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A *NETA World Journal* Special Publication

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CHANGING OBJECTIVES FOR **RELAY PROTECTION TESTING**

BY ED KHAN, Doble Engineering

echnical training is important to ensure the smooth operation of utilities, industrial plants, power plants, and testing companies. A lack of training can bring operations to a halt if problems occur and properly trained staff are not present. Staff involved in protection and substation engineering are in particular need of technical training as they use a variety of tools for testing of relays, circuit breakers, and other equipment.

Technical training for relay protection has gained importance due to the following factors:

- 1. The rapid evolution of relay protection technology
- 2. Increased government regulations for protection testing
- 3. A wave of retirements by experienced engineers and relay technicians coupled with a shortage of new professionals entering the energy industry workforce
- Fewer universities and community colleges offering power system and relay testing courses

CURRENT PROTECTION TECHNOLOGY LANDSCAPE

In the United States, three types of relays are applied: electromechanical, solid state, and microprocessor. According to a Newton Holt market report, approximately 50% of the relays in the U.S. are electromechanical; solid state relays make up 8–10% of that 50%. The percentage of electromechanical relays continues to decline each year as a result of ongoing replacement programs.

With a diverse population of relays, it becomes imperative to design a training program that covers old as well as new technologies. In spite of significant advances in relay protection technology, the basic philosophy of protective relaying remains unchanged. The concepts developed during the early days of relay protection are still very much alive; it is the implementation of those concepts that has changed. Electromechanical relays are not designed to implement the newer concepts or algorithms.

Any training on relay protection testing must incorporate three elements:

- 1. Basic protection philosophy
- 2. An understanding of electromechanical relays
- 3. Knowledge of microprocessor relays

Some organizations may opt to simply train technicians to use protection software for relay testing, but that is not a suitable alternative for a variety of reasons.

ADVANCED ALGORITHMS IN RELAY PROTECTION

Protection technology is mature enough to incorporate dynamic and adaptive elements, such as adaptive slopes for transformer restraints, within microprocessor relays. Testing these elements requires dynamic testing tools. Similarly, current transformer saturation algorithms are now available in microprocessor relays.

When relays expect current transformer saturation, they adjust operating characteristics to take into account the expected saturation. These algorithms are implemented within the relays in various ways, and testing these features requires a solid understanding of the relay algorithm and development of an appropriate test method. Conventional methods of steady-state testing are no longer applicable in all cases. Tools such as COMTRADE replays or state simulations (also referred to as state sequencers) are required for dynamic testing. As implementations of dynamic features in relays become commonplace, protection staff must be familiar with COMTRADE files and how they are replayed. Using state simulations also requires a clear understanding of the dynamic operations within a relay in order to prepare a test.

This advanced method of testing requires highly trained testing technicians familiar with basic electricity theory who also possess advanced knowledge of electrical engineering. While engineers responsible for recommending relay settings can assist testing staff, technicians must still be knowledgeable about the advanced theories implemented in the relays. This requires more training in this specific area of advanced testing.

At some utilities, engineers prepare test plans and are more familiar with relay algorithms. The test plans are handed off to relay technicians who use the controls on the test set to perform the tests. However, this approach is not recommended. Technicians cannot always rely on engineers to support the test. If the test doesn't run as expected, the technician should be able to troubleshoot an issue or at least be able to effectively discuss the issue with the responsible engineer. To do that, test technicians must understand relay theory and the algorithm within the relays.

Other utilities prefer to use highly automated relay testing programs. These programs contain canned testing procedures with constant communication between the software and the relays. This allows for quick retrieval of relay settings and online changes to relay settings. However, if the test does not run, the technician must contact the vendor for a solution in most instances.

Since using the tester does not require knowledge of relay protection, the technician does not develop the skills to become a fully trained protection relay technician. Such technicians will not be able to perform troubleshooting tasks when a need arises in the field. The remedy for this shortcoming is for technicians to take courses in basic protective relaying. With a diverse population of relays, it becomes imperative to design a training program that covers old as well as new technologies.

A BETTER APPROACH

The following approach is needed to conduct productive training:

- 1. Test staff must be provided with a foundation of basic electric theory.
- 2. Training must involve education on relay design and its functioning principles. Learners must be taught the working principles of electromechanical as well as microprocessor relays, and the differences between the two must be made clear.
- Training programs should be tailored to learners with different levels of experience. A simple solution is to offer courses at the basic, intermediate, and advanced levels.
- 4. In the United States, engineers typically are not involved in testing relays. Engineers select relays, design relaying systems, perform coordination studies, and recommend relay settings. However, as relay applications using microprocessor relays have become more complex, engineers are now being asked to support testing of relays and protection systems. Therefore, it would be beneficial for engineers to take courses in relay testing in order to interact effectively with testing technicians.
- 5. Some smaller utilities, such as cooperatives, do not hire technicians solely dedicated to relay protection. The technicians at cooperatives are often jacks-of-all-trades who conduct transformer and circuit breaker testing as well as relay testing. These technicians may only perform relay testing every six or seven months and may find it challenging to recall the correct steps after a long period of time.

6. Technicians should have access to clearly written instructions in hardcopy or an online format to refresh their memories when they move from one type of testing to another.

CONCLUSION

To keep employees and equipment safe, continued technical training is important. This also ensures the smooth operation of utilities, industrial plants, power plants, and testing companies. A lack of training can bring operations to a halt if problems occur and properly trained staff are not present. In-house training programs should be developed in collaboration with reputable third-party companies specializing in conducting training courses. Larger companies are more likely to utilize this model. For smaller companies with fewer resources, outsourced training is likely the preferred option.

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ED KHAN has been with Doble Engineering Company for 14 years working in various capacities including Product Manager for protection testing-related instruments. He is currently the Director of Protection R&D and Protection Training at Doble. In this capacity, he manages and conducts the relay protection training program. Prior to Doble, Ed worked for GE, ABB, SEL, KEMA, and others in various capacities. He has 38 years of experience in system studies, protection applications, relay design, power plant design, teaching, and product management. He has thorough knowledge about product development, protection, harmonic analysis, harmonic filter design, stability studies, real-time digital simulations, generator protection, and more. Ed has written several articles and has made presentations at several venues. He holds an MS in electrical engineering from Texas A&M University.

BUILD A SAFETY CULTURE

BY CHUCK BAKER, PowerPro 360

ou have developed a safety program, implemented safety protocol, explained how important safety is... but have you created a safety culture? A safety culture is comprised of the beliefs, understanding, and values your employees carry while completing their day-to-day work. To build a true safety program, strategize on how to create a safety culture.

BRAD'S STORY

It was a challenge writing this article. My name is Brad, and I am now the Director of Health and Safety for a medium-size manufacturer. I have been on board for three weeks and think the challenge ahead of me is a big one. In this article, I am going to try and communicate the safety challenges I have and what my long-term plans are to solve them and build a true safety culture.

When I interviewed for this position, it was communicated to me that this industrial manufacturer had gone through an employee buyout, and they were still in their first year under this new business format. Unfortunately, in that first year there were two OSHA recordables and one lost-time accident. Janet, the President of this reorganized company, was new to her job and actually recruited me via a mutual friend to lead safety for her — a big challenge, but a good one. In my first three weeks, I worked diligently to review the current culture. I then prepared a summary of my findings and recommendations and will present them to senior management this afternoon.

The meeting started with three others attending: President Janet, VP of Operations Jarod, and Caroline, head of human resources. I was getting to know Janet, but had only met the other two. I believed I would know them much better by the end of this meeting.

THE PROBLEM

I started my slide presentation with the tough part: the problems identified. I walked through these key items I observed on startup:

- There was a lack of interest in safety. My first question to all of the individuals I met with was, "What are the top three things you are responsible for?" Out of the 11 people I interviewed, not one person listed safety in their top three. In fact, as I explained my new position, they appeared to find the subject somewhat boring. I asked each one how they individually managed safety for their area of responsibility, and the general response was, "We follow the guidelines."
- 2. My second concern was that on my first day I asked Caroline and Jarod who the head of safety was for the company; their common answer was "everyone." That was when Janet jumped in and, appearing a little frustrated, explained that they were aware of this, and that is why I was recruited and hired. OK, I pushed a little too far on that one.
- 3. In my interview with the manager of finance, I had asked what my safety budget was for the balance of this year. I was told there is no safety budget; they buy the items and training required to stay in compliance when they need them not a big enough cost to warrant a budget.
- **4.** I asked the team to share the outline of safety communication with me. I asked when I would be asked questions or provided information on safety in the course of a normal month if





Communicate that it is your desire to have every employee go home each evening as safe and whole as they were when they came in.

I was the HR assistant or the lathe operator. I also asked what tools I would have available to bring up a safety observation or concerns if I have any. Is there a confidential source for tough circumstances? The answer was always a blank stare.

5. I observed that the current approach had resulted in a high accident rate, lack of safety concerns, and insufficient verification of a need for attention. I confirmed, "Yes, Janet, that is why you hired me."

I went on to tell them I did see the safety banners and a couple mentions of safety in the monthly employee newsletter. I also said I was confident that this group had their hearts in the right place and will do very well as we bring safety into the day-today culture. At this point, Jarod asked me what my ideas were on creating a safety culture.

THE SOLUTION

Here is what I communicated to the members of this small team, who were still listening.

Make it a priority. First, my definition of a safety culture is every employee understanding and believing that safety is a priority in all we do, and each employee carries that with them in everything they do. For example, your family finally picks this year's vacation spot — Disney world in Orlando, Florida. You leave in six weeks, and everyone is excited. During the next week, you notice references, signs, or TV ads that mention Disney, Florida, Vacation. Isn't that unique...because you have plans for Disney, you have simply made that

a conscious thought. You observer more because your mind is prioritizing it.

Mihaly Csikszentmihalyi writes, "We filter around 2 million bits of information per second down to seven plus-or-minus two chunks of information." When something becomes a priority, it makes its way to the front of the mind, and that is what we need to do here to build our safety culture.

Value Safety. I told them it starts with the four of us understanding and valuing safety. I have a one-day workshop I want the four of us to go through. In this workshop, I will share the reality of safety problems, the effect it has on all of our lives, how it will improve team relationships, and why the end result will be safer and higher production.

Here, Janet interrupted by calling out to her administrative assistant to get this one-day workshop scheduled for the four of us. I followed up by saying I already believe that the culture and leadership of this company will excel at the safety culture. When company leaders value employee safety, the people will see that and follow you. If you don't, they won't take safety seriously.

Start with managers. When we complete that workshop, we plan to talk to the managers. Each one of you can sit down one-on-one in a closed-door meeting and communicate what is about to happen. Tell them they are going to see a cultural change with safety becoming a critical component in our company. Let them know they are going to be a critical component.

Communicate to employees. Once all senior and middle management is communicated with, a corporate announcement about this program will be sent out. Communicate that it is your desire to have every employee go home each evening as safe and whole as they were when they came in. Communicate the reality of the dangers we all face and are going to be exposed to. Communicate some key facts such as that more than 2.5 million workplace illnesses and injuries and over 5,000 deaths occur in the workplace each year. Relay to employees that the three serious safety problems we have had indicates that it is going to continue until....well, let's stop it where we are. Let them know you desire to have the best and safest workplace possible.

IMPLEMENT THE NEW PLAN

It's now time to implement the plan.

The manager's role. Pull management together in a single group and explain that you want each of them to have a one-on-one conversation with each employee to let them know that Precision Manufacturing is prioritizing safety. Explain that senior management has made a huge commitment. They have created a new position for the director of health and safety. Communicate to them that they are the front-line workers for creating a safe workplace, and they will be active members of the new safety culture.

It is about building a safety culture that let's the safety plan be alive, in everyone, and a program that every employee begins to understand, live, and believe in.

Inform employees. Janet, gather all employees together face-to-face and communicate that the people responsible for the safety of our workplace is us — everyone — and when it comes to safety, we all have the responsibility and the authority to develop and deliver the safe place to work we all want.

My role. As all of this is done, I will have short meetings with teams and leaders throughout the organization and share who I am and how I am here to help, to guide, to train, to be their voice, and to provide confidential methods for reporting if they are not comfortable with communicating a safety problem to others.

Invest. Make a tangible investment in the program beyond just my position. Our marketing group appears to do a very good job marketing our products, so work with them to put together the one-year safety marketing strategy and program we are going to run. I would really like to be a member of that team, and I have a couple of good strategy paths we can take.

Create the culture. At the end of this cultural adjustment, I will have implemented the program you have 90% of already. Everything I am talking about is not your safety program; you have a pretty good one now. It is about building a safety culture that lets the safety plan be alive, in everyone, and a program that every employee begins to understand, live, and believe in.

As we all work on the safety culture, I will be creating the mechanical program with visual aids, methods of communication, and education on why we are using these safety programs to create a comfortable, but firm, safety program.

THE RESULT

Jarod and Caroline stood up at the same time, with Caroline saying, "Let's do it!" And Jarod said, "I am in." As they walked out, Janet gave me a high-five, said she would be setting up the meetings, and asked if she could sit down with me as I start to detail the plan. Culture starts at the very top, is verified by caring and investment of real time, and she was all in. Precision Manufacturing is officially on the path to a true and deep safety culture.

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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 38 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.

ORGANIZATIONAL STRESS NOW AN OMNIPRESENT, OMINOUS CONCERN

BY MERILEE KERN, The Luxe List

mid the large number of health, economic, political, and other macro-crises of late, organizational stress is at an alltime high. For many, stress has become so burdensome that it is more than just a personal issue that can be placated with a few mental health days out of the office. Workplaces have become overwhelmed by employees struggling with stress — whether driven by feelings of unease, anxiety, depression, frustration, or any number of unwanted emotions. Given the current level of demands, pressures, and uncertainties, employees and businesses can be severely undermined over time.

Since it's clear that any number of stressors will remain an indelible and formidable foe that distracts and derails staffers to an extent that impacts the bottom line, employers are eager to find ways to efficaciously deal with this unfortunate truth. This is understandable, given the extensive amount of research substantiating the calamitous effects of excessive levels of stress on employee performance. One notable cost-of-illness study^[1] estimated that "the cost of work-related stress ranged from US \$221 million to upward of US \$187 billion..."

A more inclusive analysis^[2] conducted by the American Institute of Stress found that after including

factors such as absenteeism, turnover, diminished productivity, increased medical costs, and increased legal costs, the total economic impact of stress to US employers was estimated at \$300 billion.

This expert interview with Dr. Gabe De La Rosa, Chief Behavioral Science Officer for training company Fierce Inc., reveals what business owners and managers can do to gain a better grip on organizational and operational stress. Dr. De La Rosa has valuable experience measuring the impact of stress on individuals in one of the highest stakes workplace cultures: the United States Navy. There he works as a contractor in the role of Industrial/Organizational Psychologist for the Naval Center for Combat and Operational Stress Control and is responsible for understanding and enhancing organizational factors impacting performance among sailors and marines.

His work has been published in peer-reviewed empirical journals including the *Military Medicine Journal* of Traumatic Stress, Journal of Addictive Behaviors, and Psychological Trauma: Theory, Research, Practice, and Policy. He's also edited books such as The Handbook of Employee Engagement, which is considered a valuable resource for organizational psychologists.



De La Rosa

The first step, according to Dr. De La Rosa, is for companies to have a proactive communication strategy to help address and alleviate staff stress and anxiety. "It's key to create cultures that eliminate the gap between what people feel and what they say in workplace conversations, as this is at the center of what drives a lack of mental and emotional health," he says. "Leaders who steer their groups toward eliminating this gap produce higher-performing company cultures. When employees feel safe to truly show up as they are, they can invest more of themselves into their work roles. While stress has always been a cause of operational unease, the ensuing pandemic has raised the stakes far higher. It has exacerbated concerns far beyond the health realm - a reality that can have grave consequences for individual businesses and industries at large."



Q: How would you say stress impacts our ability to tap our relatively limited resources?

A: One commonly cited reason for decreased performance while under stress is that when employees are coping with elevated levels of stress, they have fewer personal resources available to focus on constructive endeavors because so much of their cognitive and emotional resources is focused on dealing with the various stressors they perceive. Given the limited number of physical, emotional, and cognitive resources any person has to devote toward their work roles, it makes intuitive sense that when stress accumulates to a level that becomes unmanageable, adjustments must be made or performance in one's work and personal life will suffer. This creates a vicious cycle: Stress can lead to errors; errors can cause more stress. If employees anticipate some form of punishment or feel they have no safety to experiment or make mistakes, innovation and creativity will suffer and stress levels will rise.

Q: What about the stress of dealing with COVID impacts at work?

A: The well-established relationship between stress and personal and professional consequences is even more important in today's reality. Employees are coping with traditional stressors such as excessive workload or interpersonal conflicts with coworkers, clients, or supervisors all while attempting to manage a work role and personal life impacted by a global pandemic. The COVID pandemic is something that is mostly out of any individual's control; it is constantly changing and is completely unpredictable, so it is unlike anything we have dealt with previously. Situations like this are likely to elicit anxiety-related symptoms such as excessive worry, decreased ability to concentrate, and loss of sleep.

Q: Can you share some insights about the efficacy of formalized stress management programs in the workplace?

A: For many of us, talking about our emotions is not a skill we've learned. In many workplaces, talking about our negative emotions has a bit of a taboo attached to it. Employees often feel one emotion internally but are forced to externally display another emotion. This can be incredibly taxing. That gap — the empty

space between what we feel and what we actually say in conversations and relationships — is in large part what drives a lack of mental and emotional health.

Research suggests that stress has an incredibly destructive impact on employee productivity, wellbeing, and social relationships. Because of this well-documented relationship, forward-thinking organizations have invested in resources designed to help their employees cope with stressors, and research on the effects of stress management solutions reveals promising results. Those participating in stress management programs tend to experience beneficial changes in psychological wellbeing, somatic symptoms, and work-based performance outcomes.

Q: What about factors correlating stress and employee performance?

A: Today, employees and leaders can be equipped with tools to proactively address some of the prickliest interpersonal stressors. There is often an overarching layer of pressure or stress that is felt, but instead of confronting it head on, a common choice is to try to ignore it or just carry on and hope it gets better by itself. This common choice is not sustainable. People have limited resources, and performance will eventually decrease or they may burn out and completely leave the organization. By procuring the tools necessary to create meaningful change, people can be empowered to take the bull by the horns and move forward. Outcomes include lowered stress, increased productivity, and enhanced relationships with coworkers or leaders who were previously sources of stress.

Of course, the negative effects of stress extend far beyond an employee's work role into a workfamily conflict that can present in a variety of ways. According to Dr. De La Rosa, this can include time pressures that cause parents to miss out on key developmental milestones or psychological strain that causes parents/spouses to be mentally checked out from their home life when they are physically present. "Indeed, work stressors have been linked to poorer physical health, decreased emotional health, and coping behaviors such as drug usage, alcohol use, and other counterproductive behaviors," he says.

CONCLUSION

Those currently in a leadership role should strive to not only remain vigilant about managing their own level of stress, but also establish a way to identify, measure, and proactively address employee stress within their organization. Awareness of employee stress levels is incredibly important. Without some knowledge of how well employees are managing the demands of work or home roles, it is unlikely that a leader would even know when to provide additional support.

One important factor in getting employees to open up about how they are feeling is authentic leadership. When leaders show up in an authentic manner as real human beings, employees can take this as a cue that it is safe to be honest and open about their own levels of stress and the causes thereof. It will surely prove cathartic to have this kind of open and frank twoway conversation about stress, work, and life. The intention and exercise is itself an inherent win.

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MERILEE KERN is a senior-level brand, leadership, and communications analyst and strategist. As Founder and Executive Editor of The Luxe List, she works with companies, agencies, C-suite thought leaders, and subject matter experts worldwide across a wide array of B2B and B2C companies. Merilee is also Chief Strategy Officer at The Ascendant Group and a Senior Advisor at AlphaMille. She has an MBA from Nova Southeastern University. THE PREMIER ELECTRICAL MAINTENANCE AND SAFETY CONFERENCE

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Elements Covered

- Differential protection (differential & current transformer performance)
- Stator ground fault (including 100% winding protection)
- Negative sequence
- Loss of field
- Out-of-step
- Reverse power
- Backup protection
- Rotor ground fault
- Over/under frequency
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- Rotor ground fault
- Reclosing
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Topics Covered

- Detailed theory of differential
- Magnitude and phase compensation
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- Current transformer performance
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Learning Outcomes

- Create System Routines
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- Use RTS to test relays
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- Perform basic troubleshooting

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the numerous tools and techniques available for creating or customizing any test routine. Moving beyond test plan modification, attendees will learn about RTS commands, gain insights that will be useful as they develop new test routines of their own, and learn basic troubleshooting techniques. This class is a primer for understanding and utilizing BASIC code as it relates to RTS test functionality. The class focuses on some of the most commonly used BASIC commands in RTS and proper syntax.

Learning Outcomes

- Creating new test routines using the FasTest module
- Features within the FasTest module to assist in routine customization
- Methods to automate the population of settings into SETTINGS tab
- Introduction of RTS COMMANDS
- Displaying messages to Users
- Utilizing RTS COMMANDS to create intelligent routines
- Working with string variables
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- M. Shaik, webinar participant







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Benefits of Battery Testing – How to Perform the Capacity Test August 18, 2022 | Presenter: Tom Sandri

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Since 2004, Protec has been an industry leader in electrical testing equipment rental, sales, calibration, and asset management. With eight locations across the United States, we are large enough to serve your needs, small enough to care! For more information on training opportunities, visit **protecequip.com/training**.

LECTRIC POWER IQ

The most comprehensive and accessible training in the industry

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Live-Online Foundational Courses

- Transformer Management 1
- Inspection and Sampling of Transformers

Live-Online Advanced Courses

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