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. 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.

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

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-rated clothing and other PPE dramatically reduce both the incidence and severity of injury and save lives.

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):

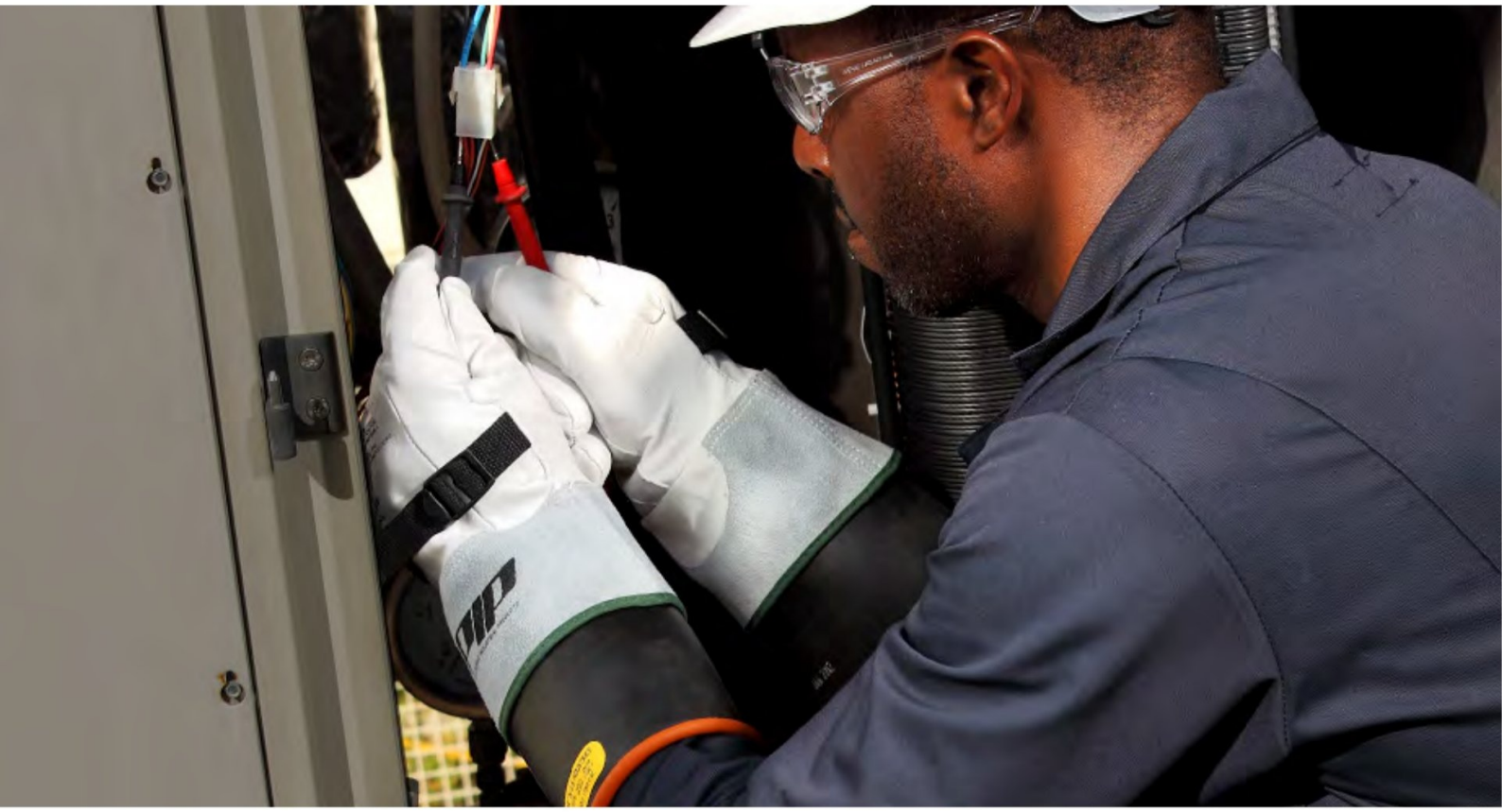
> **130.5 Arc Flash Risk Assessment**
> In general: arc flash risk assessment shall be performed:

- 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. ESW



PPE: ELECTRICAL SAFETY IN THE WORKPLACE

We chatted with Ben Julian, Marketing Channel Manager – Electrical at Protective Industrial Products, Inc (PIP®) about the NOVAX® line of electrical safety products and how it improves the safety of electrical workers.

ESW: What makes NOVAX® brand rubber insulating gloves the glove of choice for utility and electrical workers?

BEN JULIAN: With more than 20 years of experience in latex dipping processes, NOVAX® is an industry-leading brand in electrical safety products which include rubber insulating gloves, sleeves, and blankets for the industrial and utility electrical markets.

Through the NOVAX® brand, PIP® leads the industry by providing users with gloves and sleeves that are more flexible than traditional cement dipped products. NOVAX® rubber insulating gloves and sleeves are manufactured using an environmentally friendly Aqueous Dip Process. Natural rubber (latex) is kept in its natural aqueous state, as compared to a solvent-based dip process used by other manufacturers that relies on extensive amounts of volatile organic compounds (VOCs). An Aqueous Dip Process results in much softer and more flexible gloves that allow for greater dexterity and reduced hand fatigue for users.

ESW: PIP® offers multiple kits for Electrical PPE. What's the advantage of getting electrical hand protection in a kit as opposed to individual pairs of gloves?

JULIAN: With PIP's electrical safety kits, the user can choose the class that their application requires, along with the color and size of

rubber glove needed, and then we do the rest by assembling the kit that meets their specifications. This is a one-step solution that is easier for ordering, but more importantly offers less risk of missing a critical component. The electrical safety kit includes a pair of NOVAX® insulating gloves, leather protective glove covers, and a glove storage bag.

ESW: NOVAX® gloves have straight cuffs that range in length from 11" to 18." Which kinds of tasks call for longer cuffs?

JULIAN: NOVAX® straight cuff gloves are the most common type used in the industrial and utility sectors. The longer cuffs are designed for customers working in areas where contact might occur outside of the typical 11" glove length, predominately high-voltage applications such as utility work.

ESW: Are there specific tasks or environments that would call for a ventilated hood versus an unventilated one?

JULIAN: Ventilated and unventilated hoods are used for the same tasks and environments. Unventilated hoods came to market first, while ventilated hoods were created to address the pitfalls of unventilated hoods; discomfort, heavy material, and lack of airflow causing sweating and poor breathability. PIP's ventilated hoods make use of a mechanical power pack that blows fresh air directly into the heavily insulated interior of the hood. This, coupled with a much lighter material, enhances worker comfort and productivity by reducing sweat and the accumulation of fog on the hood's lens, all while remaining 37% lighter than the traditional 40cal material. With our ventilated hoods, workers remain comfortable from don to dismount, maintain clear sight, and are far less likely to remove their hoods in or around flash boundary areas.

Through the NOVAX® brand, PIP® provides users with gloves and sleeves that are more flexible than traditional cement dipped products.

ESW: Are your electrical safety gloves independently tested, where and how? What would be the single biggest takeaway you would want the end-user to know about this?

JULIAN: All NOVAX® gloves are tested at the manufacturer to satisfy the ASTM D120 standard, prior to arriving at PIP's testing facility. At this time, a date stamp is issued to the glove along with a serial number. Once they arrive at our full testing facility, we perform a second inspection to ensure compliance. The biggest takeaway here is

that when we send a glove to a customer, we ensure that multiple levels of compliance testing have been performed; this gives the customer peace of mind knowing both the manufacturer and our test lab have confirmed ASTM D120 adherence on all our gloves.

ESW: What are five electrical safety tips from PIP's product experts?

JULIAN: Matt Smith, PIP's Product Manager of Technical Products, suggests the following electrical safety tips:

1. Electrical PPE goes well beyond just rubber insulating products – it also includes ARC apparel (shields, coveralls, balaclavas, etc.). The calories may be marked on the panels you are going to work on, but if not, you need to conduct an ARC flash assessment using the NFPA 70E handbook to figure out what PPE level (1-4) clothing you need for the job. Then, establish your arc flash boundaries.
2. Inspect your PPE: Regularly check your clothing for holes, rips, tears, stitching issues, as well as petroleum distillates. This includes inspecting your gloves by manually inflating or using a glove inflator. Look for abrasions and cracks and listen for pinholes. If any of these are present, the glove must be discarded immediately before use. Remember the rule: Once the gloves are put into service, you must have them dielectrically tested by an independent test lab every 6 months for the life of the gloves.
3. Properly store your gloves. While the standard says you must store away from heat, there are best practices that will help extend the life of the glove: Store in a bag, hang the bag fingertips up, and keep the bag away from sources of ozone.
4. Wear the leather protector. Rubber gloves can be nicked and damaged when working with tools and around metal hardware. Leather protectors will help ensure that the insulating properties of the glove are not compromised. They also provide an additional layer of mechanical and oil protection, which is especially important in live electrical situations.
5. Double check your tools: Ensure the tools you are using to do energized work are truly insulated hand tools and include the ASTM interlocking double triangles and the 1000V symbol. ESW

Protective Industrial Products (PIP®) is a leading supplier of hand protection and personal protective equipment to wholesalers and distributors worldwide. Visit us.pipglobal.com/en/brand/novax to learn more, or email marketing@pipusa.com.

NFPA 70E® Training: A Springboard To Greater Safety And Health Performance Excellence

By Colin Duncan, Contributor

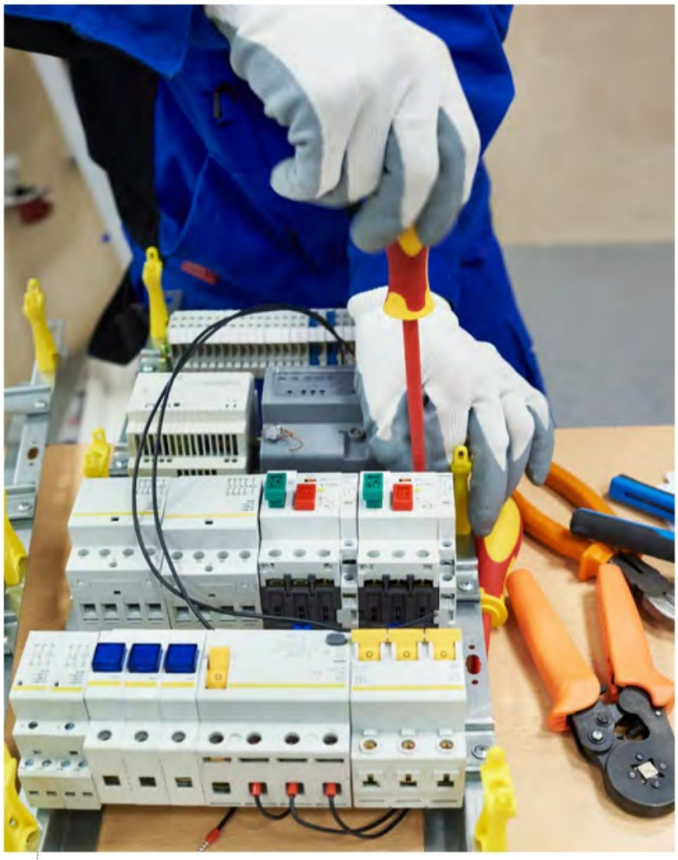
In 2019, the U.S. Bureau of Labor Statistics (BLS) reported 166 workers were killed on the job due to exposure to electricity -- the most electrical-related fatalities in the past five years. Many of those events occur during maintenance work and construction. The BLS reports maintenance and repair as one of the most dangerous occupations for serious injuries and fatalities. In 2019, 771 workers received fatal injuries doing this work -- almost 15 fatalities every week.

The U.S. is wrestling with reducing serious injuries and fatalities (SIFs) as work fatalities increased 2% in 2019, according to the BLS. SIFs are demanding increased attention to safety in the work environment, with electrical hazards high on the concerns list. Electricity scares people to take action!

Electrical safety webinars draw a thousand registrants or more. Electricians, maintenance personnel, and safety and health professionals who audit their work often form partnerships, a tag-team effort to assess and mitigate the high risks involved. And the National Fire Protection Association's NFPA 70E® Standard for Electrical Safety in the Workplace® is one of the most closely followed set of safety requirements. NFPA 70E® is a continually evolving document, updated every three years.

NFPA 70E® training is a necessity to safeguard employees from ever-more complex, inter-connected work environments. Training is required for a "qualified person," described in 70E® as one who demonstrates the necessary skills and knowledge relating to the construction and operation of electrical equipment and installations thereof. Qualified persons must receive training to identify hazards and reduce the associated risk.

The most common electrical hazards in the workplace include overhead power lines, damaged tools and equipment, inadequate wiring, overloaded circuits, exposed electrical parts, improper grounding (the most common OSHA electrical violation), damaged insulation, overuse of 'temporary' extensions cord, and wet conditions.



NFPA 70E® training is a necessity to safeguard employees from ever-more complex, inter-connected work environments.

NFPA 70E® sets the bar high for qualified persons. Training requirements are numerous, including:

- The ability to plan jobs safely, identify electrical hazards, assess the associated risk, and select appropriate risk control methods.
- Identify the correct personal protective equipment (PPE) and demonstrate the proper application of PPE.

- Identify and demonstrate the proper use of insulating tools and test equipment.
- Identify the critical elements of the calculation of nominal voltage and conduct the analysis.
- Identify exposed, energized conductors and circuits from other parts of equipment.
- Understand the approach distances and determining risk factors for shock, arc blast, and arc flash boundaries.

WHO NEEDS TO BE TRAINED

Unqualified persons also need to be trained in any electrically related safety practices necessary to keep them out of harm's way. These are employees who, in the course of work, may interact with electrical equipment. They may be employees using extension cords and portable equipment. For example, a janitor who opens a panel to turn on lights in a facility at the start of the day, or a machinist who starts equipment at the beginning of a shift.

Supervisory managers also need to be trained. They require an executive summary knowledge of NFPA 70E® -- not a deep dive into technical specifications -- but enough information to effectively audit the practices of qualified and unqualified personnel involving electrical risk.

Unqualified persons do not face the same level of inherent risk as qualified individuals, but it can be difficult for employers to distinguish. Employees may be qualified for some tasks and not others. SEAM Group provides an e-learning module with basic electrical safety concepts and an assessment at the conclusion to score an individual's training performance and make a recommendation.

- Yes, the person has the requisite knowledge and skills to take a Qualified Person course. Or,
- No, the individual needs more basic training before moving on to the qualified courses.

The NFPA 70E® training population, aside from supervisory management such as safety professionals, consists of technical, hands-on employees who typically learn procedures and practices by doing the work versus listening to a lecture. And that work can be different at every worksite. Employers often want customized training for their panels and equipment, PPE, and terminology. Some employers want training to a higher standard than required by 70E®, and this training can be customized for customer specific needs.

Targeting training for qualified employees to the level required is one of the most challenging aspects of NFPA 70E® training. A company can have qualified personel doing completely different kinds of work. Some are qualified to work with heavy equipment, others qualified only for maintenance, while others are qualified for troubleshooting.

Perhaps the most common question regarding 70E® training regards the scope of a qualified person's work. Employers ask: "Is Larry qualified to do this? He's qualified for some tasks; how do we assess if he's qualified for other work?"

Consulting and Training providers such as SEAM Group help companies organize around assessing their training needs, scoping, customizing, and delivering the training courses. Large, mature corporations with best-in-class safety and health management systems and internal training departments have their finger on the pulse, and they understand 70E® definitions and requirements. They often use a third-party to handle training capacity.

THE CHANGING WORKFORCE

In booming industries, such as online retailing and express delivery services, on-boarding safety training is overwhelming internal training

departments due to frenetic hiring brought on by the pandemic.

In contrast, small businesses may grow beyond what was once perhaps efficient "old school" safety training, where a veteran of 20 years would show a new hire the ropes. They now contract with outside training providers to modernize training methods.

Changing demographics in the workforce is increasing the need for training. Aging baby boomers are retiring and replaced by new workers who need help following procedures safely supported by the 'why we do it this way'.

NFPA 70E® training is also triggered by the need for either retraining or additional training. If an employee is transferred or promoted to a new position, additional training is required. Additional training is required for all new hires. Retraining is required every three years as NFPA 70E® is updated. The 2021 edition of 70E® is now in effect, and providers such as the SEAM Group are busy setting up retraining based on 2021 edition requirements.The inclusion of human performance and human error knowledge and skills in the 2018 edition of NFPA 70E® is an example of how NFPA 70E's® continually evolves.

One requirement, a human performance assessment, is to conduct pre-job briefings before the day's work begins. Workers huddle together briefly to review all workplace hazards associated with completing the task and identify other variables that may impact a safe completion, such as simultaneous operations, cumulative fatigue, time of day, alertness, staff competency, lighting, noise, etc.

This is a risk assessment that goes beyond 'electrical hazards' and identifies exposure associated with the work, procedures to be used, special precautions to be deployed, control of energy sources, required PPE, and planning of any actions to undertake in the event of a change of job circumstances or deviation from the process, i.e., Stop the Job! The emphasis on spotting the hazard, assessing the risk in the context of the task to be completed illustrates how NFPA 70E® training can be a springboard to a broader scope of safety and health program training.

Employers may widen the aperture from regulatory conformity and complementarily integrate force-multiplying programs that integrate hazard spotting programs (understanding hazard types and the job safety analysis process) and observation programs (learning how to observe and spot hazards); important skills sets beyond electrical safety to improve safety and health performance.

Another development is the increasing use of technology tools for training in today's virtual world. In 2020 due to COVID-19, most of SEAM Group's training was conducted on a virtual, interactive platform that streamed live video of the instructor to participants and mixes in live polling, real-time results, gamification, chat boxes -- as close to a live event as possible, a trend continuing in 2021.

In this genre, we have introduced augmented reality allowing competency-based training and assessment to be completed using interactive wearable technology. Many occupational safety and health experts believe the pandemic has raised the profile of safety and health in organizations, garnering increased credibility, increased the use of technology, and company investments in safety have increased, and there is no turning back. ESW

Colin Duncan is the CEO of SEAM Group. He is responsible for overseeing operations, company vision, and business activities globally. Duncan has been an independent board member and executive working with several leading organizations in the safety services market across human factors, process safety, software, and operational excellence. He was previously CEO of safety consulting firm BST/DEKRA Insight. (www.seamgroup.com)

All Signs Point to Required Labeling as Key Component of Electrical Workplace Safety

By Corey Hannahs, Contributor

"Do this, don't do that – can't you read the sign?" The year was 1971 and I certainly find some irony in the fact that the original band to perform this well-known ditty was dubbed as the Five Man Electrical Band. In a rare case of double irony, there was a remake of the song in 1990 by a band named Tesla. With names like the Five Man Electrical Band and Tesla taking the lead on this song, it leaves little doubt that electricity and signs were meant to be united. If you listen closely to the lyrics of the song, it doesn't necessarily portray signs in the best light (see what I did there?). The songwriter depicts signs as being controlling and limiting to individuals who may look or act differently than what may be considered as the norm. For someone who is looking for unlimited freedom to do whatever they choose, signs can certainly be seen as restrictive and unnecessary. But when it comes to ensuring the safety of individuals working around electricity, signs can be a critical factor in determining life, or death.

NFPA 70®, National Electrical Code® (NEC®), and NFPA 70E© Standard for Electrical Safety in the Workplace® are two of the three components that are crucial to the electrical Cycle of Safety, with NFPA 70B® Recommended Practice for Electrical Equipment Maintenance® being the third. While the purpose of the NEC is to safeguard persons and property from hazards that may arise from the use of electricity, NFPA 70E provides enforceable responsibilities for both employers and employees to protect workers from exposure to electrical hazards. So, while the focus of the NEC is on safe installations, NFPA 70E exists to help ensure that the installation is done safely by the individual(s) performing the work. With that said, it becomes easier to see how the NEC and NFPA 70E must be applied together in harmony to ensure the safety of both people and property within any given scenario that is dealing with electricity.

Signs, or "labeling" (not intended to imply product labeling by a listed laboratory) as they are often referenced, can be seen regularly within the NEC as well as NFPA 70E. NEC section 110.16(B) deals specifically with labeling of service equipment rated at 1200 amps or more, maintaining that the label itself must meet the requirements of NEC section 110.21(B), which deals with label design, affixation, and durability as well as containing the following information:

- Nominal system voltage
- Available fault current at the service overcurrent protective devices
- The clearing time of service overcurrent protective devices based on the available fault current at the service equipment
- The date the label was applied

The exception within NEC section 110.16(B) states that "service equipment labeling shall not be required if an arc flash label is applied in accordance with acceptable industry practice." Such accepted industry arc flash labeling practices reside within NFPA 70E. As a means of tying the NEC installation requirements back into NFPA 70E, Informational Note No. 3 within NEC section 110.16(B) goes on to note NFPA 70E as covering labeling information stating that "Acceptable industry practices for equipment labeling are described in NFPA 70E-2018 Standard for Electrical Safety in the Workplace. This standard provides specific criteria for developing arc-flash labels for equipment that provides nominal system voltage, incident energy levels, arc-flash boundaries, minimum required levels of personal protective equipment, and so forth."

FOR THE PURPOSE OF SAFETY

So, you may be asking yourself, where does the information we are talking about being

Electrical safety wheel.

listed on the labeling come into play as far as safety? Much of this information can be utilized for risk assessment as well as personal protection equipment (PPE) selection, should we get to that level as we work our way through the Hierarchy of Risk Control Methods as listed within NFPA 70E section 110.5(H)(3). Understanding the known risk(s) and having the information needed allows us to make a well-educated decision, including choosing proper PPE when deemed necessary.

Stepping back and taking a bird's eye view of both the NEC and NFPA 70E, let's again look at the purpose of each document. The NEC is about the practical safeguarding of both people and property from the hazards that arise due to the use of electricity. NFPA 70E is focused on the safety of those individuals who are performing the work. When we look at the contents of the required labeling in each standard, we see a clear picture of the purpose of each document come to life. Required labeling within the NEC primarily focuses on available fault current and short-circuit current rating (SCCR), both of which focus on the equipment itself. A miscalculation of either utilized to purchase equipment being installed, or replaced, could result in a catastrophic event that could impact the building structure and likely people within the vicinity as well. Not to mention the daunting task of getting an outage of all, or part of, the electrical system back up and running. Service equipment such as switchboards, switchgear, and panelboards are crucial pieces within the electrical distribution system. And arguably some of the most serviced and modified equipment after the initial installation takes place. Even in future alterations to the electrical distribution system, it is crucial to make sure that the available fault current and SCCR ratings of any new equipment is sized properly.

The 2020 cycle of the NEC took another step toward safety within section 408.6 by adding a requirement that states all switchboards, switchgear, and panelboards must have a SCCR not less than the available fault current. It goes on to add a labeling requirement on the equipment that states both the available fault current and the date the calculation was performed, data that would prove invaluable when it comes to properly sizing additional or replacement equipment. While the NEC doesn't have any labeling requirements that are specific to directly establishing safety for individuals working on the electrical system, the aforementioned NEC section 110.16(B) Informational Note No. 3 points us to NFPA 70E which does. Information such as arc-flash boundaries, incident energy levels, and minimum required levels of PPE contained within NFPA 70E developed arc-flash labels have a direct impact on the safety of the individual(s) working on the equipment.

Understanding safe work distances and the equipment needed to keep you safe, should you have to work inside those distances, are critical pieces to maintaining personal safety. All things considered, NEC section 110.16(B) Informational Note No. 3 is our safety ribbon that ties both the NEC and NFPA 70E together, solidifying a shield of safety for both property and people. Labeling, as applied by both the NEC and NFPA 70E, is our sign. Don't ignore the signs, they often point toward safety. ESW

Corey Hannahs is an Electrical Content Specialist at the National Fire Protection Association (NFPA). In his current role, he serves as an electrical subject matter expert in the development of products and services that support NFPA documents and stakeholders. He can be reached at **channahs@nfpa.org**.

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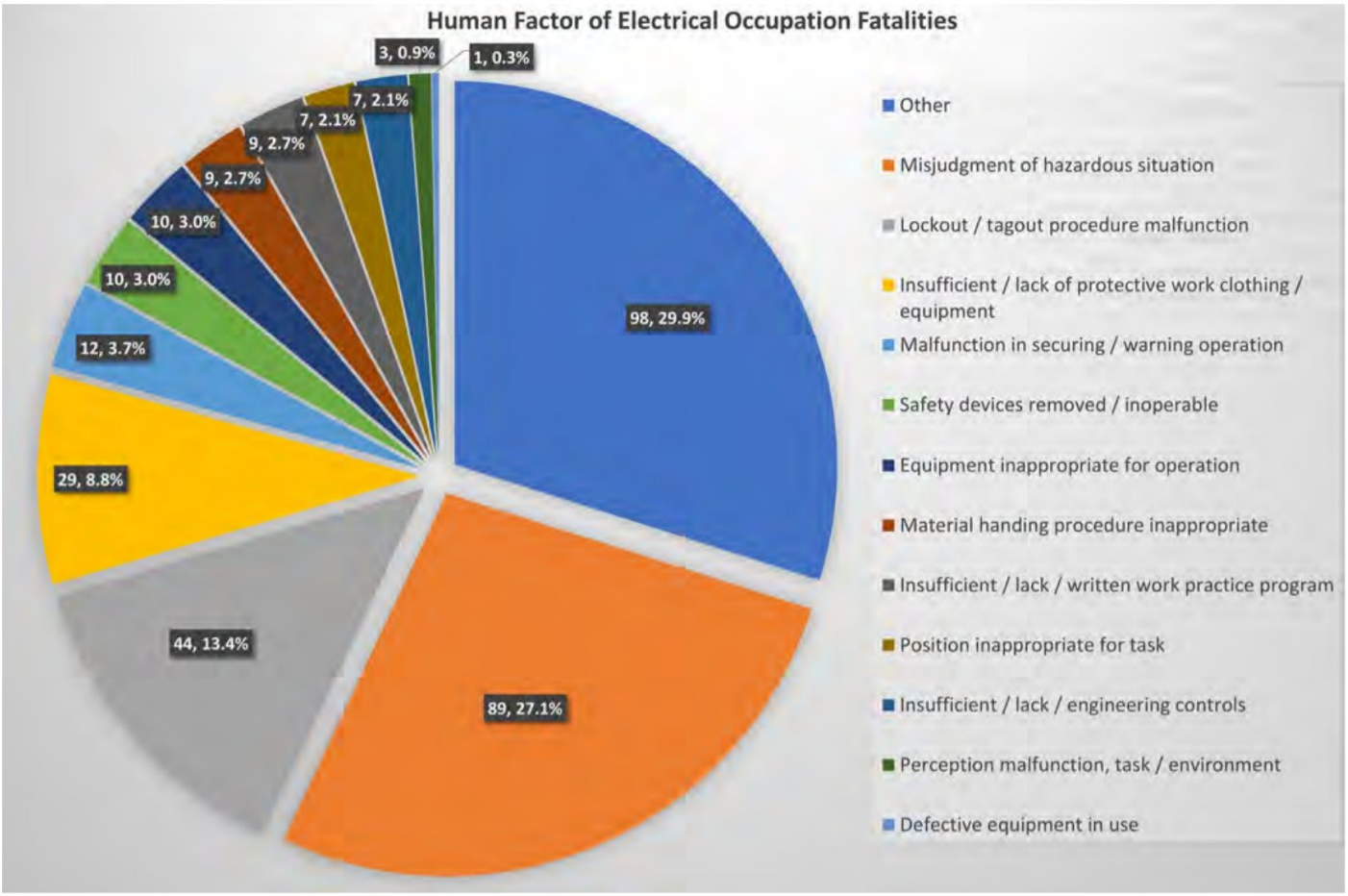

Lockout/Tagout Compliance Saves Lives

By Brianne Deerwester, Contributor

Each day, nearly three million professionals participate in work activities where lockout/tagout procedures should be used. Unfortunately, too many workers put themselves unnecessarily at risk by working energized or neglecting to follow their company's lockout/tagout procedures. These procedures safeguard workers from the unexpected energization, or startup, of machinery and equipment. They can also prevent the release of hazardous energy during service or maintenance activities. Always de-energizing and following established lockout/tagout procedures saves lives. Compliance with OSHA's lockout/tagout procedure prevents an estimated 120 fatalities and 50,000 injuries each year. In 2019, control of hazardous energy (lockout/tagout) was the fourth most frequently cited OSHA standard.

The Electrical Safety Foundation International (ESFI) publishes fatal and nonfatal U.S. occupational electrical injury information in tabular and graphical form on esfi.org each year. The data is calculated using the U.S. Bureau of Labor Statistics' (BLS) Census of Fatal Occupational Injuries (CFOI) and Survey of Occupational Injuries (SOII). The data in these reports cover electrical accidents, including the total number of electrical injuries and fatalities, the industries and occupations in which they occurred, and the rates of electrical injury and fatality for selected industries. ESFI compiles the data to track electrical injury trends and to identify occupations and industries where electrical safety training can be applied to reduce the number of occupational electrical injuries.

Failure to comply with the lockout/tagout standard is listed as one of OSHA's top 10 most frequently cited standards year after year. Workers injured on the job from exposure to hazardous energy lose an average of 24 days of work to recuperation. Looking at the 328 electrical occupation fatalities that occurred between 2011 and 2019, lockout/tagout procedure malfunction was the cause in 44 cases, or 13.4%. This was the third leading cause of electrical occupation fatalities. The first leading cause was listed as other (98 cases or 29.9%), while the second cause was misjudgment of a hazardous situation (89 cases or 27.1%). Insufficient/lack of protective work clothing/equipment (29 cases or 8.8%), malfunction in securing/warning operation (12 cases or 3.7%), safety devices removed/inoperable (10 cases or 3%), equipment inappropriate for operation (10 cases or 3%), material handing procedure inappropriate (nine cases or 2.7%), insufficient/lack/written work practice program (nine cases or 2.7%), position inappropriate for task (seven cases or 2.1%), insufficient/lack/engineering controls (seven cases or 2.1%), perception malfunction, task/environment (three cases or 0.9% of cases), and defective equipment in use (one case or 0.3%) accounted for the source of the remaining fatalities.

The following steps (https://www.esfi.org/resource/lockout-tagout-your-life-depends-on-it-544) should be implemented in your company's lockout/tagout procedure. First, notify all employees about the required lockout. Begin by shutting down equipment using the normal stopping procedure. Locate and isolate equipment from all energy sources and release any stored energy. Next, lockout all switches and controls with assigned locks and tags. After ensuring that no personnel are exposed, operate the normal operating controls to make sure the equipment won't operate. Return equipment to "off" state after the test and perform servicing. Then, remove the lockout device. Once work is completed, notify all employees. Working on energized equipment increases your risk of injury and death. The number one way to prevent these incidents is to de-energize the equipment you're working on. Be proactive about de-energizing equipment and taking steps to ensure that your work environment remains safe.

Teaching workers how and why to follow proper lockout/tagout procedures can help to avoid unnecessary risk and reduce the number of workplace injuries and fatalities. A written version of lockout/tagout procedures should always been available for workers to reference when needed. A written plan is also needed for complex lockout/tagout. A qualified worker should be appointed to handle the procedure. It is imperative that they account for all workers and energy sources. Complex lockout/tagout is used when there are multiple aspects involved, such as different locations, crews, or energy sources. These simple steps require extra planning but will take less time than the potential downtime and days away from work an accident could cause. The greatest value of any workplace is the people, so it is imperative to keep them safe by establishing safety procedures, including lockout/tagout, and a safety program that provides proper electrical training. For more information on how to implement safe practices on the jobsite and to share ESFI's materials throughout your workplace, visit esfi.org. ESW

Brianne Deerwester is the Communications Coordinator for the Electrical Safety Foundation International (www.efsi.org.com).

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Effective Electrical Safety Comes Down to Two Factors: Engaged Leadership and Technical Awareness

By Andrew Cochran, Contributor

Continuous improvement is a way of life for any business and is accepted as a standard approach in improving quality, productivity, and processes. At the core of continuous improvement is defining root causes, planning, and executing preventative action to eliminate the potential issue, and deploying technology and practices that minimize the impact of any issue or hazard.

This approach to continuous improvement can be extended to electrical safety and is sorely needed. Ask any executive, operations manager, or health and safety professional and the very first priority in dealing with a potentially negative issue is to prevent the issue from occurring whenever possible. The second priority is to minimize the impact should the negative event occur.

This structured approach is consistent with the Hierarchy of Control and is consistent with the updated language in NFPA 70E Annex 0 General Design Requirements 0.2.2.

Design option decision should facilitate the ability to eliminate hazards or reduce risk by doing the following:

- Reducing the likelihood of exposure
- Reducing the magnitude, or severity of exposure
- Enabling achievement of an electrically safe work condition

This is where the need for engaged leadership is required. We need to be asking the fundamental question, "have we as an organization taken steps to reduce the likelihood of exposure and/or reduce the magnitude of exposure, rather, or have we settled for protection and awareness only?"

Many industrial companies have taken the approach of conducting an arc flash study, or some form of electrical risk assessment, posting the resultant warning labels, purchasing PPE, and then stopped. The result is warning labels informing of a dangerous situation, but no proactive measures to reduce the likelihood of exposure or to mitigate the magnitude of the hazard. Engaged leadership can only be effective if there is technical awareness within the organization to answer the question: "what can we do to lower our risk and lower the hazard level?"

Consultants, facility managers, and maintenance personnel (the very people engaged leadership would turn to and ask the question) were asked two questions related to arc flash and electrical safety:

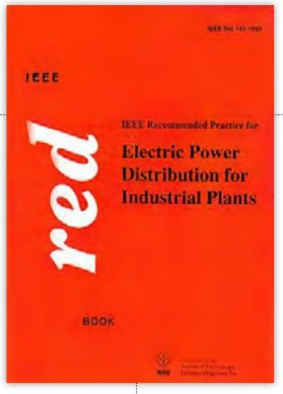
What in your opinion is the leading cause of arc flash incidences?

- Three phase faults
- Ground faults
- In-line faults
- Phase to phase faults

What is the best means to minimize the arc flash hazard?

- High-Resistance Grounding
- Optical Detection
- Labels and warnings
- PPE

The results are a cause for concern at several levels; only 50% of respondents correctly identified that the majority of arc flash incidents start as ground faults and yet 268 of these chose labels of PPE as the best means to minimize the arc flash hazard. Posting warnings, conducting awareness training, and purchasing and issuing PPE does not in any way reduce the likelihood of an arc flash event, nor does it reduce the magnitude of the arc flash. For those professing that PPE does reduce the severity of exposure, let's pause and consider what it means to wear ARC-rated clothing – there is a 50% probability



The *IEEE141-1993 Recommended Practice for Electric Power Distribution for Industrial Plants 7.2.2* states "there is no arc flash hazard (on HRG systems) as there is with solidly

of receiving second-degree burns over 50% of your body; surely, we can't accept this is safe.

This is why engaged leadership is not enough; there is a need for technical awareness also to achieve an effective electrical safety program and a safe electrical workplace.

When designing an electrical grounding system for an industrial operation for voltages of 1000 volts and below, there are three basic choices – ungrounded, solidly grounded, or resistance grounded – a technical decision.

Absent ground faults, any of the three options are reliable and safe, but ground faults are a reality in any electrical system and so the question becomes—does the grounding system choice affect the likelihood of experiencing an arc flash incident?

CONTROL THE LIKELIHOOD OF EXPOSURE

The first and obvious step is to de-energize the electric circuit before conducting any work whenever practical. If this isn't practical or safe, then consider options that reduce the likelihood of an arc flash event occurring.

Again, referring to NFPA 70E, Annex 0 clause, "A great majority of electrical faults are of the phase-to-ground type. High-resistance grounding will insert an impedance in the ground return path and below (at 5kV nominal or below), leaving insufficient fault energy and thereby helping reduce the arc flash hazard level."

This is consistent with statements in the Industrial Power System Grounding Design Handbook which states that 95% of all electrical faults are phase to ground faults and IEEE141-1993 Recommended Practice for Electric Power Distribution for Industrial Plants 7.2.2 which states "there is no arc flash hazard (on HRG systems) as there is with solidly grounded systems, since the current is limited to approximately 5 amps."

In FM Global Standard 5-18 Protection of Electrical Equipment Single Phase and Other Related Faults it states, "Sustained arcing faults in low-voltage apparatus are often initiated by a single-phase fault to ground which results in extensive damage to switchgear and motor control centers."

If we already understand that most arcing faults start as single-phase to-ground faults, (whether the specifics are 95% or the great majority) and that by employing High-Resistance Grounding (a technology that has been around for 50 years and used in all manner of industries, from petro-chemical to food processing, automotive, paper manufacturing, and data centers), we can reduce the exposure to the hazard significantly. The question then needs to be asked, "Why is this not the standard practice for grounding industrial facilities?"

HRG as a technology is recommended by IEEE, it is recognized by NFPA 70E, it is promoted by FM Global, and yet it is still not the default option when making the grounding decision for industrial facilities. One reasoning may simply be lack of technical awareness.

Of course, High-Resistance Grounding does not protect against phase-to-phase faults nor does it lower the incident energy calculation and therefore additional control steps must be taken to ensure an electrically safe workplace.

REDUCE THE MAGNITUDE OF EXPOSURE

Again, referring to NFPA 70E, Annex 0 clause states "Arc flash relay. An arc flash relay typically uses light sensors to detect the light produced by an arc flash event. Once a certain level of light is detected, the relay will issue a trip signal to an upstream overcurrent device."

An arc is developed in milliseconds and leads to the discharge of enormous amounts

of energy. The energy discharged in the arc is directly proportional to the square of the short circuit current and the time the arc takes to develop, i.e., energy = I2t.

The damage resulting from the arc depends on the arcing current and time. Of these two factors, time is the most easily controlled and managed. Rules of thumb for different arc burning times are:

- **35ms or less** – no significant damage to persons or switchgear which can often be returned to use after checking for insulation resistance.
- **100ms** – small damage to switchgear that requires cleaning and possibly some minor repair. Personnel could be at risk of injuries.
- **500ms** – catastrophic damage to equipment and personnel are likely to suffer serious injuries.

The goal of arc mitigation technology is to protect personnel and property. To effectively accomplish this, we must first detect the arc, and then cut the flow of current to the arc in as short a time as possible. As noted above, the target is to achieve a total reaction time of 100ms or less from detection of the arc to isolation of the circuit.

Arcs produce light at intensity levels that exceed 20,000 lux. This can be detected through special arc detection optical sensors connected to a relay system that has a typical operating time under 1ms and is the fastest arc flash detection technology currently available. The operating time is independent of the fault current magnitude since any current detector elements are used only to supervise the optical system.

With optical arc protection technology installed, the relay operating time is essentially negligible compared to the circuit breaker operating time. The cost is also fairly low since current transformers are only needed on the main breakers. If we sum up the circuit breaker operating time and the optical arc detection time, we are well below the goal of 100ms (regardless of the age and speed of the circuit breaker) and have mitigated the damage to a lower and safer level.

Simply changing from standard coordination and instantaneous settings on the relay (suggested by some consultants as sufficient) to a protection system which uses optical arc detection that incident energy levels are reduced substantially.

A workplace where the likelihood of an arc flash is significantly lower, where the impact of an arc flash can be minimized to very low levels is possible today – we just need engaged leadership and technical awareness.

UNINTENDED BENEFIT OF HRG TECHNOLOGY

One industrial client who made the conversion from solidly grounded to HRG technology as a means of reducing the arc flash risk found the unintended but welcomed benefit of lower maintenance costs related to motor repair.

In fact, the savings in motor repair costs provided payback for the HRG system in 24 months. This leading company, through engaged leadership and with technical awareness, lowered its risk of an arc flash from occurring and lowered operational costs at the same time.

What is stopping you from achieving the same results, engaged leadership or technical awareness? ESW

Andrew Cochran is President at I-Gard Corporation, an industry leader in workplace electrical safety, with a focus on protection from ground faults and arc flash. Cochran joined the company in 1997 having previously held operational roles in companies such as Polaroid, ITT Automotive, and Stanley. At I-Gard he is responsible for setting the company's strategic direction and focuses on driving progress in ensuring workplace electrical safety issues are addressed through technology and awareness. (https://i-gard.com)

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Understanding Rating of Arc-Rated PPE

By Jim Pollard, Contributor

Any worker at risk of exposure to an arc flash hazard shall wear specially designed and appropriately rated personal protective equipment (PPE). There are hundreds, if not thousands of commercially available arc-rated product options to choose from in multiple designs, shapes, and sizes. The selection process can be overwhelming without first understanding how arc-rated PPE is rated.

The arc rating on all arc flash PPE in North America is established based on ASTM standardized laboratory test methods. Testing is conducted in a high current test laboratory, such as Kinectrics in Toronto, Canada. The three ASTM standards used to determine arc ratings are ASTM F1959 (fabrics), ASTM F2178 (face & head protection), and ASTM F1506 (performance requirements).

- ASTM F1959 uses a flat instrumented panel to test a fabric or multiple layers of fabrics.
- ASTM F2178 uses an instrumented mannequin head that is outfitted with the protective product (e.g., faceshield or arc flash suit hood).
- ASTM F1506 provides the requirements that product manufacturers shall follow.

Arc ratings are conservative estimates for how the arc-rated product would perform if exposed to an arc flash. Different types of arcs are possible, and the arc rating is only known for the type of arc used in the ASTM test methods; 8kA using vertical electrodes in open air (VOA) with a 30cm gap. It is generally accepted within the electrical safety industry that arc ratings determined using open air type arc testing can be applied to other types of arcs (e.g., horizontal oriented electrodes). During arc flash testing sensors are used to measure the difference between the arc energy (incident energy) and the insulative value of the test specimen(s).

An example of an Oberon Arc Flash Suit Hood.

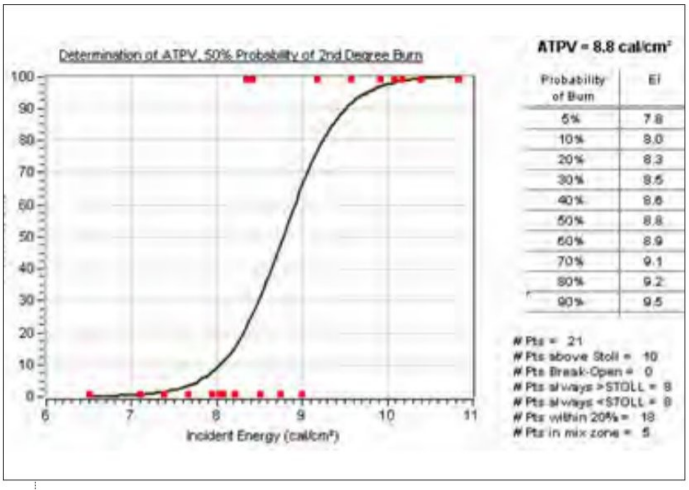
There are two different types of arc ratings as defined in ASTM F1959 as:

Arc Thermal Performance Value (ATPV): the incident energy on a material or a multilayer system of materials that results in a 50% probability that sufficient heat transfer through the tested specimen is predicted to cause the onset of a second-degree skin burn injury based on the Stoll curve, cal/cm2.

Breakopen Threshold Energy (EBT): the incident energy on a material or material system that results in a 50% probability of breakopen. The test specimen is considered to exhibit breakopen when any hole is at least 1.6cm^2 (0.5in^2) in area or at least 2.5cm (1in) in any dimension.

Arc Ratings are calculated using at least 20 data points to determine the incident energy level of a 50% probability that there is enough heat transfer to cross the Stoll Curve (used to determine ATPV), or for the material to breakopen and create exposure (used to determine EBT). Both the ATPV and EBT arc ratings are considered equally acceptable. All types of arc-rated fabrics will breakopen when exposed to sufficient arc energy. The type of arc rating that is identified on the label of an arc-rated product is determined by the lowest of the two, or what occurred first during arc testing. This ensures that arc-rated products are labeled with the most conservative of the two arc ratings. Products labeled with an EBT would have exhibited breakopen before it reached sufficient heat transfer to cause the onset of a second-degree skin burn. Products labeled with an ATPV did not exhibit breakopen before reaching the onset of a second-degree skin burn. ATPV rated products tend to be constructed with stronger materials (i.e., tensile strength) as compared to EBT products that usually have more insulative properties. Common examples for both types of arc ratings include:

- ATPV; woven fabrics (dress shirts, pants, coveralls, jackets) and denim (jeans, jackets).
- EBT; knit fabrics (long sleeve t-shirts, crew necks, hoodies) and coated fabrics (rain jackets, wind breaker shells).



Arc Ratings are calculated using at least 20 data points to determine the incident energy level of a 50% probability that there is enough heat transfer to cross the Stoll Curve (used to determine ATPV).

SELECTING ARC FLASH PPE

Arc flash PPE is selected by matching the arc rating, either ATPV or EBT, to the anticipated release of incident energy released from exposure to the arc flash hazard. The arc rating is the protective ability of the product to mitigate the thermal energy that could harm a worker. The protection is reported as calories (a unit that measures energy) per cm2 (square centimeter) of surface area. The thermal energy created by an arc flash hazard, incident energy, is also measured in calories per square centimeter. The bigger the calorie number, the greater the protection provided by the product and the greater the thermal heat energy potential of the arc flash hazard. Matching the arc rating to the hazard would best replicate the predicted performance as determined during laboratory arc flash testing. When the arc rating exceeds the arc flash hazard, the probability of a worker receiving a burn injury is further reduced. Over protection should be balanced with maintaining worker comfort and productivity. For example, wearing extra layers of arc-rated PPE could contribute to human error by causing heat stress and diminish a worker's ability to perform work safely (e.g., dexterity, movement). Another example of what not to do is avoid excessive sweating from over-dressing, which would negatively impact the arc rating of the worker's arc flash PPE once the fabric has become saturated.

The ASTM standards for electrical specific personal protective equipment are designed to work together. The most important of which is the ASTM F1506; an overarching standard with governance over all arc flash PPE performance

requirements including how arc-rated PPE is rated and labeled. To be arc rated as per the ASTM F1506 standard, the fabric must pass several tests including wash testing and the vertical flammability test using ASTM D6413. Employers creating arc flash PPE specifications as part of their Electrical Safety Program should require compliance with ASTM F1506.

Workplace electrical safety standards that reference ASTM standards for electrical protective equipment include NFPA 70E Standard for Electrical Safety in the Workplace (USA) and CSA Z462 Workplace Electrical Safety Standard (Canada). Other industries not covered by the scope of these standards, most notably Electrical Utilities, also refer to these ASTM standards when evaluating the arc-rating of PPE.

Now that you understand how arc-rated products are rated, hopefully the selection process can be easier. When selecting arc flash PPE, the arc rating must match or exceed the anticipated incident energy of a worker's exposure to the arc flash hazard. Actual arc flash incidents are focused events where the thermal energy often impacts an area approximately $12in^2$ in size on a worker's body. Survivability is achieved when we effectively prevent ignition of garments and undergarments when workers wear arc flash PPE that is adequately rated and appropriate for use. ESW

Jim Pollard is the Oberon Rep for the U.S. Midwest and Canada. His company, Unlimited PPE, provides electrical safety compliant products and services including training, consulting, and licensed electrical safety programs. He can be reached by email at jim@unlimitedppe.com (www.unlimitedppe.com).

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Enespro PPE was founded in 2018 by highly experienced professionals with long careers in the electrical safety industry. Their mission is simple but powerful: improve the electrical PPE experience to make workers safer. The company pursues this mission every day by collaborating with electricians and safety leaders to innovate and help solve problems associated with traditional electrical PPE.

Enespro's development process started by conducting extensive market research with electrical and safety professionals, including electrical contractors, utilities and commercial and industrial workers. Everyone confirmed that traditional electrical PPE is heavy, hot and uncomfortable. It's hard to put on and take off, slows workers down and makes jobs harder.

Knowing it was time for a change and that there was a better way to make PPE, Enespro started designing — and innovating. The company turned what it had learned into an all-new line of American-made arc flash protective gear designed to increase user compliance and help keep electrical workers safe. The end result is a comprehensive line of leading-edge electrical PPE solutions that are lighter, more comfortable and less cumbersome. In addition, Enespro's PPE is easier to put on/take off and stow than any other choice in the marketplace.

These offerings include arc flash kits complete with suits, hoods, face shields and custom gear bags that address the challenges of workers and safety professionals. Once Enespro's PPE was used in the field, the feedback was unanimously positive. A project executive from Therma stated, "I'm glad we made the switch. It was great to be part of the team bringing new PPE innovations to the market to keep electrical workers safe."

A safety manager from Continental Electric agreed. "I am getting requests daily to replace our current kits with Enespro PPE."

And a safety lead from Google even quipped, "Enespro's AirLite™ kits have been so well received by our workers that I'm actually getting compliments instead of complaints about having to wear PPE!"

Although feedback like this has further verified the benefits of Enespro's PPE offerings, the company doesn't plan on slowing down any time soon. In fact, it continues to make its new generation of USA-made electrical PPE as accessible as possible to everyone with a free, no-obligation trial — perfect for letting workers access and utilize these products on the job and in the field so that they can experience Enespro's benefits for themselves.

Visit our website at EnesproPPE.com or call 866-680-4950 today.

Utility Training & Awareness

By Zarheer Jooma, Contributor

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. ESW

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/).

How to Properly Care for Rubber Insulating Gloves, Sleeves, and Blankets to Extend Use and Safety

By Richard Rivkin, Contributor

OSHA, NFPA, and the ASTM standards mandate the use of rubber insulating products when even the smallest probability of contact (with 50 volts AC or higher) exists. These rules affect nearly all industrial workplaces, as every single facility (not just utilities, electrical contractors, telecom companies, municipalities, and electrical co-ops) has a need for electrical safety, and failure to comply can result in heavy fines, serious injury, and even death. Moreover, OSHA and ASTM standards also require regular inspection of in-service electrical protective equipment in order to maintain compliance and ensure the products' safety and integrity. Fortunately, there are safety measures and solutions that you can easily employ to help prevent injuries, citations and penalties, including visual inspection and proper storage of rubber insulating gloves, sleeves, and blankets.

INSPECTION HELPS ENSURE PROTECTION

ASTM F496-20 in-service standards require the regular inspection of in-service electrical protective equipment in order to maintain compliance and ensure the products' safety and integrity when exposed to a wide range of voltages. All rubber insulating equipment should be thoroughly inspected prior to use. Common problems to look for include the following:

1. **Cracking and Cutting** – Prolonged folding or compressing can cause this type of rubber damage
2. **UV Checking** – Storing in areas exposed to prolonged sunlight causes UV checking
3. **Chemical Attack** – Oils and petroleum compounds can cause swelling of the rubber
4. **Avoid Folding** – The strain on rubber at a folded point is equal to stretching the

rubber to twice its length

5. **Snags** – Wood, metal splinters, and other sharp objects can snag or tear rubber
6. **Physical Damage** – Rope burns, deep cuts, and puncture hazards are cause for rejection

Visually inspecting rubber gloves and sleeves identifies physical, chemical, or ozone damage. Direct light is recommended because it enhances the ability to see surface imperfections on the rubber. Inflating the gloves with air (or otherwise stretching the surface) helps identify age and ozone damage, as well as other physical damage such as snags, rope burns, deep cuts, and punctures. A portable, mechanical inflator may be used in the field to enhance the inspection of the glove and identification of any damage. Simply affix the glove to the inflator and pump it up to view any damage to the glove that is not otherwise visible unless viewed after inflating.

Otherwise, if a portable inflator is not available, use a rubber glove inspection tool or roll the glove cuff tightly to trap air inside. Expand the gloves no more than 1.50 times their normal size for Type I non-ozone-resistant rubber. Listen for escaping air to detect holes. Then, apply pressure to areas of the glove to inspect for escaping air. Repeat the procedure again with the rubber gloves turned inside out.

The use of two-color rubber insulating gloves can also aid in the identification of problems in that any damage to the outer layer enables the inner, contrasting color to be seen.

Do not forget that, with very few exceptions, rubber insulating gloves must always be worn with leather protector gloves manufactured in compliance with ASTM standard specification F696. Leather protector gloves themselves offer no protection against high or low voltage but are intended to be worn over rubber insulating gloves to protect them from cuts, abrasions, and punctures. Therefore, do not forget to inspect leather protector gloves every day as well, since dirt and grime can hide damage. Be sure to also inspect the leather protector gloves for embedded wires or metal shavings that could puncture or damage the rubber gloves.

There are several field storage options available for rubber insulating sleeves, including sleeve roll-ups, canvas sleeve bags, and combination bags.

When inspecting rubber sleeves, make sure to examine them along the edge as they are rolled. Rolling will stretch the sleeve along the edge, making cuts, tears, and ozone cutting more visible. Repeat this process again with the rubber sleeve turned inside out.

Roll rubber insulating blankets to properly inspect them in order to locate scratches, tears, abrasions, snags, corona cutting, or age cracking. Make sure to roll the blankets two times on each side, with the second roll at a right angle to the first. Immediately remove blankets from service that show any signs of damage.

STORE TO USE MORE

Proper storage extends the service life of the rubber insulating equipment. When not in use, store rubber goods in a suitable container such as a canvas bag designed specifically for that purpose.

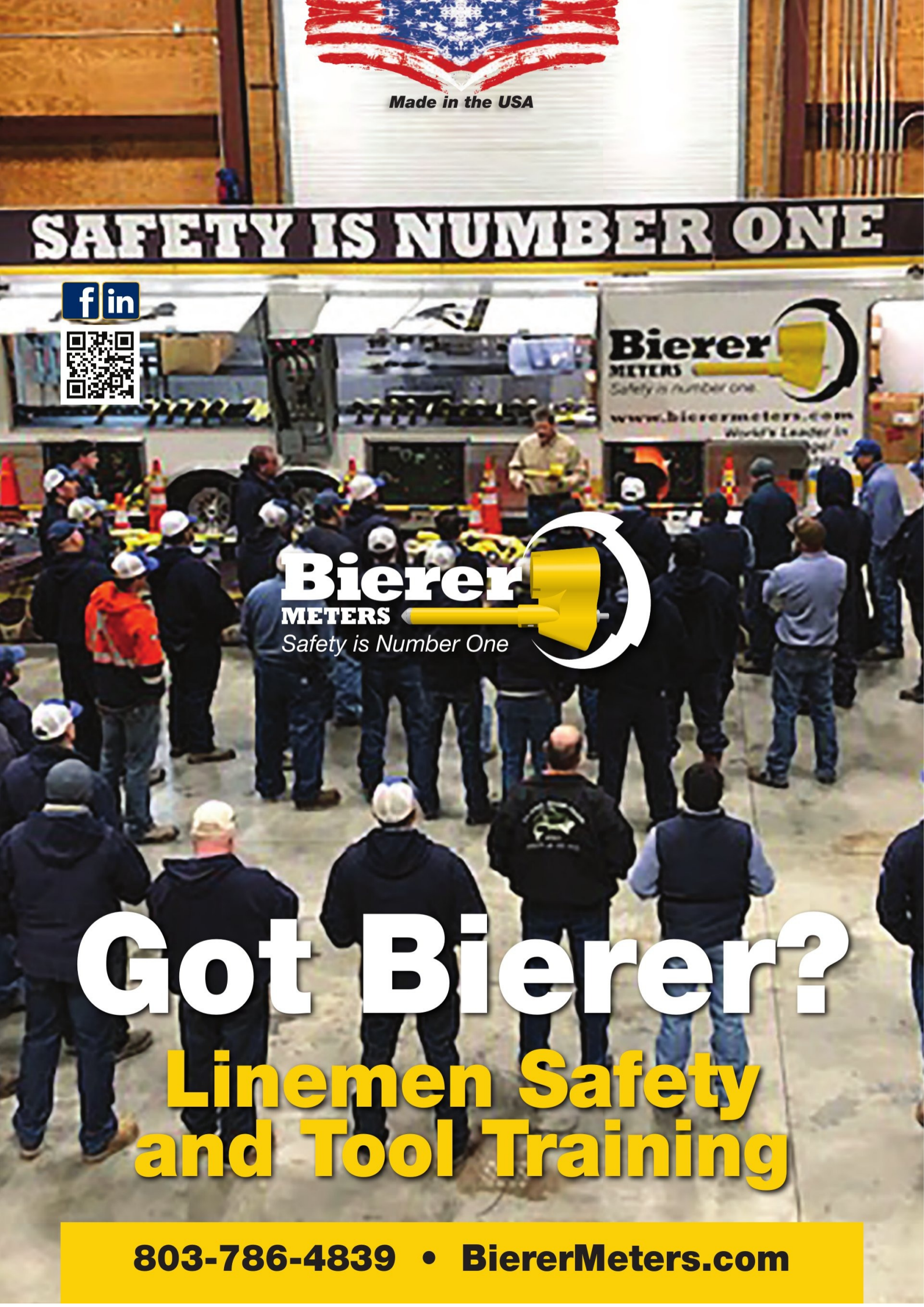
Never fold rubber insulating gloves. Folds and creases strain rubber and cause it to crack from the ozone prematurely. Store rubber gloves with the fingertips up in the right sized bag or roll up, and never force more than one pair into each bag. Avoid storing the gloves inside out, which can also cause strain and promote ozone cutting. It is permissible, according to ASTM F496, to store rubber gloves inside of their leather protectors, but exercise good judgment. If the leather gloves are wet or damp from working in inclement weather, then remove them from the rubber gloves to allow them to dry. Also remove the leather protectors so that the rubber gloves and leather protectors can both be inspected before the start of the next workday. Try to store in a dry and cool location away from sources of ozone and direct sunlight.

There are several field storage options available for rubber insulating sleeves, including sleeve roll-ups, canvas sleeve bags, and combination bags for storing gloves and sleeves together. Field storage of rubber insulating blankets shall be in a bag, box, container, or compartment that is designed for and used exclusively for them. Refer to ASTM F1236 standard guide for visual inspection of electrical protective rubber products for additional information.

TEST FOR THE ULTIMATE SAFETY SUCCESS

In summary, damage to many types of personal protective equipment (PPE) can be apparent when the equipment or devices are inspected by the user. However, rubber insulating products are more complicated. It is important to note that the reduction in effectiveness can be caused by a variety of factors that may not be readily apparent to the user, and improper use of rubber insulating equipment can be a matter of life and death. The best way to ensure that rubber goods are safe for their intended use is to have them periodically retested at their proof test voltage by a qualified test lab. If you do not have the equipment needed to perform these electrical tests, there are independent testing facilities that can perform the acceptance and in-service testing on behalf of end users. The retest process includes thoroughly cleaning the products, visually inspecting them for physical damage, performing dielectric testing at the rated test voltage, and marking and packing the accepted products for return shipment. Products passing the inspection and test procedures can then be safely returned to service. When selecting a test lab for use, make sure that it is a NAIL-accredited test lab. NAIL stands for National Association of Independent Laboratories for Protective Equipment Testing (www.nail4pet.org). It incorporates the only Laboratory Accreditation for the electrical equipment test labs program in North America. NAIL4PET helps develop uniformity in testing and works in close association with the American Society of Testing Materials (ASTM International). ESW

Richard A. Rivkin is President and Chief Executive Officer of Saf-T-Gard International, Inc., a privately held family-owned and operated global supplier of industrial safety products based in Northbrook, Illinois. Founded in 1936 as Latex Glove Company, Saf-T-Gard carries on the tradition that was started more than 80 years ago: bringing customers the products, training and service they need to keep employees safe in the workplace. Saf T Gard actively operates the Voltgard® Test Lab, one of the largest, independent, NAIL4PET-accredited test labs for rubber insulating products in the United States (www.saftgard.com).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The Art of the Layering System

By Brad Sipe, Contributor

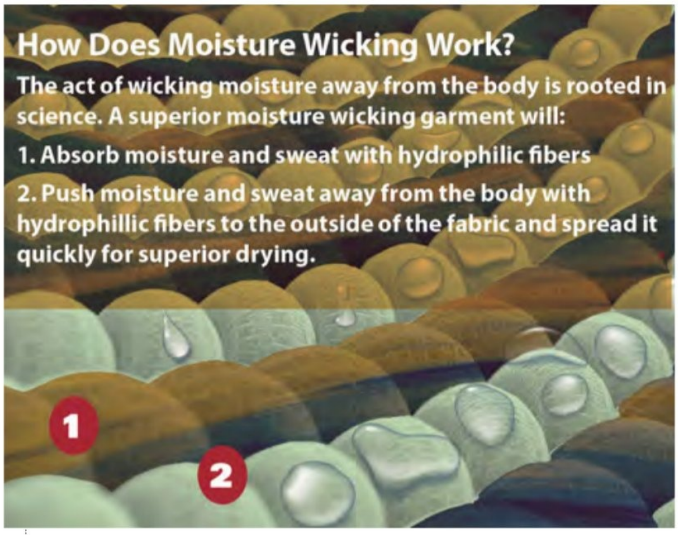
The concept of layering is not new. Weekend warriors and athletes have been successfully layering their garments for years. Each layer is important but serves a different function. This art is a tried-and-true strategy that lets you regulate comfort by putting layers on and off as your activity level or the weather changes. To understand the layering concept in changing outdoor conditions you need to know the function of each layer.

- **Base** (next to skin)- this layer needs to wick moisture off your skin.
- **Mid** (insulating layer)- this layer continues to move moisture but more importantly retains body heat to protect you from the cold.
- **Outer** (insulating layer)- this layer continues to wick moisture but more importantly shields you from the elements, like wind, rain, snow.

It's important to note that you need to have these layers in your possession to wear even if they are not needed. You can't put layers on if you do not have them, but you can take them off if you need to.

BASE LAYER = MOISTURE MANAGEMENT

The next-to-skin layer or base layer's job is moving moisture away from your skin via wicking. In cold conditions wicking base layers are needed to keep your skin dry. This is critically essential as this layer keeps you from becoming chilled or going into hypothermia. There are different weights with base layers and the general rule of thumb is the heavier the fabric the warmer you are. The real purpose of base layers is not to keep you warmer but to wick moisture away from your skin. So, look for a base layer that has optimal moisture management. One that is proven to have permanent moisture management and dries faster.



Moisture wicking does two things.

MIDDLE LAYER = INSULATION

This middle layer moves moisture but helps you retain the heat that's radiated from your body. The more efficient this layer is in retaining the heat, the warmer you will be. This layer is where the "art" of layering starts. This is where you wear different weights of fabric to protect you from the changing conditions. An example would be your first ski run in the morning where it's frigid outside. So, you wear your base, a heavier weight mid layer and a protective outer shell (more on this layer later). Once your body starts to warm up and the day becomes a little warmer you substitute this layer for a lighter weight or just simply take it off. The mid layers should include different weight fabrics, the colder the weather the heavier the fabric. (I never end up the day wearing the same layering system as I started with in the morning). Look for companies that have different weight mid layer options to keep you drier and more comfortable. Lakeland's mid layers come in different weight options including 8oz, 11oz, and 12oz. Each consist of permanent moisture management and optimal blend.

OUTER LAYER = RAIN, SNOW, & WIND PROTECTION

Your outer layer should also wick moisture and have breathability, but more importantly protect you from wind, rain, and snow. Your outer shell is most important in stormy weather due to the fact if the wind and water penetrate to inner layers you will become chilled and this is where hypothermia ensues.

Most people error here by putting on a heavier outer shell that traps moisture and doesn't protect you from the elements. Your outer wear should also be light weight allowing for more freedom of movement. Lakeland's outerwear is the lightest weight in the industry with incredible stretch, water and wind resistance with a smooth, soft touch and incredible abrasion resistance.

REMEMBER THESE CRITICAL FACTORS AND MASTER THE ART OF LAYERING

Choose a base layer that has optimal moisture management, these include:

- Inherent permanent moisture management - This ensures the moisture management will last the life of the garment and does not have a finish on it that will eventually wash out.
- Has the optimal blend of fibers to pull and push moisture through the fabric and spread it faster, which helps to dry more effectively. Ask us for the data-it is available. Be wary of marketing buzz words here.

Choose mid layers that offer you options during varying outdoor conditions:

- Use different weights during changing conditions
- Make sure they have inherent permanent moisture management

There are three types of layers: base, mid, and outer.

Choose your outer wear that offers wind, rain, and snow protection:

- These should be light weight and have inherent permanent moisture management
- Outerwear should be clearly defined to protect from wind and rain.
- Layer from inside-out not from outside-in. This combination keeps you warmer and drier.

Moisture wicking technology was created to boost an athlete's performance in extreme outdoor situations, keeping you drier and cooler in hot conditions and warmer, drier in cold conditions. The world's top athletes wear high-performance garments and layering systems to optimize their performance and have better concentration on the task in front of them. Layering systems from Lakeland offer you these same advantages. Superior performance, protection, and comfort. ESW

Brad Sipe is Director of Business Development for Lakeland Industries' High Performance FR product category (Lakeland.com).

Are Laceration Injuries Cutting Into Your Bottom Line?

By Paul A. Satti, Contributor

Electrical safety professionals cannot afford to lose focus on the all-too-common occurrence of skin lacerations in the workplace. Seemingly every year, these injuries top the list of OSHA-reported incidents by local contractors. The resulting pain is not only physical, but financial, as well.

Electricians are required to use their hands in an expert, coordinated way to grasp and manipulate objects. They must demonstrate precise movements when testing, stripping, bending, twisting, and pulling. Oftentimes this results in punctures of the skin that inhibit individual motor skills and jobsite productivity. Employees and employers suffer the consequences – an estimated $50 thousand per incident.

Due to the likelihood, and cost, of these injuries, it is recommended that contractors implement policies and procedures related to cut-resistant hand gloves. This product is available from many manufacturers that use advanced technology and materials to protect electricians from sharp edges. The gloves are functional, too, and offer innovative features to improve grip, fit, and dexterity.

The ANSI/ISEA 105 (2016) standard addresses the classification and testing of hand protection for specific performance properties, such as cut resistance, puncture resistance, and abrasion resistance. There are several glove categories that are compliant with the standard.

An effective hand-injury prevention program begins with a thorough understanding of the construction environment and the PPE required to ensure safety. Employees should be involved in the decision-making process by allowing them to experiment with different makes and models. This will familiarize them with the options available and help them to overcome resistance to use gloves in the field.

Lacerations are preventable. Cut-resistant products represent a common-sense approach to decreasing the frequency of skin punctures among electricians. It is in the best interest of all parties involved to utilize the best equipment and practices that preserve a healthy workplace. ESW

Paul A. Satti, M.S., is a Certified Safety Professional (CSP) and Certified Electrical Safety Compliance Professional (CESCP). He is Technical Director for the Chicagoland Construction Safety Council (www.buildsafe.org) and Instructor for the National Safety Education Center (www.niu.edu/nsec) – one of 26 OSHA-authorized Education Centers nationwide.

PRODUCT SPOTLIGHTS

Youngstown's 10" Secondary Protector is Arc Rated to 25 cal/cm² and ergonomically designed to fit perfectly over Class 0 & 00 rubber insulating gloves per ASTM F496/ ASTM F696. The glove features a FR Strap system to ensure nothing on the glove will drip, melt, or ignite. Item # 16-4100-10. Visit **www.ytgloves.com** for more info.

Westex: A Milliken Brand, has announced the launch of a new product selection app, the **Westex App**, developed to provide users a way to custom build a FR/AR uniform based on their workforce's individual safety standard requirements. The app is the first-to-market tool that matches products to global safety standards. The free mobile app is available for iOS and Android mobile devices.

Innovative features on the Westex App include product selection by safety standard, global perspective, and an interactive uniform builder.

The free mobile app is available to download now in the Apple App Store or Google Play Store. The product selection tool can also be viewed online at **app.westex.com**.

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Safety Through Technology – The Next Generation of Electrical Safety Measures

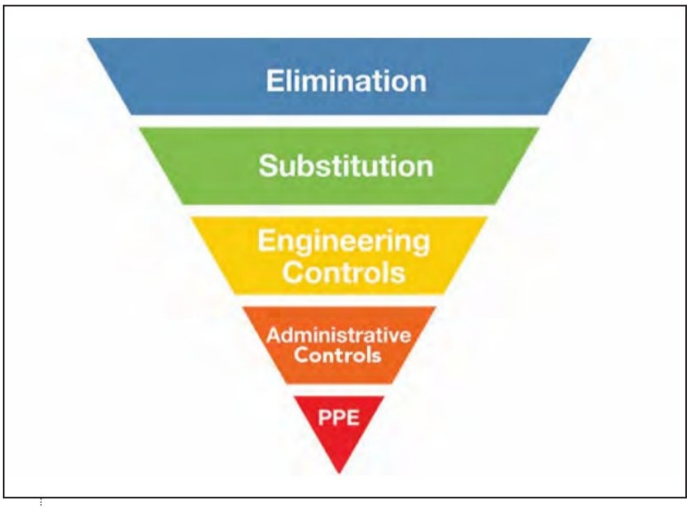
By Michael Riccio, Contributor

Electrical incidents happen daily, putting lives and operational continuity at risk. However, there are ways companies can reduce the occurrence of these incidents and protect everyone concerned from the physical, financial, and statutory consequences. The National Fire Protection Association (NFPA) regulation 70E provides a reference for facilities to meet the requirements of electrical workplace safety, while regulation 70B outlines the best practices for setting up and maintaining and Electrical Preventive Maintenance (EPM) program.

VALUE OF STANDARDS

At the heart of NFPA 70E and OSHA initiatives is the Hierarchy of Control. This concept attempts to mitigate risk wherever possible.

NFPA 70E and OSHA state that electrical equipment should be de-energized prior to opening. Some maintenance tasks must be completed while equipment is loaded and energized, rapidly causing Electrical Maintenance Safety Devices (EMSDs) to become a hot topic. Their popularity is growing as companies strive to improve safety, profitability, and uptime. Those who are implementing EMSD-based programs are reaping significant benefits in terms of efficiency gains, cost control, and incident prevention.



In order of preference, the hierarchy of control prioritizes the following.

TYPES OF ELECTRICAL MAINTENANCE SAFETY DEVICES

Just as equipment varies in design and purpose of use, so do these types of technologies. While some safety and maintenance programs might require a full-scope approach, others may require just a few of these technologies. These options are available from numerous manufacturers, and vary in size, material, certifications/ratings, etc. Having a better understanding of the design and purpose of these technologies gives companies a better understanding of how to best engineer a program focused on safety and reliability.

- Infrared windows effectively reduce downtime and risk while offering access to the points inside equipment that require inspection and maintenance. Windows placed at targeted inspection points such as cable terminations or critical current-carrying components enable viewing in the visual, Ultraviolet, shortwave, mid-wave, and longwave IR spectrums - providing full access to connections without the significant risks associated with panel removal. Organizations such as the IEEE have been at the vanguard of this movement with its "Safer by Design" campaign.
- Ultrasonic ports are used to detect arcing and tracking problems in electrical distribution systems and switchgear. They provide a standard and systematic approach to collecting data essential to establishing repeatable CBM by providing a ventilated, standardized measurement

NFPA 70E and OSHA state that electrical equipment should be de-energized prior to opening.

point. Alternately, low-cost ultrasonic sensors can be permanently mounted to electrical equipment allowing simple plug-in measurements with a handheld ultrasound detector. Maintenance personnel can therefore safely collect data on energized equipment without downtime.

- Online monitoring systems attach directly to electrical enclosures. Asset surveillance is a crucial part of maintaining electrical equipment and helps identify issues early to avoid system damage and downtime by monitoring power quality and partial discharge with permanently installed equipment and software. The data is wirelessly transmitted for analysis and to establish trends, putting equipment temperature changes in historical context to ease problem identification.
- Intelligent asset tags link maintenance instructions and equipment diagrams to simplify the inspection/maintenance process by providing technicians with the information they need when and where they need it. This invariably leads to safer working conditions and faster maintenance as the technician does not have to search around for documentations, or worse, perform service ad hoc. Asset tracking and equipment maintenance history trend analysis help a business better understand how and why systems are operating or failing.

VALUE OF ELECTRICAL MAINTENANCE SAFETY DEVICES

The main benefits of using ESMDs is that they remove risk of incidents threatening the safety of workers and provide for a more efficient pathway to asset reliability. Because there is no panel removal required, inspections require less manpower, time, and lower Personal Protection Equipment (PPE) levels.

It is significant that most electrical maintenance and safety standards value EMSDs as a critical part of an electrical preventative maintenance program (EPM). EMSDs provide a way for companies to comply with the recommendations for inspection processes, while complying with safety mandates. Most, if not all, of these organizations agree that electrical equipment should not be opened unless it is de-energized. EMSDs provide a way for companies to comply with recommendations for inspection and safety standards/ guidelines while protecting personnel, equipment, and profits. ESW

Michael Riccio, CRL, CAT-1 IRT, is the Global Marketing Manager for IRISS (www.iriss.com). He is a Certified Reliability Leader, Thermographer, and focuses on analyzing electrical industry trends.

An adequately rated portable test instrument is used to test for the absence of voltage.

How to Establish an Electrically Safe Work Condition

By Jason Moore, Contributor

The Control of Hazardous Energy (CoHE) in general industry was the fourth most frequently cited OSHA standards violation in FY 2019. While it is the obligation of the employer to establish, document, and implement a lockout/tagout (LOTO) program and provide appropriate equipment to properly control all sources of hazardous energy, every qualified worker has a critical responsibility to ensure control of these energies while establishing an electrically safe work condition.

NFPA 70E Article 120 Establishing an Electrically Safe Work Condition, OSHA CFR 1910.147 The Control of Hazardous Energy (Lockout/Tagout) and ANSI Z244.1 Control of Hazardous Energy Lockout/Tagout and Alternative Methods detail the responsibilities and processes for sequestering energy sources. Essential common denominators found in these three documents involve planning and involvement.

PLANNING

Lockout/tagout begins with planning—a critical step in proper control. It is crucial that a qualified worker knowledgeable with the equipment plans the LOTO activity. Thorough review of one-line diagrams, confirmation of equipment ID tags, as well as power source information labels—which should be found on each isolation point—are necessary to begin this process. A qualified person should thoroughly walk through the proposed LOTO process while ensuring all points of isolation are properly identified, aligned with the one-line diagrams, and indisputably the only sources of hazardous energy associated with the equipment to be put into an electrically safe work condition.

Any noted omittance of equipment labeling or observed errors must be promptly corrected prior to proceeding with the LOTO process. While this article highlights the electrical component of a safe work condition, it is significant that readers also recognize that the

Thorough review of one-line diagrams, confirmation of equipment ID tags, as well as power source information labels — which should be found on each isolation point — are necessary to begin the LOTO process.

planning process for LOTO often includes the identification of isolation points associated with other forms of hazardous energy. These too must be confirmed, and the written plan must systematically organize all points ensuring each point is isolated in the proper order.

Once the plan is accurately documented and management approval obtained, the load current(s) are to be interrupted, and a qualified person will open the disconnecting device for each source. Whenever possible, visual verification of this equipment in the "open" position should be made. For disconnect switches, the knife blades should be confirmed to be "open." For draw out-type circuit breakers, visual verification must ensure they are properly withdrawn to the "test" or fully disconnected position. With these hazardous energies isolated any other sources of stored electrical energy must be released. Additionally, all remaining non-electrical energy are blocked or relieved to the extent that circuit parts cannot be unintentionally energized by such devices.

DISCREPANCY AMONG ORGANIZATION GUIDELINES

A key discrepancy in practice guidelines exists between OSHA and NFPA regarding achieving a zero-energy state and applying locks/tags. OSHA CFR 1910.147 details their process as the isolation of energy sources, application of locks/tags to these devices, followed by the release of any stored or other types of energy using stored energy controls. NFPA 70E Section 120.5 prescribes the isolation of energy sources, with subsequent release of any stored or other types of energy followed by the application of locks/tags. OSHA's document is a Code of Federal Regulations (CFR) is enforceable but is not updated on a frequent basis. NFPA is considered the consensus standard and is updated on a much more frequent schedule (every three years). In the experience of the author, the guideline identified by NFPA is more widely applied.

ABSENCE OF VOLTAGE

With all sources properly isolated, LOTO devices are to be applied in accordance with the energy control program. An adequately rated portable test instrument is used to test for the absence of voltage. In lieu of the traditional handheld voltage meter, NFPA 70E – 2021 edition provides an exception allowing the use of an adequately rated permanently mounted absence of voltage tester (AVT), provided it meets the following requirements:

1. It is permanently mounted and installed in accordance with the manufacturer's instructions and tests the conductors and circuit parts at the point of work.
2. It is listed and labeled for the purpose of testing for the absence of voltage.

3. It tests each phase conductor or circuit part both phase-to-phase and phase-to-ground.
4. The test device is verified as operating satisfactorily on any known voltage source before and after testing for the absence of voltage.

For instances where the possibility of induced voltages or stored electrical energy exists, all circuit conductors and circuit parts must be grounded before they are touched.

ASSOCIATED AND ADJACENT MACHINES

While this process is necessary to reach a zero-energy state on the primary machine/process where work is to occur, consideration must also be given to possible energy sources for associated and/or adjacent machines. Associated machines interface with the primary machine, but their power is not derived from the primary equipment. Adjacent machines may not be associated with the primary machine, but by proximity may present a hazard to persons working on the primary machine. Thorough planning should identify these hazards and isolate their energy sources as needed to allow for a safe work condition.

INVOLVEMENT IS EVERYONE'S RESPONSIBILITY

The establishment of an electrically safe work condition requires the involvement of all stakeholders. From the employer to the employee or contractor, all persons affected or qualified and performing the work of the energy control procedure must be fully invested toward complete control of all electrical and other hazardous energies. Electrical conductors and circuit parts are considered energized until the process of establishing an electrically safe work condition is complete. The appropriate PPE must be worn throughout this process.

AUDITING

Processes, equipment, personnel, and other factors can change over time. ANSI, NFPA, and OSHA require the auditing of these written instructions to maintain their integrity and to ensure a safe work environment. The key consistency amongst these standards is that this auditing task is to be performed by an authorized person other than the one(s) utilizing the energy control procedure being inspected. ESW

Jason Moore, CESCP is the Electrical Safety Mitigation Specialist for Thompson, focused on mitigation of electrical hazards; arc flash, coordination, and short-circuit studies; as well as electrical safety training and authoring of electrical safety programs to promote a safer work environment for customers across North America (www.thompsonknows.com).

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