NETA®

TRAINING TALK

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NETA

TRAINING TALK

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IEEE IAS ELECTRICAL SAFETY WORKSHOP (ESW): WHY SHOULD YOU GO?

BY MIKE DOHERTY, e-Hazard

Anyone interested in expanding their current knowledge and expertise in electrical safety will find attending the 2024 Electrical Safety Workshop (ESW) in Tucson, Arizona, from March 4–8, 2024, to be an exceptional opportunity.

The mission of the Electrical Safety Workshop is to:

- Accelerate the application of breakthrough improvements in human factors, technology, and managing systems that reduce the risk of electrical injuries
- Stimulate innovation in overcoming barriers
- Change and advance the electrical safety culture to enable sustainable improvements in preventing electrical accidents and injuries

The mission is carried out by:

- Providing forums for people to meet and exchange ideas for preventing electrical accidents and injuries in the workplace
- Accelerating advancements in the development and application of technology, work practices, standards, and regulations
- Linking professionals and centers of excellence in industry, engineering, government, and medicine

Scott Seaver, the chair for ESW 2020 in Reno, Nevada, covers these thoughts well here. *"The ESW is the most important conference to attend because it serves a need that everyone has in common: the desire to survive. It is the most complete electrical safety conference available today, addressing the needs of all who can come into contact with electricity regardless of education, experience, or status. I always say, " If you can attend one conference a year, make it the ESW. It can save your life or the life of someone you love."*

Attending the IEEE Electrical Safety Workshop (ESW) will be a valuable experience for anyone involved in electrical safety. Here are some reasons someone might consider attending:

EDUCATION

The workshop provides an opportunity to learn about the latest developments in electrical safety from the top experts on the globe. Attendees can take part in technical session papers, case history and poster presentations, and multiple tutorials that cover a wide range of topics related to electrical safety best practices and leading-edge thinking.

H. Landis Floyd, ESW 2003 chair in Houston, Texas, and electrical safety pioneer had this to say: *"For more than 30 years, I have eagerly anticipated the next IEEE IAS Electrical Safety Workshop, commonly referred to as the ESW. The events and activities at the ESW are packed with challenging thoughts, innovative ideas, and extraordinary networking with electrical safety leaders, pushing the envelope of what is possible to further advance the prevention of electrical injuries. The annual ESW has challenged me to look beyond simple compliance with the minimum requirements found in the regulations, codes, and standards that have already helped prevent many injuries and saved countless lives. I always come back to this question: If compliance with minimum requirements has produced significant results, what can we achieve by encouraging a safety culture that fosters curiosity about what is possible by focusing on risk and setting our targets beyond compliance? The ESW is the forum to do just that, and I'm looking forward to the next round of stimulating engagement at ESW 2024 in Tucson, Arizona, March 4–8."*

NETWORKING

The workshop is an excellent opportunity to meet and network with professionals in electrical safety and workplace tasks. Attendees can connect with

USED WITH PERMISSION FROM THE IEEE IAS ELECTRICAL SAFETY COMMITTEE.

Past and Present IEEE IAS Workshop Chairs in Attendance in Reno, Nevada, 2023

peers, potential employers or employees, and industry leaders. There has always been a strong alignment and powerful synergy between NETA and IEEE ESW safety professionals who have attended NETA's PowerTest and IEEE's ESW many times over the years. Workplace electrical safety guru, high-end electrical technical expert, and NETA legend **Jim White**, sadly passed, was one of the biggest participants at both events. He was the IEEE ESW Workshop chair in Dallas, Texas, in 2008 and presented many papers over the years. His presence is very much missed. Jim clearly understood the value of participating at NETA and the ESW.

Rene Graves, the chair of ESW 2019 in Jacksonville, Florida, sent these thoughts on the value of the ESW. *"I began attending this workshop in 2008 when one of my electrical engineers invited me to attend the Dallas, Texas ESW. I was not familiar with the workshop and did not know what I was getting into. There were so many presentations around electrical safety that I was hooked. I had no idea there was a conference where the only thing that was discussed was electrical safety. I began my career as an electrician and became a Certified Safety Professional, so this conference was just what I was looking for. During my first conference, a man named Lanny Floyd approached me and asked me why I was there. He asked if I would be interested in conducting a tutorial on electrical safety management, and Floyd, Mike Doherty, and I began our journey together. That one invitation to become a part of a much larger community has led me to become a part of a solution to keeping individuals safe while working on or near electrical hazards. If you are looking for a great interactive conference with the pioneers of electrical safety, I have a recommendation for you! We would love to get to know you and see you in Tucson, Arizona, the week of March 4–8, 2024. The conference begins on Tuesday afternoon, but before the conference officially begins, we have standards meetings on Monday morning that are open to everyone. These are followed by sub-committee meetings on Monday afternoon that are also open to everyone. These sub-committee meetings are of great interest to many people including individuals interested in how electrical safety is achieved for occupational safety and health professionals. Or perhaps you have an electrical lab and want to talk to people about how to manage it better, or maybe you are an early-career person wanting to know where you fit in? All these and more can be found at the electrical safety workshop. It's an opportunity for all attendees to see friends and talk about their passion for electrical safety. Come join us and become a part of the growing Electrical Safety Community."*

PROFESSIONAL DEVELOPMENT

Attending the ESW can contribute to your professional development by providing continuing education units (CEUs).

CAREER ADVANCEMENT

The workshop provides an opportunity to gain new skills, knowledge, and perspectives that can help advance your career in electrical safety — and indeed at your workplace.

INDUSTRY TRENDS

Attending the workshop can provide insight into the latest industry trends and emerging technologies that can help attendees stay up-to-date and relevant in their field. **Marcelo Valdes**, 2014 ESW chair, San Diego, California, says: *"The workshop is important to different people in different ways. The people that gather there come from a variety of places and backgrounds, with unique experiences and knowledge, all needing to fulfill their different and varying professional responsibilities better. Regardless of their differences, they all have something in common: Ensuring electrical workers — whether it is their fellow workers, their customer's workers, or their employees — greater safety. The need to achieve a safe work environment unites them all. Many leaders come to learn how to manage maintenance and operations more effectively at their facilities. Providers of electrical products may come hoping to get a sale, and many do, but the greater value often lies in learning the details and subtleties about safety-related needs in the market that they can glean from industry experts able to explain the why, the how, the when, and the where of those needs in learned detail. Contractors, consultants, and facility engineers will learn from the concentrated experience of their peers and experts that surround them, standing on the shoulders of not one or two experts, but on a platform of shoulders, including some of those who wrote the book on electrical safety. This is where electrical safety thought leaders and teachers congregate to learn from each other. It's their living room! Accidents often happen when something is ignored, some risk is missed, misunderstood, or unseen. At a lunch table, over a cup of coffee during a break, or while listening to a presentation or conversation by others at ESW, a light can suddenly be turned on, illuminating that otherwise unseen risk that would cause tomorrow's accident. You just have to be there with your eyes and ears open!"*

LOCATION

Tucson, Arizona, is known for its beautiful natural scenery, warm climate, and cultural attractions. If you are interested in exploring the city and its surroundings, attending an event in Tucson provides a chance to combine business with pleasure. We expect the daytime weather to be 75°F (24°C) in March. The 2024 ESW will be held at the stunning El Conquistador Hotel and Resort.

SUMMARY

Attending the IEEE Electrical Safety Workshop in Tucson, Arizona, in 2024 will provide an excellent opportunity for you to expand your knowledge, network with others, advance your career in electrical safety, and help improve worker electrical safety.

MIKE DOHERTY, *chair of ESW 2007 in Calgary, Alberta, is an is an independent electrical safety consultant and training contractor for e-Hazard and is President/Owner of Blue Arc Electrical Safety Technologies Inc. Mike has over 47 years of industrial and electrical utility experience as an instrumentation technician, licensed electrician, training professional, electrical utility safety professional, and electrical safety consultant. He is a Senior Member of IEEE and IEEE (PCIC) Emeritus; past chair of ULC CAN/ULC-S801-14,* Standard on Electric Utility Workplace Electrical Safety for Generation, Transmission and Distribution*; and past chair of the Association of Electrical Utility Safety Professionals (AEUSP) in 2018-2019. He was chair of CSA Z462 Technical Committee* Workplace Electrical Safety *Canada from March 2006–December 2018 and continues to serve on Z462. Mike was the 2013 recipient of the IEEE IAS Petroleum and Chemical Industry Committee (PCIC) Electrical Safety Excellence Award, the 2017 Technical Presentation Award — Best of Electrical Safety at NETA's PowerTest Conference, and the 2019 IEEE electrical safety workshops outstanding service award.*

HP&D'S APPROACH TO IMPACTFUL ONBOARDING

BY STEPHANIE McLAUGHLIN,
Hood Patterson & Dewar

In 2018, Hood Patterson & Dewar (HP&D) was struggling with the same concerns many companies encounter as they expand: how do you ensure that as you grow, you continue to retain the culture that made you a success while also confirming that knowledge is effectively transferred to new employees? Our leaders realized we needed a comprehensive employee development program to address these concerns, and I was hired to focus on creating a formal employee development program while allowing billable employees to stay focused on client satisfaction.

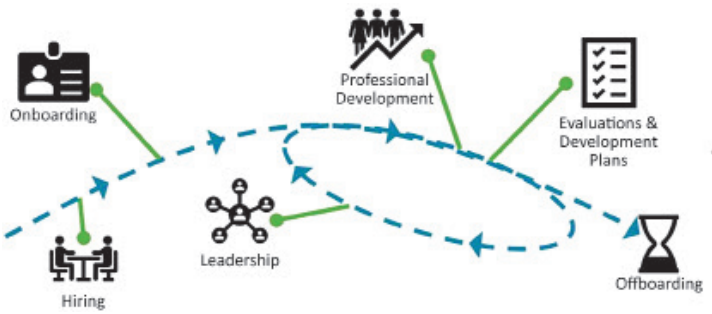

Figure 1: *The Employee Journey Diagram*

IDENTIFYING THE IMPORTANCE OF ONBOARDING

To create our employee development program, I completed a needs analysis to determine what structure and components would work best for our company. One key takeaway from this process was that we needed to ensure we were setting our new employees up for success from the start of their tenure with us. According to a research study by Glassdoor, "*Organizations with a strong onboarding process improve new hire retention by 82% and productivity by over 70%.*"

When we created our employee development program, titled The Employee Journey, onboarding was identified as one of the main pieces of the program.

CREATING IMPACTFUL ONBOARDING EXPERIENCES

Sometimes onboarding is viewed as just the initial elements of hiring a new employee, bringing them into an organization, and perhaps issuing their computer and other equipment. While these steps are included in our onboarding experience, we also identified other important elements of an impactful onboarding experience:

- Mentorship
- Day 1 Orientation
- Core Competency Books (CCBs)
- Online Training
- On-the-Job Training
- New Employee Boot Camp Class

Mentorship

Mentorship is an important part of our onboarding experience. Every new employee is matched with a mentor. A mentor is a trusted advisor for the new employee — someone who will answer their questions or provide advice and guidance. The relationship between the mentor and the mentee is key to helping the mentee feel connected to the company as quickly as possible.

All of our mentors are volunteers. Since mentoring takes time away from other tasks, a mentor has to be willing and able to perform in this capacity. We prefer mentors who are enthusiastic, and since the formal mentoring program lasts a year, it is also a long-term commitment. If it is the first time that

someone has served as a mentor, training is provided around the process and expectations, including:

- The basic responsibilities of a mentor are to engage in regular, supportive communication with the mentee and to provide guidance as appropriate.
- Mentors should plan to contact mentees regularly, including:
  - Before the first day (highly recommended)
  - During the first week
  - Weekly for the first month
  - Monthly for the first year, at a minimum

I check in regularly with mentor and mentee to see how the relationship is progressing. This gives the mentee another person who is reaching out and connecting with them. For the mentor, this tends to be a gentle reminder to stay in contact with the mentee. We have received amazing feedback from mentees as well as mentors on our program. For example:

"Time certainly is flying by; it hasn't felt like five months! Everything is still great on my end, I'm always improving, and XXX is a big part of that. He is always there anytime I need his advice or can at least point me in the right direction. I have completed the survey and I appreciate the effort you put in to constantly improve an already great system!"

Day 1 Orientation

We bring all new employees to our headquarters so they have an opportunity to meet with different stakeholders involved in their onboarding, such as the HR manager, the employee development team, the safety team, the marketing team, the accounting team, and the IT team. These teams make up the administrative department, whose job is to serve our people's needs throughout the organization. By having everyone meet in person, new employees tend to feel much more comfortable with us and are more likely to reach out when they need assistance.

On their first day, our senior leaders take new employees to lunch to get to know them better. This helps to start building that relationship. For us, relationships have been the foundation of our success, and getting our new employees acclimated to that culture as quickly as possible is beneficial.

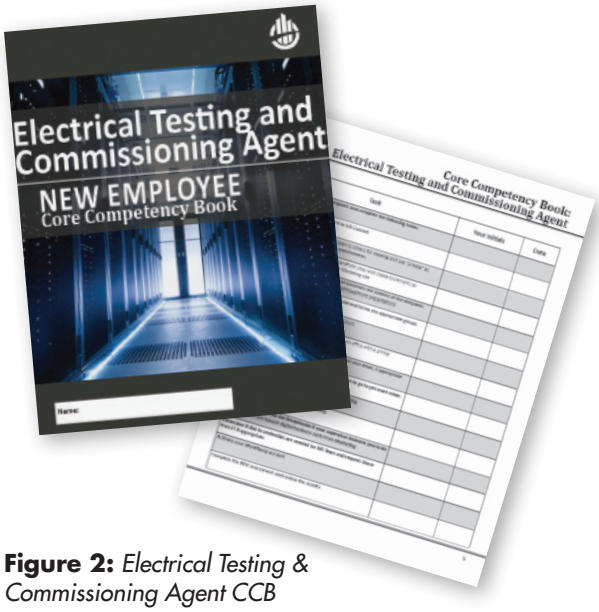

Figure 2: *Electrical Testing & Commissioning Agent CCB*

Core Competency Books (CCBs)

Our core competency books (CCBs) provide new employees with a comprehensive list of all the onboarding tasks that need to be completed and a list of soft, hard, and technical skills to be mastered throughout their time in that position. Each role has a unique CCB. These books allow employees to take the reins of their onboarding and professional development and serve as a tool for mentors and supervisors for development discussions throughout the employee's career. Each new employee is provided with their CCB during day 1 orientation.

Online Training

Training is vital for all new employees. We utilize a learning management system (LMS) that allows employees to complete their assigned training classes virtually. Each new employee is assigned a learning path specifically created for their role. This path includes basic training related to entering time and expenses, basic safety, general company expectations, and information technology.

Depending on the new employee's role, they are also assigned comprehensive safety training classes that will prepare them to enter a job site with an understanding of the processes and procedures required to work safely.

On-the-Job Training

All new employees start with on-the-job training (OJT). Depending on their prior experience, OJT will last until the employee is able to complete tasks without support. OJT can also occur when people learn new skills or cross-train for new positions.

New Employee Boot Camp Class

In the 1990s, we had fewer than 10 employees within HP&D. At that time, we were able to impart our culture and values to new employees in an organic way since everyone worked so closely together. By 2019 when we launched our employee development program, we were closing in on 100 employees, and we knew we needed a way to intentionally instill the culture and values that had helped us to be so successful in the past. It was during this time that we created the New Employee Boot Camp class.

This is a two-day class where we explore the different departments in our organization and the elements that have led to our success over the last 75 years. We start by exploring our history and beliefs. Leaders from each department speak about their teams, the services they offer, and the clients they serve. Finally, we have incorporated some hands-on time during Day 2 to explore the resources and tools available to all employees.

Overall, we have worked hard to make this course informational, engaging, and interactive. We have also structured this class to allow senior leaders to join the attendees for lunch each day, which is a great opportunity for everyone to put faces with names and build relationships.

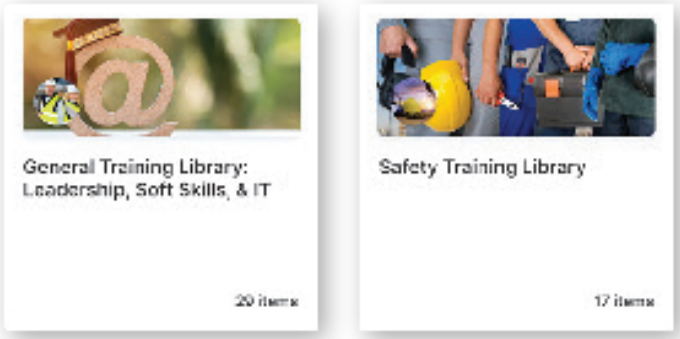

Figure 3: *Online Training Libraries*

New Employee Boot Camp Class in March 2023

START NOW!

Creating an impactful onboarding experience benefits everyone in an organization and the clients you serve. I encourage you to reflect on your current processes and try to identify at least one area that can be improved. Employee development is less about having a perfect program and more about continuously improving to meet the evolving needs of your people.

STEPHANIE McLAUGHLIN *is Director of Employee Development & Marketing for Hood Patterson & Dewar, where she led the development and implementation of HP&D's employee development program that supports employees in offices in five states, including a large team of registered Professional Engineers (PEs), degreed engineers, and career test technicians. Stephanie specializes in analyzing learners' needs and then designing and developing components to meet those needs. She has experience creating development initiatives in the automobile, hospitality, and cloud computing industries, as well as developing initiatives for Gwinnett County (Georgia) Public Schools. Stephanie earned a BS in technical and professional communications at Southern Polytechnic State University and an MBA from Georgia Institute of Technology as well as an education certificate from Brenau University.*

CABLE TESTING WITH TIME DOMAIN REFLECTOMETRY

BY TOM SANDRI,
Protec Equipment Resources

A time domain reflectometer (TDR) measures reflections along a cable. It is similar in principle to radar. To measure those reflections, the TDR transmits an incident signal into the cable and watches for its reflections (Figure 1). If the cable is of a uniform impedance and is properly terminated, there will be no reflections, and the remaining incident signal will be absorbed by the termination at the far end. However, if impedance variations exist, some of the incident signals will be reflected to the source.

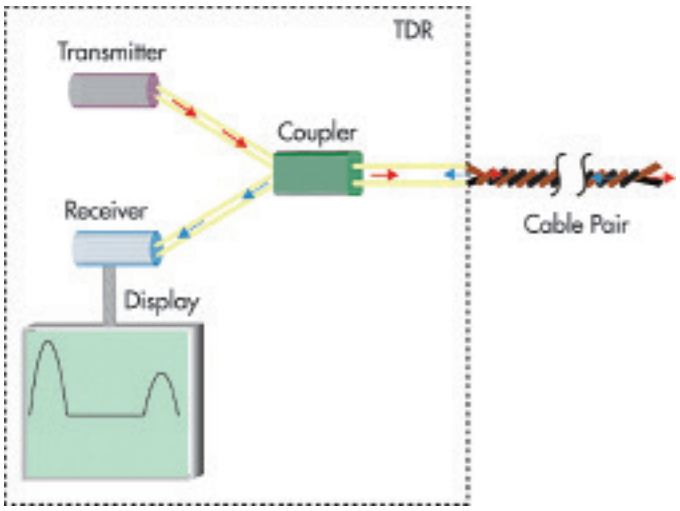

Figure 1: *TDR Theory*

TECHNOLOGY REVIEW

Two side-by-side conductors separated by an insulator (as in a cable) will show characteristic impedance between them. If the distance between the conductors does not change, the impedance does not change. If the distance between them increases, the impedance goes up. If the distance between them decreases, the impedance goes down. Time domain reflectometers (TDRs) use simple transmission-line theory and pulse-reflection principles to detect these impedance changes along a cable. The TDR transmits high-frequency electrical pulses that travel through the cable until a change in characteristic impedance is encountered (Figure 2). Depending on the nature of the impedance change, all or part of the transmitted pulse will reflect to the TDR.

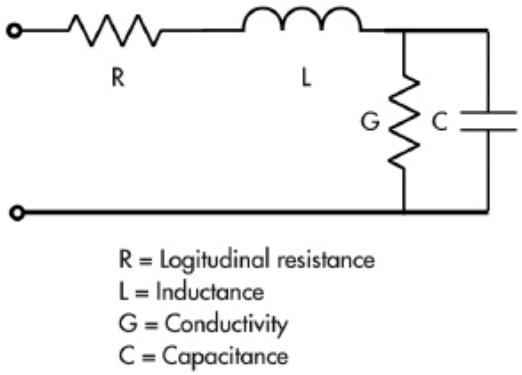

Figure 2: *Characteristic Impedance*

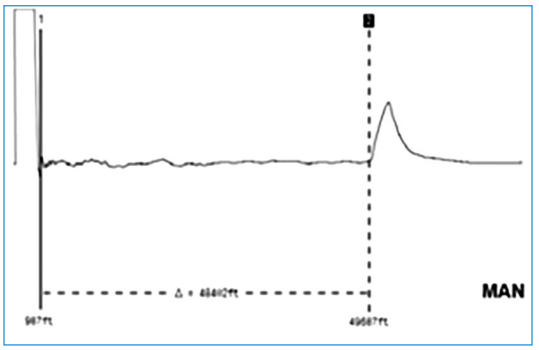

Figure 3: *Positive Reflection Caused by Increased Impedance*

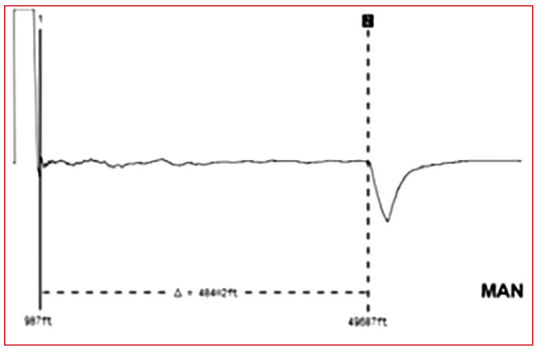

Figure 4: *Negative Reflection Caused by Decreased Impedance*

A change in a cable's characteristic impedance will cause one of two types of reflections: positive or negative.

Positive reflections are caused by increases in impedance (Figure 3). This will occur if the longitudinal resistance were to increase or if the conductors go farther apart, causing an inductive change.

Negative reflections are caused by decreases in impedance (Figure 4). This will occur if the conductance and/or capacitance change as the conductors get closer together, causing a capacitive change.

The reflections are translated by the TDR into traces that can be interpreted to indicate certain events, such as open circuits, short circuits, splices, etc., in the cable circuit. All traces follow the two basic rules of impedance changes.

Let's review the TDR pattern for a common cable splice (Figure 5). As the TDR pulse enters the splice and the conductor and metallic shield are separated, an inductive change in the characteristic impedance is seen. This results in a small positive reflection. As the TDR pulse exits the splice, the conductor and metallic shield are coming back to their natural separation, resulting in a capacitive change. This transition results in a small negative reflection.

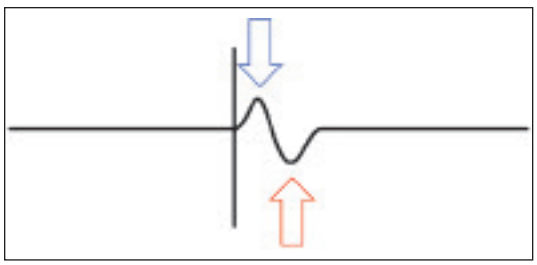

Figure 5: *Common Pattern for a Cable Splice*

Reading a TDR signature is like reading a map. Before reading a map, however, you must learn what the symbols mean. Before reading a TDR trace, you must first learn the reflection patterns.

MAKING MEASUREMENTS

Knowing that these events occur in a cable is beneficial, but to be helpful, we also need to know where they are in the cable. A TDR sends pulses along the cable that are reflected when they encounter a change in impedance. The TDR times how long it takes for the transmitted pulse to travel along the cable and for the reflections to get back to the unit. If the TDR knows how long the pulse has been gone and how long it has been traveling, it can determine distance. TDRs are like an arithmetic word problem that asks, "If you leave Dallas and travel for two and a half hours at 50 miles an hour, how far have you gone?" Because the TDR knows how long the pulse has been gone, if we can tell it how fast these pulses and their reflections travel along the cable, it will be able to calculate the distance from the TDR to the impedance change. We can do this. But to complicate it, the TDR's pulse travels at different speeds in different types of cables.

The transmitted pulses travel at different velocities on different cables, much like a ball travels at different velocities through liquids with different viscosities. The velocity of propagation changes according to these factors:

- Impedance
- Dielectric materials (e.g., XLPE, PVC, PILC, EPR)
- Age of the cable
- Temperature
- Moisture content (water inside cable)
- Wire position inside the cable (communication cable)
- Cable manufacturer (composition of insulation material and additives)

Fortunately, we can tell the TDR how fast the pulses and their reflections travel in various cables.

Table 1: *Typical Velocity of Propagations*

Cable Type	Construction	Velocity Factor %	Velocity Factor m/ s
Power	Paper Oil Filled	0.72 to 0.84	216 to 252
Power	XLPE	0.54 to 0.62	162 to 186
Power	EPR	0.45 to 0.57	135 to 171
Twisted Pair	Polyethylene	0.64 to 0.67	192 to 201
Twisted Pair	PTFE	0.71	213
Twisted Pair	Paper	0.72 to 0.88	216 to 264
Telecomms	PIC	0.65 to 0.72	195 to 216
Telecomms	Pulp	0.66 to 0.71	198 to 213
Telecomms	Gel filled	0.58 to 0.68	174 to 204
Telecomms	Coax	0.82 to 0.98	246 to 294

This speed is usually stated as a ratio of the speed of the pulse in the cable divided by the speed of light in a vacuum. This ratio is called the velocity of propagation (VoP). If the VoP is 0.50, the speed of the pulse is 50% of the speed of light in a vacuum or 0.5 x 186,000 miles per second. Examples of VoPs by cable type are seen in Table 1.

If velocity is not known, the velocity of a cable can easily be determined by connecting it to a sample cable of known length. If we can see the length markings or measure it to get the length of a section of cable, we can work backward with a TDR and calculate the VoP. Simply, if we know the true length of a cable, and the TDR knows the time the pulse and its reflection were gone, the speed or VoP can be calculated.

The TDR now has enough information to calculate the location of the event. Like our trip from Dallas, it knows how long the pulse and its reflection traveled, and it knows how fast that pulse was going. The TDR must merely do the arithmetic.

If neither the velocity nor length of the cable is known, an accurate location can be accomplished by measuring the distance to the fault from both ends of the cable. If an error exists in the velocity setting, the TDR will over-measure or under-measure from both ends of the cable. The fault will be between the two measurements.

Theory into Practice

- A TDR cannot work on a single conductor. The TDR relies on the impedance model of two conductors in parallel with one another.
- TDR pulses do not travel down the conductor and return on the neutral. TDR pulses travel down the conductors and reflect back on the conductors.

Think of the TDR pulse as a train and the cable as train tracks. The train requires two tracks (rails) to function; the TDR pulse requires two conductors. If one rail is missing, the train must stop; if one conductor becomes open, the TDR pulse cannot travel any farther. If a rail is missing, the train may need to return to the station and will take the same path, but travel backward; if a conductor is open, the TDR pulse cannot continue and will reflect back to the source.

APPLICATIONS

Communication Cable

For telephone and CATV applications, water can seep through the conductors of a twisted-pair cable at multiple ingress points along the insulation. In these situations, testing the cable from both ends and recording the distance to a fault will give the lineman an accurate illustration of the severity of the

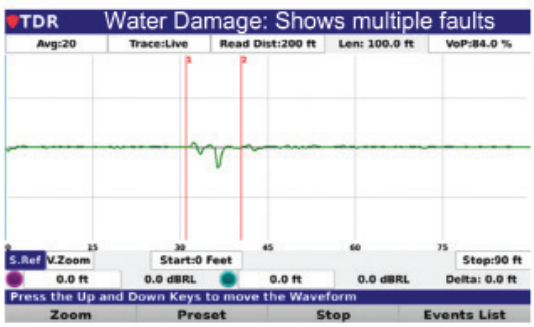

Figure 6: *TDR Pattern - Water Damage*

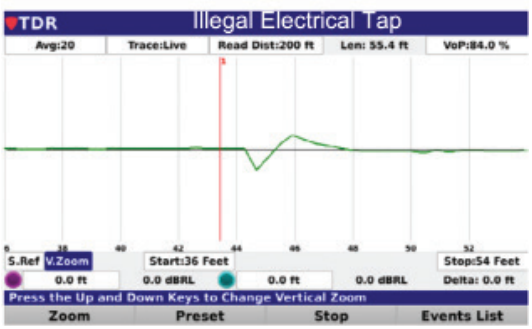

Figure 7: *Illegal Electrical Tap*

water issue (Figure 6) or confirm that the anomaly that was initially spotted is correct.

Electrical Cable

Illegal taps are a huge problem for many electric companies throughout the world. An illegal tap occurs when an individual connects to the power cable before it reaches the meter. When a customer connects before the meter, they bypass the meter that measures power consumption (Figure 7). Millions of dollars are lost due to theft of service.

Low-Voltage Electrical Cable. The best methods for locating a fault on a low-voltage circuit involve a good vs. bad comparison (Figure 8). A healthy TDR trace produced by a complex network shows many reflections caused by the service connection taps and the ends of these cables. Even a gross fault down the network will be masked by other features of the network. In many cases, comparison and differential techniques are the only option.

Medium-Voltage Electrical Cable. The arc reflection method of prelocating a fault on medium-voltage electrical cables combines the use of a TDR and a surge generator (thumper). By using an arc reflection filter, a low-voltage TDR and a high-voltage surge generator can be connected to the faulted cable, and the TDR can be looking down the cable while surging (thumping). The filter protects the TDR from the surge generator's high-voltage pulses and routes the low-voltage pulses down the cable. This method is based on the fact that when an arc is created at the fault, its resistance is reduced to a very-low value, less than 200 ohms, which will reflect TDR pulses. The arc

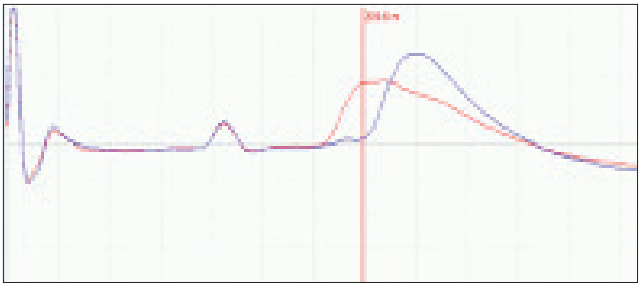

Figure 8: *TDR Trace Comparison*

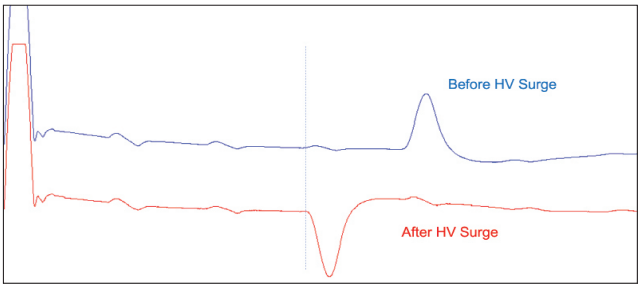

Figure 9: *Arc Reflection Test*

location will appear as a downward-going reflection — a short circuit — on the TDR cable trace (Figure 9).

SUMMARY

The TDR is a versatile, low-voltage device that can be used on almost any cable structure provided two conductors are traveling in parallel. The TDR creates a map of the cable displaying impedance changes or events that occur along the transmission path. Distances to events can be determined by knowing a) the travel time between the launch of the incident pulse and any reflected pulses, and b) the speed or velocity at which the pulses are traveling. Pulse width settings determine how far pulses can travel and reflect along a cable. They also determine a dead zone or the ability to identify closely spaced events.

THOMAS SANDRI *is Director of Training Services at Protec Equipment Resources, where his responsibilities include the design and development of learning courses. He has been active in the field of electrical power and telecommunications for over 35 years. During his career, Tom has developed numerous training aids and training courses, has been published in various industry guides, and has conducted seminars domestically and internationally. Thomas supports a wide range of electrical and telecommunication maintenance application disciplines. He has been directly involved with and supported test and measurement applications for over 25 years and is considered an authority in application disciplines including insulation system analysis, medium- and high-voltage cable, and partial discharge analysis, as well as battery and DC systems testing and maintenance. Tom received a BSEE from Thomas Edison University in Trenton, New Jersey.*

MANAGING A POWER SYSTEM TEAM

BY CHUCK BAKER, PowerPro 360

If you manage a power system maintenance team, you know that over time, some employees on your industrial maintenance and facility maintenance teams will retire and some will find jobs at other employers. Knowing that you will have turnover, how do you manage this challenge? Here are some thoughts to consider as you evaluate your current strategy and build on to it for the future.

Finding the right power system maintenance employees is a challenge. Let's look at some trends and statistics on the challenge we are facing:

- The current state of electrician shortages is shocking. Data from the National Electrical Contractors Association estimates that 7,000 electricians join the industry each year, while 10,000 retire.
- The cost to maintain extra employees in preparation for this challenge is very high.
- The younger generation is showing a lack of interest in skilled labor positions. This is magnified for those positions requiring travel.
- A survey conducted by Tallo revealed that only 16.7% of Gen Z high school and college students were interested in construction-related careers like electricians.

Availability is a challenge, but once you find and bring the new person on board, you have the new problem of the vast difference in experience between the person leaving and the new person with 25% of the experience. Furthermore, your facility is likely different from the environment this new person has seen.

To meet this challenge, address three key areas:

1. Plan for labor to find the right employees
2. Transition the employee into your program
3. Follow the program

PLAN FOR LABOR

Work with the human resources team to look at the history of employment going back as far as possible. Set up some general categories for job type and begin to document employee departures, including the reason and after what tenure. Use this data to forecast the next probable employee departure.

Once that is determined, think through the cost of a new employee and employee turnover. Consider these factors:

- The direct cost of a new employee being brought on board
- The cost of the new employee working at half the productivity of the exiting experienced employee
- Training the new employee using existing employees to bring the new person into the system
- Overtime required to make up for the missing experience

When you know the probable frequency and the cost of employee turnover, calculate when you should bring on the next person so that the transition cost (frequently, the cost of the first year for a new employee) is minimized. Include the logic and statistics in your proposed hiring and include it in your plan.

TRANSITION THE NEW EMPLOYEE INTO YOUR PROGRAM

To improve the speed and quality of bringing a new employee into your maintenance team, it is important to understand the requirements of the position. Key steps in this could include:

- Name each position and create simple but clear levels of responsibility. You don't want this to be too complicated, but one of the applications of

this stage will be defining tasks that can be done with a newer person vs. those that require the most experienced employee. It will also be a guide to building and improving your training of new employees.

- List the tasks each position will be required to perform and detail the levels of expertise required. Experienced employees often use some of their time on simpler tasks that a new employee could perform when brought on board. The logic of this is that a new employee has so much to learn:
  - The facility and location of key equipment
  - Tools and resources available
  - The correct person to take a question or problem to
  - Daily procedures from showing up in the morning to the lunch routine to the close of the day
- For each major task, build a training strategy.
- Name the topic expert for each area where the new employee will be working and communicate that information to the new employee. If the new employee can identify where to take their questions, communication is increased. This expert is available to all employees, and by defining the person for each area, you make it easier for less experienced employees to find answers.
- Document the work that is assigned, as well as what key tasks are required, and have the employee check off and make notes on each one to ensure the work is complete. Provide an opportunity to ask questions and comments to be reviewed by the topic expert. Typical fields on a work order for the new worker may include:
  - Who requested the work task
  - Who performed the work task
  - What key steps are required to complete the task
  - Inspection checkoff for the more complicated tasks
  - Hours required
- Select an experienced employee as a mentor for each new person and connect them. The mentor will be available to the new person for any question, problem, or challenge the new employee may have.
  - Train the mentor. Those who have the experience to share sometimes have a challenge in sharing. One of the critical things a mentor must do is to have the ability to never push the learner past their comfort zone.

is the level of authority the new employee has relating to safety concerns. If the new employee has the confidence to communicate their safety concerns, they will be a safe employee.

FOLLOW THE PROGRAM

When it comes to maintaining a power distribution system, training and documenting that training is a real challenge. A core component of this program is having the procedures and instructions for each task ready for the mentor and the new employee.

When it comes to maintaining a power distribution system, training and documenting that training is a real challenge.

If you are looking to initiate a program or improve your current program, we are fortunate to have the new 2023 ANSI/NETA MTS, *Standard for Maintenance Testing Specifications for Electrical Power Equipment and Systems.* This standard lists key steps for the maintenance work order and provides step-by-step instructions that guide the new employee and also allow the employee to check off maintenance steps as complete and record the test results and findings. They keep the experienced and the new employee on the same page.

SUMMARY

Maintaining a team of experienced power system maintenance employees is a challenge and will continue to become more difficult. The key steps to success are understanding the rate of turnover, being prepared for turnover, developing a method to bring the new employee into your program, and following a method to train each new employee.

- Communicate to the mentor all the information you want communicated including key topics and actions. Some people document this from two perspectives: The trainer is satisfied and signs off, and the learner signs off when comfortable.
- Have a formal introduction and establish a routine for a meeting schedule, possibly 5 minutes in the morning to walk through the assignments the new person is going to work on and 5 minutes at the end of the day to discuss the activities of the day.
- One critical trait for any mentor is a deep and consistent passion for safety. The mentor and new employee will work together on projects that contain potentially fatal conditions. If the mentor takes shortcuts that don't follow protocol, they can't be a mentor. The other component the mentor must communicate

The ideal conclusion is to have a detailed plan that includes:

- Use standards such as ANSI/NETA MTS to back up your maintenance logic for steps and frequency. Documenting the work to be performed and prioritizing it by condition and criticality makes budget justification much easier.
- Develop procedures for your current and future employees to assure safe and clear maintenance instructions. These procedures provide good instructions for newer employees and work well as a reminder to those who are experienced.
- Have a plan that details what your program is based on and brings logic to budget requests. The write-up includes historic turnover research and lays out your logic related to workforce hiring practices.

It may take time, but the benefits that are derived from this program are well worth the investment.

CHUCK BAKER *is President of PowerPro 360, a company offering power system reliability assessment and a CMMS designed for the maintenance of a power distribution system. Chuck entered the world of substation and power system maintenance 40 years ago and has spent the majority of his career on the operations side of power and distribution system maintenance and the development of power system maintenance programs.*

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Electrical Documents: Intermediate	September 12-13	Palm Beach, FL	16	16
Virtual NFPA 70E	September 21	Virtual	0	0
Relay Testing & Commissioning: Intermediate	September 25-28	Lake Mary, FL	24	24
Industrial Fundamentals	October 9-12	Louisville, KY	32	32
Power Systems 101: Relay Philosophies	November 6-9	St. Louis, MO	32	32
Virtual NFPA 70E	December 7	Virtual	0	0

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