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FALL 2025 NETA WORLD™

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FALL 2025 FEATURE

REFRAMING THE WORKFORCE ENERGY CRISIS

Page 42, by Morteza Talebi, PHD, SMIEEE

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WORKFORCE DEVELOPMENT

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Fax: 269.488.6383
neta@netaworld.org
www.netaworld.org
EXECUTIVE DIRECTOR: *Bryant Phillips*

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TACKLING THE CHALLENGE OF WORKFORCE DEVELOPMENT

In this issue of NETA World, *we tackle one of the most pressing challenges facing our industry today: workforce development. Across the electrical testing industry, companies are grappling with how to staff critical projects while pursuing ambitious growth goals. The talent gap is real and growing. Organizations must balance workforce transitions, technological adaptation, and cultural shifts to remain competitive and attract, retain, and engage a successful labor force. This issue offers valuable insights into why hiring is harder than ever and what we can do about it.*

To that challenge, I'm excited to share important news about the next phase of the NETA Department of Labor-approved Electrical Testing Technician Apprenticeship Program. This nationally recognized program is designed to help member companies attract, train, and retain qualified workers.

To support this effort, NETA has welcomed a new Manager of Training to our staff, dedicated to assisting NETA Accredited Companies (NACs) in understanding and implementing the program. We will be holding a presentation and Q&A session during the September 12, 2025, Member Meeting in Boulder, Colorado, where attendees can learn how to integrate this powerful workforce development tool into their operations.

All member companies are encouraged to send representatives who would benefit from participating, especially those involved in training, HR, or workforce planning. This is a pivotal opportunity to invest in your team and the future of our industry.

Sincerely,

Dan Hook, President
InterNational Electrical Testing Association

ZAK HOUK: BUILDING A STRONG CULTURE

This edition of *NETA World's* "Insight and Inspiration" series features Zachary (Zak) Houk, General Manager at RESA Power Canada, a NETA Accredited Company headquartered in Calgary, AB, Canada. A NETA Level 4 Senior Technician, Houk is the newest member of the NETA Board of Directors and is already active on the Member Application Review Committee, Training Committee, and Technical Exam Committee.

ZAK HOUK

NW: **What attracted you to electrical testing?**

Houk: I grew up in North Battleford, SK, and when I was finishing high school, a family friend had great things to say about the Electrical Engineering Technology Program he had attended at a trades college in Moose Jaw, SK. The course fit my strengths in high school math and physics, so I felt it would be a good choice. I was also aware of the electrical industry and specifically electrical testing, and it seemed like a very stable choice for a career.

After graduating, I moved to Calgary, AB, and worked for Magna IV Engineering. In 2008, Kevin Noonan, Marc MacHattie, and I founded Advanced Electrical Services (AES). AES became a NETA Accredited Company in 2017 and was acquired by RESA Power in 2022. I began joining NETA committees in 2017 and have increased my involvement over the years.

NW: **What about this work keeps you committed to the profession?**

Houk: The most interesting part of this industry is that you will never stop learning and experiencing new challenges, which keeps you engaged and involved in the ever-changing landscape of electrical testing. It also introduces you to associations and organizations such as NETA, where you will meet other professionals in your field from different parts of the world who have experienced similar as well as different challenges throughout their careers.

NW: **As you start your work on the Board, what are your thoughts about how you can contribute to NETA and our member community?**

Houk: I expect to contribute to NETA by working with the other members and adding my 25 years of field testing experience to the Association. I have already met such amazing people and developed great relationships within NETA, and we are all driven to be accountable to each other. NETA has built a very strong culture, and I am looking forward to being a part of it now and future.

NW: **Do you have any issues you are passionate about?**

Houk: I am passionate about educating clients about the testing standards that are of the most critical nature to their facilities. As industry experts, we need to continually educate others on the ever-changing and evolving landscape of the electrical testing industry. That is why I am so excited to have the opportunity to contribute as a Board member going forward.

I'm also passionate about my family. When I'm not on the motocross track being pit crew, mechanic, and coach for my 14-year-old son, I am watching my 12-year-old daughter's gymnastics. When I get some personal time, I enjoy golfing, skiing, and socializing with friends.

NW: **What about this work do you find challenging?**

Houk: The most challenging aspect of this work is the travel component. The majority of sites are located away from home, which compromises your personal schedule. Balancing family time and

work is always difficult, but when done correctly, the rewards far outweigh the downsides. This involves open communication between managers and employees regarding time off and scheduling well in advance.

NW: **In your experience, what makes for a great workday?**

Houk: The most rewarding aspect to me is when clients rely on you and projects get finished and energized successfully. It is always gratifying and rewarding to apply our expertise in a manner that contributes to our clients' success on their projects. This also leads to future client relationships and further growth within your company, which ensures your employees will have stable work and gain further experience in their careers. The most rewarding aspect is the relationships you develop with clients on a personal and professional level.

NW: **Why is ongoing training and professional development important in this field?**

Houk: Training is key to our industry, and two areas require continual training: safety and technical training. Technicians must stay up to date on these areas to deliver a quality product safely and reliably. This industry will not allow corners to be cut and procedures not to be followed; the consequences are far too significant for technicians, clients, and all other parties involved.

This is the reason involvement in associations such as NETA is critical to all personnel who must stay up to date on testing standards, technology, and safety. If ongoing training and development are not taken seriously, those involved (company and employees) will fall behind in the industry, which will impact careers and reputations.

NW: **What do you think should be the No. 1 priority for the electrical testing industry over the next year?**

Houk: The priority should be for companies to build a strong culture, where safety and quality are held at the highest level. Once this is achieved, it will promote growth and drive client relationships. This goal can be accomplished through internal and external training, keeping up with evolving technologies, and having commitment from the top down within the organization.

NW: **If you were talking to a young person interested in knowing more about having a career in electrical testing, what advice would you give them?**

Houk: If they hold themselves and others accountable and put in the work, the sky is the limit in this industry. The time to focus on personal development is when they are young and coming into the industry. All other aspects will follow along with a successful career. I would also encourage them to never stop learning and experiencing the different skillsets required to succeed in this industry. They will never have to worry about their job becoming routine if they choose to follow this path. NW

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BE THE HUNTER: OUTSMART THE KILLER THAT NEVER SLEEPS

BY RON WIDUP, *Shermco Industries*

Electricity doesn't take breaks. It doesn't sleep. It doesn't care how experienced you are, how close you are to retirement, or how many safety meetings you've sat through. It's always there…silent, invisible, and deadly. And it's always hunting.

If that sounds dramatic, good. It should. Because electricity kills, and it only takes one mistake. One missed step. One lapse in judgment.

The difference between being the hunter and being the hunted isn't luck. It's training, awareness, discipline, and compliance. It's NFPA 70E® in action, but not just what's in the 113 pages of the standard, but also in your boots, your gloves, your arc-rated clothing… and in every decision you make on the job. This article is your basic field guide to surviving the hunt.

THE PREDATOR IN THE WIRES

You won't hear it coming. There's no growl, no rustle in the grass. Just the hum of equipment, the closing of a contactor, the arc, the flash, the tremendous heat. That's how electricity strikes – without warning.

According to **NFPA 70E Informative Annex K**, electrical contact and arc flash incidents represent a serious workplace health and safety issue. They rank among the top causes of occupational fatalities in industrial and commercial environments. The victims? Often skilled, most certainly dedicated, but usually caught off guard. Caught being hunted.

What's missing in too many cases is the shift in mindset. Here's a thought: You must stop walking into electrical environments like a bystander and start entering like a hunter — aware, cautious, deliberate.

Electrical safety culture is vitally important, and electricity doesn't care about your experience, only your preparation. A strong safety culture is your first and best defense.

Many of the embedded sections in NFPA 70E represent an electrical safety culture theme. From the personal side, go down into the individual performance side of things, where risk assessment and human performance are addressed in **Section 110.3(H)(2) Human Error**. This provides a risk assessment procedure to ensure human error is considered. It also points to **Informative Annex Q, Human Performance and Workplace Electrical Safety**, and specifically check out **Section Q.8, Workplace Culture** for further information. With electrical hazards, personal responsibility for workers, managers, and the organization, in conjunction with appropriate preparation, is everything.

Culture begins with mindset, and mindset begins with realizing, "This is a hunt."

KNOW THE TERRAIN: UNDERSTAND YOUR ELECTRICAL ENVIRONMENT

A good hunter knows the land — every dip, every shadow, every path. In our world, that means knowing your surroundings, your equipment, and what's energized and when.

Situational awareness is everything. Never assume a circuit is de-energized. Never trust labels that haven't been verified. Open panels, look-alike equipment, temporary wiring and backfeed, missing covers — these can all be your ambush points.

- **Article 100 Definitions** defines key terms, including "qualified person," as someone who has demonstrated skills and knowledge related to the construction and operation of electrical equipment and installations, along with safety training to identify and mitigate hazards. This sets the foundation for why understanding equipment is essential for safety.

- **Article 110.4 Training Requirements** outlines the mandatory training for qualified persons, which must include understanding electrical hazards, precautionary techniques, proper use of PPE, insulating tools, and test equipment, as well as skills to distinguish exposed live parts, determine nominal voltages, and assess equipment-specific risks. It emphasizes that qualification is task- and equipment-specific.

- **Chapter 2 Safety-Related Maintenance Requirements** provides guidance on maintaining electrical equipment to prevent failures and other hazards. Those of us in the electrical maintenance arena should have a complete understanding of Chapter 2, as it requires equipment to be maintained per manufacturers' instructions or industry consensus standards such as NETA's testing standard, ANSI/NETA MTS–2023, *Standard for Maintenance Testing Specifications for Electrical Power Equipment and Systems.*

The terrain may look familiar, but the danger hides in plain sight. You must constantly verify, not assume. (ASS-ume; that always gets you!)

ARM YOURSELF: PPE IS YOUR BODY ARMOR

No hunter walks into danger unprotected. With what we do, that means wearing the proper PPE at all times — every time! Arc-rated clothing, voltage-rated gloves, face shields, safety glasses, and hearing protection: Every piece of PPE is there to absorb what would otherwise hit your body in the event of an electrical incident.

- **Article 130.4 Shock Risk Assessment** requires assessing shock hazards based on nominal voltage, approach boundaries using resources like Table 130.4(E)(a), and taking necessary protective measures. Understanding the equipment's configuration and possible exposure points helps you determine safe working distances and the required PPE.
- **Article 130.5 Arc Flash Risk Assessment** requires you to evaluate arc flash hazards through analyzing incident energy or using the PPE category method available in Tables 130.7(C)(15)(a) and 130.7(C)(15)(b), which relies on your knowledge of equipment parameters such as available fault current, clearing times, and working distances. Understanding the equipment's design and condition is critical for accurate assessment and arc flash hazard labeling.

These aren't just tables in a standard. They are lifesaving checklists!

There are many real-life stories about electrical workers who lived to tell the tale because they wore the right gear. Unfortunately, just as many were seriously injured because they skipped this aspect of the hunt "just this once."

You wouldn't walk into a lion's den in flip-flops. Don't open an electrical panel in jeans and a t-shirt.

TRAIN LIKE YOUR LIFE DEPENDS ON IT (BECAUSE IT DOES)

Instinct doesn't come from guessing. It comes from training. From repetition. From repetition. From repetition. From knowing your tools, your risks, your equipment, and your escape plan. (Read: being qualified!)

- **Article 100** defines a **Qualified Person** as someone not just familiar with the work but trained to recognize and avoid the electrical hazards involved.

- Per **Article 110.4 Training Requirements**, retraining is required at least every three years, or whenever the job changes, the hazards change, or a safety lapse occurs.

- **Section 110.4(A)(1) Elements of a Risk Assessment Procedure** states, in part: "persons shall also be familiar with the proper use of applicable precautionary techniques, electrical policies, procedures, PPE, insulating materials, shielding materials, and insulated tools and equipment."

A good hunter reacts faster because they've prepared longer. They've trained for the moment before it arrives. So should you.

TRACK THE HAZARDS: PLANNING, RISK ASSESSMENTS, AND CONTROL

Never go in blind. Every job should start with a job safety plan and job briefing as required by **Section 110.3(I)(1) Job Safety Planning** and **Section 110.3(I)(2) Job Briefing**. You need to identify:

- What could go wrong?
- What's the likelihood?
- What are the consequences?
- What will we do to eliminate or control the risk?

Here's a good practice to implement: Use the Hierarchy of Risk Control Methods found in **110.3(H)(3) Hierarchy of Risk Control Methods.** Elimination is best. PPE is the last line of defense. Don't rely on the armor (PPE) if you can just neutralize the threat altogether.

THE HUNT NEVER ENDS

This is a daily battle. Every task is a new opportunity to do it right or a new chance to make a mistake. Don't let familiarity breed complacency. Respect electricity. Fear it a little. And hunt for it every day.

Hunters don't wing it. They track, observe, and assess before taking the first step.

Check your PPE. Follow procedures. Do the training. Complete the job plan. Think. Ask. Stop when something doesn't feel right. Because when it comes to electricity, there's no rewind button. Only the choice to be ready…or not.

BACK AT CAMP

In summary, we'll leave you with this: You don't rise to the level of the hazard; you fall to the level of your preparation. So hunt hard, hunt smart, and **never let electricity hunt you!**

You'll be glad you did.

And hey, Bubba, turn it off and…**Test Before Touch.** NW

Ron Widup *is the Vice Chairman, Board of Directors, and Senior Advisor, Technical Services for Shermco Industries and has been with Shermco since 1983. He is a member of the NETA Board of Directors and Standards Review Council; a Principal member of the Technical Committee on* Standard for Electrical Safety in the Workplace *(NFPA 70E); Principal member of the* National Electrical Code *(NFPA 70) Code Panel 11; Principal member and Chairman of the Technical Committee on* Standard for Competency of Third-Party Evaluation Bodies *(NFPA 790); Principal member and Chairman of the Technical Committee on* Recommended Practice and Procedures for Unlabeled Electrical Equipment Evaluation *(NFPA 791); a Principal member of the Technical Committee* Standard for Electrical Equipment Maintenance *(NFPA 70B); and Chair of IEEE Std. P902 (Yellow Book)* Recommended Practice for Maintenance and Operational Safety of Electrical Power Distribution Systems in Industrial and Commercial Facilities.*He is Chairman of the Texas State Technical College System (TSTC) Board of Regents, a NETA Certified Level 4 Senior Test Technician, State of Texas Journeyman Electrician, a Senior Member of the IEEE Standards Association, and an NFPA Certified Electrical Safety Compliance Professional (CESCP).*

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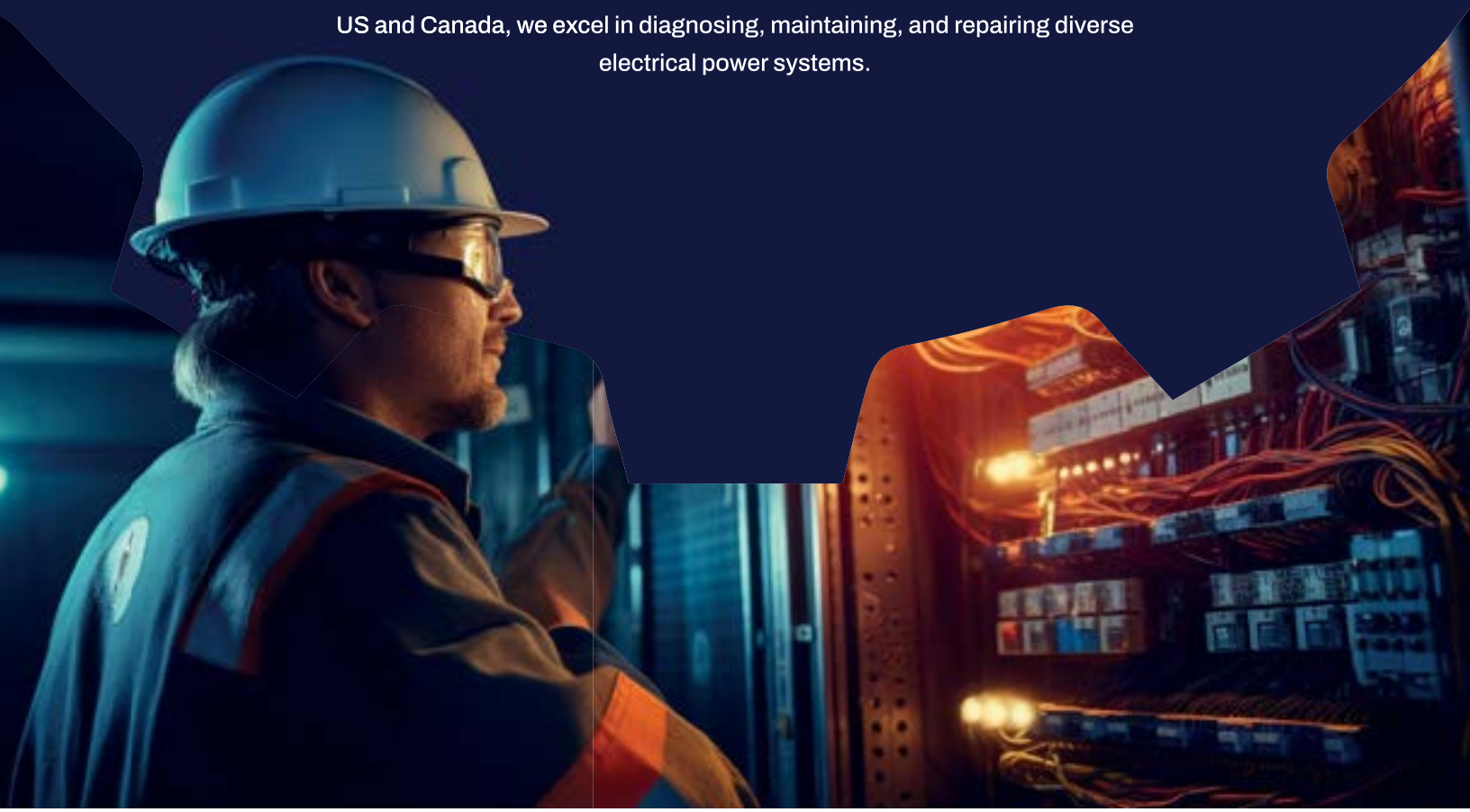

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THE CASE FOR ON-LINE ASSESSMENTS

BY MICHAEL LABEIT, *RESA Power*

Asset failures versus time are often non-linear. As assets degrade over time, the degree of degradation and the rate of degradation often increase. If asset degradation were linear, the rate of degradation would be constant.

This implies that an asset, such as a circuit breaker, could function properly for approximately 30 years, develop a detectable defect at year 31, and fail at year 35 (or even sooner). This phenomenon is often conveyed by the potential failure (P–F) curve, which illustrates the nonlinearity of asset condition: An asset's condition is good at the time of installation, remains satisfactory throughout much of its lifespan, and then degrades at ever-faster rates toward the end of its lifespan (Figure 1).

OFF-LINE ASSESSMENTS

This nonlinearity of failure poses particular problems for off-line assessments of equipment, such as power factor or insulation resistance testing. Off-line assessments, by definition, require outages, which are challenging for the owner due to loss of production time and reduced revenue. Outages also pose risks, such as poorly reassembled equipment and loose connections. As a result, off-line assessments are performed sparingly. For example, a utility might test a transmission transformer or

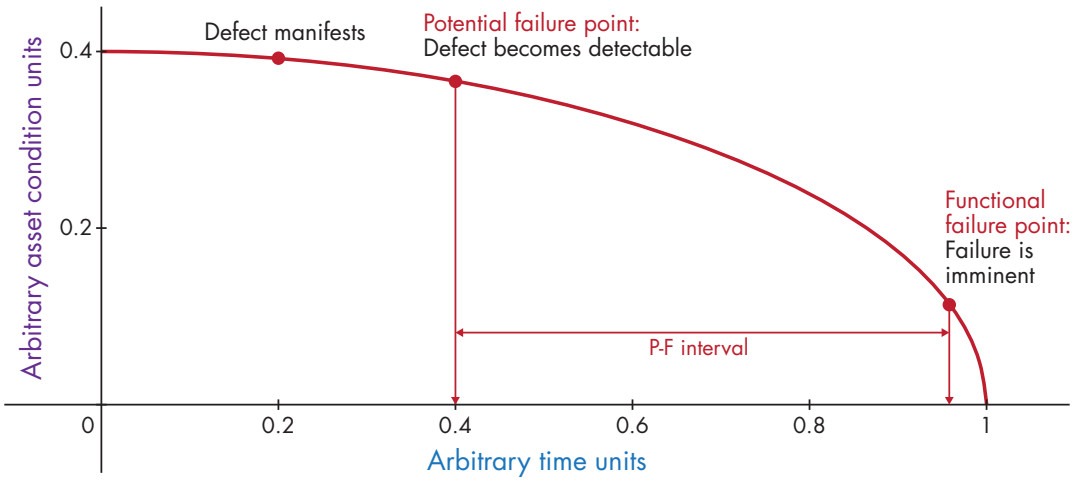

Figure 1: *Potential Failure Curve*

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circuit breaker using a time-based maintenance schedule, and the cycle time may be driven by the criticality of the equipment.

This wide maintenance interval creates the potential for defects to develop and go unnoticed. Suppose a utility tested a 230-kV transformer bushing in January 2025, and a microfissure formed in the porcelain the next month. A three-year maintenance scheme composed of only off-line assessments would fail to intercept that fissure until January 2028. During that time, the fissure could develop into a serious crack that could compromise the integrity of the bushing and cause a catastrophic failure.

One way to reduce this risk is to increase test frequency. For example, transformer bushings could be tested annually rather than every three years. This would produce more data per unit of time, thereby hastening the identification of asset deviations from the norm. However, even this schedule assumes that one datum per year would suffice to identify asset deviations from normality. The trouble with this approach is dispersion.

Dispersion Matters

Anyone who has conducted insulation resistance testing knows that, while valuable as a trendable parameter, insulation resistance is subject to considerable dispersion, even if you correct for temperature. Dispersion is also affected by humidity, which has no correction factor, as well as other factors. The most common measure of dispersion is standard deviation. If you conduct one-minute insulation resistance tests repeatedly on the same asset during one hour, you receive a range of results yielding a non-zero standard deviation. Consequently, if you conduct an

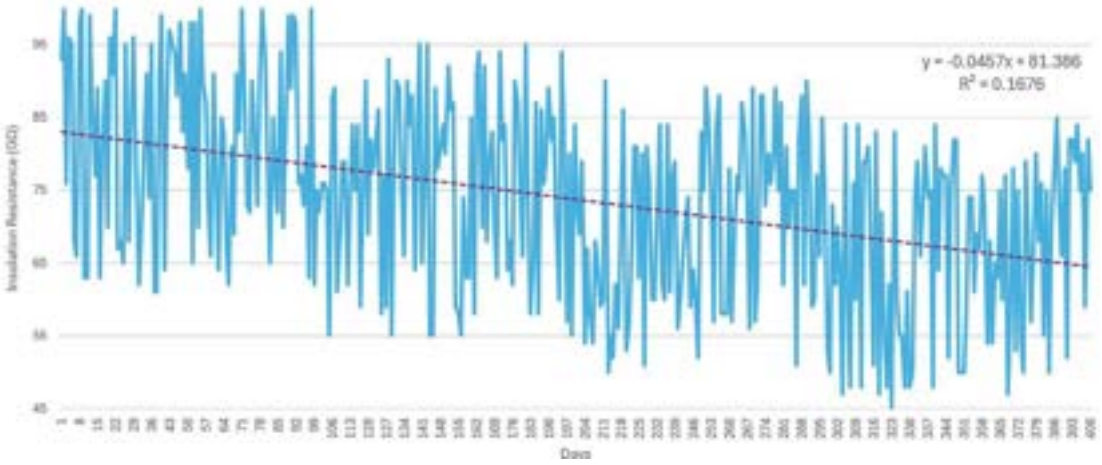

Figure 2: *Insulation Resistance across 400 Days*

insulation resistance test on an asset every day for 400 days, your data set could look something like Figure 2.

The range of this large data set is 55 GΩ. The standard deviation is 13.85 GΩ. This means, on average, the data diverges from the mean by about 13.85GΩ. Suppose a utility followed an annual maintenance regime (daily is impractical) and conducted insulation resistance tests on day 22 and day 387 (365 days apart) of the graph. As shown, the insulation resistance was 72 GΩ on day 22 and 80 GΩ on day 387. This small data set would give the utility the impression that the insulation resistance of the asset was holding steady.

However, a large data set of values captured daily would suggest the opposite, that the insulation resistance is steadily decreasing. The small data set (72 GΩ and 80 GΩ) wouldn't prompt any interventions from the asset owner. By contrast, the large data set might convince the utility to investigate. This is why trending data based on annual testing may not be effective for identifying equipment deterioration.

Dispersion, which is defined as the extent to which numerical data is likely to vary around an average value, also applies to other diagnostics. I once ran power factor tests on an SF6 circuit breaker for a customer who was insistent on not getting negative values. Negative power factors are common on UST mode with SF6 breakers, and power factor is a dubious parameter for very-low-capacitance assets. Catering to this customer meant running perhaps a dozen ungrounded specimen tests per breaker. This produced a dozen distinct test results, some positive, some negative, with a considerable standard deviation.

On-Line Assessments

On-line assessments — those made while assets remain energized — can fill in the data gap that plagues off-line assessments. Because on-line assessments do not require outages, they can be made with far higher frequency. And since they can be made with a higher frequency, they can gather the data to intercept defects that off-line assessments may take too long to notice. Let's view some on-line assessments of SF6 circuit breakers as examples.

Visual Inspection

The most basic on-line assessment for an SF6 unit is visual inspection, and perhaps nothing is more important during a visual inspection than checking the pressure gauge. Figure 3 shows an SF6 pressure gauge of an energized 121-kV circuit breaker, with the needle sitting at around 15 psig, well below the minimum acceptable pressure of 57 psig according to the data plate.

No alarm or lockout functions asserted, as should have been the case. I discovered this during downtime at a substation while working on a completely different circuit breaker. Lest

Figure 3: *SF6 Pressure Gauge Reading on an Energized 121-kV Circuit Breaker*

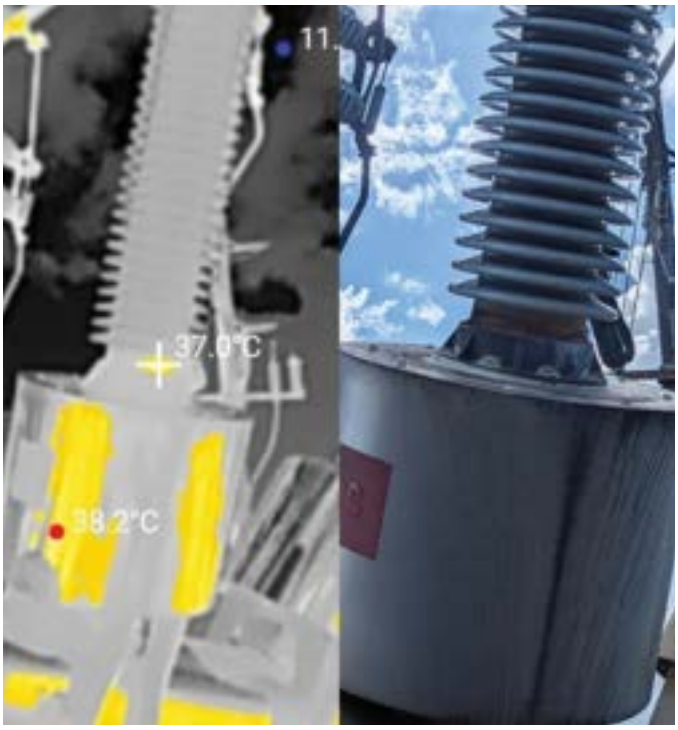

Figure 4: *Thermogram (left) and Visual Image (right) Showing Possible Partial Discharge on a 121-kV SF6 Breaker Bushing*

anyone think that the gauge malfunctioned, when the breaker was repressurized, the needle climbed back to the green line just past 70 psig. Had the gas density reached breakdown voltage, a ground fault would have ensued and likely destroyed the unit. I've developed the habit of checking every pressure gauge in substations, provided I have the time.

Infrared Thermography

Infrared thermography is my favorite tool due to its wide applicability and accessibility. A wide range of defects developing unbeknownst to asset owners can be discovered during an infrared survey, including an anomaly I discovered in the same substation as the low gas pressure incident. Figure 4 shows a thermogram as well as a visible image of what appears to be partial discharge occurring at the camera crosshairs just above the flange and just below the last insulator skirt of a 121-kV SF6 breaker bushing.

Partial discharge like this is typically detected via acoustic or ultraviolet cameras, but the heat from mature partial discharge can be detected with an infrared camera.

Figure 5: *Zoomed-In Visible Image of Hotspot*

Figure 5 is a zoomed-in visible image of the hotspot. Notice the damage incurred by the weather sealant/cement used where the porcelain of the bushing meets the metal of the flange. This is a common location for contamination and a source of measurement distortion for off-line testing.

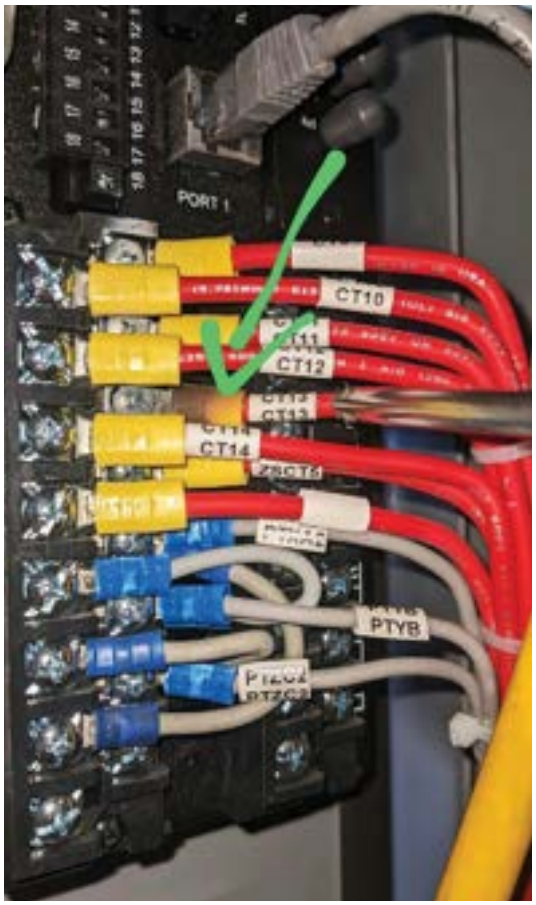

Figure 6: *Overheating and Thermal damage at a CT Wiring Terminal*
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Figure 7: *Results of SF6 Gas Analysis Showing Elevated Sulfur Dioxide*

While the exterior of a transmission or distribution breaker serves as a perfect candidate for an infrared scan, we must not forget the interior, including the breaker control cabinet. Figure 6 illustrates clear overheating and thermal damage at a CT wiring terminal. While this anomaly was discovered via a visual inspection, it would have appeared even more conspicuously on an infrared survey.

Gas Analysis

Lastly, gas analysis is a valuable on-line assessment that can be done on energized breakers, provided the manufacturer permits. Figure 7 shows the results of an SF6 analysis I conducted several months ago. Note the elevated sulfur dioxide content. Sulfur dioxide is a decomposition byproduct of SF6 in the presence of electric arcing; thus, it can be used to assess the integrity of a breaker after it has interrupted fault current, instead of waiting until the next maintenance period. In the absence of the manufacturer's literature, SF6 results should be graded in accordance with ANSI/NETA MTS, Standard for Maintenance Testing Specifications for Electrical Power Equipment and Systems, Table 100.13.

CONCLUSION

Nothing written here is meant to disparage or discourage off-line assessments. Some tests simply cannot be done while assets are energized. However, just like the decision to surgically remove a cancerous tumor might be informed by a monitoring tool such as a mammogram, the decision to recondition transformer oil or replace SF6 tank components might be informed by a monitoring tool like fluid analysis.

On-line assessments (literally) fill in maintenance time gaps and help mitigate the issue of data dispersion that off-line assessments suffer from. And as our on-line assessments become more sensitive and investigate more asset domains, potentially fatal defects will be detected faster, making interventions cheaper and improving safety. NW

REFERENCES

[1] Blann, Dale R. "Maximizing the P-F Interval through Condition-Based Maintenance." *Maintworld*. July 10, 2013.

[2] Murray, Adam. (n.d.). "Thermal Damage at CT Wiring Terminal."

Michael Labeit *is a Prime Power Production Specialist, Lineman, a Power Systems Technician for RESA Power, and a NETA Level 3 Technician in the 249th Engineer Battalion, U.S. Army Corps of Engineers. He has operated and maintained medium-voltage power plants in Turkey and Saudi Arabia as well as at Ft. Leonard Wood, Missouri, and Ft. Bragg, North Carolina. Labeit graduated from Prime Power School in 2018 and has an AAS from Excelsior College.*

THE-DOs AND DON'Ts OF ELECTRICAL EQUIPMENT LUBRICATION

BY PAUL CHAMBERLAIN, *Asplundh Engineering Services, LLC*

Switching devices must be adequately lubricated so they operate smoothly and efficiently as designed. This helps ensure a safe environment for employees working with, on, or near the equipment. Many things must be taken into consideration when selecting a lubricant for electrical equipment. Let's take a look at some of those factors.

First, the correct type of lubricant must be used. Review the manufacturer's service manuals, bulletins, and safety data sheets (SDSs) to obtain and use the proper lubricant and apply it to the proper locations. If the lubricant is being applied to electrical parts and equipment that will be energized, it must be appropriately rated for that use.

Will the lubricant be applied manually, such as by using a brush, or sprayed on via an aerosol can or pump sprayer? Common commercial lubricants can be purchased in bulk form for use in a pump sprayer or an aerosol can. Review the service manual and confirm the design and configuration of the equipment being serviced to determine which application method is best.

FLAMMABILITY

If either the material or the propellant is flammable, it cannot be used in an area where heat or a potential arc could ignite it. Review the lubricant's SDS to determine its flash point. Avoid materials that contain the words "flammable" or "keep away from heat or flames," feature the Globally Harmonized System (GHS) pictogram (Figure 1) on the label, or contain a propane propellant. These materials typically have a lower explosive limit (LEL), indicating that they will readily ignite in the presence of heat or spark.

Figure 1: *Flammable Label*

PHOTO: © WWW.SHUTTERSTOCK.COM/G/KHOZINULASR

STORAGE

Once the correct lubricant for the application has been determined, estimate how much of it will be purchased and stored for future use. The quantity of equipment to be serviced determines the amount of materials needed, and lubricant shelf life and flammable storage limitations must also be considered. Review local and federal fire codes and the SDS for the chemical to determine how much can be safely stored on site. Depending on the chemical's properties, it may or may not be considered a hazardous or flammable material that requires special storage containment and notification to the local emergency planning commission.

Most petrocarbon-derived chemicals have a shelf life, after which time their effectiveness in lubrication breaks down. If the servicing is done infrequently or in small quantities, it does not make sense to have a large quantity of the lubricant sitting on the shelf for an extended period. Review the SDS to determine shelf life.

If service is performed frequently, or on a large number of similar components, storing hundreds of small aerosol spray cans does not make sense. It may require special storage and disposal considerations, such as a flammable cabinet, due to propane in the aerosol or as the propellant, causing the material to be listed as flammable. In this situation, it may be better to purchase the material in bulk, such as in a 55-gallon container, and use other means to apply it, such as small pump sprayers. This eliminates the propane propellant.

DISPOSAL

The environmental impact of disposing of the chemical should also be considered. Refer to the SDS to identify the environmental impacts of an accidental release. If the substance could

16. Other information, including date of preparation or last revision

Issue date	01-16-2015	**HMIS® ratings**	Health: 2* Flammability: 4 Physical hazard: 0 Personal protection: B
Revision date	06-12-2017		
Prepared by	Allison Yoon		
Version #	02	**NFPA ratings**	Health: 2 Flammability: 4 Instability: 0
Further information	CRC # 568F/G		

Figure 2: *HMIS Label for White Lithium Aerosol Spray Lubricant*

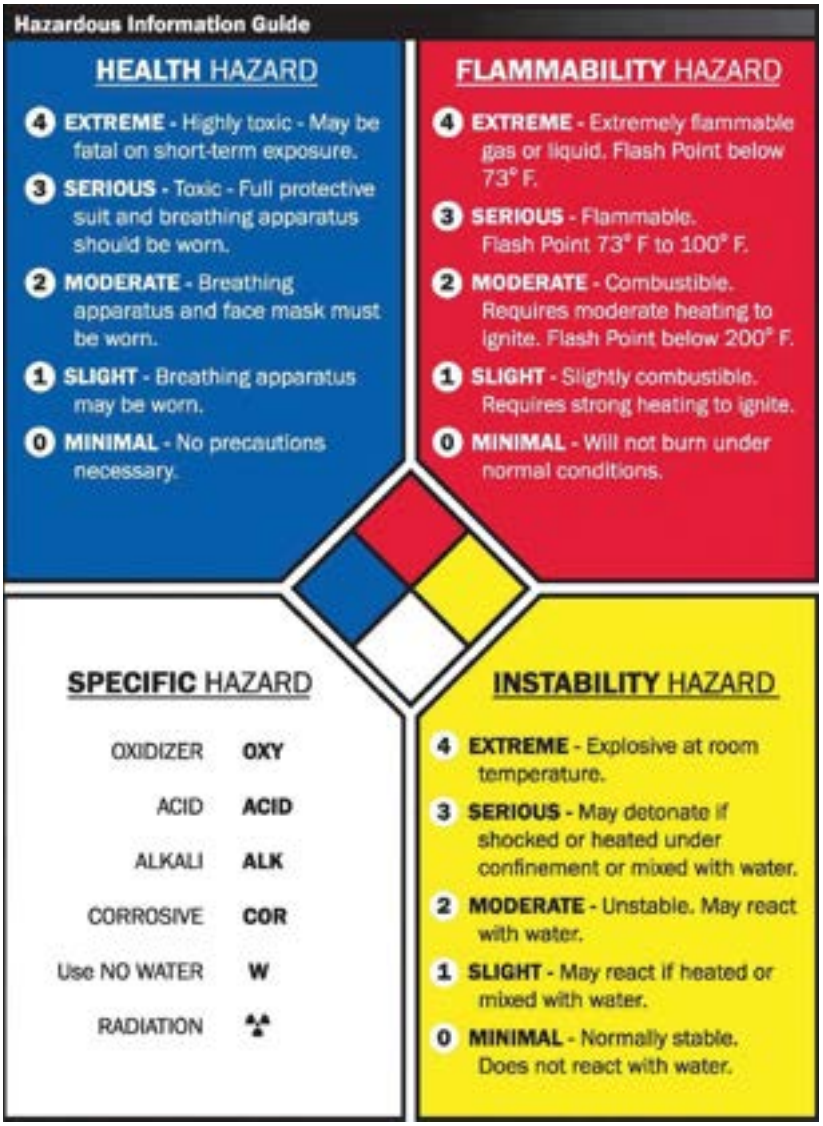

Figure 3: *Sample NFPA Hazard Rating Label*

pose an environmental hazard upon release, employees must be trained on spill-response procedures for that chemical.

Disposal of lubricant waste can also pose an environmental risk. State and federal agencies such as the Department of Environmental Protection (DEP), the Environmental Protection Agency (EPA), and the Department of Environmental Management (DEM) may require notification when disposing of certain quantities of chemical wastes. There may also be time limitations on the storage of regulated waste chemicals based on certain quantities. Additionally, waste generators, shippers, and disposers are required to obtain certifications and track the shipment of the chemical from cradle to grave.

SAFE HANDLING

Before using any lubricant, check its health effects, flammability, and reactivity. This can sometimes be done by referencing the label, but referencing the SDS is best.

Employee health is a factor when considering an appropriate lubricant. What personal protective equipment (PPE) must the employee wear to apply the lubricant according to the SDS? The technician or electrician may need nitrile gloves and safety glasses or goggles to handle the chemical safely. If the equipment being serviced is enclosed within a cabinet with limited ventilation, fumes and vapors released from using the lubricant can accumulate and possibly overwhelm the employee. This author was involved in an OSHA investigation due to

this exact scenario. Always ensure additional ventilation or respiratory protection is provided if required by the SDS. It is important to determine whether the fumes generated from the chemical are denser than air. Dense fumes can collect in low-lying areas and cause a flammable or health-hazardous atmosphere.

The Hazardous Materials Information System® (HMIS®) is commonly used to determine the hazard level of a chemical. Figure 2 shows the HMIS and NFPA data for a common white lithium aerosol spray lubricant.

Figure 3 shows that this lubricant has very similar ratings under NFPA and HMIS. To understand what those ratings mean, review the detailed rating levels.

Comparing the white lithium grease's SDS and label and cross-referencing it to the NFPA label shows that the grease has a flash point of less than 73°F and is considered "moderately hazardous" on the health scale. Therefore, this material should not be exposed to an open flame or spark. Additionally, the material has a high enough health rating to warrant concern. By taking proper precautions while using the grease, such as wearing protective gloves (i.e., nitrile), not concentrating and breathing the fumes, and ensuring that it is not exposed directly to open flame, the material is safe enough to use in most cases. Finally, this spray has a propane propellant, so if the material is non-aerosol, the flammability of the material is most likely significantly decreased. If this material is to be used in an area where the possibility of flames or sparks exists, a non-aerosol version would be recommended.

SUMMARY

There are many factors to consider when determining what type of lubricant to use. Most of this information can be quickly obtained from the SDS or label on the chemical container. The SDS for any chemical your company uses must be available to all

employees when they are on duty and kept updated per OSHA 29 CFR 1910.1200, *Hazard Communication.*

Before using a lubricant, review the SDS and label to determine whether the product will be safe for the intended use, what safety precautions may be needed, and which PPE may be required. Review this information with all employees utilizing this chemical to ensure they understand the hazards of its use and how to properly interpret the label and SDS. NW

REFERENCES

[1] American Coatings Association. Hazardous Materials Information System®.

[2] Globally Harmonized System of Classification and Labelling of Chemicals.

[3] OSHA 29 CFR 1910.1200, *Hazard Communication.*

[4] NFPA. NFPA 704–2022, *Standard System for the Identification of the Hazards of Materials for Emergency Response.*

Paul Chamberlain *has been the Safety Manager for Asplundh Electrical Testing, LLC (formerly American Electrical Testing Co., LLC), a subsidiary of Asplundh Engineering Services, LLC since 2009. He has been in the safety field since 1998, working for various companies and industries. Chamberlain received a BS from the Massachusetts Maritime Academy.*

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No. 149

WORKFORCE DEVELOPMENT

BY MORGAN GIENI, *Magna IV Engineering*

Employers must ensure that competent and qualified workers complete electrical work. Focusing on work development is a key part of ensuring your organization meets the qualification requirements. NETA's Electrical Testing Technician (ETT) certification program helps companies gauge the competency of their electrical workers.

1. How many levels of technician certification does NETA define?
   a. Three
   b. Four
   c. Five
   d. Six

2. Which of the following prerequisites would be typically required to become a NETA Level 1 Trainee Technician?
   a. There are no prerequisites for NETA Level 1 candidates.
   b. High school diploma / equivalent
   c. College degree/equivalent
   d. Technical field experience

3. How many years of field experience are required to become a Level 4 Certified Senior Technician?
   a. Four years
   b. Five years
   c. Seven years
   d. Ten years

4. After gaining the required field experience, which requirement permits technicians to advance to the next NETA technician level?
   a. Passing a technical examination
   b. Hands-on field demonstrations
   c. A list of work references
   d. A NETA-directed phone interview

5. NETA utilizes which of the following to validate level advancement?
   a. Signed affidavit
   b. Certifying body
   c. Company representatives
   d. Proctored examinations

6. Which NETA technician level permits someone to work on moderately complex tasks and be responsible for the safety of others?
   a. Level 1 Trainee Technician
   b. Level 2 Certified Assistant Technician
   c. Level 3 Certified Technician
   d. Level 4 Certified Senior Technician

7. If someone is not performing electrical work, when will their NETA certification level expire?
   a. Two years
   b. Three years
   c. Four years
   d. Five years

8. Completing which of the following activities can earn an approved NETA CTD (Continuing Technical Development) credit?
   a. Self-directed learning
   b. Delivering an approved electrical course
   c. Peer–peer mentoring
   d. Attending an approved course NW

See answers on page 130.

***Morgan Gieni, CET, PSE**, is the Technical Support Lead — Technical Field Services (TFS) at Magna IV Engineering. He is a Certified Engineering Technologist through ASET — The Association of Science & Engineering Technology Professionals of Alberta and a Power System Electrician. Gieni has extensive knowledge and experience regarding the commissioning, repair, and maintenance of electrical power systems equipment. He has spent the past few years of his career building technical training programs, providing technical support, and mentoring field service employees. Gieni holds NETA Level IV Senior Technician Certification and is on NETA's Technical Resource Committee.*

SOIL RESISTIVITY TESTING GONE WRONG

BY LEE HOWARD, *Hood Patterson & Dewar, Inc.*

Soil — most think, "Hey, it's just dirt," but when it comes to electricity, soil becomes more complex. Electrical resistivity (resistance to current flow) is one characteristic of soil that requires specific knowledge regarding testing and application in grounding system design.

Soil is made up of combinations of clay, sand, loam, and various types of rocks. These components have differing amounts of electrical resistivity, and the soil composition varies significantly throughout the United States.

Soil resistivity testing and the resulting measurements are the foundation of designing an effective grounding system. A properly designed and installed ground grid will be able to carry fault or lightning current safely without damaging equipment or injuring personnel. The industry standard for soil resistivity testing is IEEE Std. 81, *Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Grounding System.*

Several methods of soil testing can be employed before the design and construction of a new site, including:

1. **Soil borings**. These are typically used for structural/engineering purposes and create a soil disturbance. They are typically not taken deep enough to use for soil resistivity results and are not considered reliable for ground grid design.
2. **Three-point/driven rod**. This measures a small volume of soil around a driven rod. It requires long rods, creates a soil disturbance, and is not very practical or reliable for soil resistivity results.
3. **Four-point/Schlumberger.** This measures a large volume of undisturbed soil using equally spaced test probes. While the results can be useful, this method is more commonly used in the oil and gas industry, as it is able to identify vertical shelves.
4. **Four-point/Wenner**. This is the most commonly specified test method for acquiring soil resistivity data. Like Schlumberger, it also measures a large volume of undisturbed soil by taking readings at prescribed test probe spacings that indicate, when plotted against probe spacing width, whether there are distinct layers of soil or rock, and gives an idea of their respective resistivities and depth.

Unfortunately, many testing firms are not familiar with IEEE Std. 81 and the common

Soil is typically made up of layers and is not homogeneous.

pitfalls of soil resistivity testing. Successful test requirements include:

1. Avoid interference from nearby structures, which can affect results.
   a. Active interferences, including parallel transmission/distribution lines, communication circuits, and stray DC currents
   b. Passive interferences, such as metallic fences, tower grounds, pole grounds, building foundations, buried conductive objects, metallic pipes, and sidewalks with rebar
2. Be aware of shock potential from induced voltage on test leads.
3. Research the recent and long-term weather conditions, including drought, flooding, or temperature fluctuations
4. Familiarize yourself with the site by studying Google Earth and planning your traverses before arriving on site. Actual site conditions will dictate traverse options.
5. Arrange for locating services **before** testing, if required by the client.
6. Acquire permission to access private property, if required.
7. Be aware of extremely dry or high resistivity (sandy or rocky) soil that may require:
   a. Extra probes at each probe location
      i. We've used up to four 4-foot probes in a single location to increase current flow and reduce probe resistance.
   b. Longer probes (2 feet typically, may need 4+ feet)
   c. Add water/salt to reduce the probe-to-soil resistance and increase current flow.
      i. Specifications frequently say this is not allowed, but it is often necessary to achieve enough current flow for successful testing.
      ii. This is included/recommended in IEEE Std. 81 6.2

Soil resistivity testing requires sturdy, conductive probes.

Case Studies

These case studies outline common mistakes made in soil resistivity testing. Review them to learn about the recommended best practices.

This company hired a testing firm that measured one traverse with a 50-foot maximum spacing (Figure 1). This is not enough data to ensure correct values and good design data. They should have done a minimum of two traverses. Many clients require two sets of perpendicular intersecting traverses (a total of four traverses). Additionally, depending on the site's size (which was not documented in the report), larger spacings may be required. Pay attention!

Example 1: Not Enough Data

FIELD ELECTRICAL RESISTIVITY WENNER FOUR-ELECTRODE METHOD

PROJECT NAME: Substation and Switch Station
TEST LOCATION: ER-1
DATE:
TECHNICIAN:
INSTRUMENT USED: Megger DET2/2
ELECTRIC POTENTIAL: 50 Volts

TEST NO.	ELECTRODE SPACING (FEET)	RAW METER READING (Ω)	CALCULATED EARTH RESISTIVITY (Ω = CM)
1	1	527	100,921
2	2	167.0	63,961
3	4	55.8	42,743
4	8	9.17	14,048
5	15	2.20	6,320
6	25	1.447	6,928
7	50	0.569	5,448

Figure 1: *This test result does not provide enough data to ensure good design.*

On this test form, the calculated soil resistivity value is in Ohm-centimeters, while results are typically reported in Ohm-meters. The Mars Climate Orbiter burned up in the Martian atmosphere due to a navigation error caused by a unit conversion mistake between different teams involved in the mission. Always verify that the measured or reported units are reasonable. If they are not, the data may not be trustworthy until corrected.

Example 2: Wrong Test Location

Figure 2: *Test results indicated the presence of conductive items in the soil.*

Another testing firm measured three traverses inside an existing plant area (Figure 2). Based on satellite imagery, the location of the testing and the previous structures implied that utilities were still buried in the area. The soil resistivity measurements appeared to show non-conforming data and lower than expected results for the area, likely due to conductive items in the soil where the testing was performed. Any metallic items, grounding and bonding conductors, or concrete pads will have a negative/false effect on the measured resistivity of the soil. Any fencing in the general location may also have influenced the readings. We recommended retesting away from the site.

Another firm performed testing next to the site and along the fences (Figure 3). While it may seem ideal to test the soil as close to the site as possible, best practice involves avoiding testing parallel to transmission and distribution lines, as well as over pipelines or other underground utilities. We recommended the client use Google Earth and site observations and retest in locations away from buried and grounded metallic equipment.

Example 3: Location Challenge

Figure 3: *Testing should be done away from buried and grounded metallic equipment.*

An existing data center planned a new building next door in place of an existing parking lot, and the electric utility required soil resistivity measurements (Figure 4). The closest suitable area for measurements (red arrow) was ½ mile away – not ideal, but the best that the site location and conditions would allow. Testing site access can have unique circumstances. In this case, the owner of the testing site, a mental health facility, had patient safety concerns regarding the injected current on their property. After careful explanation of our testing process, we were granted access. Be prepared to explain to a site owner what you are doing, especially when accessing private property.

A densely developed college campus required soil resistivity data to design a new, dedicated grounding system for lab test equipment (Figure 5). The area next to the lab was heavily wooded and included underground utilities. Measurements taken in this area were inconsistent, making the data unreliable. The closest suitable location was a ½ mile away, where two diagonal traverses were measured with 100-foot spacings. In urban and suburban areas, athletic fields, golf courses, and parks are tempting measurement sites. While these may

Example 4: Access Challenge

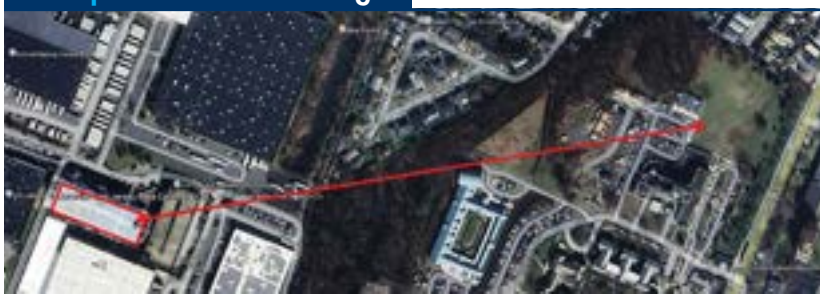

Figure 4: *The closest suitable area for measurement was a half-mile away.*

Example 5: Density Challenge

Figure 5: *Results can be influenced by underground utilities and buried objects.*

be the best or only nearby options, watch out for buried irrigation systems, lighting circuits, and other underground objects that may influence results.

BEST PRACTICES

Plan ahead!

1. Know the client specifications and IEEE Std. 81 requirements.
2. Know your equipment and the test process. We have seen competent individuals use a meter incorrectly.
3. Identify traverse lengths/locations with Google Earth. When on site, adjustments may be necessary.
   a. Never perform only one traverse. Multiple traverses help confirm that the data is correct and identify any outlying or suspect data points.
4. Pay attention to the soil type around the site through internet search, on-site observations, and a Geotech report, if available.
5. Research the recent and long-term weather data for the area. Be aware if the area has experienced a drought or a recent flood.
6. Request access to private property sites and "call-before-you-dig" markings if required.
7. Never leave the site without calculating and plotting the soil resistivity values. This provides a clearer understanding of what's happening. If two traverses in the same area are drastically different, find another test location and attempt another traverse or two to validate the results.
8. Include all of this information in your report. Make sure to provide a marked-up Google Earth map showing where you measured your traverses.

CONCLUSION

Achieving outstanding results in soil resistivity testing requires prioritizing comprehensive knowledge, thorough research, and meticulous planning. These elements will lay the foundation for your success. NW

Lee Howard *is a senior grounding specialist with Hood Patterson & Dewar, Inc. With more than 25 years of experience, Howard specializes in the design and analysis of grounding, lightning protection, and surge suppression systems. He speaks at various industry conferences and offers grounding testing and consulting services to a wide range of domestic and international clients, including electrical utility, industrial, and commercial sites. Howard holds two patents in grounding and lightning protection products. He earned a BS in electronics engineering technology at DeVry University and a Power Systems Certificate from the Georgia Institute of Technology.*

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NETA APPRENTICESHIP: WHAT IT MEANS TO YOU

BY STEVE NEWTON, *Integrated Power Services*

Before NETA was established in 1972, electrical testing in the U.S. was fragmented, inconsistent, and largely unregulated, with significant variation in practices depending on region, company, or manufacturer. Various types of companies accomplished the testing.

WHO PERFORMED ELECTRICAL TESTING BEFORE NETA?

Before NETA, consistent test procedures or pass/fail criteria across different projects, companies, and equipment did not exist. Inadequate or skipped testing increased the risk of electrical failures, arc flash incidents, and fires, and test results were often informal or incomplete, making future troubleshooting and evaluation of the equipment difficult.

Technicians often learned on the job with no formal certification or career path. Testing was done by installers or manufacturers rather than independent, unbiased contractors or testing companies.

Electrical contractors often performed limited testing right after equipment was installed. Their focus was primarily on verifying that systems turned on and did not fail immediately, not long-term reliability or performance.

Some manufacturers tested their products during and after installation (factory and field tests). However, that created a conflict of interest. Testing done by the same people who supplied the equipment lacked true independence.

Large industrial facilities, utilities, and government institutions often had their own maintenance departments. These technicians had varying levels of training and may not have followed national standards. On occasion, engineering firms might supervise or write specifications for testing, but did not always have field expertise or staff to do hands-on work.

NETA STANDARDIZED FIELD TESTING

NETA introduced a third-party, competency-based approach by standardizing field testing procedures across the industry, developing certification for technicians, creating auditable documentation and traceability, and encouraging preventive maintenance practices, not just post-installation checks.

NETA was founded 50-plus years ago as a non-profit association with the vision to standardize electrical testing practices in the United States. Its founding members included independent electrical testing companies who recognized

PHOTO COURTESY AVO TRAINING INSTITUTE

the need for uniform procedures and standards for acceptance and maintenance testing of electrical power systems and equipment. The goal was to create a third-party standard independent of manufacturers, installers, or owners — a standard focused solely on safety, reliability, and performance.

NETA APPRENTICESHIP PROGRAM

After more than 50 years, NETA has taken the next step as an industry leader, introducing its U.S. Department of Labor-approved Electrical Testing Technician Apprenticeship Program. By creating a standardized apprenticeship program with training and testing specifications, NETA can now offer NETA members and the industry a curriculum that will help build an experienced and reliable technical workforce.

In today's energy-driven world, reliable and safe electrical systems are more crucial than ever. From industrial facilities and data centers to hospitals and utility grids, the integrity of electrical infrastructure directly affects productivity, safety, and economic performance. At the heart of ensuring this integrity are electrical testing professionals — specialists trained to inspect, evaluate, and maintain complex electrical systems. As the demand for highly skilled technicians grows and the workforce ages, apprenticeship programs in electrical testing have become essential for preparing the next generation of professionals.

The electrical testing industry is highly technical and governed by national standards and specifications including those from the InterNational Electrical Testing Association (NETA), the National Fire Protection Association (NFPA), and the Institute of Electrical and Electronics Engineers (IEEE). These standards demand dedication, up-to-date knowledge, and hands-on competence.

Yet, many employers face a shortage of skilled workers who can perform this work safely and effectively. Traditional classroom education alone is insufficient to prepare technicians for

the wide range of real-world scenarios they will encounter in the field. Apprenticeship programs solve this problem, offering a structured blend of classroom instruction and practical, on-the-job experience under the guidance of experienced technicians.

BUILDING A ROBUST WORKFORCE

Electrical testing involves high-voltage systems, critical safety procedures, and complex diagnostic tools. Apprenticeships provide the only practical way for aspiring technicians to safely build proficiency with this equipment and understand how to interpret test results in live environments. From insulation resistance testing to relay calibration and transformer diagnostics, these skills cannot be fully mastered without time in the field. Apprenticeships also emphasize troubleshooting, problem-solving, and adherence to safety protocols — all vital components of electrical testing work.

Organizations like NETA have helped professionalize the electrical testing industry by establishing clear qualifications and certification pathways, as specified in ANSI/NETA ETT–2022, *Standard for Electrical Testing Technicians.* Many apprenticeship programs align with these standards, creating a pipeline of technicians who are ready to pursue certification as a NETA Level 1 Trainee Technician and beyond. Structured apprenticeships not only prepare individuals for these certifications but also support long-term professional growth. As apprentices progress, they can become senior field engineers, safety managers, or technical consultants — careers that require the foundational knowledge and discipline only an apprenticeship can provide.

For companies in the electrical testing industry, apprenticeships represent a sustainable investment in their workforce. Hiring pre-trained workers from outside the industry is often difficult, expensive, and risky due to the specialized nature of the work. By developing in-house apprenticeship programs, companies can train new hires in their specific procedures, safety culture, and equipment while retaining institutional knowledge. Apprentices are more likely to stay with the company that trained them, reducing turnover and promoting a strong internal talent pipeline.

Electrical testing apprenticeships offer an alternative career path to individuals who may not pursue a traditional four-year degree. With competitive wages, clear advancement tracks, and nationwide demand, these programs offer excellent opportunities for young professionals, veterans, and those seeking career changes. Apprentices earn while they learn, gaining valuable experience without incurring student debt. This opens doors to a rewarding technical career that blends fieldwork, critical thinking, and hands-on skill.

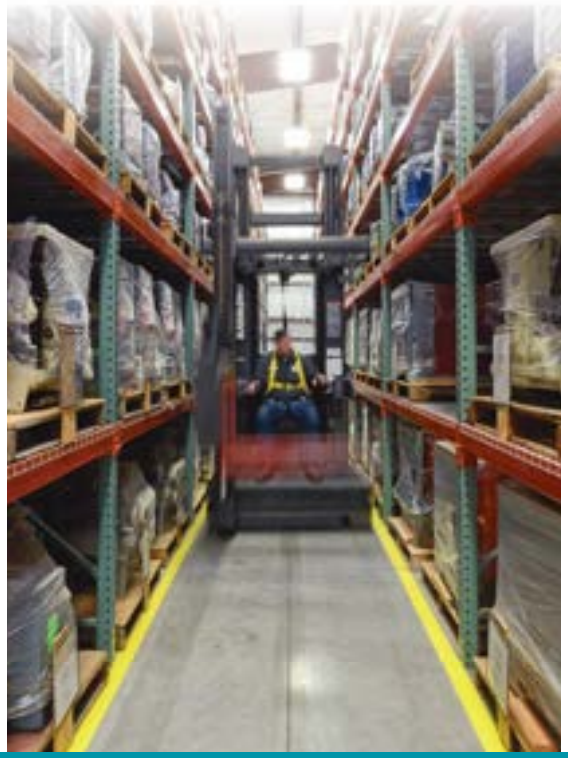
CONCLUSION

Apprenticeships in electrical testing are vital for developing a qualified workforce capable of maintaining and verifying the integrity of critical electrical infrastructure. These programs ensure that technicians are not only trained to industry standards but are also prepared to handle the real-world complexities of their trade.

In a high-risk, high-demand industry like electrical testing, the apprenticeship model is more than important — it is essential. Investing in these programs benefits individuals, employers, and the broader economy by securing the future of electrical safety, reliability, and performance. NW

Steve Newton, SET, *is the National Training Center Training Program Manager at Integrated Power Services (formerly National Field Service). He is a subject matter expert for the National Institute for Certification in Engineering Technologies (NICET), a certified National Center for Construction Education and Research (NCCER) Instructor, a Master Trainer for the Instructor Certification Training Program, and a Level 4 NETA Certified Senior Technician in electrical power testing. In addition to his duties at IPS, Newton is a certified instructor for electrical, instrumentation, electronic, solar, and various power curricula, holds several professional memberships including IEEE and NFPA, and is actively involved in reviewing and developing training and procedural materials for the electrical industry. He received NETA's 2023 Outstanding Achievement Award for his exceptional service on the CTD Review and Training Committees.*

CAN'T AFFORD TO WAIT FOR ELECTRICAL EQUIPMENT?



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REFRAMING THE ENERGY WORKFORCE CRISIS: A CALL TO ACTION

BY MORTEZA TALEBI, PhD, *PowerX*

The electric power sector's workforce is older than that of most industries and is grappling with a crisis that has been building for over a decade and has now reached a critical point.

UNFOLDING CRISIS IN THE ENERGY WORKFORCE

An aging workforce, combined with surging energy demand driven by EV charging infrastructure, massive data center growth, the expansion of renewable energy projects, and rapid technological change, has left the sector facing unprecedented talent gaps. A looming silver tsunami of retirements over the next decade threatens to drain organizations of vital field experience and technical know-how.

At the same time, non-retirement turnover has spiked to record levels, compounding the labor shortage as younger employees leave at higher rates. Front-line experts in operational and maintenance and testing and commissioning — often the guardians of system reliability and safety — are walking out the door with specialized skills that cannot be quickly replaced.

Table 1 shows the recent turnover rates among utility field employees, highlighting the increase in non-retirement departures and the higher exit rates among younger workers.

Compounding this challenge is the lack of ready replacements in the pipeline. Based on the author's direct industry experience, only a handful of academic institutions in the United States offer programs specifically designed to train the next generation of electrical technicians and frontline energy workers. This is not just an educational gap — it is a systemic failure in workforce development. Traditional college programs aren't producing enough graduates with the specialized skills electric power jobs require. As a result, companies find themselves competing fiercely for a small pool of qualified technicians to meet basic project staffing needs. Despite early warnings and

Table 1: *Turnover Trends in the Energy Sector*[1,2,3]

Trend	Evidence/Rate	Notes
Non-retirement turnover (2022)	7%+	Highest since tracking began
Turnover among ages 23-37	60% of non-retirement attrition	Younger employees leaving at higher rates
Distributed generation turnover (2024)	27.8%	Highest among energy segments
Gen Z share of workforce (2022)	9%	Up from 1.5% in 2021

some progress with educators, dedicated energy workforce training programs remain far too few to meet growing demand.

THE GAP IN TRAINING AND EDUCATION

The shortage of formal training avenues for energy trades is stark. Many critical frontline roles — lineworkers, substation electricians, power plant operators, and apparatus and relay technicians — have historically relied on on-the-job training or apprenticeship programs rather than academic degrees. While these pathways are effective, they cannot scale fast enough to meet growing workforce demands without stronger industry support and investment. This means aspiring power utility and company workers often have limited options: a handful of community college programs focused on utility work, military training pipelines, or seeking an apprenticeship slot.

At the same time, college programs are not producing enough job-ready graduates in electrical power disciplines. This leaves utilities and contractors with two options: Hire from an existing limited labor market or build talent through internal training programs. Often, they must do both, as demand for skilled young technicians far outstrips supply, leading to bidding wars for talent.

A deeper concern is the persistent gap between what academia teaches and what the energy industry actually needs. Many degree programs focus heavily on theory, offering little in the way of hands-on, applied learning and practical training. This leaves graduates unprepared for critical tasks like grid operations and commissioning — skills that are essential for safety and reliability in the field. As a result, even the most well-meaning academic

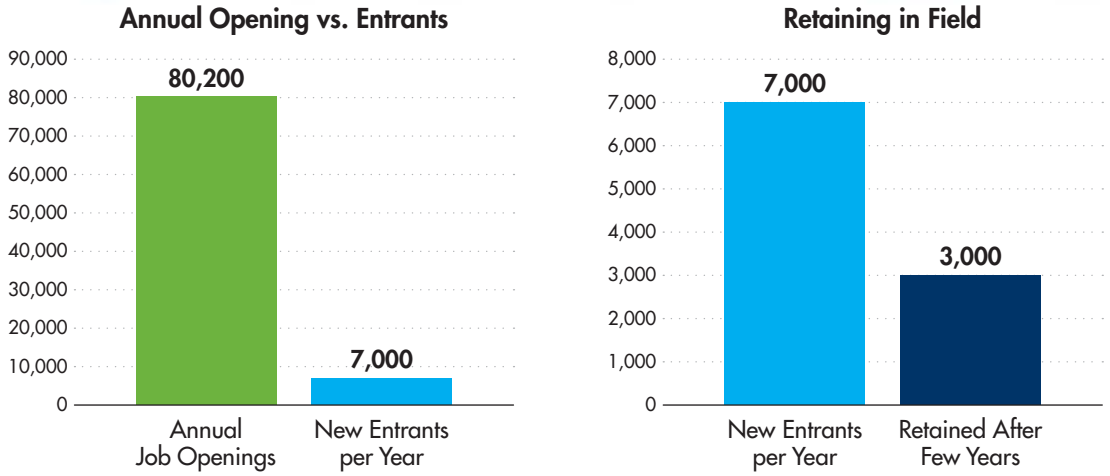

Figure 1: *Training and Retention Gap in the U.S. Electrical Workforce Pipeline*[4,5,6]

programs often fall short, forcing employers to invest significant time, effort, and financial resources to bring new hires up to the required level of job readiness.

The shortage of training programs is a long-standing issue. As early as 2009, IEEE warned that workforce aging and lack of new entrants threatened grid reliability. The problem that has only worsened as technical demands grow, while efforts by the Department of Energy and the Electric Power Research Institute (EPRI), though helpful, remain limited in scale. The reality is that most young people entering the energy trades today are not coming from university programs tailored to our industry. It is a glaring blind spot in our national workforce strategy for energy, and one that requires urgent attention from both educational institutions and industry leaders. Figure 1 shows the sharp workforce gap, from openings to retention, highlighting critical shortages and underrepresentation in the U.S. electrical trades.

SHORT-TERM METRICS VS. LONG-TERM RELIABILITY

One thing must change above all else: the mindset of industry leadership. The fundamental challenge is not awareness. Executives across the energy sector are by now acutely aware of workforce demographics and the looming skills gap. They have seen the internal HR data on retirement eligibility, read the trade press headlines about the "critical workforce shortage," and struggled with delays in hiring qualified personnel.

Yet too many leaders remain paralyzed by short-term financial metrics, pressured to deliver quarterly profits and keep O&M costs low. Investing in training and human capital gets relegated to the back burner, viewed as a cost center rather than a core business imperative. HR reports note that training budgets are often the first to be cut during tough times, as their value and ROI are hard to quantify, making it easy for organization to view them as expendable costs, even though the real benefits, like improved safety and productivity, may not be immediately visible.

This short-term thinking is deeply rooted and requires courageous leadership to overcome. So why does it persist? Consider a few key barriers:

- **Immediate cost vs. delayed payoff.** Developing high-quality training programs is expensive upfront. The returns (fewer errors, higher efficiency, and talent retention) accrue over years and are hard to tie to a specific line item in the ledger.
- **Intangible ROI.** It is difficult to quantify the return on investment for training in the same straightforward way one might calculate ROI for a new

piece of equipment or project, leading many to view it as a cost to cut rather than a long-term investment.

- **Workforce mobility.** There is a lingering fear that if we pay to train an employee, they might take those skills to a competitor. But responding by not training anyone is a self-defeating strategy that only worsens the industry-wide skills gap.
- **Pressure for short-term results.** Public and privately owned companies face constant pressure to hit quarterly targets, making it difficult to justify long-term investments without strong leadership pushing the case.

It takes real courage and vision for a leadership team to push back against the constant pressure to focus only on short-term gains. Leaders must be willing to defend multi-year workforce development investments in the boardroom, armed with the argument that these investments are essential to the company's future viability. The truth is that failing to invest in human capital will cost far more in the long run, but those costs often appear indirectly, or on someone else's watch, which is perhaps why they don't get the attention they deserve.

THE HIDDEN COSTS OF UNDERINVESTMENT IN TRAINING

Put simply, failing to invest in training — or plan for workforce succession — leads to delayed projects, maintenance backlogs, safety incidents, unplanned outages, a weakened safety culture, and rising operational costs. In grid projects, labor shortages often result in extended work shifts to meet deadlines, adding pressure to project timelines and complicating resource planning.

The utility sector's safety statistics provide a stark warning. According to industry research, nearly 40% of construction worker injuries may occur within the first six months of employment, and close to half within the first year for new workers who have not received adequate training.[7] This unusually high injury rate among inexperienced workers illustrates the price we pay when people learn on the fly instead of through formal training.

In the electric power industry, where mistakes can be fatal, this is unacceptable. The 2023 NERC report found that over 45% of electric power incidents since 2017 were linked to organizational performance issues, many of which can be attributed to inadequate training, poor quality control, and insufficient management oversight.[8] A single misstep — like a dropped line or an incorrect switching procedure — can trigger customer outages or life-threatening accidents. Figure 2 shows the main causes of electrical worker fatalities or the vast majority of incidents.[9]

Table 2 shows the average direct and indirect costs associated with different types of electrical safety incidents in the energy sector, highlighting the significant financial impact of arc flashes, fatalities, nonfatal injuries, unplanned downtime, and property damage.

Utilities and companies may experience costs above or below these averages, depending on their size, safety culture, and incident severity.

These hidden costs are like termites gnawing at the foundations of our industry. They may not be immediately visible in a quarterly report, but

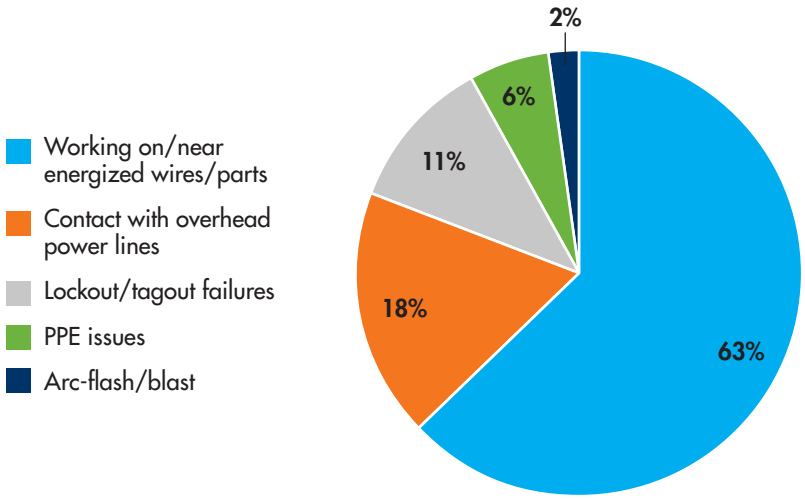

Figure 2: *Main Causes of Fatalities*

Table 2: *Average Cost per Incident by Type**

Incident Type	Average Cost
Arc Flash	$250,000–$750,000
Fatality (Litigation)	$10M–$15M
Nonfatal Injury	$200,000–$1M
Unplanned Downtime	$2,000,000 (avg/event)
Property Damage	$200,000+

**Cost estimates presented in the table are based on a synthesis of industry data, safety case studies, and benchmarking reports. Figures reflect both direct (e.g., medical costs, equipment damage, fines) and indirect costs (e.g., lost productivity, litigation, reputational impact).*[10–19]

over time, they undermine the reliability of the grid and the financial health of companies. In other words, investing in training saves money and lives in the long run, and the data backs this up. Conversely, not investing in training is a false economy. Any short-term savings will be paid for tenfold through the costs of outages, injuries, and inefficiencies.

COURAGEOUS LEADERSHIP: INVESTING IN PEOPLE

If short-term thinking is the disease, then courageous, long-term leadership is the cure. We must raise our collective voice in support of the leaders in our industry who fight for quality training and who treat safety and skills as non-negotiable priorities. These are the transformational leaders who understand that an energy company's greatest asset is not just the power plants or the poles and wires, but the people who design, operate, and maintain them.

Fortunately, there are encouraging signs. A number of forward-looking utilities, companies, and union-backed initiatives have started investing heavily in structured workforce development programs. These efforts range from pre-apprenticeship academies to internal multi-year technician development tracks and mentorship pipelines. Many programs are now pairing technical training with soft skills, leadership modules, and digital tools to build holistic readiness.

Leaders who champion these initiatives sometimes face skepticism or pushback. There can be resistance to spending on training, mentorship programs, or scholarships for trade school partnerships, especially when budgets are tight. But this is where leadership courage and long-term vision must prevail. A true energy industry leader must be able to stand in front of the board or investors and make the case that human capital is every bit as important as physical capital. The return on a lineman or technician and engineering training program may not appear on next quarter's balance sheet, but it will manifest in the company's performance over the next 5, 10, 20 years in the form of fewer outages, higher customer satisfaction, and a stronger safety record. It is the classic ounce of prevention that saves a pound of cure — except in our case, that pound of cure could be a life saved or a blackout averted.

A CALL TO ACTION: DO WHAT'S RIGHT, NOT JUST WHAT'S EASY

History will judge how we respond to this pivotal moment. The energy industry is on the point of one of the greatest technological transformations in a century — grid modernization, renewable integration, electrification of transportation, and more. But none of those innovations will succeed if we don't have the skilled workforce to build and maintain them.

This is a call for leadership at every level. We must collectively support those leaders who stick their necks out to invest in people. That means celebrating the project manager who institutes a new safety training module,

backing the utility or company CEO who allocates budget for an apprentice academy, and listening to the veteran worker who says, "We need more guys out here who know what they're doing," and then doing something about it. Every unfilled position that remains unaddressed, every preventable incident that occurs because someone lacked the proper training, is on all of us. If we continue to ignore the warning signs, we risk a future of frequent outages, stalled clean energy projects, and workers put in harm's way — a future where we are constantly reacting to crises rather than preventing them.

We stand at a crossroads where the courage to invest now in the next generation of energy workers will yield dividends for decades to come. The long-term reliability of our electric power system, the safety of our workforce, and the success of the energy transition all hang in the balance. This is our moment to choose vision over shortsightedness, to support the foundation of skills that will power our nation forward. Let it show that we came together — as an industry and as a community — to do what's right, not just what's easy.

In the end, the kilowatts and technologies may change, but it is human expertise that will power our success. Now is the time for bold action to reframe this workforce crisis opportunity to build a stronger, smarter, and safer energy workforce for the generations to come. NW

REFERENCES

[1] Victoria A. Rocha. "Survey: Energy Sector Job Turnover Remains High Amid Skills Shortage," *Cooperative.com*, February 6, 2024.

[2] Victoria A. Rocha. "Survey: Energy Workers Are Getting Younger, But Their Turnover Is Highest," NRECA, August 2, 2022.

[3] Henrique Hein. "Energy Companies Lose Talent and See Turnover Rise in 2024," *Canal Solar*, June 13, 2025.

[4] Angelo Mendoza. "America Needs Electricians: Addressing the Electrician Labor Shortage," *Indeed.com*, June 9, 2025.

[5] Pranav Srikanth, Marissa B. Baker, Hendrika W. Meischke, Noah Seixas, Christopher Zuidema. "Factors Associated with Construction Apprenticeship Completion in the United States," *The Economic and Labour Relations Review*. 2024;35(4):939-958. doi:10.1017/elr.2024.50.

[6] Estel Masangkay. "57 Electrician Facts and Statistics You Need to Know in 2025," *The Workyard Blog*, June 11, 2025.

[7] Gerhard Schneibel, Megan Boehnke. "Study: Construction Injuries Linked to Inexperience," *The University of Kentucky Knoxville News*, March 20, 2019.

[8] NERC. Analysis of Human vs. Organizational Performance in the ERO Event Analysis Process, North American Electric Reliability Corporation, November 9, 2023.

[9] Daniel Majano. "Workplace Injury & Fatality Statistics 2011–2023," Electrical Safety Foundation International, March 23, 2025.

[10] National Safety Council. Injury Facts®.

[11] Colton Rossiter. "Understanding the Arc Flash Incident Liability & Costs," *Leaf Electrical Safety*, August 31, 2023.

[12] Jennifer Busick. "Don't Let Arc Flash Cost You," *Electrical Safety*, August 25, 2015.

[13] Sentinel. "The Real Cost of a Workplace Accident Is Five Times What You Think," *Sentinalblog.com*, February 10, 2017.

[14] Power Partners Group. "The Cost of Downtime: Beyond Lost Revenue," *powerpartnersblog*, August 1, 2024.

[15] OSHA. Estimated Costs of Occupational Injuries and Illnesses and Estimated Impact on a Company's Profitability Worksheet, OSHA's Safety Pays Program.

[16] OSHA. Business Case for Safety and Health, OSHA's Safety Pays Program.

[17] Geetha Waehrer, Xiuwen Dong, Ted Miller, Elizabeth Haile, Yurong Men. "Costs of Occupational Injuries in Construction in the United States," *Accident Analysis & Prevention*, Vol. 39, Issue 6, 2007, pp. 1258–1266n=, ISSN 0001-4575.

[18] Toby Graham. "Construction Injuries: A Look at the Direct and Indirect Costs," *KPA Blog*, March 27, 2024.

[19] John Devendorf. "How Much Does a Construction Worksite Injury Cost?" *Lawinfo.com,* January 29, 2024.

Morteza Talebi, PhD, SMIEEE*, is Vice President of Workforce Development at PowerX. A Senior IEEE Member, he is an engineering leader with over 17 years of experience in electrical engineering, workforce strategy and training, and professional development. Dr. Talebi's work emphasizes the integration of human performance and quality principles into workforce strategies, connecting business goals, operational needs, and HR initiatives to create alighted, sustainable talent pipelines. He earned an MS in electrical engineering from North Carolina Agricultural and Technical State University and a PhD in power systems from the University of Central Florida.*

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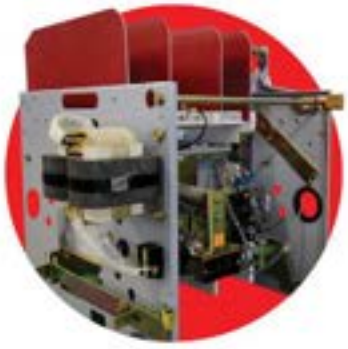


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WORKFORCE DEVELOPMENT FOR NETA TESTING COMPANIES

BY STEVE PARK, PE, *Electrical Reliability Services*

Many companies in our industry are struggling with staffing projects that require qualified workers to meet industry needs as well as individual company growth initiatives. Let's first explore why it seems more difficult to find employees to execute our projects, then dive into the process necessary to develop those employees into qualified workers.

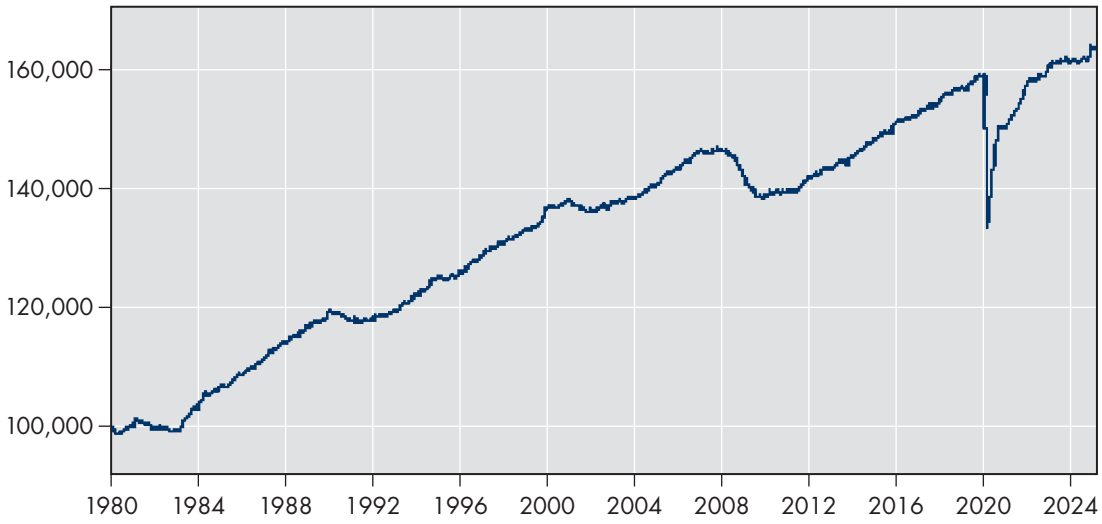

Figure 1: *Civilian Employment (Seasonally Adjusted) 1980-2025 (Number in Thousands)*
SOURCE: U.S. BUREAU OF LABOR STATISTICS[1]

Statistics from the U.S. Bureau of Labor Statistics (Figure 1) show that over the last quarter century (2000–2025), the annual labor growth rate has decreased by 39.4% compared to the previous 20 years (1980–2000).[1]

- From 1980 to 2000, the U.S. Bureau of Labor Statistics reports that the civilian workforce grew from 107 million to 142.6 million (33.3%), an annual growth rate of 1.7%.

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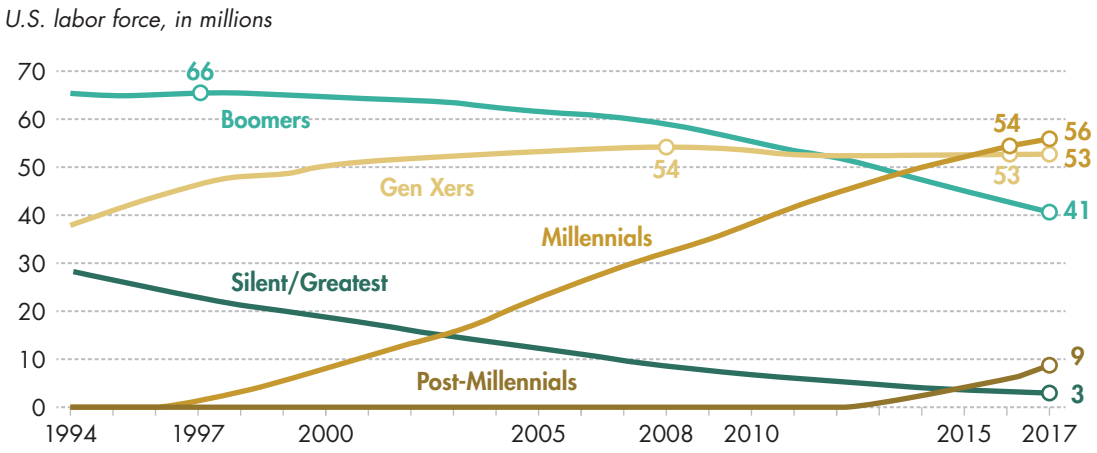
- From 2000 to 2025, the workforce has grown from 139.4 million to 168.1 million (20.6%), an annual growth rate of only 1.03%.

Additionally, the workforce landscape is changing. Until 2010, Boomers were the largest workforce in American history. In 2016, Millennials became the largest single generation in the labor force (Figure 2). Gen Xers and Millennials have now surpassed the Boomers, and together, they dominate our workforce (nearly a 50–50 split). The Post-Millennials, or Gen Zers (Zoomers), are now the latest generation of workers entering the workforce.[2]

That brings us to the challenge of today: How do we meet our workforce needs and the business demands of tomorrow?



Note: Labor force inludes those ages 16 and older who are working or looking for work. Annual averages shown.
Source: Pew Research Center analysis of monthly 1994–2017 Current Population Survey (IPUMS).

Figure 2: *Workforce Generation Mix*

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Over the past five years, the workforce landscape has changed abruptly. The 2020 pandemic may not have been the sole cause of this shift, but it may have accelerated the imminent outcome. Remote work, increased emphasis on work-life balance, increased need for flexible work hours, and other adjustments have become top priorities for many in the newest generations of workers. This is not the world NETA testing companies live in. Our field employee, the NETA Certified Technician, lives in a world of varying work schedules, long days/weeks, work in adverse conditions, travel, and a physically demanding but rewarding job.

We've all felt the pain of various supply chain issues during and since the pandemic. Our supply chain crisis is our employees. The demand for talented labor that wants to work in our business is high, and the supply is limited. This has driven up the cost of labor (basic economics), increased costs to customers and job margins, and impacted the ability to meet project schedules. The field employee has become extremely valuable. This labor scarcity will continue to be a challenge unless we can find a way to expand the talent pool. If we can't find ways to satisfy our industry's needs, the industry will find ways to achieve its goals without us.

FIND AND DEVELOP QUALIFIED EMPLOYEES

NETA's Qualified Electrical Maintenance Worker (QEMW) program is expected to create a paradigm shift in the way we do business. This program promotes testing companies to partner with electrical contractors that have QEMW employees and use these workers to expand our capabilities. This will allow us to utilize our highly talented test technicians to focus on high-end testing, leaving the more basic maintenance and testing, including cleaning, inspecting, insulation resistance tests (meggering), and contact resistance tests (ductoring), to the QEMWs.

Even with the advent of the QEMW program, we still need to grow our business and improve the skills and talents of our employees, and that requires an effective employee development program. If we do nothing, nothing will change. To make the necessary improvements, NETA companies will need to identify needs and goals, recruit and evaluate talent, execute a training program, and establish metrics to measure results.

Evaluate your Needs and Goals

The first requirement is to define what you want to accomplish. Most of us want to

grow our business — get a bigger piece of the pie. Growing a business is usually talked about in financial terms. How do these goals get realized? Executable plans and strategies must be put into place to accomplish these objectives.

In the testing business, we sell skilled labor. We know there is a direct correlation between revenue generation and billable heads. That means we must grow and develop our talent pool to accomplish these goals and support the business objectives. From an employee development perspective, you want to reduce the time it takes to advance the skills and knowledge of your employees from a NETA Level 1 to a NETA Level 2 and your NETA Level 2 to a NETA Level 3. Ultimately, you want a skilled team of employees who can execute a project safely and efficiently.

Developing your employees to NETA Level 3 and Level 4 is important. NETA requires NETA Level 3s and Level 4s to be a minimum of 25% of your workforce. Because of this, we often include this as a key metric. However, achieving your long-term goals of developing NETA Level 3s and Level 4s may be better served by focusing elsewhere!

To develop more NETA Level 3s, you must first develop more NETA Level 2s. To have a progression from NETA Level 1 to NETA Level 2 requires a good pool of newly hired employees. This is where I focus most of my energy and attention. Our first focus should be on NETA Level 1s — our new hires. I envision our organization as a pyramid with NETA Level 1s at the base (Figure 3). This group is the foundation, and a strong foundation will make for a strong structure and organization.

Recruit and Evaluate Your Talent

To grow your team, you'll need to actively find and recruit candidates you can develop. Your first responsibility is to ensure employee safety. Your employees must go through your company's safety program, and you must provide them with the necessary PPE and tools commensurate with their skill level. This

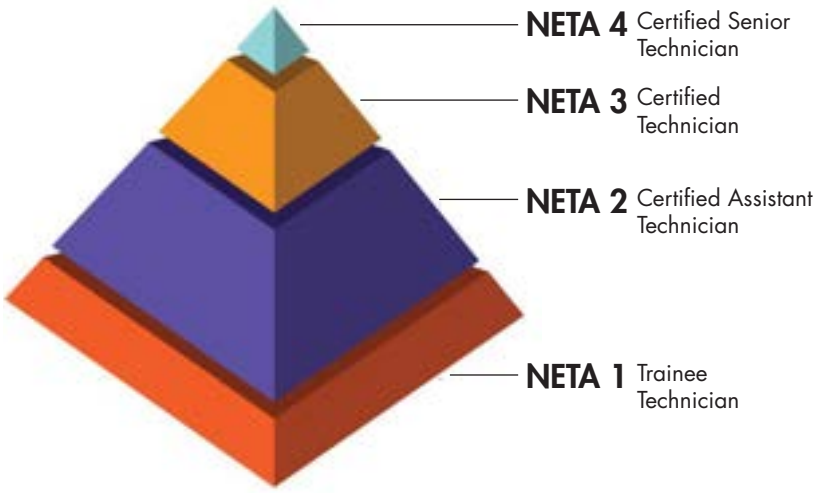

Figure 3: *Talent Pyramid*

classifies your new employee as a NETA Level 1 Trainee Technician.

Initial technical training will be a combination of classroom (academics), controlled lab hands-on learning, and as a helper in the field under close supervision. Each new employee should be paired with a supervisor/coach/mentor to help them learn, track their progress, and identify their weaknesses. The employee is evaluated to determine where they fit into the overall training program. Do they need help with fundamentals (basic math, geometry, trigonometry, Ohm's Law, basic circuit analysis, power calculations), or are they ready to tackle testing fundamentals and theory?

EXECUTE YOUR TRAINING PROGRAM

A successful employee development plan has three key components:

1. Academic learning
2. Hands-on skill development
3. On-the-job learning (OJL) and training (OJT)

Safety Training

Safety training is paramount. Your training program must include a safety-focused course(s) focused on your safety manual, OSHA, NFPA 70E, and CPR/First Aid/AED

training. Your company should also have an electrical safety qualified worker program that requires the employee to demonstrate safe work practices given various commonly encountered scenarios. Once this is completed, we can turn our attention to technical training.

Technical Training

Training includes academics (fundamentals and theory) as well as hands-on practical learning. The academics can be accomplished through a combination of instructor-led training (ILT) and virtual on-line training. Fundamentals should include math (basic math, geometry, and trigonometry), science, and electrical circuits (Ohm's Law, circuit fundamentals, power calculations). Virtual instructor-led training (VILT) and consumable video training can be beneficial to help ensure standardized training delivery and control training costs. The biggest challenge, especially with consumable video training, is ensuring its effectiveness.

Classroom Training

Provide formal classroom instructor-led courses. We have a two-week Basic Technical Training (BTT) course for recently hired employees. Employees are scheduled for BTT 90–180 days (ideally) after their start date. This provides time to send them on jobs that expose them to real work experiences before sending them to be trained. This course includes classroom and hands-on lab activities. The classroom sessions cover the fundamentals of testing and teach them about electrical test equipment.

Lab Experience

Next, hands-on lab experience walks them through the testing and maintenance process on the equipment. For this lab activity, we use our training group instructors and supplement them with experienced field staff trainers to ensure students get a real-world experience in the lab. One advantage of these lab exercises over on-the-job training (OJT) is that there is no time pressure. The students have time to think about what they are doing and ask questions to better understand the process. We always caution our students that completing BTT does not make them qualified. To become qualified, they must complete the OJT program under the guidance of a qualified worker designated as their coach and mentor.

Formal OJT

A formal OJT program is invaluable. An OJT program should document the knowledge and skill levels expected of the employee to be successful at the current level (competence) and to reach the next level (advancement). The OJT program also allows management to set expectations and metrics, provides feedback based on the knowledge and skill advancement of each employee, and can be used to track the readiness of an employee to test for the next certification level. The OJT program should contain elements of knowledge and skill that can be evaluated by a standardized test. The skill is observed by their assigned supervisor, coach, or mentor, and the coach/mentor and the employee must sign off on the OJT tasks. This ensures the OJT record accurately reflects what the coach/mentor has witnessed, and that the employee agrees they are competent in the specific tasks. This program ensures the employee's knowledge and skills are aligned with their certification level.

Video Calls

To supplement the core training of new employees, an instructor delivers monthly training topics via interactive video calls to all field employees. These sessions are usually scheduled for two hours, where a predetermined topic is presented and the employees answer questions and can also ask questions. This has gained a lot of popularity, and we regularly get 30–50 of our team on the calls. The call is recorded and posted in our learning management system (LMS) for future viewing by those who missed the call.

ENSURE PROGRAM SUCCESS

Many NETA companies have a similar and obvious goal: Grow the business. Our challenge is to hire and train employees to meet those goals. Ensuring the success of each employee is key.

Ensure Focus

It's easy for a student to let a training video run and get distracted by emails, other tasks in the office, or even social media. There are three ways to help ensure the student remains connected to the training.

1. Keep the modules short and focus on a specific learning topic/objective. Break more complex topics up into multiple modules.
2. Create interactions where the student must perform an action. Interactions can be a question or several questions that the student needs to get right to advance. If the student can't answer a question correctly, they must review the material again. Make this even more effective by using a bank of questions, so the student doesn't see the same questions each time they review the material.
3. The supervisor must ensure there are no work distractions. Do not expect the employee to do multiple things while they are learning. When it comes to learning, multi-tasking does not exist. They must stay focused on learning.

Establish Metrics

Now that you have plotted your course, created the tools to be successful, and evaluated your talent, you can establish the key metrics to measure your results. To set your employee development metrics, you must know what your business growth plan looks like and determine how that impacts your employee development needs. How many more employees at which skill levels are needed to achieve these goals?

We previously acknowledged a direct correlation between revenue and headcount and noted that NETA requires a minimum ratio of NETA Level 3s and Level 4s to NETA Level 1s and Level 2s. Rapidly hiring too many NETA Level 1s and Level 2s can impact your ability

to maintain the 25% requirement for NETA Level 3s and Level 4s. It's best to be proactive and grow your workforce at a manageable rate and not out of desperation. While the 25% is a NETA minimum requirement, it also makes good sense, and similar ratios are used by other trades.

If you compare the roles and responsibilities of a NETA Level 1 and NETA Level 2 to those of a NETA Level 3 and NETA Level 4, the ratio of 4:1 ensures that the less experienced testers are working with and being provided adequate supervision by a qualified tester. This also helps ensure they develop the necessary skills to perform their work safely and according to NETA testing specifications. If you need to grow your talent by 10%, you must evaluate the impact of adding 10% NETA Level 1s and Level 2s to the required ratio. However, if you proactively and methodically develop your talent, you can manage this metric and avoid dropping below the requirement.

Manage Career Progression

Actively manage employees' career progression and identify candidates who are approaching the window of advancement in NETA certification. I track employees and urge them to begin their preparation for the NETA examination about six months before their testing window. We determine the employee's learning needs and provide direction in preparation for the exam. In addition to the NETA requirements, we establish OJT expectations to increase the likelihood of passing the exam. After they take the exam, pass or fail, we follow up and identify topics they felt they were or were not prepared for. This not only helps us coach that employee but also helps us better prepare other employees.

Once you create a strong foundation of NETA Level 1 Trainee Technicians and tailor your program to develop their talent and transition to NETA Level 2, it's easy to develop a similar program and strategy for transitioning to NETA Level 3 and then to NETA Level 4. While ANSI/NETA ETT, *Standard for Certification of Electrical Testing Technicians*, provides a framework, you will need to develop the details of the program to achieve those requirements.

Use Trainers and Mentors

An employee development program must include all the right pieces in all the right places. This includes training key senior employees as trainers, coaches, and mentors. Some people inherently make good teachers, others do not. Some see the new employee as a threat to their employment and advancement, and intentionally, but covertly, do not help the new employee learn and advance. Over the years, I have seen this too many times.

Make sure you have the right people in the right roles and paired up with the right trainees. The employees you identify as trainers must have the heart of a teacher. They must understand the knowledge that must be taught and the skills that must be developed. You must invest in these trainers so they understand how to train and how to employ adult learning methods. Many good programs that teach adult learning processes and methods are available. Ensure your trainers understand their responsibilities. Remember, the objective here is to develop the new employee into a NETA Level 2 Certified Assistant Technician.

Schedule regular meetings with trainers and mentors to get feedback about a new employee's skills development. Identify any new employees who struggle to advance. If you've provided your NETA Level 1 Trainee Technicians with the needed field experience and formal training, but they are struggling, you must identify the cause of their struggles.

Are they simply poor test takers? There was a time when I thought this was just an excuse, but it's a real thing. I've seen some very bright and talented individuals have difficulty passing a test they should ace. They second-guess themselves. They think the questions are trick questions. They read things into the questions. To help these employees, you will need to coach them

on how to take tests. Discuss ways to examine the questions and evaluate their responses.

Practice exams are great for these individuals. To help them, I created a list of 10 things employees can do to improve their test performance, including time management skills, avoiding distractions, answer selection strategies, managing difficult or wordy questions, and when it's OK to change an answer. Recent results indicate this has been helpful.

Provide Resources

Employees must have the necessary reference materials available to facilitate their learning. We recently created a resource center within our LMS where our technicians can access, download, and review content to learn more about various topics. This resource includes the basics of transformers, CTs, VTs, circuit breakers, grounding, EVs, relay fundamentals, and more. Short videos teach some of the more academic topics, such as basic math, geometry, trigonometry, science, circuit analysis, Ohm's Law, power calculations, and phasors. Links to other material are available via YouTube to assist with learning and development. This has proven very beneficial to providing focused and vetted material that helps develop their knowledge. The academics help them understand the why. Working with a good teacher helps them learn and understand the how.

ANALYZE YOUR TALENT POOL

What if you have employees who don't want to be developed? In the past, we were often satisfied with those who just wanted to be rag workers or helpers. They were not interested in enhancing their talents, taking on additional responsibilities, or climbing the ladder (literally and figuratively). They were satisfied to be told what to do and when to do it. About 10 years ago, I analyzed our company, and I was surprised to see how many career NETA Level 1s we had!

When working to improve your talent pool, being bottom-heavy with limited advancement potential can be problematic if your goal is to create a conduit for advancement. This weakens your foundation. Each of these career NETA Level 1s is someone you can't develop or expect to become a productive tester or job lead. They are your knob turners. They are on the dumb end of the test set. They are in the way of others who want to advance. However, because they've been with your company for so long, they're loyal; everybody likes them. It becomes difficult to replace them, so they continue to get rewarded for mediocre performance and, in many cases, end up getting compensated like a NETA Level 2 or NETA Level 3.

How do you resolve this challenge? You will need to schedule a career counseling session to outline your expectations for them to achieve their NETA Level 2 and Level 3 over a given period if they want to continue working for you. An alternative is to cap future raises to align their position with their compensation. What is the likely outcome? You may lose them. If you do, you have created an opportunity to fill that position with someone who has career aspirations and can benefit your company long term. The key takeaway: Don't reward poor behavior.

You also need to know what your employees want out of their careers. Most companies have a formal and documented meeting with each employee at least once a year to discuss, at a minimum, the employee's performance and merit increase. Instead of simply saying, "We appreciate you; here's your raise," take advantage of this opportunity to have a career discussion. Find out what their interests and expectations are and let them know your plan for them. Employees appreciate knowing that you have a place for them in your organization and plans for their future. These conversations are enjoyable and pleasant when their performance and expectations align with yours.

However, these conversations can be challenging and difficult when expectations don't align. While an employee may see themselves as a rockstar, you may see them as problematic or an underperformer. Now is the time to get those issues out in the open. You must clearly communicate your expectations. When discussing the need for improved performance, use specific instances where the employee did not meet your expectations. If you believe the employee has a future with you, let them know, but also let them know what must change so you don't have to have another conversation like this one.

For these employees, a year is too long to wait for a follow-up meeting. Set the next meeting in three months. Then, when you meet again, you can determine if you've seen positive change and praise them; if not, let them know what is next. This is the time to determine whether they have a future with your company. These conversations can be challenging. Always prepare for these meetings and determine what is necessary to create a win-win outcome.

FIND NEW TALENT

Another stream of future talent is to consider potential candidates coming directly out of high school. Many high school students approach graduation without knowing what they want to be when they grow up. Many years ago, I was one of them!

However, this young and inexperienced talent pool creates special challenges. How can we develop someone with no work or electrical knowledge and experience into our workforce? They will need significantly more training than someone who has already learned about electricity from a trade school or the military. They will also need more supervision. Most testing companies don't have the time or finances to create such an extensive program or resources to invest at this level.

How can this be done timely and at a reasonable cost? That is the key question moving forward. Very few programs that focus on our industry are currently available, and in limited locations. High school graduates may not live in areas where these programs are offered, lack the finances to attend, or may

not be aware of the program and the potential career that could be available should they complete such a program.

CONCLUSION

Employee development is a critical component of the growth and success of NETA testing companies. Over the past five years, we have reached critical mass in the supply and demand market of our most valuable resource: our employees. There is no short-term, quick-fix solution. The projected job market has no light at the end of the tunnel. We must invest in developing our employees and organically grow our own talent to meet the needs of tomorrow.

This won't happen by accident or without a plan. You must identify your needs and develop a program that supports those needs. In addition to developing your employees, you must focus on the necessary actions to retain existing talent and groom them for the future.

A professional and positive work culture can go a long way in retaining valuable talent. From a financial perspective, be aware of the cost of turnover. In our business, where we use skilled workers, the cost of turnover can reach six figures when all factors are considered. Consider this cost when making business decisions that could alienate workers and increase turnover.

Don't make promises you can't keep just to meet the labor needs for today's job. Every employee should be thought of as a long-term investment. Do everything possible to develop their skills to help you not only on today's job, but also the jobs of tomorrow.

Employee development is an important topic that affects all NETA testing companies, and I hope others will offer their perspectives on the numerous additional aspects not addressed in this article. NW

REFERENCES

[1] U.S. Bureau of Labor Statistics. Civilian Employment (Seasonally Adjusted) 1980-2025.

[2] Fry, Richard. (2018, April 11), Millennials are the largest generation in the U.S. labor force. Pew Research Center, Short Reads.

Steve Park, PE, *is Director, Training and Employee Development at Electrical Reliability Services. With over 45 years of distinguished experience in the power system industry, Park is a recognized expert in electrical systems and professional development whose comprehensive background encompasses hands-on experience as a power system maintenance lineman, electrical design engineer, and system studies expert. Park's technical expertise includes short-circuit analysis, selective coordination, load-flow assessment, arc flash analysis and mitigation, harmonics analysis, medium- and high-voltage cable testing, and system apparatus testing and maintenance. In his current role, Park leads transformative initiatives in ERS training and employee development programs. Park is a Professional Engineer and a NETA Level 3 Certified Test Technician, and is OSHA-30 qualified. He received his BS and MS in electrical and electronics engineering from Purdue University and an MBA from Indiana Wesleyan University.*

THE IMPORTANCE OF APPRENTICESHIP PROGRAMS

BY ELIZABETH DOUGLAS, *Integrated Power Services, LLC*

In today's competitive business environment, investing in workforce development is critical for sustained growth, productivity, and industry leadership. Apprenticeship programs, recognized and approved by the U.S. Department of Labor, provide a comprehensive framework for developing highly skilled professionals, offering businesses a strategic advantage.

This article explores the strategic importance of apprenticeship programs for businesses. It highlights the benefits of federal recognition and structured training initiatives, illustrating how apprenticeships play a vital role in enhancing workforce stability, operational safety, and competitive advantage. The discussion reveals that structured training and certification can lead to reduced employee turnover, greater customer trust, and the potential for scalable growth. By engaging in apprenticeship programs, businesses can cultivate a skilled workforce, ensuring compliance with industry standards and establishing themselves as leaders in a rapidly evolving market.

CULTIVATING A SKILLED WORKFORCE

Federally recognized apprenticeship programs add a significant layer of credibility and structure to workforce training initiatives. This recognition provides businesses with a clear pathway to develop certified professionals under stringent safety and quality standards, reducing training inconsistencies and ensuring compliance with industry and federal regulations. Apprentices also benefit from a Journeyman card at the end of the program, along with any milestone certifications that can be applied throughout the program.

For instance, the NETA Apprenticeship Program has milestones at the end of each year that require passing a NETA examination to continue in the apprenticeship program. At the end of the program, apprentices will hold the NETA Level 4 Senior Certified Technician qualification.

Registered apprenticeships significantly reduce turnover rates by creating structured career paths. Research consistently demonstrates that approximately 94% of apprentices maintain employment post-completion, with 91% retaining their roles for at least nine months.

For businesses, this results in lower recruitment costs, increased employee loyalty, and greater operational stability.

Apprenticeship programs offer companies a ready-made, standards-aligned training curriculum and learning management system (LMS), streamlining their training processes. This facilitates consistent skill acquisition, saves time, reduces resource investment, and ensures comprehensive, quality instruction aligned with industry standards.

Professionals trained through structured apprenticeship programs undergo rigorous instruction in industry-specific protocols, safety procedures, and best practices. This ensures a workforce capable of performing advanced diagnostics and maintenance, which significantly improves equipment reliability, minimizes downtime, and enhances safety — core elements critical for business success and customer trust.

Participating in a federally recognized apprenticeship program signifies a commitment to high-quality standards and ongoing skill development. Companies engaged in apprenticeship programs distinguish themselves in competitive markets by demonstrating their commitment to regulatory compliance, quality assurance, and industry excellence, particularly valuable in sectors requiring rigorous safety and operational standards.

Structured progression within apprenticeship models naturally supports internal growth and succession planning. Businesses can strategically fill senior roles internally, significantly reducing external hiring pressures and costs, while fostering a loyal, well-prepared workforce ready to take on leadership roles.

Apprenticeship programs foster industry collaboration by encouraging companies to develop best practices, standards, and training resources collectively. This collaborative approach elevates not only individual businesses but the entire industry, positioning participants as thought leaders and enhancing their reputation.

Apprenticeship programs are potent tools for workforce development, regulatory compliance, safety improvement, and competitive differentiation.

A CNBC article, "Why These Gen Zers Are Ditching College Degrees for Blue-Collar Careers," highlights a growing trend among young adults who are increasingly favoring apprenticeships and trade careers over traditional college degrees. Driven by factors such as rising student debt, the need for practical hands-on learning, and the potential for high early-career earnings, Gen Z's preference underscores the relevance and attractiveness of apprenticeship programs to both younger workers and businesses. By aligning with these evolving workforce preferences, companies can attract and retain motivated, skilled talent prepared to meet future challenges.

To leverage the full benefits of apprenticeship programs, businesses should:

- **Register as a sponsor.** Integrate federally recognized apprenticeship models to leverage structured standards.
- **Deploy curriculum.** Utilize standardized LMS and curriculum to ensure consistent and high-quality training outcomes.
- **Mentor and certify.** Actively mentor apprentices, guiding them through certification levels to develop highly skilled professionals.
- **Showcase credentials.** Highlight apprenticeship certifications in marketing materials and business proposals to enhance competitive positioning and customer trust.

CONCLUSION

Apprenticeship programs are potent tools for workforce development, regulatory compliance, safety improvement, and competitive differentiation. By adopting these federally recognized and industry-supported apprenticeship models, businesses can achieve long-term operational excellence, workforce stability, and sustainable growth, setting the stage for lasting success in an ever-evolving marketplace. NW

REFERENCES

[1] U.S. Department of Labor. *Apprenticeship.gov: https://www.apprenticeship.gov/*.

[2] CNBC. "Why These Gen Zers Are Ditching College Degrees for Blue-Collar Careers," *CNBC.com.*

Elizabeth Douglas *is the Vice President of Talent Enablement at Integrated Power Services, where she leads a team of professionals focused on employee development, succession planning, performance enablement, and the design and delivery of impactful training programs. With over a decade of experience, Douglas brings deep expertise in adult learning theory, instructional design, and leadership development. She holds an MS in business administration and management from Indiana Wesleyan University and is a certified practitioner in the Herrmann Whole Brain Thinking methodology.*

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BRIDGING THE GAP:

DEVELOPING A MULTIGENERATIONAL WORKFORCE FOR THE FUTURE OF ELECTRICAL TESTING

BY KRISTY SWEGHEIMER, *RMS Energy Co LLC*

How do you build a future-ready workforce when your team communication ranges from texts instead of calls to TikTok in the breakroom?

It's not a rhetorical question. It's one companies in the electrical testing world face every day. We have Baby Boomers with decades of field wisdom, Gen Xers balancing leadership and independence, Millennials pushing for innovation and flexibility, Gen Z entering the workforce with a completely different set of expectations and digital instincts, and right on their heels, Generation Alpha, quietly getting ready for their turn.

PHOTO: © ISTOCKPHOTO.COM/PORTFOLIO/TIMSA

This isn't just a fun workplace quirk; it's a serious operational challenge.

In our industry, we can't afford breakdowns in communication or trust. We work with high-stakes systems where precision, safety, and collaboration aren't optional. And if we don't find a way to intentionally integrate these generations with empathy and strategy, we risk losing not only institutional knowledge but also the momentum and innovation we desperately need.

This article is about workforce development, yes, but more importantly, it's about connection. It's about looking at the people who do the work, understanding how and why they work the way they do, and building bridges between them. Because when we do that right, we don't just get better teams, we get safer systems, stronger organizations, and a future we can trust.

UNDERSTANDING THE GENERATIONAL LANDSCAPE

Let's start with the basics: Who's actually on the team?

Right now, many companies in our space have employees from four or even five generations working side by side. And yes, they're all showing up to get the job done, but how do they do that job? That's where it gets interesting.

- **Baby Boomers** (1946–1964) grew up in a world of loyalty, structure, and face-to-face conversations. They have knowledge we can't afford to lose and a serious commitment to doing things the right way.
- **Gen X** (1965–1983) is independent, experienced, and a little skeptical of too much oversight. They're the get-it-done crowd, often acting as the glue between teams.
- **Millennials** (1981–1996) want purpose in their work, fast feedback, and flexibility. They've pushed companies to modernize and think beyond business as usual.
- **Gen Z** (1997–2010) is just getting started, but they are already bringing digital fluency, creative thinking, and a real desire to personalize how they work.
- **Gen Alpha** (born ~2010 and beyond) may not be on the job site just yet, but they're watching. They're growing up with AI, automation, instant access to information, and global connectivity. How we prepare our workplaces today will directly impact how ready we are to welcome them tomorrow.

These aren't just personality differences. They affect everything, from communication to leadership to how people respond in the field.

Each generation also brings a unique perspective on risk, authority, technology, and teamwork. Recognizing that these perspectives were shaped by global events, economic trends, and social norms is key to managing expectations and creating a more harmonious team culture.

WHY GENERATIONAL DIVERSITY MAKES US STRONGER

Here's the thing: Having all these different viewpoints and experiences on one team isn't a liability. It's a serious strength if we can bring them together.

When we build teams with generational range, we're layering institutional knowledge with fresh thinking and consistency with creativity. That kind of diversity helps us spot risks earlier, adapt quicker, and work smarter.

But let's be honest, it also takes effort. These groups don't automatically mesh. Without guidance, they can butt heads over everything from email etiquette to how often they need feedback. That's where leadership comes in.

Generational friction usually isn't about values; it's about delivery. Everyone wants respect, flexibility, and purpose; they just express those needs differently. If leadership can meet each group where they are, they can unlock productivity and engagement in ways that a one-size-fits-all culture never will.

LESSONS FROM THE FIELD

Not long ago, one of our field crews faced a power issue at a facility that required a fast response. A senior technician (Boomer) remembered a similar situation from 2007: what failed, why, and how they worked around it then. A Gen X team lead stabilized the client relationship and ensured protocol was followed. An on-site Millennial quickly accessed updated schematics through a cloud-based system, and a Gen Z tech noticed an overlooked alert in the software interface.

What could have been a disaster became a win, not only because of knowledge, but also because of shared experience. This is what it looks like when multigenerational teams work, not in competition, but in collaboration.

LEADERS CAN BRIDGE THE GAP

Here's the good news: You don't have to overhaul your org chart. But you do have to get intentional.

PHOTO: © ISTOCKPHOTO.COM/PORTFOLIO/SIMONKR

Start by asking the right questions:

- Who's mentoring whom, and why not both ways?
- Are we giving feedback in a way people actually hear it?
- Are we rewarding only tenure, or also ideas?
- Are we listening to the people doing the work?

Try this:

- **Mentorship that flows both ways.** Let a Boomer teach a safety process, and a Gen Z tech show how to use new software more efficiently.
- **Flexible feedback.** Not everyone wants a formal sit-down. Some just want a quick text message or a walk-by conversation.
- **Share projects across generations.** Let them learn from each other by working side by side, not just on paper.

Consider implementing team charters that acknowledge working styles and communication preferences upfront. Encourage managers to facilitate conversations around not just **what** work is done, but **how** it gets done, and **why** certain styles matter to each person.

This isn't about coddling anyone. It's about creating a culture where everyone feels they belong and can contribute. When people feel seen, they show up stronger.

TRAINING THAT WORKS FOR ALL GENERATIONS

Let's talk development, because if our people aren't growing, our companies aren't either.

Here's what I see working:

- **Upskilling and reskilling.** This isn't just about younger workers. Older workers need training on new tech, while younger workers benefit from a grounding in standards, safety, and field-tested techniques. The most effective programs recognize that everyone is a learner, just at different points in their development cycle.
- **Microlearning.** Give people small, actionable lessons they can learn on the go.
- **Structured new-hire training.** Getting new talent in the door is just the start. Early-career employees need focused programs that take them from safety orientation to field readiness quickly and consistently. When you set expectations and build confidence early, you reduce early turnover and create a stronger internal labor bench.
- **Field-based mentorship.** Nothing replaces real-time learning. Let experienced techs take newer hires under their wings, with support and recognition.
- **Clear career pathways.** Not everyone wants to be a manager. Build tracks that reward technical excellence as well as leadership.

Worth noting: Flexibility in training delivery helps. On-demand modules, podcasts, brief in-person labs, and peer-led sessions serve a multigenerational audience better than traditional, top-down instruction alone.

When people can learn the way they're wired to absorb information, everyone wins.

THE ROLE OF TECHNOLOGY IN BRIDGING GENERATIONAL GAPS

Technology is often blamed for disconnects, but it can be one of our best tools for connection if used well. From digital test equipment to collaborative platforms like Microsoft Teams or project management apps, the way we use tech has to be inclusive.

Older generations might need more structured onboarding to new tools; younger employees might benefit from understanding the why behind older protocols. Consider building digital literacy and historical context into your training programs, so each group not only learns from the system but also from each other.

When Gen Z can teach Gen X a new interface, and Gen X can show Gen Z why precision still matters even in automation, we don't just bridge gaps, we build teams that learn in every direction.

WHERE DO WE GO FROM HERE?

We work in an industry that literally keeps the lights on. That's not changing, but the people doing that work? They are.

If we want to attract the next generation and retain the current one, we must keep evolving. That means making room for new ideas without losing the legacy that got us here. It means listening more, assuming less, and leading with the kind of clarity and compassion this work deserves.

Here are four big questions to keep top of mind:

1. How do we market our industry to younger generations who may not even know it exists?
2. Are we adapting our talent strategies to fit different life stages, not just entry-level and executive?
3. Can we create internal champions to represent each generation's perspective on workforce strategy?
4. And most importantly: What are we doing today that will make this industry more attractive to Generation Alpha?

Generation Alpha is growing up in a world of voice assistants, climate concerns, and global connectedness. They won't just expect their workplace to be digital; they'll expect it to be intelligent, sustainable, and inclusive from day one.

WHAT DO WE WANT TO LEAVE BEHIND?

When I think about the mentors I had early in my career, I remember not just what they taught me, but also how they made me feel capable, trusted, and part of something bigger. That's the kind of legacy we get to build.

This isn't about figuring everything out all at once. It's about leaving the ladder down, turning back to help, and asking honest questions about the world we're shaping. What will your legacy be?

No one has this perfectly figured out. But the companies that lean in, that treat workforce development as a real strategy, not just a checkbox, will be the ones that thrive.

We're not just preparing for tomorrow's work, we're shaping tomorrow's workforce. Let's do it on purpose. NW

Kristy Swegheimer *is the Chief Human Resources Officer (CHRO) at RMS Energy Co LLC. Prior to RMS, she was the Chief Human Resources Officer for Qualus and was the Managing Partner for Redbrick Insights, a human capital consulting firm. A graduate of the University of Central Florida, she holds Senior Professional in Human Resources (SPHR) certification from HRCI.*

EMPOWERING WORKFORCE DEVELOPMENT THROUGH DIGITAL TRANSFORMATION

BY KATIE BLEILER, *TRC Companies*

In the rapidly evolving electric utility sector, attracting, developing, and retaining a skilled workforce has never been more critical. As infrastructure modernization accelerates and demand for technical talent intensifies, businesses must take proactive steps to ensure its teams are equipped, engaged, and empowered for success.

This article offers an in-depth case example of how TRC employed a digital transformation strategy designed to enhance employee training, strengthen retention, and improve overall workforce development.

Investment in digital tools and data-driven systems helps retain top talent, accelerates onboarding for new hires, and fosters continuous learning and growth among existing employees — all while supporting operational excellence across the organization.

ADDRESSING WORKFORCE DEVELOPMENT CHALLENGES

In many companies, field services span a national footprint, with employees deployed across numerous project sites. Managing a mobile, geographically dispersed workforce presents challenges in training consistency, onboarding, career development, and visibility into team performance.

Historically, TRC's national teams operated in silos with limited cross-communication or

centralized workforce planning. This approach created inefficiencies and made it difficult to identify employee development opportunities at scale. The digital transformation initiative breaks down these barriers and builds a connected, data-informed framework for workforce development — one that directly supports employee engagement, retention, and long-term success.

THE RESOURCE MANAGEMENT TOOL: TRANSFORMING TRAINING AND RETENTION

A cornerstone of this digital transformation strategy is a resource management tool, or scheduling app. Designed internally by field experts for field operations, this platform does far more than manage logistics — it drives professional development and retention across the organization.

Key features that support workforce development include:

1. Streamlined scheduling and forecasting
   - Provides real-time visibility into project assignments and future demand, enabling better planning of training and onboarding.
   - Aligns project opportunities with employee career goals, reinforcing engagement.
2. Integrated employee profiles
   - Centralizes certifications, skills, tenure, and project history, making it easier to assign roles that match individual development paths.
   - Identifies training needs and flags lapsed certifications before they impact deployment.

3. Transparent career planning
   - Managers gain insight into employee utilization and growth, allowing for targeted mentorship and on-the-job learning opportunities.
   - Cross-regional collaboration exposes employees to broader experiences and advancement opportunities.
4. Proactive staffing decisions
   - Open roles are tied to skill and certification requirements, ensuring qualified candidates are placed while also revealing skill gaps that training programs can address.

This tool has played a key role in reducing turnover by promoting transparency, predictability, and career progression. New hires benefit from a smoother onboarding experience, while long-term employees see a clear trajectory for growth.

HARNESSING DATA ANALYTICS FOR SMART TRAINING INVESTMENTS

TRC uses Microsoft Power BI to integrate data from its own resource management tool, financial systems, safety tracking platforms, and learning management systems. This consolidated view allows leadership to make informed decisions that support individual and team development.

Key benefits include:

- Automated reporting for managers
  - Reduces administrative burden and enables real-time monitoring of team performance and training progress.
- Targeted training initiatives
  - Data analytics reveal trends and gaps in safety compliance, project performance, and skill development, enabling precise, need-based training.
- Enhanced retention insights
  - Dashboards help identify at-risk employees based on utilization trends, allowing for early interventions and engagement efforts.

This level of visibility ensures employees are not only trained effectively but also feel supported through continuous learning and growth opportunities — factors that significantly improve job satisfaction and retention.

THE MANAGER TOOL KIT: EMPOWERING LEADERSHIP TO SUPPORT TEAMS

The manager tool kit, a suite of real-time dashboards developed from the Power BI infrastructure, provides supervisors and regional leaders with actionable data to guide team performance and development.

Workforce-focused features include:

- Employee performance dashboards
  - Managers get real-time insights into resource allocation, enabling customized coaching and planning.
- Safety and quality trends
  - Managers can proactively address patterns that suggest training gaps or burnout risk.
- Operational analytics
  - Real-time insights into resource allocation ensure the right personnel are deployed effectively and that development opportunities are aligned with strategic goals.

Managers use these tools to accelerate new hire readiness, identify opportunities for internal promotion, and ensure continuous alignment between team capabilities and project requirements.

MEASURABLE IMPACT ON TRAINING AND RETENTION

Implementing a digital workforce has resulted in significant improvements in workforce engagement and operational outcomes:

- Onboarding time was reduced by 40% through automated scheduling and training assignments.
- Retention rates increased 30% due to improved career transparency and targeted development.

- Safety metrics improved by 200%, driven by early identification of trends and tailored retraining.
- Enhanced scheduling accuracy boosted employee satisfaction by minimizing last-minute changes and aligning work with preferences and strengths.

These gains underscore how digital tools — when thoughtfully implemented — can directly improve workforce stability and satisfaction while driving better business results.

LOOKING AHEAD: CONTINUOUS INNOVATION IN WORKFORCE DEVELOPMENT

Digital transformation is not a one-time effort, but an ongoing commitment to innovation, agility, and employee success. As we continue evolving our systems, exploring AI-driven workforce planning and predictive training models furthers personalized development and maximized retention.

Future workforce initiatives will focus on:

- Expanding skills mapping and certification tracking to support emerging technologies and regulatory requirements
- Enhancing employee feedback loops to fine-tune onboarding and training based on real-time input
- Creating AI-driven career pathways to help employees visualize future roles and chart meaningful growth

GROWING THE WORKFORCE OF THE FUTURE

By implementing a digital transformation strategy through the use of tools like the resource management tool, Power BI dashboard, and the manager tool kit, TRC has built a more connected, capable, and committed workforce.

Creating a framework that aligns individual growth with organizational goals fosters a workplace where employees at all levels are empowered to thrive. As the electric industry evolves, our continued focus on training, retention, and digital enablement ensures continued leadership in workforce innovation. NW

Katie Bleiler *is an accomplished Energy Sector Executive at TRC Companies with over 25 years of progressive leadership experience in high-impact roles across the electric power industry. She has led major transmission and distribution (T&D) construction projects and electrical testing and commissioning efforts with a strong focus on safety, efficiency, and client satisfaction. With deep expertise in resource management and operational execution, she has successfully supported large-scale initiatives for utilities, municipalities, and commercial and industrial clients, including complex data center systems. Known for her strategic vision and relentless pursuit of excellence, she continues to drive innovation and performance in the utilities sector.*

ELECTRICAL FIELD SERVICE EMPLOYEES' INTENT TO STAY OR LEAVE

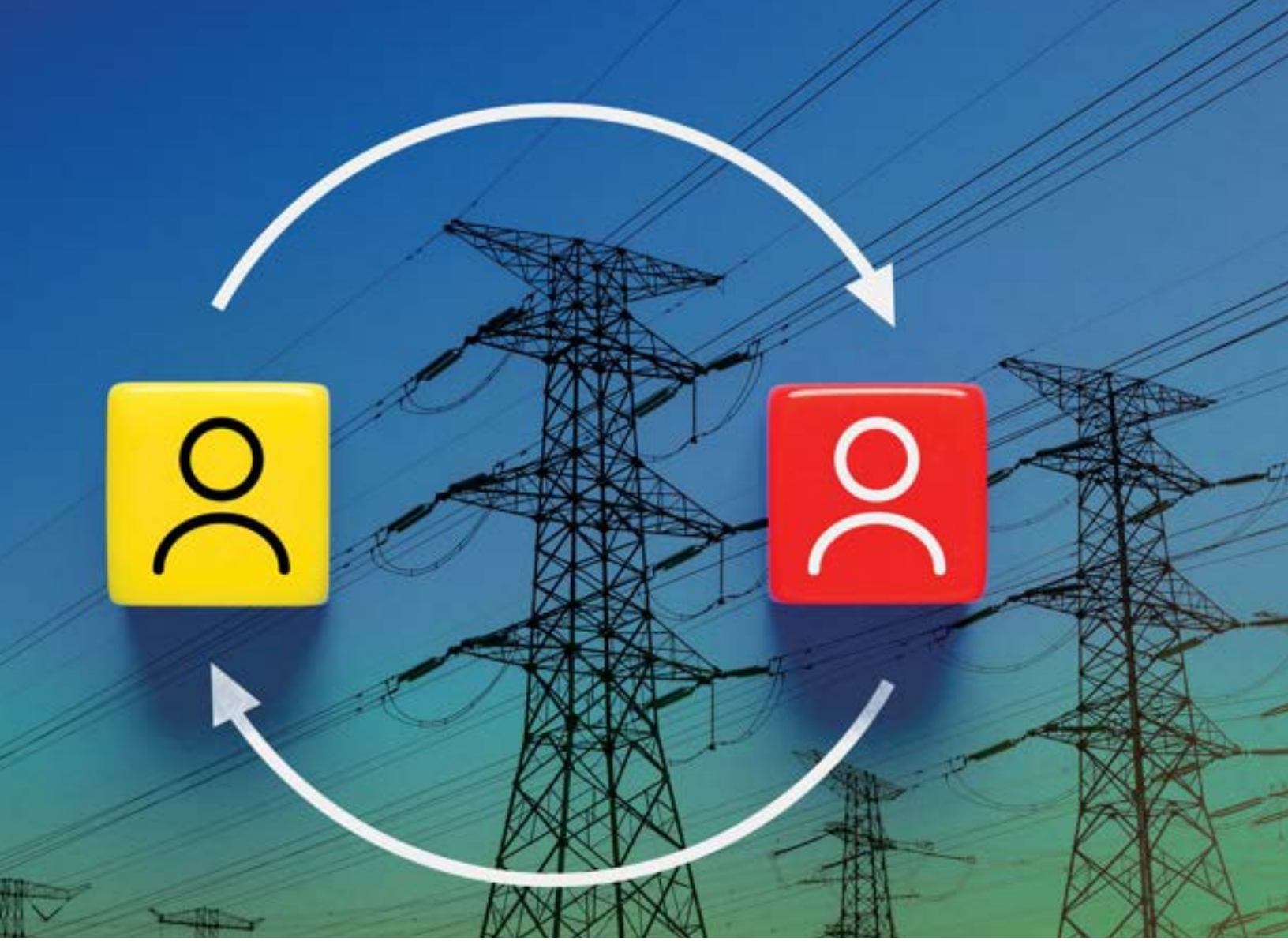
BY JEFFREY M. DANIELS, PHD, *CBIONE*

Maintaining operations and achieving financial goals often requires shifting or reallocating both economic and non-economic resources. One of the top concerns among leaders in the electrical field service industry is the loss of human capital.

Over the last three years, I have been involved with a quantitative correlational study that examined the relationship between general job satisfaction, employee motivation, and employee turnover intentions. Participants included electrical engineers and technicians in the electrical field service industry, focusing on NETA-Certified Technicians. This article will present the findings of this study and offer insights related to today's electrical power industry work environment.

BACKGROUND

The United States workforce, and specifically the electrical field service industry, is a collection of individuals working in various environments and industry segments with different levels of formal education and professional certifications. Electrical engineers and technicians interact on-site with individuals who may or may not have a technical understanding of what they do or their scope of work. Because of that, they



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must understand how to communicate with multiple levels of leadership to ensure customer satisfaction and understanding.

In recent years, we have seen electrical professionals who have been working in the field continuing to work later in life. This means that with the aging of the workforce, companies are increasingly faced with integrating multiple generations, necessitating a broader understanding of the needs and skills of each age group. Each generation grew up with different advancements in technology and forms of written and digital communication. What works for one generation may not work for another. In addition, the distinct generations differ significantly in their orientation and motivation to work and advance their careers.

Therefore, having one approach to employee management does not work for all employees. Furthermore, we cannot assume that one type of employee relates better to a particular form of communication, or that specific generations will not or cannot adapt to it.

Factors Impacting Job Satisfaction, Employee Motivation, and Turnover

Many factors impact employee retention, culture being one of the most important. The workforce is made up of cultures from around the world, yet the existence of varying norms and traditions within the different regions in the United States is often overlooked. A multicultural workforce will have different drivers and motivation factors that lead to job satisfaction and motivation. In the past,

organizations often applied one approach to improving employee retention. Today, no one solution will equally impact every employee in the same manner.

The purpose of this electrical power services industry quantitative correlational study and this article is to help organizations understand the constantly changing factors driving employee retention so they can lower voluntary turnover intentions.

Benefits of Increased Employee Retention

Employee turnover increases hiring costs and reduces company profitability. Reducing voluntary turnover allows an organization to reinvest the savings into programs that directly impact and drive employee retention. Maintaining the mindset of just accepting present turnover rates means businesses have to adjust their budgets to include additional hiring costs to maintain expected financial performance.

Human resource teams are looking for answers: What is the correlation between job satisfaction, employee motivation, and turnover intentions?

As the industry has evolved, electrical field service workers' mindset about full-time versus on-demand or gig-worker philosophy has shifted. If we unpack on-demand or gig-worker concepts, we find a changing perspective. Some workers are no longer driven by overtime pay or guaranteed hours, but rather by more time off or not working weekends or holidays. They want to dictate their schedule and choose when and if they work. This mental shift is problematic, as we know this industry lives and dies with after-hours support, holiday work, and long outages or quick turnarounds. Due to this shift in employee desires, organizational leaders need to take an active and continuous approach to identify and understand the issues leading to turnover intentions within their workforce.

Problem and Purpose

Because workforce demands are unique to the electrical field service industry, companies struggle to understand the connection between job satisfaction, employee motivation, and employee turnover intentions and appropriately create retention improvement plans.

So, what are turnover intentions? Employees generally take an active or passive approach to finding a new job. For example, an employee who is satisfied but not motivated would passively look for a job, meaning they will respond to an email or take a phone call from a recruiter or hiring manager. With an active approach to turnover, a motivated employee will actively seek a new job that fits with their career growth, financial expectations, or their stage of life.

The first step to understanding turnover intentions is to define the reasons employees are resigning:

- Seek to understand why each employee chooses to quit.
- Evaluate how employees are recognized, rewarded, and motivated.
- Consider how the work environment, culture, or workforce makeup has changed, and how this drives different desires or motivators.

ELECTRICAL SERVICE INDUSTRY QUANTITATIVE CORRELATIONAL STUDY RESULTS

The purpose of the electrical service industry quantitative correlational study was to examine the relationship between job satisfaction, employee motivation, and employee turnover intentions. The primary target of the study was electrical field service personnel working for NETA Accredited Companies. The focused group of participants resided in the United States and currently held a NETA I, II, III, or IV certification.

Defining Job Satisfaction and Employee Motivation

In exploring job satisfaction, field service personnel defined satisfaction differently based on communication styles, demographics, cultures, groups, and security risks.

The study found that employee motivation is a business topic researchers and leaders are working to understand, and they are investing in identifying ways to minimize the impact of reduced profitability and lower efficiency in productivity hours on business objectives.

Independent Variable: Job Satisfaction

The funnel (Figure 1) represents a wide range of topics that feed into job satisfaction, which is defined as a sense of fulfillment, enjoyment, or an emotional state derived from one's job.

The study found that job satisfaction is made up of three parts.

1. Communication styles, including types of communication, categories or classifications, and sociability versus dominance
2. Security risks
3. Demographics, cultures, and groups

A funnel compresses something into a small output while blending all the inputs. The circles are a fraction of what does or could make up job satisfaction. For example, job security could be a larger percentage of job satisfaction over how team members interact, but both impact the value or quality of one's job satisfaction.

Figure 1: *Job Satisfaction*

Communication Styles

Email, instant messenger, reports, meetings, phone calls, and presentations are just a few of the formats to be considered (Figure 2). An organization should have a formal communication protocol that addresses which form of communication should be used when communicating with its workforce.

Figure 2: *Types of Communication*

Understanding the work environment and context of different types of messages is critical to ensure clarity, timeliness, and communication satisfaction. For example, an individual working in the field or during an outage is not able to receive important or time-sensitive information via a presentation, report, or email. An instant message or a phone call could prove more beneficial. Another example is expecting a field technician to read and review reports or email communications by the end of their on-site work shift.

An organizational communication protocol will ensure that the proper or most effective form of communication is used based on an understanding of the work environment and the nature of the information being relayed. The lack of a communication protocol can adversely impact job satisfaction through unrealistic employee expectations.

Different types of messages require different methods of delivery. More complex communications — such as policy changes or major organizational announcements — are best shared via email or presentations that can be saved and referenced later. Instant messages or phone calls may omit key details or follow-up actions. For example, if employees are required to review and acknowledge a document, it should be delivered via email to ensure proper tracking.

Similarly, significant organizational changes should be communicated through a formal channel, like email or a detailed report.

However, to positively influence job satisfaction, the research shows it is most effective to personally reach out to individuals most affected by the change through phone calls, in-person meetings, or video conferences. Personal communication fosters trust and helps ensure clarity.

Equally important is understanding direct report employees' preferred communication style and how it impacts the delivery and reception of messages.

We often get only one chance to have a first and impactful impression with the communication of information. Consider how best to communicate information and in what format.

- Deliver the details in the most effective manner.
- Communicate in a manner that fits the audience by determining tone of voice and body language.

Communication Classifications

Six categories or classifications of communication can impact job satisfaction: verbal, written, non-verbal, visual, interpersonal, and listening.

In addition to verbal, body language is a natural form of communication and is classified as non-verbal and visual. During a meeting, a loud and overbearing presenter could negatively impact job satisfaction. For example, an individual might interpret the tone and visual cues as anger or even disappointment in performance.

It is important to know your team and peers and their response to different classifications of communication. A good practice is to regularly engage in two-way interactions, following up in writing to capture key points for later discussion and follow-up. A leader's words are important and impactful, and the style of communication directly impacts employee job satisfaction.

A practical comparison can demonstrate the importance of understanding communication classifications and nuances. Aggressive and assertive communication are similar, and individuals might not recognize the difference. Assertive communication contains an essential element of sociability or a personal approach. If an interaction is a win/win, the communication is assertive. On the other hand, if both parties win, but one party feels less open, then communication is aggressive, which can lead to decreased job satisfaction.

- Aggressive: Assigning or demanding a quota based strictly on run rates without considering the knowledge of the local team or local market.

- Assertive: Presenting the quota, staying open to direct feedback, and modifying the objective or quota based on peer feedback and insight.

Comparing passive versus assertive communication, taking a personal approach can be considered assertive or aggressive communication, while passive interaction can be seen as a lack of dominance or confidence in one's leadership.

INDEPENDENT VARIABLE: EMPLOYEE MOTIVATION

The circles in Figure 3 represent the topics that feed employee motivation and what employee motivation needs to survive. Even though the outer circles are the same size, they do not equally contribute to employee motivation, yet all are needed in different quantities and at various stages of life to ensure a strong and healthy environment.

Consider:

- What motivates your team members?
- Are managers and field engineers motivated by the same items?
- Does life stage, job stage, or career stage have a greater impact on employee motivation?

Employee motivation is made up of motivational drivers past and present, compensation, organizational drivers and employee behaviors, positive emotional traits, employees' needs and desires, and stages of life.

Figure 3: *Employee Motivation*

Now let's focus on the stages of life broken down by life stages, job stages, and career stages. It is vital to know which stage individual employees are in to accurately identify and implement employee motivation initiatives.

Motivation: Life Stages

Traveling through life stages (Figure 4) is often — but not always — linear. A worker might be in the advanced stage of their career or thinking about winding down, but be moved into a

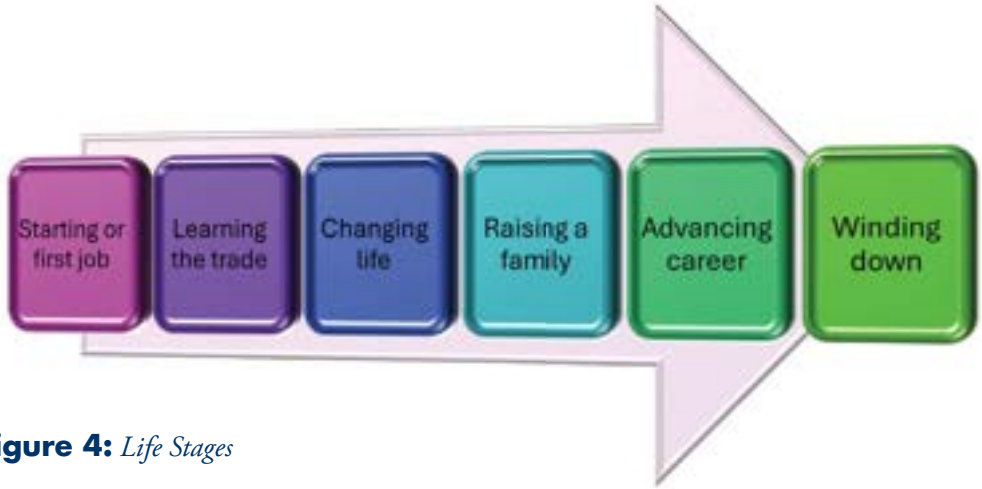

Figure 4: *Life Stages*

leadership or consulting role, only to feel like they were starting over. Or perhaps someone moves their focus to family, like having another child or being a caretaker for aging parents.

Each life stage comes with different motivating factors. When starting a career or a first job, workers are eager to perform while learning the trade. Then maybe life changes, like starting a personal relationship, and now you have more than work to focus on and nurture. For some, raising a family becomes a primary focus outside of work, while others may focus on advancing their careers. In some cases, an individual may be forced to wind down their career.

The complexity of life stages and the lack of linearity are important considerations when considering employee motivators. A keen understanding of the life stage concept will prepare organizational leadership to recognize and support employees while aiding in employee motivation.

Motivation: Job Stages

What are job stages, and how do they impact employee motivation? We break down job stages into seven parts: attraction, recruitment, onboarding, development, retention, exit, and advocacy (Figure 5).

Attraction: How to attract prospective employees to your organization.

- Offer sign-on bonuses, a customized service vehicle, or other perquisites.
- Offer perquisites for the short- or long-term.
- Offer tuition reimbursement for formal education and portray the organization's desire to drive professional growth and career development.
- Offer professional development and outline career paths.

Retention: Why an employee chooses to stay with the company

- What is the value of retention?
- What are your costs for hiring, onboarding, and training one individual?
- If you could reduce voluntary turnover by 1%, which equals the cost of hiring two people, would you do it?

Advocacy: How an employee will speak about or portray their employer and the leadership team after they exit the organization. This is the most significant and defining part of a person's job stage.

Motivation: Money

Money can buy short-term results, but investing in employee development returns long-term dividends with loyal people. Short-term sign-on bonuses invest in the local economy, not your business.

Long-term investment can include annual formal technical training or formal education, like college. In either case, money is invested into human capital that will pay long-term dividends with loyalty and the most technically knowledgeable team in your market.

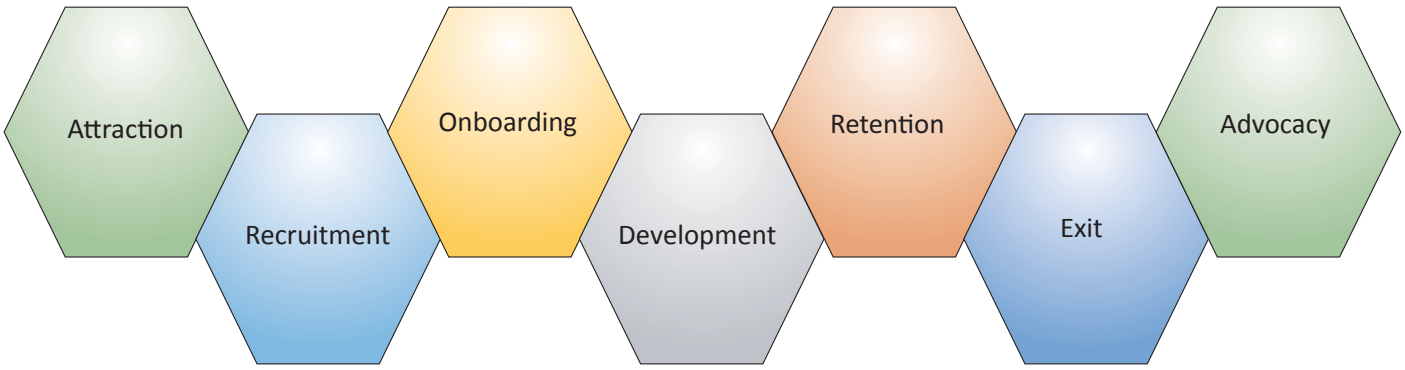

Figure 5: *Job Stages*

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Figure 6: *Career Stages*

For example, research indicates that a tuition reimbursement program increases employee motivation for all employees, even when only a few people use the program. The value and strength of peer collaboration or achievement far outweigh the cost of the program, and depending on their life stage, other employees might want tuition reimbursement in the upcoming years.

Motivation: Recruitment and Onboarding

The recruitment and hiring process can also impact employee motivation. Does the process take days, weeks, or months with numerous interviews for a decision to hire? Recruitment is more than a job posting. It directly impacts employee motivation when other employees are working longer hours without sufficient support.

Having a well-defined onboarding process is important to an employee's first impression of a company. It sets the trajectory of a new hire's employment. With a structured onboarding process, a manager can review and discuss the development process and programs offered, such as tuition reimbursement for formal education.

Motivation: Manage Employee Exit

When an employee resigns, they exit the organization, and the exit process is the last interaction you have with them before they become a positive or negative advocate for the organization. Whether an employee leaves voluntarily or for other reasons, it is critical to treat them with respect, dignity, and encouragement. Everyone is connected within industries, and word of mouth carries tremendous power that will impact current employee motivation, along with the potential motivation of future employees and candidates. Create a strategy to have a positive impact on departing employees to drive advocacy.

Motivation: Career Stage

The challenge: How can we in the electrical power service industry attract people to explore the amazing and ever-changing world of reliable power?

When people enter the workforce stage, they explore industries looking for the types of jobs where they can find motivation to wake up every day and go to work. Career stages include exploration, establishment, mid-career, late-career, and retirement (Figure 6). People work to make money; however, many look forward to some version of retirement.

Society may think that data centers ensure they can stream their favorite TV shows or movies. Those of us in this industry know that without our services to maintain reliable electrical infrastructures, data centers could not successfully function and deliver content. We need focused initiatives that inspire the next generation to explore electrical field service and testing as a career.

After individuals join the electrical power service industry, they begin to establish themselves through peer connections and professional development, such as NETA Technician certification. When individuals pass a technician exam, they have immediate expectations. Organizations that have a formal policy on employee advancement will be best positioned to meet those technicians' expectations. The importance of this is realized when a technician posts their accomplishment on social media, and recruiters instantly reach out.

Moving into the mid-career stage, individuals may shift their focus from professional development to a better work-life balance.

When employees achieve contributorship status, their motivation shifts from development to retention and staying at a company. Even if employees choose a state of contentment, but not complacency, it's still important to find ways to nurture employee motivation.

For example, when organizations do not focus on employee motivation during the mid-career, they lose employees through voluntary turnover as they enter the late-career stage. At this point, it is difficult to attract individuals to come back or stay, as they are focused on winding down to retirement. Ultimately, if leaders can retain employees at the later stages of their mid-career, they have a better chance of retaining them until retirement. It is also important to remember that mid-career employees are still driving employee motivation among their peers and the next generation.

During the winding-down career phase — the retirement stage — retirees often fade into the sunset, even if they still have a desire to contribute. While their motivations are very different from their younger colleagues, organizations should develop a focused plan to keep them motivated and consider retaining them in a mentorship or training position, supporting the organization in developing the next generation or doing project management on the next major contract.

RECOMMENDATIONS

Every employee is unique, and they have various career aspirations. It takes an investment of time and resources to regularly have two-way conversations with team members to discover their needs, motivators, and career trajectory.

Successful organizations that focus on maximizing employee retention have defined objectives and programs with defined check-in periods that contain both measurable and social metrics.

Draft career paths for individuals, then support them financially and with mentoring to ensure their success.

Establish communication policies and long-term perquisites, such as tuition reimbursement programs, that can improve employee loyalty and satisfaction.

Monitor and measure the impact of your retention plan, evaluate the depth of knowledge your team gains, and how they share what they learn.

Modify your retirement plan to include matching funding and a variety of contribution options.

Finally, invest in employees through social or environmental initiatives. Corporate social responsibility (CSR) is a business model where leaders focus on activities and initiatives that directly impact society or the environment. An example is when leaders invest in social programs that help the local community. If employees participate in a social program outside of work, they show a personal attraction and appreciation for the company's support, leading to a stronger personal connection with the company. This type of connection positively influences job satisfaction and employee motivation because employees feel that company leaders are using profits to support causes that matter to them.

An environmental initiative in CSR could focus on projects or contracts related to renewable energy or energy efficiency. Imagine if your employees had solar, wind, or battery-backup systems at home. Leaders who prioritize renewable energy projects will boost employee motivation because they have a personal and direct link to the company's products or service offerings. NW

REFERENCES

[1] Daniels, J. M. (2024). Electrical Field Service Employees' Intent to Stay or Leave. Publication No. 30991912, Doctoral Dissertation, Walden University-Minneapolis. ScholarWorks Dissertations and Theses Global. *https://scholarworks.waldenu.edu/dissertations/15380/*.

[2] Asante Boadi, E., He, Z., Boadi, E. K., Bosompem, J., and Avornyo, P. (2020). Consequences of corporate social responsibility on employees: The moderating role of work motivation patterns. *Personnel Review, 49*(1), 231–249.

[3] Chesney, A. J. (2022). Should I get a master's degree? Evaluating peer effects on education investment decisions in the workplace. *Economics of Education Review, 91,* Article e102329.

[4] Guinot, J., Monfort, A., and Chiva, R. (2021). How to increase job satisfaction: The role of participative decisions and feeling trusted. *Employee Relations: The International Journal*, *43*(6), 1397–1413.

[5] Marx, C. K., Reimann, M., and Diewald, M. (2021). Do work-life measures really matter? The impact of flexible working hours and home-based teleworking in preventing voluntary employee exits. *Social Sciences, 10*(9), 1–22.

[6] Miller, S. (2022). Reports filter human capital and talent access data by industry, size, region and sector. *Society for Human Resource Management*.

[7] Nagurney, A. (2021). Supply chain game theory network modeling under labor constraints: Applications to the Covid-19 pandemic. *European Journal of Operational Research*, *293*(3), 880–891.

[8] Navarra, K. (2022, April 11). The real costs of recruitment. *Society for Human Resource Management.*

[9] Nwafor, O., Ma, X., Hou, J., and Johnson, N. (2022). Online communities and discontinuance of information technology-enabled on-demand workers: Impacts of informal social interactions through dual commitments. *International Journal of Information Management*, *66*, Article e102540.

[10] Ozsoy, E. (2019). An empirical test of Herzberg's two-factor motivation theory. *Marketing and Management of Innovations, 1,* 11–20.

[11] Szostak, M., & Sułkowski, Ł. (2021). Artist, creator, manager, entrepreneur, leader: How society perceive these identities? *Economics & Sociology*, *14*(2), 209–221.

[12] Thome, M. J., and Greenwald, J. M. (2020). Job and community embeddedness on voluntary turnover. *Journal of Business & Industrial Marketing, 35*(10), 1573–1580.

[13] Vora, D., Martin, L., Fitzsimmons, S. R., Pekerti, A. A., Lakshman, C., and Raheem, S. (2019). Multiculturalism within individuals: A review, critique, and agenda for future research. *Journal of International Business Studies, 50*(4), 499–524.

[14] Wei, L., & Nezaj, J. (2022). Missing workers: The labor market has yet to recover from the pandemic. *ADP Research Institute.*

Jeffrey M. Daniels, PhD, *currently works for CBIONE, supporting business growth based on his experience in hands-on fieldwork, back office and program support, local and regional leadership roles, and significant capital expense negotiations and purchases. He started his career in the Navy Nuclear Power Program as an Electrician's Mate and joined the electrical testing industry at Electrical Reliability Services, formerly known as Electro-Test Inc., where he worked as a NETA Level 3 Certified Technician and held various leadership positions, including a director role. During that time, Jeffrey earned a BS in applied sciences and technology with an emphasis in nuclear engineering and an MBA from Thomas Edison State University. Roughly a decade later, Daniels earned a PhD in business administration (DBA) from Walden University. Daniels serves on the board of directors for the Strategic Alliance for Veteran Integration (SAVI), which supports clarifying benefits and providing customized transition solutions to veterans and organizations.*

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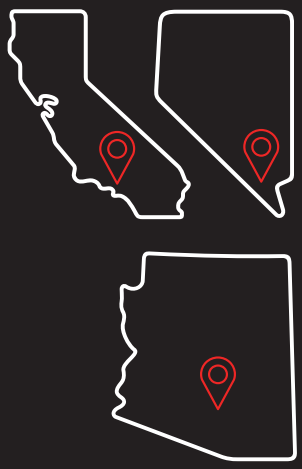

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LIFE AFTER 40: A CRITICAL LOOK AT ELECTRICAL SAFETY'S MOST CONTENTIOUS NUMBER

BY MATTHEW J. ROBINSON, *Sigma C Power Services LLC*

Life ends at 40. It's just a fact that after 40, survivability drops to zero, and we are assured of a fiery, violent death. I am, of course, referring to incident energy calculations that indicate a value above 40 cal/cm².

It is easy to understand the origin of this misconception. In bold black letters, some analysis software indicates that above 40 cal/cm², "NO SAFE PERSONAL PROTECTIVE EQUIPMENT (PPE) EXISTS." Some of the standards we use daily provide simple tables that stop at 40 cal/cm².

These apparent limits prompt panic and hand-wringing among facility owners and safety officers who think that a piece of equipment has effectively been removed from their ability to operate or interact with. Even more perplexing, consider the switchboard with a hazard analysis label indicating 120 cal/cm² installed next to an identical piece of equipment with a label indicating 8.7 cal/cm². A person less versed in the nuances of NFPA 70E®, *Standard for Electrical Safety in the Workplace®*, and its underpinning standards may see that sticker indicating 120 cal/cm² and flatly state, "*There is no way to safely maintain, operate, or even look at the equipment while it is energized*," and proceed to work on the nearly identical equipment right beside it.

The reasons this number is so entrenched in our industry are based on the best of intentions and the desire to protect our fellow workers, but its use has become a point of contention. Safety always comes first; we must ensure that each and every worker makes it home safely at the end of the day. Still, this article aims to prove that there is, indeed, life after 40 cal/cm².

GREATER EMPHASIS

NFPA 70E states:

When incident energy exceeds 40 cal/cm² at the working distance, greater emphasis may be necessary concerning de-energizing before working within the limited approach boundary of the exposed electrical conductors or circuit parts.[3]

This informational note may be the source of the idea that 40 cal/cm² is a hard limit for safe work around energized equipment.

Starting with the 2000 edition, NFPA 70E has focused on providing a structured approach to selecting protective garment clothing systems up to a hazard risk category of 4. In later iterations of the standard, the use of hazard risk categories would be supplanted by the selection of garments based on calculated incident energy. For many in the industry, Table 3-3.9.3 in the 2000 edition of NFPA 70E marked the first time the hazard from an arc flash was quantified in a way that could be used to select a garment system. What had previously been a nebulous set of recommendations, calculations, and rules of thumb became fully formed tables and guidelines that provided a clear path for

Table 3-3.9.3 Protective Clothing Characteristics

Typical Protective Clothing Systems			
Hazard Risk Category	Clothing Description (Number of clothing layers is given in parentheses)	Total Weight oz/yd²	Minimum Arc Thermal Performance Exposure Value (ATPV)* or Breakopen Threshold Energy (E_{BT})* Rating of PPE cal/cm²
0	Untreated cotton (1)	4.5-7	N/A
1	FR shirt and FR pants (1)	4.5-8	5
2	Cotton underwear plus FR shirt and FR pants (2)	9-12	8
3	Cotton underwear plus FR shirt and FR pants plus FR coverall (3)	16-20	25
4	Cotton underwear plus FR shirt and FR pants plus double layer switching coat and pants (4)	24-30	40

Figure 1: *Table 3-3.9.3 as First Published in NFPE 70E, 2000 edition.*

worker protection from Hazard Risk Category 0 through Category 4.

This first table laid the groundwork for what would be the industry-perceived 40 cal/cm² **limit**. However, this first iteration of Table 3-3.9.3 defined the **minimum** arc thermal performance exposure value (ATPV) for clothing as selected for differing levels of hazard risk. By the next edition (2004) of NFPA 70E,[5] the note indicating a need for greater emphasis at incident energies greater than 40 cal/cm² first appeared in Annex D.8 FPN. This informational note still allowed work above 40 cal/cm² but marked a shift towards engineering analysis that would continue to shift the industry standard away from broad hazard risk categories towards discrete, calculated incident energies. By 2018,[6] this informational note was removed from 70E to reduce the confusion surrounding work above 40 cal/cm². In this author's opinion, this change only created more chaos.

2018 was marked by the revision of IEEE STD 1584-2018, *IEEE Guide for Performing Arc Flash Hazard Calculations*[2]. The standard formalized the methodologies for calculating incident energies and quantifying hazards, but was a departure from the emphasis on energy impressed upon workers that was the cornerstone of the initial 2002 publication. Between the elimination of the "greater emphasis" informational note and the modified approach to incident energy calculation, the industry as a whole was left with little guidance as to hazard exposure above 40 cal/cm².

These two revisions to the de facto industry standards appear to have been the final nail in the coffin for any semblance of a life after 40. By now, it appeared that the industry was set on a feedback loop where standards did not provide a clear path to safe work above a certain threshold. Management and personnel alike sought to eliminate their work around such hazards, and garment manufacturers all but eliminated arc protective clothing with ATPV values greater than 40 cal/cm². On one hand, this enhanced overall safety in the electrical industry by pushing management and workers to advocate for elimination, substitution, and engineered controls.

Perhaps this result was the goal all along. However, some incident energy calculations cannot be engineered around, and some equipment must be accessed, even while energized. Although modern standards do not cite the need for greater emphasis, perhaps greater understanding will allow the industry to approach arc flash incident energy with a clear head.

A BRIEF HISTORY OF ARC-RATED GARMENTS

If 40 cal/cm² has become the self-reinforcing limit to arc protective garments, where did that number come from? For that matter, what is the basis for any of the arc flash incident energy thresholds commonly used today? These numbers are easily recognized in the electrical power industry, but their origins predate all but the most grizzled of veterans.

Although the 2000 edition of NFPA 70E was one of the first standards to correlate ATPV values to levels of hazard risk, research into arc-rated garments was already established. The supporting work that culminated in IEEE 1584-2002 analyzed incident energy levels of 1.2, 8, 25, 40, and 100 cal/cm², showing that there is indeed a level of consideration that can be made for incident energies in the 40–100 cal/cm² range. The actual selection of these benchmarks predates even Lee's seminal paper, *The Other Electrical Hazard: Electric Arc Blast Burns,*[7] and requires a look back to the early days of OSHA.

Starting in 1971 and in response to CFR1910.132, *Personal Protective Equipment*,[8] which specifically targeted personal protective equipment in the petrochemical industries, a number of flash protective garments were devised. These flash garments were manufactured to protect personnel from flash fires rather than arc flashes. The standards for these garments were based on flash fires as defined by NFPA

2113®, *Standard on Selection, Care, Use, and Maintenance of Flame-Resistant Garments for Protection of Industrial Personnel Against Short-Duration Thermal Exposures from Fire®* (2025),[9] with a duration of three seconds and were selected to conform to Alice Stoll and Maria Chianta's pioneering work[12] on heat resistant fabrics (the basis for the Stoll curve). This research was parlayed into arc protective clothing and carried with it the history of garment manufacture from its origins in the petrochemical industry. Indeed, full flash-fire suits were provisioned at 8, 12, 20, 25, 31, 40, 50, 55, 75, and 100 cal/cm²[10] during the initial translation of flash-fire protective garments to arc flash protective garments, and ASTM F1959, *Standard Test Method for Determining the Arc Rating of Materials for Clothing*[11] historically provided testing standards of these garments up to 100 cal/cm².

This list explains some of the threshold values for arc flash garments, but let's break down each individually:

- **1.2 cal/cm².** Defined as the threshold between a just curable and just incurable burn, this incident energy value was popularized by Ralph Lee's original research into arc flashes. This level has occasionally been used to denote Hazard Risk Category 0 (before its retirement).
- **4 cal/cm².** Originally published as 5 cal/cm², this was corrected in later editions to correspond to the calculated thermal performance properties of natural cotton with a density of 8 oz/yd² after updates to ASTM F1959. Otherwise known as Hazard Risk Category 1, this level has become the industry's baseline expectation for electrically safe clothing during the performance of most activities. This benchmark was initially tested by Stoll[12] to determine the effectiveness of standard industry worker clothing, often lightweight denim or canvas coveralls.
- **8 cal/cm².** Normalized for most testing according to ASTM F1959, this level comes from early garment guides for the performance of work in most conditions based on the characteristics of natural cotton with a density of 12 oz/yd². Similarly to the origins of the 4 cal/cm² threshold, this benchmark separated heavy-duty workwear from medium-duty garments and was the expected performance for workers exposed to common flash-fire hazards. For most maintenance technicians with regular exposure to arc flash hazards, this is the baseline performance of standard uniforms.[13]
- **25 cal/cm².** This level of incident energy marks the first departure from what would be considered normal workwear into task-oriented garments. For arc flash clothing, this level historically indicates Hazard Risk Category 3 and requires donning a medium-weight flash suit. Strangely enough, this threshold was chosen because of work pants. Common flash-rated pants (excluding coveralls or bibs) had a rating of no greater than 25 cal/cm² because of the thickness and usability of the fabric used in their construction. This was chosen as a standard because it created a system that allowed up to a 25 cal/cm² rating by donning a jacket and hood on top of a worker's normal wear.[14]
- **40 cal/cm².** Similarly to the selection of 25 cal/cm² based on a portion of a garment system, 40 cal/cm² was historically the highest rating of a flash-fire coverall, allowing the worker to only have to don a hood to complete the garment system. Most modern work does not require constant exposure to elevated flash risk, and so modern arc flash suits are part of the layered system that allows workers to quickly achieve the desired ATPV.[15]

What appears to have been lost in the translation from flash-fire garments to arc flash garments are values above and beyond 40 cal/cm². Ultimately, research into the nature of arc flash physics and its complexities above 40 cal/cm² necessitated a cutoff, above which work

can still safely be completed, but in which extant circumstances start to play a greater role.

WHAT REALLY HAPPENS AFTER 40?

After 40? Life goes on. It also gets more complicated. Consider two case studies on the impact of arc flash and its relationship to the arc blast.

Case Study 1: Low Incident Energy and Significant Blast

This fault involved a medium-voltage (13.8 kV) transformer primary switch. Due to a leak in a cable transition bulkhead directly connected to an external oil-filled switch, the insulating fluid slowly drained from the switch, exposing the phase-conducting components to air. The switch arced, creating a blast that ruptured the switch housing (1/4-inch gasketed steel) and blew the switchgear room door off its hinges (photo).

Result of a Low Incident Energy Flash in an Airtight Vessel

Hazard analysis of the system indicated a worst-case incident energy of approximately 12 cal/cm², a level most technicians would not associate with the raw damage the fault caused. The actual thermal energy at the calculated working distance likely would have been minimal, but the associated blast would have caused serious injury to personnel, suited or not. The small, mostly air-tight confines of the primary switch created the perfect conditions to focus and contain the flash energy, amplifying the blast and maximizing its destructive force. Analysis of the panel steel indicates a blast wavefront pressure of 30,000–70,000 PSI.

Flash incident energy and blast potential are interrelated but not correlated in such a way that one can predict the other. Above 40 cal/cm², these interacting phenomena become even more impactful, necessitating careful analysis but not necessarily preventing work, as evidenced by the next case study.

Case Study 2: Excessive Incident Energy and Minimal Blast

This fault was initiated by the failure of a potential transformer in a metering section of a customer's main service outdoor switchgear. Due to relatively high line impedance and the miscoordination of upstream utility protection, the fault persisted for several minutes with an incident energy that could only be estimated in the thousands of cal/cm² (photo). The nature of this fault is closer to an arc furnace than a true arc flash event, but it underscores the role equipment configuration plays in a subsequent arc blast.

When interviewed, onsite personnel were not aware of the fault until after the smoke from the burning material was noted. The gear was vented and louvered, providing ample opportunity for the arc flash to rapidly dissipate thermal energy, creating a minimal pressure wavefront. Accident reconstruction did not indicate any damage from blast pressure, and nearby equipment that was not subject to the arcing heat showed no sign of damage. Truly, the associated blast would not have presented

Result of a Sustained High Incident Energy Fault

Auxiliary Damage Caused by High Incident Energy Fault

a hazard if there were a suit that could have withstood the inferno of plasma this fault generated.

CONCLUSION

Safety is ultimately the responsibility and the right of the individual performing the work. While some hazards may be difficult to fully articulate, we can rely on our gut to help us determine if work should be performed or if we should exercise our authority to stop work and find a better way. This article is not meant to advocate for disregarding many years of truly excellent work in the field of electrical safety. Instead, it proposes that greater emphasis be placed on understanding the inherent hazard of the work we perform and the potential impact of an arc flash.

40 cal/cm² was never designed as the absolute edge of safe work; it was instead provided as a suggested threshold above which further analysis is needed to work safely. While hazard elimination sits at the top of the NFPA 70E hierarchy of controls, substitution and engineering controls come in right underneath. This confirms that elevated levels of incident energy do not prevent work on the equipment while energized. When faced with values that exceed what some may consider safe, seek out that challenge and ensure that the hazard is not only quantified but also understood. Life goes on after 40. None of us wants to meet a premature end, but we still have to live and work. Although 40 isn't the end, it's definitely worth spending some time thinking about. NW

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REFERENCES

[1] IEEE STD 1584-2002, *IEEE Guide for Performing Arc Flash Hazard Calculations.*

[2] IEEE STD 1584-2018, *IEEE Guide for Performing Arc Flash Hazard Calculations.*

[3] NFPA 70E®, *Standard for Electrical Safety in the Workplace®*, 2015 Edition.

[4] NFPA 70E®, *Standard for Electrical Safety in the Workplace®*, 2000 Edition.

[5] NFPA 70E®, *Standard for Electrical Safety in the Workplace®*, 2004 Edition.

[6] NFPA 70E®, *Standard for Electrical Safety in the Workplace®*, 2018 Edition.

[7] R. Lee. "The Other Electrical Hazard: Electrical Arc Blast Burns," *IEEE Transactions on Industry Applications,* Vol. 1A–18. No. 3, p. 246, May/June 1982.

[8] OSHA 29 CFR1910.132, Subpart I, *Personal Protective Equipment.*

[9] NFPA 2113®, 2025 Edition, *Standard on Selection, Care, Use, and Maintenance of Flame-Resistant Garments for Protection of Industrial Personnel Against Short-Duration Thermal Exposures from Fire®.*

[10] F. Selcen Kilinc, Editor. *Handbook of Fire Resistant Textiles*, First Edition, Woodhead Publishing, Philadelphia, Pennsylvania, USA, 2013.

[11] ASTM F1959, *Standard Test Method for Determining the Arc Rating of Materials for Clothing.*

[12] A.M. Stoll and M. A. Chianta. "Method and Rating System for Evaluation of Thermal Protection," *Aerospace Medicine,* Vol. 40, No. 11, pp. 1323–1238, November 1969.

[13] S. Jamil, R. Jones, and L. McClung. "Arc and Flash Burn Hazards at Various Levels of an Electrical System," *IEEE Transactions on Industry Applications,* Vol. 33, No. 2, p. 359, March/April 1997.

[14] T. Gammon, W.J. Lee, Z. Zhang, B. Johnson. "Arc Flash Hazards, Incident Energy, PPE Ratings, and Thermal Burn Injury — A Deeper Look," *IEEE Transactions on Industry Applications,* Vol. 51, No. 5, p. 4275, September/October 2015.

[15] D. R. Doan, E. Hoagland IV, and T. Neal. "Update of Field Analysis of Arc Flash Incidents, PPE Protective Performance, and Related Worker Injuries," *2010 IEEE IAS Electrical Safety Workshop.* doi:10.1109/esw.2010.6164450.

Matt Robinson *is the Director of Safety and Training at Sigma C Power Services LLC. He is also an adjunct professor at Worcester Polytechnic Institute and a student pursuing a PhD in electrical engineering at Penn State. Robinson's passion lies in educating and developing the electrical power workforce, where he uses his position as an excuse to learn as much as he can from the talented folks that make up what he considers one of the most important and poorly understood industries. He holds a BS and MS in electrical engineering from Northeastern University, as well as NETA Level 4 Senior Technician and NICET III certification, is a board-certified safety professional, and serves on NETA's Practice Exam Committee. Specific to this article, Robinson's qualifications include being over 40.*

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INSULATED CABLE FAILURES IN WIND FARMS:

THE ROLE OF SOIL THERMAL RESISTIVITY

BY NILSON BARONI JR and DANIEL BENTO, *Baur USA Corp,*
and DANILO DE SOUZA, *USMT*

The reliability of medium-voltage underground systems is a foundational element for the continuous performance of wind farms, particularly in regions with challenging environmental conditions. In a global context of increasing integration of renewable energy sources into the electrical matrix, failures in buried insulated cables not only affect system availability but also jeopardize operational and economic safety.

The investigation described in this case study was triggered by an unexpected shutdown in December 2019, when one of the collector circuits in a wind complex in northeastern Brazil experienced a phase-to-ground short circuit. This event prompted an extensive technical analysis aimed at understanding the immediate failure as well as the underlying systemic causes that could compromise the full operation of the plant.

The analyzed complex comprises eight wind farms, each equipped with ten 3 MW wind turbines. Each turbine operates at 690 V and is connected to a step-up transformer that raises the voltage to 34.5 kV, the standard value used in the medium-voltage underground collector network. This network consolidates the energy produced across the turbines and delivers it to a substation collector, which then transmits power via transmission lines to a central step-up substation. The collector network employs a 20/35 kV aluminum single-core cable with a nominal cross-section of 300 mm², soft temper, and round compacted construction, classified under stranding class 2. The cable features TR-XLPE insulation rated for 90 °C operation, longitudinal water-blocking, and metallic shielding with bare copper helically wound wires of at least 6 mm² cross-section. Its outer sheath is made of black high-density polyethylene (HDPE, ST7 type), ensuring mechanical strength and protection against environmental stresses.

The coastal region where the wind park is located features specific environmental characteristics, predominantly sandy soil and a humid tropical climate. While these conditions are favorable for wind

PHOTO: © STOCK.ADOBE.COM/CONTRIBUTOR/200620103/ENGEL-AC

generation, they impose demands on the design and operation of underground cables, especially regarding thermal dissipation. The thermal behavior of the soil, its compaction and moisture content, and the spacing between circuits become critical variables in determining the cables' ampacity and the preservation of their dielectric properties over time.

INSPECTION AND ANALYSIS

Initial inspections revealed clear visual evidence of cable degradation. During the excavation of the trench where six three-phase circuits were buried, cracks, deformations, and fusions were found between the outer sheaths of adjacent cables along with signs of carbonization and melting of the polymeric coating (Figure 1).

Figure 1: *Damage Identified on the External Cable Jackets*

This damage raised immediate concerns about the thermal integrity of the system, suggesting that the cables were operating beyond the manufacturer's specified limits, particularly regarding the maximum continuous operating temperature of 90°C.

The methodology adopted for conducting the technical investigation was based on IEEE 1511.1–2010, *IEEE Guide for Investigating and Analyzing Shielded Power Cable Failures on Systems Rated 5 kV through 46 kV*, which provides detailed guidelines for analyzing failures in shielded medium-voltage power cables.

The standard classifies failure modes into six major categories:

1. Mechanical
2. Chemical
3. Electrical
4. Natural aging
5. Thermal
6. Other miscellaneous causes

Using this framework, technical hypotheses were formulated to correlate the observed visual symptoms with potential structural, operational, or environmental root causes.

Mechanical

Mechanical analyses were the first to be considered. The possibility of breaks in the metallic shield or deformations resulting from excessive bending during installation was investigated. Time-domain reflectometry (TDR) tests conducted on the end sections of the circuits showed proper continuity of the shielding, with no peaks or dips indicating breaks. In addition, visual inspections confirmed that the shielding wires were arranged uniformly and remained intact, with no signs of crushing or twisting.

Chemical

The hypothesis of chemical failures was also investigated, particularly due to suspicions of potential interactions between the soil and the cable's outer jacket. In aggressive soils, or those containing contaminant chemical compounds, accelerated degradation of polymeric materials or corrosion of the metallic shielding may occur.

However, tangent delta tests indicated low dielectric losses, suggesting that the internal insulation was in good condition. The absence of records of chemical use in the area, combined with the observation of intact cables installed adjacent to failed ones, reinforced the conclusion that there was no systemic chemical agent present in the soil. Thus, chemical failure was also ruled out as the primary cause.

Electrical

The analysis of electrical failures focused on investigating possible voltage surges, lightning strikes, or partial discharge activity in the affected areas. Electrical testing, oscillographic analysis, and field inspections revealed no evidence of significant surges or localized insulation breakdown. Furthermore, the damage observed on the cables did not match typical patterns of electrical failure, which usually originate from the inside out, whereas in this case, the damage had clearly visible external origins.

Natural Aging

The hypothesis of natural aging was also dismissed based on the short operational life of the cables, less than three years, and the absence of water treeing signs in the laboratory tests.

Thermal

After ruling out the previous causes, attention shifted to the hypothesis of thermal failures. A comparison between in-service cable samples and new cables revealed significant darkening of the insulation, indicating early thermal degradation. This visual difference is shown in Figure 2, where the dark tone of the operating cable stands in stark contrast to the light color of the new cable, indicating exposure to elevated temperatures, possibly exceeding the continuous operating limit.

The observed discoloration is not limited to the fault location. It extends across significant portions of the circuit where improper cable grouping and inadequate thermal backfill were

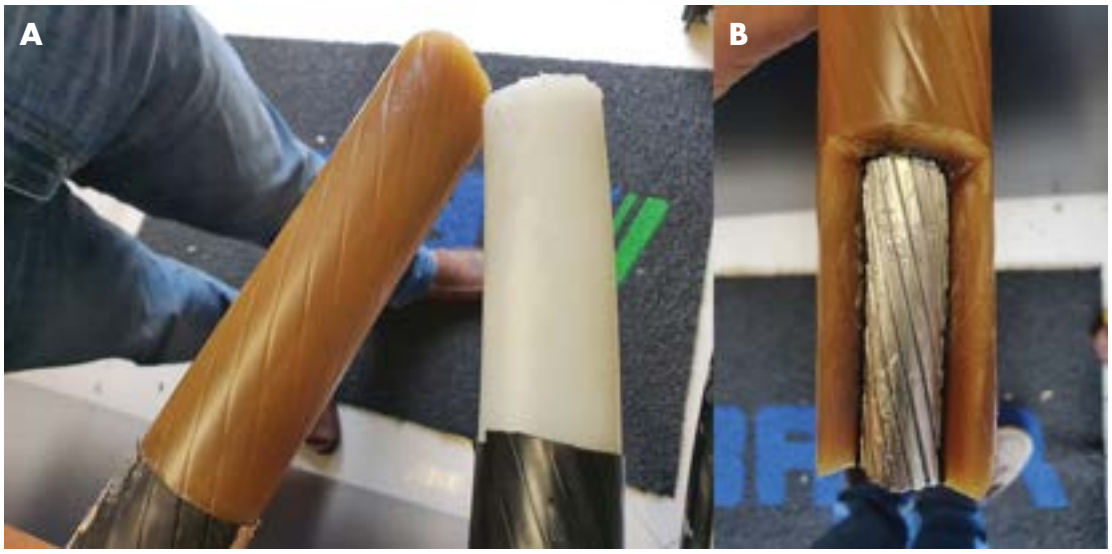

Figure 2: *(A) Operating Cable (left) Condition Compared to the New White Cable (right); (B) Detail of the Insulation Cross-Section after Operation*

applied. These segments experienced recurrent thermal stress, leading to visible changes in cable coloration. In contrast, areas where proper spacing between circuits was maintained and backfill was correctly implemented did not exhibit similar discoloration.

Considering this evidence, the design report for the circuits was reviewed with a focus on three key variables affecting thermal performance:

1. Spacing between circuits
2. Soil temperature
3. Thermal resistivity

Field investigations revealed that the spacing between the trefoils was often less than the 30 cm specified in the design, reaching as little as 19 cm in some sections of the route, which severely impairs thermal dissipation between adjacent cables. Even localized reductions in spacing contribute to the formation of thermal hotspots, accelerating the aging of both the insulation and the outer jacket.

Regarding soil temperature, it was found that the project had adopted a standard value of 20°C, commonly used in temperate regions. However, measurements and meteorological studies of the site indicated an average of 28°C at the cable installation depth (90 cm), a value that compromises the current-carrying capacity of the conductors if not properly compensated for through other design factors.

Even more concerning was the underestimation of soil thermal resistivity. The project used values ranging from 1.0 to 1.5 K·m/W for various segments, whereas IEC 60287, *Calculation of the Continuous Current Rating of Cables,* recommends values between 2.5 and 3.0 K·m/W for dry sandy soils, precisely the conditions at the site.

Thermal simulations were carried out using different scenarios for soil resistivity and temperature. The results showed that with resistivity between 1.0 and 1.5 K·m/W, even under high temperatures, the cables operated below the 90°C threshold. However, with actual resistivities of 2.5 K·m/W or higher — as encountered in practice — the conductor temperature exceeded this limit in nearly all circuits. This confirms that the failure was not caused by electrical overloading, but rather by deficiencies in the thermal design of the installation, particularly due to the absence of thermally stable backfill, inadequate soil compaction, and reduced spacing between cables.

RECOMMENDED ACTIONS

At the end of the analysis, the study concluded that the root cause of the cable failures was

sustained operation beyond the recommended thermal rating, with excessive heating induced by a combination of factors:

- Underestimation of thermal resistivity
- Failure in soil characterization
- Inadequate spacing
- Lack of clear guidelines for soil compaction

This situation led to accelerated material degradation, loss of dielectric properties, and the emergence of mechanical-thermal failures observed visually.

In response to this scenario, two primary actions were recommended.

1. The first, corrective in nature, is the complete replacement of the affected cables, even in the absence of visible electrical failures, considering the accumulated damage and the risk of future collapse.
2. The second, preventive in nature, involves redesigning the system with the implementation of low thermal resistivity backfill, increased spacing between trefoils, and specific measures to ensure proper soil compaction.

As a short-term palliative measure, periodic soil irrigation in the most critical areas was suggested to temporarily reduce thermal resistivity and improve heat dissipation. For the remaining circuits, applied voltage testing with monitoring via partial discharge and tangent delta measurements was recommended to detect latent failures and maintain the operational reliability of the system.

CONCLUSION

This case study illustrates how small inaccuracies in design parameters can lead to significant consequences in medium-voltage underground systems. In contexts of harsh climate and unfavorable soil conditions, neglecting thermal aspects can compromise asset longevity, cause substantial economic losses, and hinder the performance of renewable energy sources.

The analysis reinforces the need for an integrated approach that combines local measurements, laboratory testing, and engineering simulations to ensure the robustness of underground electrical systems in a sector that is increasingly strategic for the country's energy future. NW

REFERENCES

[1] IEEE. IEEE 1511.1–2010, *IEEE Guide for Investigating and Analyzing Shielded Power Cable Failures on Systems Rated 5 kV through 46 kV.*

[2] IEC. IEC 60287, *Calculation of the Continuous Current Rating of Cables.*

Nilson Baroni Jr, PMP®, *is the Operations Director of BAUR USA Corp. He is a Senior Electric Engineer with more than 34 years of experience leading teams and managing projects in engineering, operations, and maintenance of low-, medium-, and high-voltage electrical networks in the overhead and underground segments in the largest electric utility in Brazil (more than 7 million customers). Baroni is an international speaker on topics related to electric utilities.*

Daniel Bento, PMP®, *CEO of BAUR do Brasil and BAUR USA Corp. He is an electrical engineer with over 30 years of experience in medium-voltage insulated cable networks. Bento is a former coordinator of CIGRE Study Committee B1 on insulated cables and co-author of CIGRE Technical Brochures 773 and 924 on fault location and cable diagnostics. He was the technical lead for the entire underground distribution network in the city of São Paulo, Brazil.*

Danilo de Souza, PhD, *is a member of the technical standards committees of the Brazilian Association of Technical Standards (ABNT). He holds a PhD in energy from the University of São Paulo (USP) and is an Associate Professor at the Federal University of Mato Grosso (UFMT). He works in electrical safety, energy efficiency, and energy planning and supervises master's and doctoral research at UFMT and USP.*

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GENERATIVE ARTIFICIAL INTELLIGENCE IN THE POWER INDUSTRY

FLORIAN FINK and JUAN-CARLOS SÁNCHEZ, *OMICRON Energy*

This article explores how generative artificial intelligence (GenAI) can enhance our work and the power grid's efficiency.

CHALLENGES AND TRANSFORMATION IN THE POWER INDUSTRY

The power grid faces numerous challenges, from aging infrastructure and increasing demand to retiring professionals and integrating new technologies like virtualization. We are moving away from large, centralized power plants towards more renewables such as solar and wind. All these factors combined make power grid reliability a complex and evolving challenge:

- **Aging infrastructure.** In some countries, the grid is outdated, prone to failures, and requires significant upgrades and maintenance investments.
- **Increasing demand.** The challenges stemming from decarbonization efforts, such as reducing the use of SF6 and the rise in renewables, electronics, electric vehicles, heat pumps, and air conditioning, are straining the power grid significantly.
- **Retiring professionals and knowledge gaps.** Many experienced professionals are retiring, leading to a loss of expertise and the challenge of training new workers.

Digital tools are no longer optional but are essential for solving these challenges. Can GenAI be the solution to some of these problems? How can GenAI foster the creation of conversational models that can access vast, complex data sets and help close the knowledge gap?

ARTIFICIAL INTELLIGENCE: WHAT, WHY, AND HOW

To clarify some basic principles, let's start with two definitions:

1. **Artificial** refers to something created by humans, for example, computer software.
2. **Intelligence** is the ability to learn, understand, and apply knowledge to solve problems, adapt to new situations, and comprehend complex concepts. It

PHOTO: © WWW.ISTOCKPHOTO.COM/PORTFOLIO/OLEMEDIA

involves cognitive functions, such as reasoning and memory, and emotional abilities, like empathy.

Artificial intelligence (AI) combines these two ideas. AI is a branch of computer science focused on creating solutions that can perform tasks that typically require human intelligence. These tasks range from recognizing speech, making decisions, and translating languages to playing games or driving cars.

AI has evolved significantly from early rule-based systems like IBM's 1997 Deep Blue, a specialized chess software that analyzed millions of moves per second to defeat world champion Garry Kasparov. It advanced through machine learning in the 2000s with systems like Amazon's recommendations and progressed to deep learning in the 2010s, exemplified by iOS Face ID.

AI in the Power Grid

AI holds tremendous potential in power grids. Although not yet widely used, it is starting to gain attention. AI can analyze massive amounts of data to predict and detect failures. For example, machine learning helps predict asset failures and optimize grid operations, aiding decision-making. However, it is important to emphasize that humans always make the final decisions.

GenAI, popularized by ChatGPT in 2022, can create conversational models that access vast data sources and provide human-readable

answers to complex questions. These models can make critical knowledge easily accessible to new engineers, bridging the knowledge gap and enabling quicker problem-solving and more efficient grid management.

GenAI is advancing very quickly. This rapid change creates significant gaps between what is possible with new technologies, what we can understand, and, most importantly, how we can integrate them into our daily work.

At OMICRON, company culture will help us close these gaps with continuous learning, sharing knowledge, and exploring innovative ideas. Failure isn't something to avoid; small, manageable failures are the best way to learn and grow, both individually and as a company.

RETRIEVAL-AUGMENTED GENERATION

Large language models (LLMs) are a specific type of GenAI focused on understanding and generating human-like text. LLMs like GPT-4 are incredibly powerful but have significant limitations, particularly from a training perspective. Training these models is extremely expensive due to the massive computational resources and energy required.

Additionally, LLMs need vast amounts of diverse and high-quality data, making data collection and curation challenging. Once trained, updating these models with new information is also complex and time-consuming, often requiring costly retraining or fine-tuning.

Luckily, retrieval-augmented generation (RAG) offers a solution to these limitations. RAG needs to be used with models that have already been trained, such as GPT-4 (OpenAI), Gemini (Google), LLaMA (Meta), or Claude (Anthropic). It combines their power with a real-time retrieval system that accesses relevant information (Figure 1).

Figure 1: *Retrieval Augmented Generation Schema*

This approach reduces the need for constant retraining, making it more cost-effective. Furthermore, RAG can give models access to specific knowledge stored in internal documents and collaboration platforms. This ensures accurate and up-to-date responses

to internal queries. RAG also has an important advantage: The information it retrieves is not used to train the models, which is crucial for maintaining data confidentiality.

Another advantage of RAG is its independence from the specific LLM it uses. This independence makes it easy to switch between different versions or LLMs as needed, ensuring the system can adapt quickly to new advancements or specific requirements without significant reconfiguration.

CHALLENGES OF IMPLEMENTING AI

Implementing AI in any field has several challenges. We had to consider the following factors before implementing AI:

- **Data preparation.** AI solutions can only be as good as the data they use. Ensuring clean, reliable, and well-organized data helps AI systems learn effectively, achieving more accurate results.

- **Integration with existing systems.** Integrating AI with existing systems is challenging due to data silos and outdated legacy material. In some cases, these systems store data in disconnected and inconsistent formats. Established processes tied to these legacy systems often lack the flexibility to support AI, making it difficult for AI to access and process data efficiently. Departments will need to collaborate and adapt established processes to ensure seamless data flow and maximize the potential of AI tools.

- **Acceptance.** Resistance to change, lack of understanding, and lack of trust in AI's capabilities make accepting AI solutions challenging. Overcoming this reluctance requires training, clear communication, and demonstration of AI's value. Encouraging a culture that embraces innovation with ongoing support helps smooth the transition and enhance the overall effectiveness of AI initiatives.

CASPER: OUR EXPERIMENTS WITH GenAI AND LLMs

Casper is our first GenAI-powered assistant. It was developed in 2023 as part of an innovation project aimed at helping colleagues find and draft answers related to OMICRON products. It can retrieve information contained in files and other knowledge resources. Along with the answer, it references related documents, allowing the user to obtain more information that helps validate it (Figure 2).

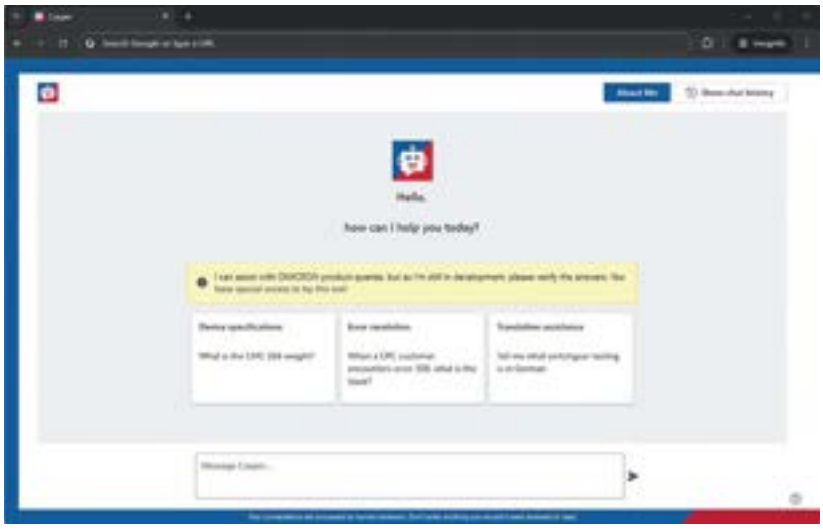

Figure 2: *Casper — Our First GenAI-Powered Assistant*

Casper is intended for internal use only. Currently, there are no plans to turn it into an OMICRON product. Experimenting with a GenAI-powered bot enhances our innovative capabilities and lets us explore new ways to improve our solutions.

During 2024 and 2025, we will collect feedback about the technology and its potential in our industry. This feedback will help us identify new opportunities for improving our solutions.

IS CASPER A CUSTOM VERSION OF CHATGPT OR COPILOT 365?

Casper, ChatGPT, and Copilot have different purposes and access to other data. Our bot understands the relationships between our products, such as software and accessories compatible with main devices, which differentiate Casper from ChatGPT. Casper also considers documents that may be less relevant, such as those related to phased-out products or obsolete accessories.

Copilot 365 is an AI-powered assistant integrated into Microsoft 365 applications. It is designed to enhance productivity by providing contextual suggestions and automating tasks. It can access data, such as emails, meeting notes, and documents, during retrieval. Copilot offers personalized insights and support directly within Microsoft Office apps like Word, Excel, and Outlook. This makes it a personal assistant integrated with Microsoft Office and tailored to our needs.

On the other hand, Casper can use data about OMICRON products. It is meant to be a virtual intern, able to quickly answer OMICRON product-related questions, draft responses, grant access, and provide references to related documents or knowledge sources.

CONCLUSION

While still in the experimental stage, GenAI shows great promise in enhancing the value we deliver to customers. We are exploring this technology to boost efficiency and improve internal knowledge management.

If you want to know which parts of this article were AI-generated and which parts we wrote ourselves, email *juan-carlos.sanchez@omicronenergy.com* or *florian.fink@omicronenergy.com.*

LISTEN TO THE PODCAST

In this episode, OMICRON digital transformation experts Florian Fink and Juan-Carlos Sánchez discuss how implementing digital tools, such as artificial intelligence (AI), helps optimize power grid reliability. They describe the advantages AI presents to the power industry in removing knowledge barriers and improving the efficiency and accuracy of daily tasks, such as analyzing data to predict and detect failures or to optimize energy distribution. Scan the QR Code or visit: *omicron.energy/episode80*

Florian Fink *has been part of OMICRON's product management team since 2013. He focuses on protection testing and industrial and distribution applications and has been driving the topics of digital transformation and generative AI since 2022. He worked as a project engineer for Cegelec, Germany, from 2009 to 2012 and as a planning engineer for InfraServ Knapsack, Germany, from 2012 to 2013. Fink received his diploma in electrical power engineering from the University of Applied Sciences in Cologne in 2009.*

Juan Carlos Sánchez Calle *has been part of OMICRON electronics since 2013. He has more than eight years of experience in software engineering and seven years in product management. As the driver of digital transformation, Calle focuses on leveraging Generative AI and advanced technologies to enhance decision-making and innovation. Passionate about agility and lifelong learning, he actively fosters collaboration to drive digital evolution. Calle holds an MSc in artificial intelligence and big data from Universitat Oberta de Catalunya.*

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A-RENT: BUILDING A BETTER FUTURE TOGETHER

NETA's Corporate Alliance Partners (CAPs) are industry-leading companies that have joined forces with NETA to work together toward a common aim: improving quality, safety, and electrical system reliability.


PAUL SEPPANEN

This ongoing *NETA World* series focuses on the thought leadership behind these successful companies. For this issue's CAP Spotlight, we talked to Paul Seppanen, who founded A-Rent Test Equipment in 2019 to offer a new option for electrical test equipment rental, calibration, and asset management services. Seppanen previously led businesses providing field services in the pipeline, wind energy, and semiconductor manufacturing sectors. He holds BS and MS degrees in engineering from Worcester Polytechnic Institute and Stanford University, respectively.

SERVICES

Whether you need rental test equipment, calibration services, or asset management services, A-Rent can meet your needs. With locations in Chicago, Houston, and Phoenix, A-Rent goes beyond just offering rental equipment. They also provide comprehensive asset management solutions that provide firms with optimized performance and value for their equipment, plus calibration services to ensure the accuracy and reliability of existing equipment. Leveraging a cloud-based system, we ensure asset visibility and utilization while serving as a partner in your project planning.

Renting the best electrical test equipment from the top OEMs is A-Rent's primary business. The company offers flexible daily, monthly, and long-term rentals as well as lease and rent-to-own options and they have the logistical solutions for fast and reliable nationwide deliveries. Customers also have the option to buy equipment out of their rental contracts.

A-Rent calibrates all of its equipment with the correct standards to ensure proper functionality and precise measurements. Its calibration services are NIST-traceable with a three-day turnaround.

A-Rent also helps customers get the most out of the test equipment they already own. Their asset management services include nationwide logistics to support field service teams. Between uses, they look after kit completeness, cleaning, repairs, and calibration.

"We strive for excellence in everything we do," says Seppanen, "and we ensure that our customers receive the highest quality service and equipment."

CULTURE

Seppanen says A-Rent's culture reflects its mission, vision, and values. Guided by a mission to "build a better future together," they are dedicated to becoming the premier test equipment partner for maintaining safe and reliable electrical infrastructure. "Our vision drives us to continually strive for excellence in everything we do, ensuring that our customers receive the highest quality service and equipment," Seppanen explains.

"We are also committed to fostering growth through our people, empowering them to reach their full potential and contribute to our collective success. With a customer-driven approach, we prioritize understanding and exceeding the needs of our clients while building lasting partnerships," he adds. "Together, we seek excellence in all aspects of our work, driven by a shared commitment to delivering exceptional value to our customers and making a positive impact."

NW: **What is the biggest challenge facing your company (e.g., hiring talent, supply chain, recession, safety, etc.)?**

Seppanen: Our biggest challenge is sustaining our organizational culture and exceptionally high service standards as we scale up. We now have 50 people and three locations, with a fourth location to be added this fall. So we've been investing in systems and people development to allow the much larger

and more dispersed team to execute with the same passion we've had since we launched with three people in 2019.

NW: **What are the biggest challenges facing your customers?**

Seppanen: While the industry remains busy, our customers will continue to face challenges maintaining sufficient field technicians and engineering staff to meet the workload. These are deeply technical roles that also require arduous hours, physical demands, and travel, which only a narrow subset of people can sustain.

NW: **Which industry trends are you keeping an eye on?**

Seppanen: We actively track project activities in the grid, data center, and solar spaces, with a special eye on the companies with sufficient personnel to execute the testing and commissioning scopes.

Many newcomers beyond the traditional NETA and OEM firms are now providing these services, including electrical contractors, EPCs, and other specialists. We will continue to tailor our rental, asset management, and technical support offerings to align with the needs of these diverse service providers.

NW: **What new technologies are changing the way you work?**

Seppanen: We seek to deploy AI in every useful application within our business. That does not mean — and will never mean — that we ask clients to organize a rental with a chatbot, but we are actively working on about eight significant use cases across our business that will streamline and improve our execution and analysis.

One tangible example is an AI logistics agent that helps automate the work our inside sales team does for every rental: evaluating and costing the various delivery methods to get test equipment wherever it is needed on schedule.

NW: **What do you predict will impact your business in the near future?**

Seppanen: I'm concerned about the new round of inflation we're experiencing and the possibility of an economic recession

NW: **Is this a good time to be in the electrical power testing business — why or why not?**

Seppanen: Absolutely! There isn't another sector I would consider shifting focus to. As an industry, we provide a critical enabling service for safe and reliable infrastructure that enhances everyone's quality of life.

NW: **If you could change one thing about how your business operates, what would it be?**

Seppanen: It's unrealistic, but I wish FedEx and UPS service levels were higher. We start every day by tracking outbound packages before we help mitigate potential impact to customers. We only consider an order fulfilled when a customer has a complete kit in hand and is ready to test, so shipping problems are ours to solve.

NW: **What advice do you have for young people entering the field?**

Seppanen: Pick a highly professional organization that is committed to your development. Then, try to be the most reliable and hungry young employee you can be. Pay your dues by energetically doing the work assigned, while following role models who have ascended the right way. Stay curious about your company, your client's business, and evolving technology — eventually, these will all fit together into a comprehensive understanding of our sector.

NW: **How important is mentoring in the electrical testing field, and why? What is your personal experience with mentoring?**

Seppanen: Mentoring is vital, and the NETA community has a deep tradition of it. I've personally benefited from it, as Finley

Ledbetter of CBS took me under his wing when I first got involved in the industry. He guided me on switchgear fundamentals, the right rental equipment priorities, and introduced me to many people who have become customers and suppliers.

I seek to continue this tradition by helping others with their businesses, way beyond test equipment needs. I'm also very proud that almost everyone at A-Rent came from outside our sector, and we've been able to develop them into contributing members.

NW: **What are your personal strategies to keep growing and learning as a professional?**

Seppanen: I'm interested in the 'why' of the people, projects, and clients we support. I love hearing people's career stories and what brought them to our niche sector. As a company, we also try to understand the projects where our equipment is used, from a new data center in Louisiana, located for power availability, to a remote mine in the mountains yielding new rare earth supplies.

THE DIGITAL NERVOUS SYSTEM: REINVENTING THE POWER GRID FOR THE AGE OF AI

BY SIMON LOO, *Siemens*

Our world is in the midst of a profound electrical transformation, a foundational shift comparable to the industrial revolution's transition from steam to electricity or the telecommunication industry's leap from analog to digital. While this change is driven by many forces — from the electrification of transport to the integration of renewables — it is being supercharged by one in particular: the artificial intelligence revolution.

The computational power required to train and run today's advanced AI models has an almost insatiable thirst for electrical power, creating an urgent and unprecedented challenge for our global energy infrastructure. The scale of this demand is staggering. The latest generation of AI-specific hardware, such as GPUs and TPUs, consumes immense amounts of energy, and the cooling required to keep these processors from overheating can account for nearly 40% of a data center's total power load.

Consequently, a single large AI data center campus can require a power capacity of hundreds of megawatts, sometimes exceeding a gigawatt, equivalent to the consumption of a small city. This is forcing the tech industry and utility providers to plan and build new, dedicated electrical infrastructure, including entire substations, at a pace and scale never witnessed before. This explosive growth in AI is the primary catalyst fueling the need for a rapid expansion of our power grid.

And it is precisely here, at the critical intersection of urgent digital demand and physical grid construction, that the crisis begins. As we race to build the power systems to fuel the AI era, we are colliding with a wall of physical limitations and technological stagnation.

THE LOOMING CRISIS: A 20TH-CENTURY GRID UNDER PRESSURE

For any organization involved in building this vital infrastructure, the problem is immediate and acute. The construction of a new data center or the supporting utility substation faces staggering delays that can cripple a business case before the doors even open. The primary culprit is the extended lead times for

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essential power equipment. Ordering critical components like large power transformers or medium-voltage switchgear can mean a debilitating wait of up to 52 weeks, with some estimates now pushing 65 weeks or longer.

These delays have monumental real-world consequences. An AI data center, essential for a company's competitive edge, might sit idle for months awaiting switchgear, its business case eroding with each passing day. This is not merely a supply chain issue; it is a systemic crisis rooted in decades of technological stagnation. It is exacerbated by a Great Crew Change in the specialized manufacturing workforce, where decades of tacit, hands-on knowledge in building electromechanical devices is retiring without being fully replaced.

> This explosive growth in AI is the primary catalyst fueling the need for a rapid expansion of our power grid.

At the very heart of this challenge lies an often-overlooked component: the sensor technology used in current and voltage transformers. This foundational technology — the basic senses of the grid — has remained fundamentally unchanged since Edison's era. Its inherent physical and manufacturing complexity is the anchor weighing down our ability to build the grid of tomorrow at the pace the AI revolution demands.

The Achilles' Heel: Deep Flaws of Traditional Sensor Technology

For over a century, the power industry has relied on conventional current transformers (CTs) and potential transformers (PTs). These devices are marvels of electromechanical engineering, consisting of heavy iron cores meticulously wrapped in thousands of copper windings and often submerged in barrels of insulating oil. Yet, the very principles that make them work are also the source of their most significant limitations.

- Their most critical technical flaw is **magnetic saturation**. A simple analogy illustrates the problem: Imagine trying to measure a flash flood with a one-gallon bucket. Once the bucket is full, you have no idea if there are two gallons or two hundred gallons more water flowing by. The iron core of a CT is that bucket. During a massive short circuit, the sheer magnitude of the fault current completely fills the magnetic capacity of the core. At this point, the CT stops measuring accurately and sends a distorted, clipped signal to the protective relay. This can cause a delayed trip command, allowing immense destructive energy to flow for extra milliseconds, or even cause the relay to misinterpret the fault entirely, leading to catastrophic equipment failure.

The industry is rapidly shifting to a nimble, intelligent, and inherently safer electronic-based solution: the low-power instrument transformer.

- Beyond saturation, traditional instrument transformers are plagued by other issues. They are susceptible to **ferroresonance**, a complex and dangerous phenomenon of electrical resonance that can produce extreme overvoltages, potentially destroying the transformers and any connected equipment. Their physical nature is a massive constraint; their immense weight and size dictate the entire physical design of a switchgear cabinet or substation bay. The maintenance burden is significant, requiring periodic oil testing for dissolved gases (DGA) to detect internal faults and replacing aging gaskets to prevent environmentally hazardous oil leaks. Finally, safety is a constant concern. An accidentally open-circuited secondary on a live CT can generate lethal voltages, a well-known hazard that makes routine testing and maintenance inherently risky work.

A PARADIGM SHIFT: THE RISE OF LOW POWER INSTRUMENT TRANSFORMER (LPIT) TECHNOLOGY

A revolution is underway to solve these deep-seated problems. The industry is rapidly shifting to a nimble, intelligent, and inherently safer electronic-based solution: the low-power instrument transformer (LPIT). This innovation, conforming to the IEC 61869 family of standards, is a complete rethinking of power measurement.

Instead of brute-force electromechanics, LPITs employ sophisticated electronic sensing components. They offer a cascade of benefits: radically reduced lead times, lower component costs, vastly simplified installation, and, for the first time, natively integrated temperature sensing.

This is how they achieve it:

- **For current sensing.** The heavy, saturable iron-core CT is replaced by an elegant Rogowski coil. This is a simple air-cored coil that measures the magnetic field around a conductor. Its output is a voltage proportional to the rate of change of the current, which is then digitally integrated with extreme precision. Because it has no iron core, it is physically impossible for it to saturate,

ensuring a linear, highly accurate measurement from normal operation to the most severe fault conditions.

- **For voltage sensing.** The bulky wound PT is replaced by a precision-calibrated capacitive or resistive voltage divider, stepping down high voltages with exceptional stability and accuracy while avoiding the risks of ferroresonance entirely.

Crucially, an LPIT is a point-to-point device. It uses a standard, shielded Ethernet cable to create a direct, dedicated connection to a protective relay, adhering specifically to IEC 61869-10 and -11 for standardized, reliable communication. This is not a fragile IT network link; it is a hardened, industrial-grade data link, as robust as a dedicated hardwired connection but with the speed and precision of digital communication, ensuring that critical protection functions are insulated from any potential network failure.

The Universal Relay: The App Store for Grid Protection

Working in perfect harmony with LPITs is the universal protective relay. This concept represents another significant advancement, mirroring the smartphone paradigm where a single hardware device's functionality is defined by various applications. Instead of requiring dozens of unique relay models for various apparatus types, a single universal relay can now protect motors, breakers, capacitor banks, transformers, and generators — all through a simple software configuration.

This approach, a form of software-defined protection, has transformative benefits. For large corporations, it enables global standardization. A single, highly optimized protection philosophy can be developed and then deployed identically in facilities across the world, ensuring consistent performance. Engineers can now confidently copy and paste one-line diagrams without concerns about hardware compatibility. Technicians can manage programming in the office or the field without worrying about ordering or installing incorrect part numbers. The entire ecosystem of protection and control becomes more flexible, scalable, and efficient.

THE ECONOMICS OF DIGITAL TRANSFORMATION: A TOTAL COST OF OWNERSHIP PERSPECTIVE

While the technical benefits are clear, a complete picture requires an analysis of the economic advantages, which extend far beyond the initial component price. The adoption of LPITs and universal relays offers compelling savings across the entire lifecycle of an asset, affecting both capital and operational expenditures.

Reducing Capital Expenditure (CAPEX)

The upfront savings begin with the equipment itself but ripple throughout the project. The dramatically lower weight and smaller footprint of LPITs lead to significant reductions in secondary costs. Civil works are minimized, as smaller foundations and less physical space are required. The need for heavy structural steel within switchgear and substations is reduced, lowering material costs. The replacement of thick, heavy-gauge copper secondary wiring with a single, lightweight Ethernet-style cable per phase results in substantial savings on copper and the labor required to pull and terminate it. Finally, the simplified, standardized nature of the system reduces the number of engineering hours required for design, integration, and commissioning.

Reducing Operational Expenditure (OPEX)

Over the 30-to-40-year lifespan of a substation, the OPEX savings are even more profound.

- **Maintenance.** Traditional CTs and PTs require a rigorous maintenance schedule, including periodic oil sampling and dissolved gas analysis (DGA), re-gasketing, and mechanical inspections. This is a labor-intensive

and costly process. LPITs, being solid-state electronic devices, require virtually no preventative maintenance beyond periodic visual inspection, freeing up skilled technicians for more critical tasks.

- **Energy efficiency.** Conventional instrument transformers are themselves small transformers that continuously consume power (excitation losses) simply to be ready to measure. While small on an individual basis, this parasitic load adds up across hundreds of devices in a facility over decades. LPITs consume a fraction of this power, leading to measurable energy savings over the life of the installation.

- **Safety and insurance.** The inherent safety of the LPIT system — no oil, no risk of explosive failure, no lethal open-circuit voltages — creates a safer working environment. This can lead to tangible benefits in the form of lower insurance premiums and a reduction in costs associated with workplace accidents and safety compliance.

Cybersecurity in the Modern Substation: A Digital Fortress

The digitalization of the substation naturally raises questions about cybersecurity. Introducing intelligent electronic devices and communication protocols could be perceived as creating new attack vectors. However, the architecture of this modern protection system is designed with security at its core, following a defense-in-depth strategy aligned with standards like **IEC 62443**.

The first and most important layer of defense is the point-to-point nature of the LPIT connection. The critical measurement data travels on a dedicated, isolated cable directly to the relay. It is not on a routable network, effectively creating a digital air gap that makes it immune to network-based cyberattacks. The most critical function — sensing a fault — is hardened by its very architecture.

For the universal relay itself, which does connect to station-level networks for monitoring and control, security is paramount. These devices are hardened industrial controllers featuring:

- **Secure boot.** Ensures the relay only loads trusted, digitally signed firmware, preventing malicious code from being loaded during startup.

- **Role-based access control (RBAC).** Restricts user permissions, ensuring that only authorized personnel can change critical protection settings.

- **Encrypted communications.** Uses strong encryption for all remote management traffic, protecting commands and data from eavesdropping or manipulation.

This layered approach ensures that the digital substation is not only more intelligent and efficient but also robustly secure against modern cyber threats.

PROVEN PERFORMANCE AND A DAY IN THE LIFE, TRANSFORMED

This new digital ecosystem is not merely theoretical. Its power and interoperability were recently demonstrated at Siemens' Frankfurt facility. Inside a state-of-the-art, high-power lab, engineers subjected the system to simulated faults exceeding twenty times the normal operating current. In a key validation, three different vendor LPIT sensors successfully integrated with a single Siemens universal relay, proving true plug-and-play functionality with a low-latency protection response.

The adoption of this technology fundamentally revolutionizes the day-to-day work of the people who design, build, and operate our power systems.

- **The design engineer.** Before, their work was dominated by physical constraints — wrestling with catalogs of heavy components and designing oversized

cabinets to accommodate them. Now, their canvas is digital. They can design elegant, compact systems with logical precision, knowing the sensors are small, lightweight, and standardized.

- **The commissioning technician.** Their day used to involve carefully wiring hundreds of connections, performing complex, multi-step injection tests, and working with constant awareness of high-voltage hazards. Now, their primary tools are a laptop and a patch cable. They can run automated test scripts through a safe Ethernet connection, completing in minutes what used to take hours, with far greater accuracy and personal safety.

- **The grid operator.** Their role evolves from reactive to proactive. Instead of analyzing a cryptic cascade of alarms after an outage has occurred, the continuous, real-time temperature data from the LPITs allows them to see a busbar connection slowly degrading over weeks. They can move from forensic analysis to predictive maintenance, scheduling a repair during a planned, low-cost outage and preventing the failure entirely.

GAZING INTO THE FUTURE: THE INTELLIGENT, CLOUD-CONNECTED GRID

As powerful as this technology is today, its true potential is only just beginning to be unlocked. It provides the high-fidelity, real-time data needed to build a truly intelligent grid. The industry is moving toward even more sophisticated solutions that build upon this digital foundation.

- **The digital twin and cloud-native engineering.** This technology directly enhances real-time digital simulation (RTDS), enabling the creation of high-fidelity digital twins of the power system. Furthermore, cloud integration will allow engineers to test and validate entire protection schemes in a virtual environment. This brings the continuous integration/continuous deployment (CI/CD) model of the software world to the grid, enabling new protection logic to be fully tested on a digital twin and deployed remotely without costly physical factory acceptance tests.

- **From predictive to prescriptive AI.** Future AI-driven systems will move beyond just prediction. It won't just say, "This motor might fail." It will offer prescriptive guidance: "This motor shows waveform signatures indicating bearing wear. Based on the current load profile, we recommend scheduling maintenance within the next 45 days to avoid a critical failure, and the next planned site-wide outage is in 38 days, which is the optimal time for replacement."

The industry is moving toward even more sophisticated solutions that build upon this digital foundation.

- **The grid at the edge.** Universal relays are powerful edge computers. This enables the grid to become decentralized and self-healing. Localized, autonomous control schemes can manage microgrids or distribution loops, isolating faults and re-routing power in microseconds without needing to communicate with a central control room for every event. The vision is of a scalable, software-based protection system that can handle hundreds of feeders simultaneously, adapting to the grid's needs in real time.

- **Mitigating new threats.** These advances will also help address emerging challenges like the impact of solar flares. An intelligent system can use LPIT data to detect the tell-tale signs of geomagnetic disturbances and automatically adjust system parameters to protect vulnerable, high-value transformers from damage.

CONCLUSION: BUILDING THE GRID OF TOMORROW, TODAY

LPIT technology and universal protective relays are more than just incremental improvements. They constitute a fundamental shift in how we approach power sensing and control. This is the essential upgrade needed to solve the deep challenges of an aging grid facing the unprecedented and urgent demands of the AI age. As we continue to face the dual imperatives of decarbonization and electrification, these innovations — offering superior performance, lifecycle economic benefits, and a hardened security posture — are crucial for building a more resilient, efficient, and intelligent power infrastructure. We are finally giving our electrical grid the 21st-century digital nervous system it needs to securely and reliably power our future. NW

Simon Loo *serves as the West Regional Sales Manager for Siemens' Protection and Control department, bringing over 20 years of experience in relay systems and power protection. His expertise spans both traditional and emerging technologies in power system protection and control.*

NETA QEMC & QEMW PROGRAM

Companies with Electrical Power System Maintenance Workers are invited.

NETA established the ***Qualified Electrical Equipment Maintenance Company Program (QEMC)*** and ***Qualified Electrical Equipment Maintenance Worker (QEMW)*** classification in support of the NFPA 70B maintenance requirements.

This qualification program is in response to the recently ANSI-approved NFPA 70B Standard, making proper electrical equipment maintenance mandatory and enforceable. The new program is intended to meet the anticipated demand for vetted, qualified electrical equipment maintenance contractors and workers.

Why become a Qualified Electrical Equipment Maintenance Company?

Facility owners need to provide proof of their maintenance workers' qualifications. Facility owners hiring electrical contractors will choose service providers based on their ability to verify and be assured of the qualifications of a contractor and its workers. The QEMC and QEMW program provides verification of all maintenance worker qualifications.

QEMC Benefits:

- Standard Compliance
- NETA Verification
- Worker Recognition of Expertise

For Contractors - NETA QEMC & QEMW recognition provides a differentiating advantage over competitors.

NETA IS A **RECOGNIZED LEADER** IN THIRD-PARTY VERIFICATION OF ELECTRICAL POWER SYSTEM MAINTENANCE QUALIFICATIONS

NETA's recognition of your ***Qualified Electrical Equipment Maintenance Company*** status provides assurance of your organization's electrical power system maintenance experience, and worker qualifications.

NETA's ***Qualified Electrical Equipment Maintenance Worker*** examination process delivers third-party validation of your field and maintenance workers' qualifications and knowledge.

BECOME RECOGNIZED BY NETA AS A QEMC.

Contact the NETA office to learn more and apply today!

A VISION FOR SUSTAINABLE SMART GRID TRANSFORMATION IN THE MIDDLE EAST

BY KHALED SHADI MORSHED, *Commissioning Services International*

The energy sector is undergoing a significant transformation, with smart grids playing a crucial role in this shift. A smart grid is an advanced electricity network that enables bidirectional communication between utilities and consumers, powered by digital technologies. Smart grids rely on advanced technologies, including automated metering, energy storage, and digital communication, to create a more efficient, responsive, and sustainable power system. These components work together to enhance efficiency, reliability, and sustainability in modern power systems.[1]

With urbanization and technological advancement, the global demand for energy is increasing dramatically. Traditional grids, with their aging infrastructure, are ill-equipped to handle these demands. Moreover, the increasing frequency of natural disasters and the growing threats in cyberspace have made the need for a more adaptive and secure power infrastructure more critical than ever. Smart grids, as the name suggests, have significantly improved the efficiency and flexibility of managing electrical systems. However, as these grids continue to evolve, so does the urgent need to strengthen cybersecurity capabilities, given the escalating cyber threats that inevitably accompany any digital transformation process.

As the world moves swiftly toward net-zero emissions, achieving this goal requires action on all fronts. According to the International Energy Agency (IEA), smart grids are a transformative technology, enhancing our ability to use renewable energy and driving progress toward the 2050 target. In the Middle East, this transition is fueled by both innovation and a strong commitment to sustainability, despite the region's vast fossil fuel resources. This shift reflects a growing

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dedication to a cleaner future, with countries in the region rapidly advancing plans and strategies to achieve their sustainability goals.[2]

WHAT IS THE SMART GRID?

The smart grid is one of the most important developments in modern electrical networks, incorporating cutting-edge technology across its features and components to enhance efficiency and reliability.

Features and Components of Smart Grid

Due to the increase in population, the dynamic nature of the load, and the imbalance in energy demand at all times, demand response becomes one of the most important features of the smart grid. It enables continuous load monitoring and adjusts the generated power to match the required energy.

Artificial Intelligence

Artificial intelligence is used to predict future energy demand before it is produced, optimizing energy management. According to the Electric Power Research Institute (EPRI), incorporating demand response within smart grids offers the opportunity to reduce overall energy consumption. When combined with efficiency improvements, EPRI predicts that the annual growth in electricity consumption will be approximately 0.7% between 2008 and 2035.[3]

Smart Meters

In remote areas where accessing electricity meters is challenging, the need for an innovative approach to measuring energy consumption became evident. This led to the development of smart meters with two-way communication capabilities, enabling utilities to remotely monitor energy usage, detect outages, and implement demand-response programs. Advanced metering infrastructure (AMI) further enhances billing accuracy, strengthens customer engagement, and optimizes energy management, ultimately making power distribution more efficient and reliable.[4]

The smart meter is a key component in a smart grid, as many countries are replacing traditional meters with new ones as part of the transition to smart grids. The smart meter facilitates communication between the power source and the consumer, enables real-time monitoring, and measures energy consumption while providing additional information to the utility company and/or system operator.

Smart meters incorporate various sensors and control devices, supported by a dedicated communication infrastructure, to enhance efficiency and reliability.[5] They collect energy consumption data from end consumers and transmit it via a local area network (LAN) to a data collector. This data transmission can occur as frequently as every 15 minutes or as infrequently as once a day, depending on the data demand requirements. The data collector then collects the information and transmits it to the company's central collection point.

Phasor Measurement Units

While smart meters improve consumer-level monitoring, a device has been developed to measure key electrical parameters such as current, voltage, and frequency at the grid level and to enable real-time monitoring of the grid. Phasor measurement units (PMUs) play a crucial role in smart grids by providing wide-area monitoring to ensure the protection and stability of power flow across long transmission systems in real-time.[6]

Moreover, due to the expansion of electrical grids and the increasing volume of data, machine learning algorithms offer an effective approach to processing information gathered from PMUs. These algorithms enable efficient monitoring and control of modern power systems within short time frames, where productivity and safety are critical concerns.

SCADA System

With smart meters collecting data from consumers and phase measurement units monitoring key grid parameters, it is essential to have a control center that gathers and manages this data. Therefore, a supervisory control and data acquisition (SCADA) system has been designed to monitor and control the system remotely, ensuring efficient and real-time management of the grid.[7]

Energy Storage Systems

Another critical component of smart grids is energy storage systems that play a crucial role in enhancing the flexibility and reliability of smart electric power systems by providing standby power to intermittent renewable energy sources. The reliance on renewable energy presents challenges, as solar panels cannot generate electricity at night, and wind energy depends on weather conditions and wind speed, making the grid vulnerable to power outages. By storing electricity during generation and utilizing it during power interruptions, energy storage systems help stabilize the grid.[8]

IMPLEMENTING SMART GRIDS IN THE MIDDLE EAST

The Middle East is ready for substantial investments in smart grid technologies over the next decades, aiming to enhance energy efficiency and integrate renewable energy sources. According to the Energy & Utilities Market Outlook Report 2020, the Middle East and North Africa (MENA) region is projected to invest approximately $17.6 billion in smart grid infrastructure by 2027.[9]

Governments in the Middle East are advancing grid modernization through supportive policies, regulatory frameworks, and public-

Riyadh, Saudi Arabia

private partnerships. National strategies, such as Saudi Vision 2030 and UAE Energy Strategy 2050, focus on digital transformation and infrastructure upgrades. These include various forms of support for smart grid projects, such as tax incentives and funding opportunities, alongside energy efficiency mandates and automation policies aimed at boosting grid transparency and reducing costs.[10]

Saudi Arabia

As part of its Vision 2030, Saudi Arabia is working to improve all areas of life, including its national power grid. The country is leading the Middle East to develop AI-powered smart grids, aiming for net-zero emissions by 2060. By using smart grids, Saudi Arabia hopes to improve grid reliability, add more renewable energy, and support clean energy goals. This change is backed by key projects like smart meters and automation systems to manage energy more efficiently.

Saudi Arabia has made significant progress in smart grid automation, with 32% of its electricity distribution network automated by 2024 and a target of 40% by 2025.[11] This is in line with the nation's vision, which emphasizes energy efficiency, renewable energy integration, and modernizing infrastructure. Key projects like the Sakaka Solar Plant and the NEOM smart city are central to this transformation. The country's focus on smart meters, grid automation, and control centers is crucial for achieving a sustainable energy future.

AS PART OF ITS VISION 2030, SAUDI ARABIA IS WORKING TO IMPROVE ALL AREAS OF LIFE, INCLUDING ITS NATIONAL POWER GRID.

Saudi Arabia has signed a $1.1 billion contract with China's State Grid Corporation (SGCC) to install 10 million smart meters across the country. This project, completed in March 2023, is part of Saudi Arabia's modernization efforts and aligns with China's Belt and Road Initiative. SGCC's involvement marks its first global expansion, providing an opportunity to export advanced grid technologies. This initiative is crucial in advancing Saudi Arabia's smart grid infrastructure, enhancing energy management across the kingdom.[12]

Mohammed bin Rashid Al Maktoum Solar Park, UAE

UAE

In the UAE, the Department of Energy in Abu Dhabi has partnered with the State Grid Corporation of China to develop an efficient, AI-driven smart energy system, focused on clean and renewable energy sources. Meanwhile, the Dubai Electricity and Water Authority (DEWA) has integrated cutting-edge technologies like AI and IoT into its infrastructure. Notably, DEWA's Automatic Smart Grid Restoration System (ASGR) autonomously detects faults and restores service, marking a significant step toward improving grid reliability.

DEWA'S AUTOMATIC SMART GRID RESTORATION SYSTEM (ASGR) AUTONOMOUSLY DETECTS FAULTS AND RESTORES SERVICE.

The UAE is revolutionizing its power grid through a $1.9 billion smart grid project led by the Dubai Electricity and Water Authority (DEWA). This project, set to integrate AI and IoT technologies, aims to enhance grid reliability, sustainability, and efficiency. A key innovation is the Automatic Smart Grid Restoration System (ASGR), which autonomously detects faults and restores services. Additionally, DEWA's Big Data and Analytics platform is improving grid operations, further boosting efficiency and reliability across the UAE's power network.[13]

The Mohammed bin Rashid Al Maktoum Solar Park is the world's largest single-site solar park, developed by DEWA under the Independent Power Producer model. With a planned capacity of 5,000 MW by 2030 and an investment of AED 50 billion, it aims to cut carbon emissions by over 6.5 million tons annually. The park currently generates 1,527 MW, with additional projects underway. Dubai's clean energy share is set to increase, reinforcing its sustainability goals.[14]

Jordan

As part of its efforts to keep up with advancements, Jordan has planned to implement smart grids in three phases, with a target completion date of 2030.

- The first phase (2020–2021) focused on feasibility studies and establishing regulatory frameworks.

Quweira Solar Power Plant, Jordan

- The second phase (2021–2025) involves deploying distribution automation technology (DAT) and advanced metering infrastructure (AMI) while integrating renewable energy.
- The final phase (2025–2030) will introduce demand response programs and advanced cybersecurity measures. This modernization effort aims to enhance efficiency, improve grid reliability, and support the adoption of renewable energy.[15]

The Ministry of Energy and Mineral Resources is responsible for developing and implementing Jordan's energy policies, including the Smart Grid Plan. It plays a key role in ensuring the plan's successful execution and coordinating various stakeholders, as outlined in the Jordan Energy Strategy 2020–2030 Executive Action Plan.

Jordan's smart grid implementation faces challenges such as high costs, technical complexities, regulatory hurdles, consumer awareness, and cybersecurity threats. The government is addressing these issues through international funding, technical oversight committees, regulatory reforms, public awareness campaigns, and strengthened cybersecurity measures. Collaboration between government bodies, utilities, and the private sector is crucial for successful deployment. These efforts aim to enhance energy reliability, efficiency, and sustainability.

COLLABORATION BETWEEN GOVERNMENT BODIES, UTILITIES, AND THE PRIVATE SECTOR IS CRUCIAL FOR SUCCESSFUL DEPLOYMENT.

SMART GRID IMPLEMENTATION CHALLENGES

Cybersecurity

With the integration of internet technology into the power grid, smart grids have become vulnerable to cyberattacks. One of the most significant challenges they face is cybersecurity threats. A notable example occurred on December 23, 2015, when Ukrainian energy companies experienced unexpected power outages, impacting a large number of customers across Ukraine.[16]

Renewable Energy

Another challenge facing the smart grid is the integration of renewable energy into the grid. Traditional grids rely on fossil fuels, which provide stable and controllable power supplies based on demand. In contrast, renewable energy sources rely on natural elements such as sunlight and wind, which are affected by weather conditions and are not always predictable. As mentioned earlier, one solution to this challenge is the addition of energy storage systems, which allow excess energy to be stored during periods of high generation and used when generation from renewable sources is low or unavailable, helping to stabilize the grid.[17]

Installing smart meters, sensors, communications networks, and other advanced technologies can be expensive, especially in areas with limited infrastructure or difficult terrain. For smaller utilities or those with limited financial resources, the high costs associated with building a smart grid can be a significant barrier to adoption. Moreover, the costs of building a smart grid may be passed on to customers, potentially leading to temporary increases in electricity prices.

CONCLUSION

The smart grid has truly revolutionized energy management, enhancing efficiency and reliability. When properly implemented, the smart grid transforms power networks from a static system to a more dynamic one, providing valuable insights and guiding operators to make better decisions.

However, such a significant advancement also brings challenges that require innovative and revolutionary solutions. In the long run, this could lead to substantial positive changes. Just as the financial burden or high cost of the smart grid poses a significant challenge, this burden could also encourage the adoption of innovative financing solutions, strategic partnerships between the public and private sectors, or affordable smart technologies.

This also includes addressing other challenges and issues such as cybersecurity and grid modernization. In my opinion, here in the Middle East, despite all the general and specific challenges, there is a genuine desire to develop and keep up with the latest advancements, just as many countries in the region have done regarding the smart grid. Saudi Arabia, the UAE, and Jordan are the leading countries paving the way for others to follow suit. NW

REFERENCES

[1] Cleetus, C. "Smart Grids and the Future of Energy: Modernizing the Grid in the UAE and Beyond," The Sustainable Times, November 6, 2023.

[2] Garcia, A. "AI-Powered Smart Grids in the Middle East," Energy & Utilities, August 5, 2024.

[3] Knapp, E. D. and Samani, R. (2013). "What is the Smart Grid?" *Elsevier eBooks*, pp. 1–15. https://doi.org/10.1016/b978-1-59749-998-9.00001-3.

[4] WTS Energy. Smart Grid: What Is It, Key Features, and Benefits, 2025.

[5] J. Zheng, D. W. Gao, and L. Lin. "Smart Meters in Smart Grid: An Overview," *2013 IEEE Green Technologies Conference* (GreenTech), Denver, CO, USA, pp. 57–64, doi: 10.1109/GreenTech.2013.17.

[6] S. Behera, N. B. Dev Choudhury, and D. Tripathy. "Brief Study on Applications of Phasor Measurement Units in Smartgrid Technology," *2021 1st International Conference on Power Electronics and Energy (ICPEE)*, Bhubaneswar, India, pp. 1–5.

[7] T. Akhtar and B. B. Gupta. "Towards a Framework for Analyzing Cyber Attacks Impact Against Smart Power Grid on SCADA System," *2018 International Conference on Communication and Signal Processing* (ICCSP), Chennai, India, pp. 1087–1093.

[8] E. Ozdemir, S. Ozdemir, K. Erhan, and A. Aktas. "Energy Storage Technologies Opportunities and Challenges in Smart Grids," *2016 International Smart Grid Workshop and Certificate Program* (ISGWCP), Istanbul, Turkey, pp. 1–6.

[9] "MENA Smart Grid Investments to Reach $17.6bn by 2027, says Informa Markets Report," *Utilities Middle East*, February 25, 2020.

[10] Credence Research. Middle East Grid Modernization Market Size and Forecast 2032. February 13, 2025.

[11] Saudi Arabia Energy. Saudi Smart Grid Automation Hits 32%, Growing Fast, December 29, 2024.

[12] World-Energy. Saudi Arabia Signs Smart Grid Deal with China's State Grid, Landgrab Continues, November 6, 2020.

[13] Fast Company Middle East. UAE to Revolutionize Power Grid with AI and IoT in DEWA's $1.9 Billion Smart Grid Project, Fast Company Middle East | The future of tech, business and innovation, December 26, 2024.

[14] Dubai Electricity & Water Authority (DEWA). Advanced Electricity and Water Infrastructure is a Key Pillar for the Sustainable Development of Dubai, May 20, 2022.

[15] Shuqair Y. "Towards a Sustainable Energy Future – The Case for Smart Grids in Jordan," *Ecological Engineering & Environmental Technology*, 2023;24(8) pp. 82–96. doi:10.12912/27197050/171569.

[16] CISA. Cyber-Attack Against Ukrainian Critical Infrastructure | Cybersecurity Infrastructure and Security Agency (CISA), July 20, 2021.

[17] Montel. "Smart Grid Challenges: Cybersecurity, Renewable Energy Integration, and Financial Barriers," October 23, 2024.

Khaled Shadi Morshed *received his BEng degree in electrical engineering from Balqa' University, Jordan. He is currently working as an Electrical Engineer at Commissioning Services International (CSI), where he is involved in testing, commissioning, and power system analysis. Morshed is experienced in electrical testing, with a solid background in performing diagnostics and evaluations to ensure the reliability and safety of power systems.*

ANSI/NETA STANDARDS UPDATE

ANSI/NETA ATS–2025 NEW RELEASE AVAILABLE IN THE NETA BOOKSTORE

The ANSI/NETA ATS-2025, *Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems*, received formal approval from the American National Standards Institute (ANSI) on February 20, 2025.

This standard defines the field tests and inspections recommended to evaluate the suitability of electrical power equipment and systems prior to their initial energization. These specifications are designed to confirm that equipment is properly installed in accordance with design requirements, is operational, and performs within applicable industry standards and manufacturers' tolerances.

D. Test Values - Electrical

1. Compare bolted connection resistance values to values of similar connections. Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.

2. Metal-Enclosed Busways

a. Low-Voltage Metal-Enclosed Busways - Insulation-resistance test voltages and minimum insulation resistance values shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data insulation resistance values are to be corrected to a nominal 100-foot busway run. Use the following formula to determine the minimum insulation resistance value, in Megohms, to a 100-foot nominal value:

Minimum Megohm Value = 100 ÷ [busway length in feet]

NETA
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ANSI/NETA ATS ~~2021~~ 2025

7. INSPECTION AND TEST PROCEDURES
7.4 Metal-Enclosed Busways

Adjusted 1000 ft Nominal Value = measured insulation resistance x (Length of Run/1000)

Converted values of insulation resistance less than manufacturer's minimum or less than the corrected minimum Megohm value should be investigated. Dielectric withstand voltage tests should not proceed until insulation-resistance levels arc raised above minimum values.

b. Medium-Voltage Metal-Enclosed Busways – Insulation-resistance test voltages and resistance values shall be in accordance with the manufacturer's published data or Table 100.1.

The 2025 edition introduces significant new content, including:

- Section 7.28: Battery Energy Storage Systems (BESS)
- Section 7.29: Solar Photovoltaic (PV) Systems
- Table 100.6: Medium-Voltage Cables Acceptance Test Values (Tables 100.6.1 – 100.6.6)
- Appendix B: Guidance for Circuit Reliability Considerations for Medium- and High-Voltage Cable Testing Methods (Pictured below).

A noteable revision in ANSI/NETA ATS-2025 is found in Section 7.4.D.2.a-b., Metal-Enclosed Busways. This update introduces separate formulas for low-voltage and medium-voltage systems and replaces the previous nominal 1,000-foot run length with the actual busway length in feet, enhancing the applicability of testing procedures.

Example: A 340-foot low-voltage busduct was tested for insulation resistance, and the result was 5.4 megohms. The minimum value for this length of busduct would be calculated as follows:

Formula: Minimum Megohm Value = 100 / [busway length in feet]

Minimum Megohm value / 340 = 100 / 340 = 0.294 Megohms

Conclusion: Therefore, this 340 busduct would be acceptable.

The ANSI/NETA ATS-2025 is available for purchase through the NETA Bookstore, offered in bound print, PDF download, and a Redline PDF (with all changes highlighted) download.

ANSI/NETA ETT–2022 REVISION UNDERWAY

The revision of the ANSI/NETA ETT-2022, *Standard for Certification of Electrical Testing Technicians,* is currently underway. The initial ballot closed July 13, 2025, followed by the end of the public comment period on July 28, 2025. The updated edition is scheduled for release at PowerTest 2026 and will replace the 2022 edition.

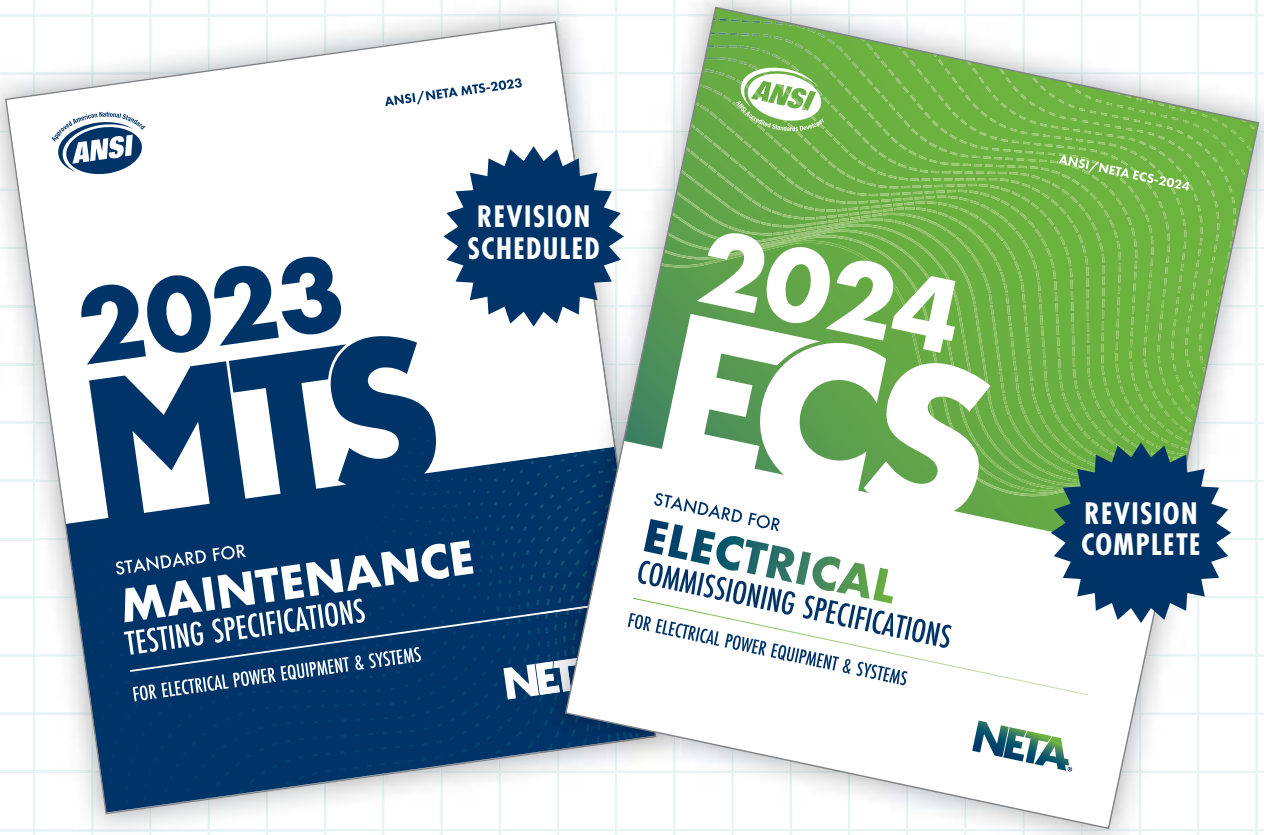
Among the key updates is a revised Detailed Content Outline (DCO), which was published in 2023. The BSR-8 for the recirculation ballot is expected to be released on September 12, 2025, coinciding with the public comment period.

The ANSI/NETA ETT standard defines the minimum qualifications for electrical testing technicians, including requirements for certification, training, and experience. It also outlines the criteria for documenting these qualifications and specifies the standards for an independent and impartial certifying body.

ANSI/NETA MTS–2023 REVISION BEGINS SUMMER 2025

The next revision cycle for the ANSI/NETA MTS–2023, *Standard for Maintenance Testing Specifications for Electrical Power Equipment and Systems*, will begin in Summer 2025. To support this process, the NETA Standards Review Council will convene a series of Working Groups composed of subject matter experts from across the industry. These Working Groups are to pilot a new approach to early-stage comment review. This beta initiative will also serve to refine procedures in preparation for the upcoming revisions of other ANSI/NETA standards. Details regarding the application process, eligibility criteria, and participation guidelines for future Working Groups will be published on the NETA Standards webpage once available.

The ANSI/NETA MTS–2023 establishes specifications for field testing and inspections to evaluate the continued serviceability and reliability of electrical power equipment and systems. These specifications help ensure that



tested equipment operates within applicable industry standards and manufacturers' tolerances and remains suitable for continued operation.

Key updates in the 2023 edition included a comprehensive overhaul of the Cables section and the introduction of a new section addressing Electric Vehicle Charging Systems, reflecting evolving technologies and industry needs. ANSI/NETA MTS–2023 is available for purchase at the NETA Bookstore at *www.netaworld.org*.

ANSI/NETA ECS–2024

ANSI/NETA ECS-2024, *Standard for Electrical Commissioning of Electrical Power Equipment & Systems*, 2024 Edition, completed the American National Standard revision process. ANSI administrative approval was received on July 2, 2024. ANSI/NETA ECS–2024 supersedes the 2020 Edition.

ANSI/NETA ECS describes the systematic process of documenting and placing into service newly installed or retrofitted electrical power equipment and systems. This document shall be used in conjunction with the most recent edition of ANSI/NETA ATS, *Standard for Acceptance Testing Specifications for Electrical Power Equipment & Systems.* The individual electrical components shall be subjected to factory and field tests, as required, to validate the individual components. It is not the intent of these specifications to provide comprehensive details on the commissioning of mechanical equipment, mechanical instrumentation systems, and related components.

The ANSI/NETA ECS revision includes the following new sections for Source-Specific Systems Commissioning: Photovoltaic (PV), Uninterruptible Power Supply (UPS), and Automatic Transfer Switches (ATS). NW

PARTICIPATION

Comments and suggestions on any of the standards are always welcome and should be directed to NETA. To learn more about the NETA standards review and revision process or to purchase these standards, please visit *www.netaworld.org*. To get involved and be considered as a ballot pool member please visit *https://www.netaworld.org/standards/standards-get-involved* or contact the NETA office at 888-300-6382.

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NEW CONTENT INCLUDES:

- Section 7.28, Battery Energy Storage Systems (BESS)
- Section 7.29, Solar Photovoltaic (PV) Systems
- Updated Tables in Section 100.6, Medium-Voltage Cables Acceptance Test Values
- Appendix B, Guidance for Circuit Reliability Considerations for Medium and High Voltage Cable Methods of Test.

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ANSWERS

1. **b.** The four NETA certification levels are Level 1 Trainee Technician, Level 2 Certified Assistant Technician, Level 3 Certified Technician, and Level 4 Certified Senior Technician.

2. **b.** Becoming a Level 1 Trainee Technician requires a high school diploma or equivalent and 8 hours of electrical safety training. Previous electrical work experience is not required. Every field worker starting work with a NETA-certified company begins as a Level 1 Trainee Technician.

3. **d.** 10. Becoming a Level 4 Certified Senior Technician requires 10 years of full-time field experience, 40 hours of safety training, and 200 hours of training related to the certification element categories listed by NETA.

4. **a.** Passing a technical examination. NETA has created technical examinations appropriate to the level being challenged. The content of these examinations goes through a thorough process to ensure they are relevant to the industry and appropriate for the level being challenged. The examination questions and answers are continuously updated.

5. **b. and d.** A third-party independent evaluator (certifying body) administers the certification process, including a proctored examination. This ensures the process is objective and separate from NETA itself, allowing the process to be consistent for all members.

6. **c.** Level 3. Before this level, a technician is developing their skills and knowledge while receiving direction from a senior technician. After five years of field experience and passing the Level 3 exam, a technician will advance to tasks such as working on more complicated systems, running crews, and performing electrical power switching.

7. **b.** 3 years. NETA wants to ensure that any level previously achieved remains relevant. Once Level 3 is achieved, documentation must be submitted every three years to demonstrate that the employee is still actively in the electrical testing industry. This ensures that a customer who hires a NETA company can trust the listed designations based on these guidelines.

8. **d.** Attend an approved course. Level 3 and Level 4 require NETA CTDs to be submitted every three years. NETA may review and grant CTS status to certain technical training or information sessions. Attending an approved three-hour relevant presentation provides three CTDs for submission to NETA. NETA's annual PowerTest conference offers the opportunity to earn many CTDs to meet the three-year CTD requirement. NW

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RESA POWER CANADA RECOGNIZED AS NETA ACCREDITED COMPANY

RESA Power Canada serves the electrical utility, industrial, and commercial markets across Canada and North America. With service locations in Calgary, Edmonton, and Surrey, the company specializes in the electrical maintenance and commissioning of medium- and high-voltage power systems, offering quality and reliable services customers can count on.

The company combines the national access and expertise of a large-scale provider with the speed and service quality of a trusted local partner. A national footprint enables them to deliver a consistent level of service wherever their customers are located. The goal is to provide courteous, expedient, professional service of the highest caliber by performing all electrical tests and inspections with the utmost care and dedication, delivering the highest levels of quality assurance and reliability.

General Manager Zak Houk explains, "At RESA Power Canada, our vision is to be the premier, first-choice provider of critical power services, trusted by our customers and valued by our employees. We are committed to delivering the best customer and employee experience in the industry, ensuring reliability, safety, and excellence in everything we do. We are also proud to be a NETA Accredited Company. This accreditation means that our

technicians adhere to NETA's rigorous certified standards, ensuring full compliance with ANSI/NETA safety regulations."

RESA's experienced team of highly skilled NETA Certified Technicians, project managers, and engineers covers a wide range of power system testing and engineering services to ensure your business is operating at its full potential. The company's specialized commissioning services help identify potential power system problems before they occur, leading to reduced costly repairs down the line.

"NETA recognizes the hard work it takes for NETA Accredited Companies like RESA Power Canada to achieve this important milestone," says Dan Hook, President of CBS Field Services and current NETA President. "NETA Accredited Companies play a critical role in securing electrical power system safety and reliability for all, and NETA is a stronger organization because of these companies' dedication to our industry." NW

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NETA WELCOMES NEW QUALIFIED ELECTRICAL EQUIPMENT MAINTENANCE COMPANIES

NETA has taken a leadership position in support of the NFPA 70B–2023 maintenance requirements by establishing its new Qualified Electrical Equipment Maintenance Company (QEMC) and Worker (QEMW) Program.

This new qualification program is in response to the recently ANSI-approved NFPA 70B®, *Standard for Electrical Equipment Maintenance®*, which makes proper electrical equipment maintenance mandatory and enforceable.

The new program is intended to meet the anticipated demand for vetted, qualified electrical equipment maintenance companies and workers. The vetting process includes a company review and the testing of the company's electrical maintenance workers.

NETA will award all vetted, qualified companies with the Qualified Electrical Equipment Maintenance Company (QEMC) designation.

NETA will award vetted, company-employed electrical maintenance workers who have passed an exam with the Qualified Electrical Equipment Maintenance Worker (QEMW) designation.

NETA is proud to have welcomed nine new Qualified Electrical Equipment Maintenance Companies (QEMC) since the program was launched in 2024. Within those nine companies, 37 Qualified Electrical Equipment Maintenance Workers (QEMWs) have passed the examination.

Congratulations, NETA QEMCs!

- Blackmon Power
- Fleming Controls & Power Specialties
- Holaday-Parks, Inc
- Industrial High Voltage
- Jesse Stutts, Inc.
- Piquette & Howard Electric
- Recore Electric
- Sabino Electric
- VarcoMac LLC

NETA's recognition of these Qualified Electrical Equipment Maintenance Companies provides assurance of the organizations' electrical power system maintenance experience and worker qualifications.

"NETA stands as the foremost authority in the field of electrical power systems maintenance and testing," explains Chasen Tedder, Hampton Tedder Technical Services, NETA Board of Directors, and Chair of the QEMC and QEMW Committee. "This prestigious position has been earned through the unwavering commitment of its network of NETA Accredited Companies (NACs) that form the backbone of its membership.

"The industry has long relied on its NACs to provide a specialized level of expertise in maintenance and testing of electrical equipment and systems. Now that NFPA 70B is a required standard, facility owners are expected to perform system maintenance more often, typically once a month or more. This means that the testing specifications for some of the shorter maintenance intervals are less specialized. It's a smart ongoing maintenance plan, then, that utilizes their qualified electrical maintenance workers for the routine light maintenance tasks, and these workers can coordinate with a NAC to bring in a NETA Certified Technician for the testing experience needed for larger maintenance projects.

"To help address the increased need for maintenance services and verified maintenance workers, NETA has implemented the QEMC and QEMW program, which is designed to meet the needs of clients and customers and provide a better value option for routine inspections and limited maintenance services. NACs can still and will continue to provide these services to clients and customers but can now also work in concert with qualified maintenance companies to augment the strained test technician labor force."

WHY BECOME A QEMC?

Facility owners and operators are aligning their electrical maintenance programs with the NFPA 70B requirement that maintenance be performed by "qualified electrical workers." To comply, facility owners will need to provide proof of their maintenance workers' qualifications, and facility owners hiring electrical contractors will choose service providers based on their ability to verify and be assured of the qualifications of a contractor and its workers.

QEMC REQUIREMENTS

To become a Qualified Electrical Equipment Maintenance Company, an organization must submit a QEMC application and complete a standardized organizational review process, administered by NETA, including:

- Appropriate business license in the state where work is performed
- Review of the company's maintenance capabilities

- Confirmation of a standards-compliant safety program
- Verification of a routine equipment calibration program
- Confirmation of electrical equipment maintenance experience and quality service business operations
- Examination and confirmation of a minimum number of company-employed electrical equipment maintenance workers

QEMW REQUIREMENTS

A Qualified Electrical Equipment Maintenance Worker (QEMW) applicant must pass an exam, administered by NETA, verifying their knowledge and expertise in performing routine electrical equipment maintenance services.

These routine maintenance services support the advanced, electrical testing services specified in the ANSI/NETA standards and performed by NETA Certified Technicians at NETA-Accredited independent, third-party testing organizations. To be eligible for the QEMW exam, applicants must meet the following prerequisites:

- Completed one year as an Electrical Apprentice
- Completed NFPA 70E Electrical Safety Training

NETA's QEMW examination process delivers third-party validation of a company's field and maintenance workers' qualifications and knowledge. The QEMW exam aligns with NFPA 70B 4.3.3 and is designed around routine maintenance services that support the advanced electrical testing services specified in the ANSI/NETA standards. The QEMW exam, which can be taken anytime throughout the year, is coordinated by NETA using the Pearson VUE online proctored platform or at an approved testing center.

CALL TO ACTION

Jill Howell, NETA Director of Sales and Marketing, shares, "In talking with facility owners and operators, they need to align their electrical maintenance programs with NFPA 70B. To do this, they must prove the qualifications of their maintenance workers. Electrical contractors also see the program as a way to verify the credentials of their technician team. The NETA QEMC and QEMW program was created to provide that third-party verification of NFPA 70B qualifications that organizations are looking for."

RESOURCES

More information on the QEMC and QEMW program, including a detailed content outline, a benefits brochure, and how to apply can be found at *NETAWorld.org/QEMC-QEMW.*

Interested in participating in the QEMC and QEMW Program? Email us at qemc@netaworld.org or call the NETA Office at 888-300-6382. NW

HONORING NAMO TECHNICIANS AT POWERTEST25

(Left to right) Dave Kreger, Premier Power Maintenance and NAMO Committee Chair, presented challenge coins to Edwin June, Falcon Allaire, and John Collins of the U.S. Navy Seabees Mobile Utilities Support Equipment (MUSE).

The InterNational Electrical Testing Association (NETA) recently welcomed a select group of military technicians to PowerTest25, its industry-leading annual conference dedicated to electrical power safety, reliability, and cutting-edge industry innovation. Hosted at the Rosen Shingle Creek in Orlando from March 11–15, 2025, this event united industry leaders, technical experts, and notably service members for five days of learning, networking, and professional recognition.

This year, 20 representatives from NETA Approved Military Organizations (NAMO) participated while actively serving in the armed forces. During the ceremonial Technician Recognition Reception, NETA honored both civilian and NAMO technicians across various certification levels for their excellence, dedication, and unwavering commitment to safety and industry standards. These acknowledgments underscore NETA's mission to bridge the gap between military service and civilian technical advancement, demonstrating that skills gained in the military are directly transferable to critical roles in electrical testing and power system reliability.

Many of the attending NAMO technicians are actively progressing in their certification journey and were presented with a challenge coin to commemorate their success and our appreciation of their dedication to excellence and safety.

Through formal recognition, advanced training opportunities, and a strong culture of collaboration, NETA continues to ensure that our NAMO technicians are well-prepared for impactful careers supporting the safety and reliability of the nation's power systems, both during and beyond their military service.

To all our NAMO members: Thank you for your service, your hard work, and your continued pursuit of excellence within the electrical testing industry. NW

SABINO ELECTRIC RECOGNIZED AS QUALIFIED ELECTRICAL EQUIPMENT MAINTENANCE COMPANY

NETA is pleased to announce Sabino Electric Inc. as a Qualified Electrical Equipment Maintenance Company (QEMC). The company achieved certification by participating in NETA's new QEMC and QEMW qualification program, launched in 2024 to respond to new requirements for electrical equipment maintenance based on NFPA 70B–2023®, *Standard for Electrical Equipment Maintenance*®. The new requirements make proper electrical equipment maintenance mandatory and enforceable. Sabino serves Arizona and the Southwest Region out of its headquarters in Tucson and a branch office in Tempe, Arizona.

"It's an honor for Sabino Electric to be recognized as a NETA Qualified Electrical Equipment Maintenance Company," says Bobby Magee, Electrical Technical Account Manager and Support. "Safety has always been a guiding principle for us, and this designation reinforces our commitment to reliable, independent testing. Being part of the NETA network strengthens our ability to support customers across the Southwest with confidence and technical expertise.

"We strive to be the best electrical service provider in our field, achieved through experience, market competitiveness, client

responsiveness, and our safety culture. These characteristics translate into trust and excellence to our clients and vendors and have made us the preferred electrical service provider in Arizona for more than forty years."

"NETA is proud to recognize Sabino Electric as one of NETA's newest Qualified Electrical Equipment Maintenance Companies (QEMCs)," says Chasen Tedder, NETA QEMC and QEMW Committee Chair. "NETA QEMC-recognized service providers are ensuring their Qualified Electrical Equipment Maintenance Workers (QEMWs) align with new NFPA 70B requirements and lead the way in meeting the growing demand for electrical power system maintenance services."

Hiring a QEMC-certified service provider guarantees compliance with the new NFPA 70B requirements for the company and its Qualified Electrical Equipment Maintenance Worker (QEMW) technicians.

Companies interested in becoming a QEMC and/or qualifying their electrical maintenance technicians can contact NETA to begin the application process. See the QEMC Update on page xxx for details. NW

SABINO ELECTRIC, INC.

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PIQUETTE & HOWARD ELECTRIC SERVICE ACHIEVES QEMC QUALIFICATION

Piquette & Howard Electric Service, LLC, was one of the first companies to participate in NETA's new QEMC and QEMW qualification program developed to respond to NFPA 70B–2023 requirements that make proper electrical equipment maintenance mandatory and enforceable. P&H services all of New England from locations in Plaistow, New Hampshire, and Raynham, Massachusetts.

We caught up with Jim Cole, Department Manager Engineering Field Services, who is a recently certified Qualified Electrical Equipment Maintenance Worker (QEMW) and a NETA Qualified Electrical Equipment Maintenance Company (QEMC) representative.

"Initially, we wanted to develop electrical maintenance programs for our existing customer base and begin offering those services," Cole explains. "The changes to NFPA 70B were about to be implemented nationally, and we quickly realized that the new requirements for a safe electrical workplace were going to result in an immensely growing market — and it was going to happen fast!

"We knew we needed to come up to speed quickly, so we began seeking formal training or certification to ensure we were first, were doing things safely, and were providing our customers with the level of service they expect from P&H. First, we looked to NETA and what it would entail to be a NETA Accredited Company, but we did not meet the qualifying criteria, specifically the percentage of our jobs that were required to be electrical testing. As we began investigating NICET courses and other options, Jim Cialdea at Sigma C Power Services LLC (a partner company to P&H) asked if we would be willing to be part of

a pilot program for a new NETA initiative called the QEMC/QEMW (Qualified Electrical Equipment Maintenance Company/Worker).

"Of course, we said, 'YES!' Since then, we have grown exponentially. We can assemble electrical preventive maintenance (EPM) programs for our customers, contract with Sigma C to do our testing and reporting, and support Sigma C with labor in the field (cleaning, running test equipment, etc) while still keeping the job staffed with all NETA Accredited Technicians or QEMW-qualifed personnel (a requirement for many of our customers' insurance carriers).

"We are now looking to expand our QEMW applicants to around 30, which will equate to an astounding 10% of our employees! We could not be happier with our new relationship with NETA's offerings of training, networking, and resources. The benefits are immeasurable."

Hiring a QEMC-certified service provider guarantees compliance with the NFPA 70B requirements for the service provider and its technicians. Service providers interested in qualifying their electrical maintenance technicians can contact NETA to begin the application process. NW

Correction: Jim Cole is the Engineering Field Services Department Manager at P&H Electric. An earlier article incorrectly identified him as the company's owner.

Piquette & Howard Electric Service, LLC
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JESSE STUTTS JOINS QEMC PROGRAM LEADERS

Jesse Stutts Inc. (JSI) has joined the leaders of NETA's new Qualified Electrical Equipment Maintenance Companies (QEMCs). The company achieved certification by participating in NETA's new QEMC and QEMW qualification program, launched in 2024 to respond to new requirements for electrical equipment maintenance based on NFPA 70B–2023®, *Standard for Electrical Equipment Maintenance*®. The new requirements make proper electrical equipment maintenance mandatory and enforceable. JSI serves North Alabama and the surrounding region from its headquarters in Huntsville.

With over 48 years of industry experience, JSI has established a reputation as one of the most highly sought-after electrical contractors in the Southeast. The company prides itself on teaming with its customers to provide the highest quality electrical construction, managed and delivered with professionalism, care, and a commitment to excellence.

One hallmark of JSI's success is its belief that quality work begins with well-trained field personnel. The company's safety program has been developed to promote a safe and healthy workplace, where protecting their personnel and the public is critical to the success of any project.

"We are honored to be able to tell our customers that JSI belongs to an organization

like NETA, whose focus is preventive maintenance," says President Jimmy Wall. "We recognize the importance of maintaining strict quality assurance standards, and now we have access to a standardized way to confirm that our technicians are qualified persons."

"NETA is proud to recognize Jesse Stutts as one of NETA's newest Qualified Electrical Equipment Maintenance Companies (QEMCs)," says Chasen Tedder, NETA QEMC and QEMW Committee Chair. "NETA QEMC-recognized service providers are ensuring their Qualified Electrical Equipment Maintenance Workers (QEMWs) align with new NFPA 70B requirements and lead the way in meeting the growing demand for electrical power system maintenance services." NTW

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- **Worker productivity and motivation**. The PowerTest Conference is the one industry event that brings together thought leaders and like-minded power professionals. The sessions provide specialized training, addressing key safety, field service, and project management issues to improve worker productivity in a collaborative and motivating environment.

- **Project profitability**. By focusing on solutions to all of the above challenges, PowerTest26 participation is one important decision you can make to invest in improving your organization's project productivity and profitability.

SAVE THE DATE

PowerTest26 is shaping up to be another amazing educational experience. The full conference provides in-depth training specifically designed for the electrical power service industry.

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POWERTEST26 LINE-UP: WHAT'S NEW?

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Day 1 and Day 2 Training Themes

- Electrical Safety
- Relays
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- Equipment and Reliability
- Emerging Technology and Business Management (New)
- QEMC/QEMW – NFPA 70B Training (New)
- NETA Technician Certification Exam Prep (New)

Day 3 and Day 4 In-Depth Seminar Themes

- Electrical Safety
- Cables
- Relays
- Transformers
- Renewable Energy
- Emerging Technology (New)
- Sales and Business Management (New)
- Workforce Development and Apprenticeship Program (New)
- QEMW Exam Preparation (New)
- NETA Technician Certification Exam Prep (New)
- Technician Level Up Recognition Reception (New)

Day 5 Targeted Training Themes (2-Hour and 4-Hour Sessions)

- Doble Engineering – Transformer Lab
- Megger Troubleshooting and On-Line and Off-Line Testing (New)
- OEM Equipment Testing and Emerging Technology (New)

PLAN AHEAD

The PowerTest26 **full agenda** is coming soon.

PT26 **registration** opens September 1, 2025. Be sure to sign up early for the Early Bird discounts.

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