

OMICRON Magazine



EXPERIENCE THE OMICRON
CUSTOMER CARE CENTER

DEAR READERS,

At OMICRON, we have dedicated ourselves to raising awareness about gender diversity and inclusiveness for several years now. There are a wide variety of areas that we'd like to cover, and the use of language is one that has had a significant impact on all of us. Therefore, we would like you to take this journey into gender-sensitive language with us. This is the first issue of the OMICRON Magazine that has been written with gender-sensitive inclusive language, and many more will follow.

Staying on the topic of diversity, you can read about two women and their careers in electrical engineering in our viewpoints article. On page 26 they talk about what defines their passion for their job and how they became electrical engineers.

Another story explains how creating our "playground for energy technicians": the new OMICRON Customer Care Center (OCC) in Klaus, Austria was a dream come true. Our showroom offers numerous options for physical and virtual product demonstrations, trainings, company tours, and events, making it a unique experience for our customers worldwide. (page 6)

Travel with us to California in Justin Henson's interview on page 22, where

he explains how PG&E invests in testing and trains their employees in using and handling testing equipment to avoid wildfires. Additionally, Justin talks about his job and responsibilities as a Distribution Line Technician (DLT) Specialist.

We have a new OMICRON family member: The UHF 800 – our latest, portable solution for performing of-line and online ultra high frequency – partial discharge measurements from 100 to 2,000 MHz on gas-insulated switchgear and lines, oil-filled power transformers, and high-voltage cable connections. (page 12)

The wait was worth it. You can find part two of the "Ready for an emergency" article in this issue. Read about test implementation and the results on page 30.

If you have any feedback about this issue, please let me know – I'm looking forward to hearing from you.

Enjoy reading!



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OMICRON electronics GmbH, PG&E (p. 4, 22–25), Kraftdiagnos (p. 14–16), Polskie Sieci Elektroenergetyczne (p. 17), iStock.com (p. 30–33), IEEE Smart Village (p. 26), Qirion (p. 27–29), LEAG (p. 30), Vattenfall (p. 30), Siemens Energy (p. 34–35), Tech West Power (p. 36)

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«*Doing is like
wanting –
only better.*»

Carpe Diem Magazine – Issue 01/22

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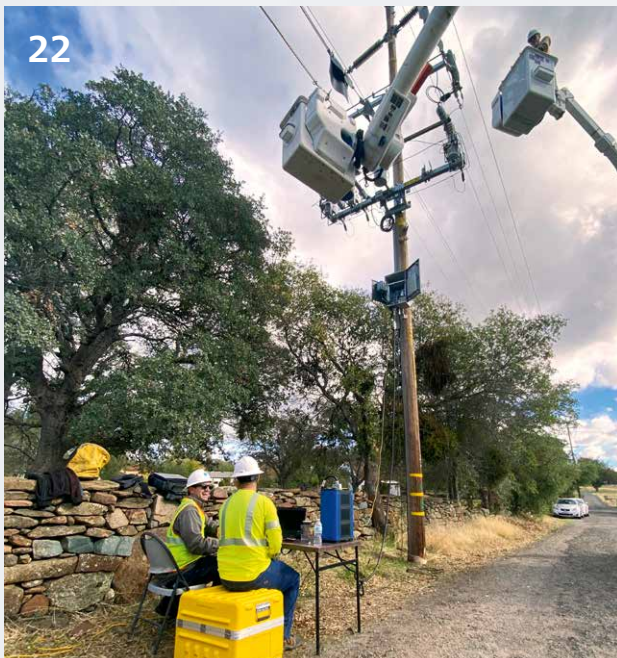
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A PLAYGROUND FOR ELECTRICAL POWER INDUSTRY ENGINEERS

Experience the OMICRON
Customer Care Center (OCC)
in Klaus, Austria



Power transformers, medium and high voltage switchboard sections, cable reels, instrument transformers, protection equipment cabinets, and much more – assets as far as the eye can see. The hall looks a little like an indoor playground: “A playground for electrical power enthusiasts,” laughs Friedrich Almer, the Project Lead and Application Engineer at OMICRON. He’s standing in the showroom, the linchpin of Klaus’s new OMICRON Customer Care Center. In the past few months, Friedrich and his broad-based project team have made sure that 750 m² (approx. 8,000 ft²) are stocked with everything that makes the hearts of electrical power industry engineers beat faster. It’s filled with rotating machines and power

transformers, protection technology, and process control systems, including IEC 61850-compliant products. Intelligent secondary substations and entire medium and high voltage switchboard sections can also be found in the showroom – along with an extensive portfolio of testing and diagnostic solutions combined with expert knowledge.

In the spring of 2020, we were able to take over an empty company building a stone’s throw away from the OMICRON Development Center. With a few adjustments, we’ve now turned it into the OMICRON Customer Care Center. We envisioned a conducive environment for exchanging knowledge and communicating with our

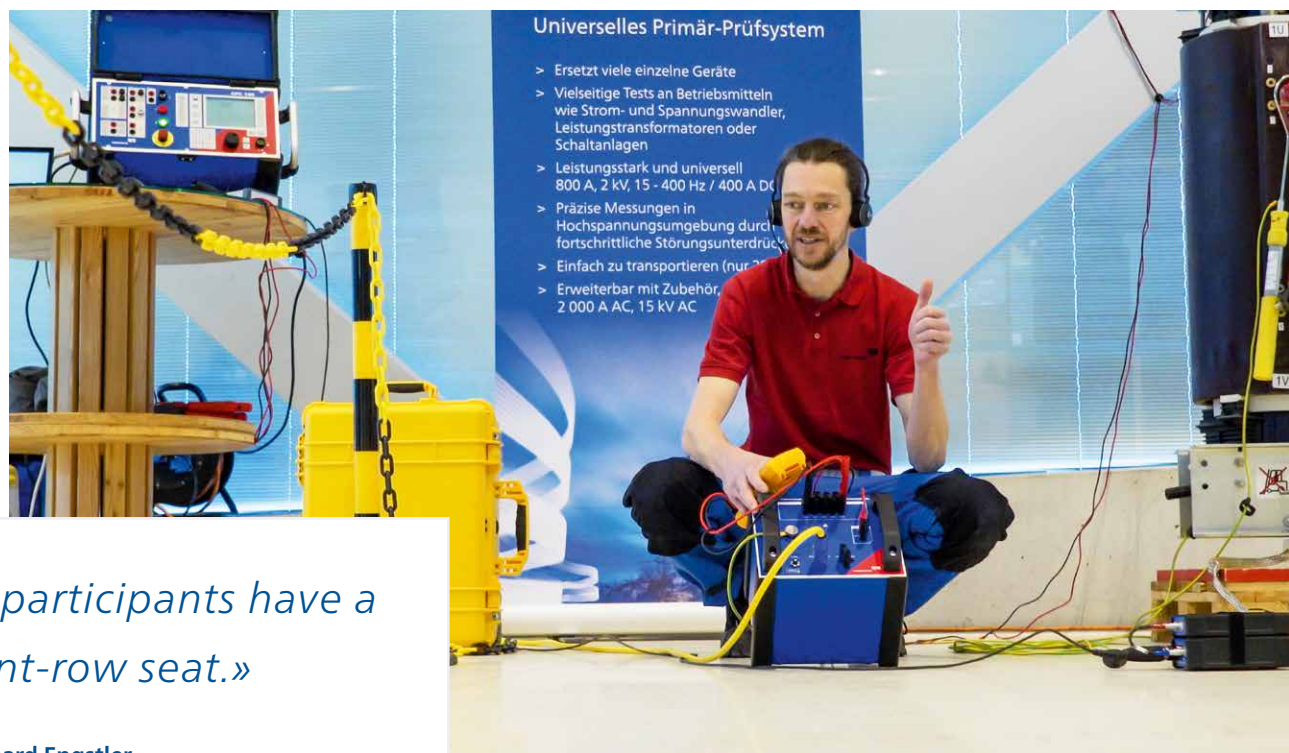
customers, a place that would make optimum support readily available. The showroom offers numerous new approaches for product demonstrations, training courses, company tours, and events. It provides a unique online and on-site experience for our customers worldwide.

“Participants have a front-row seat”

The first virtual live demonstration took place in the showroom in October 2020. A customer from the USA requested a startup training course for a 70 kV series-resonant source for testing cables and switchgear. “It wasn’t possible to travel then, so we had to find a virtual solution. I wasn’t sure at first whether it would actually work,” ▶

*«Our customers work
with real equipment.»*

Julia Steinhauser,
Event Marketing Specialist, OMICRON



*«All participants have a
front-row seat.»*

Bernhard Engstler,
Application Engineer, OMICRON



says Bernhard Engstler, OMICRON Application Engineer. But it did work – and much better than expected. “After numerous demos, training courses, and event sessions, I can safely say that we’re playing a definitive role in the virtual training field.”

Bernhard still needed to find the proper camera settings to perfect the startup training course’s broadcast during his first live demonstration. But now it’s ancient history: Friedrich and his IT colleagues put together a sophisticated video system that gives all participants a front-row seat for virtual training courses and demos. Two cameras offer different vantage points and accurate, detailed views – it’s even possible to read the measurements on device displays. “With the ‘side-by-side’ view, we can also show the physical test procedure in one window while adding the relevant software in the other,” explains Bernhard. “It’s much more difficult to get ten people to look at a laptop at the same time in a real-life training session.”

Training with real equipment

Most virtual training courses, demonstrations, and webinars are recorded, and the footage is made

available to participants. They can watch the content at their leisure and go through topics at their own pace – sometimes, questions only come up when customers start using the devices for themselves.

Of course, the showroom is also designed for on-site training. Several rooms are available for theoretical training with numerous application islands to familiarize participants with practical issues. “The showroom offers a variety of different training methods in a single room,” says Julia Steinhauser, Event Marketing Specialist at OMICRON. Julia is responsible for arranging the training courses in Klaus. “Our customers don’t work on simulators, but on real equipment. This adds a lot more quality to the course. Our customers also benefit from the synergy between the wide product range and all the assets they find here,” says Julia.

Real-time customer support

“Our technical support teams will all work in the OCC in the future,” says Verena Rein, Regional Marketing Communications Manager at OMICRON. “Our application engineers and our technical support teams can

now connect directly to assets in minutes.” Not only is this a real benefit for our customers during support inquiries, but it’s also a significant advantage for product demonstrations. “Our sales team can visit customers on-site and connect them directly to equipment and experts in the showroom. The advantage for our customers is that they don’t have to switch off their installations for demonstrations; they can watch everything from the showroom live on-screen,” explains Verena.

Verena is, among other things, responsible for product marketing in the CEU region, and she and her team also organize numerous events, such as the OMICRON Diagnostic Forum. “Some of our customers have already been able to experience the showroom virtually. Around 400 German-speaking and 300 English-speaking participants worldwide have connected to this year’s sessions. The sessions covered trends and challenges in the diagnostic world, and the response has been tremendous. We broadcast some of these sessions from the showroom. Our goal is to be able to use it for major physical events in the future as well.”

Having time and opportunities to experiment

“Here in the showroom, we’re able to experiment and try out numerous things. We have the opportunity to gain experience, which is not so easy for our customers to do because they are working under constant time pressure. These are huge advantages,” says Bernhard. “But of course, it’s also important to get out there and see customers in person,” he adds. “This is the only way to bring our on-site experience to the OCC showroom.”

We hope to see you at our showroom soon, either virtually or in person. ■



«A playground for electrical power enthusiasts.»

Friedrich Almer,
Project Lead und Application Engineer, OMICRON

«Technical support teams will all work in the OCC in the future.»

Verena Rein,
Regional Marketing Communications Manager, OMICRON



PUSHING THE PRACTICAL APPLICATIONS OF SAMPLED VALUES

IEC 61850 – History and latest developments

The use of the IEC 61850 Sampled Values protocol is steadily increasing, but many users still have a few touchpoints that concern them. In the meantime, protection engineers don't require a crystal ball to know that they'll have

to become more familiar with this subject. Fred Steinhauser, our specialist for IEC 61850 and Digital Substations, was present during some of the protocol milestones and is convinced this topic can be approached with enthusiasm.

Can you tell us a few things about how the Sampled Values protocol began?

Fred: Sampled Values have a history reaching back more than 20 years. Before 2000, ABB had already built high voltage substations for Powerlink Queensland in Australia with proprietary Sampled Values technology. These systems were upgraded with IEC 61850 technology about ten years ago.

How did OMICRON get involved in the development of Sampled Values?

In 2001, working groups from the technical committees of the International Electrotechnical Commission (IEC) met at the newly opened OMICRON Development Center in Klaus, Austria. Drivers from the scene discussed the drafts from IEC 61850-9-1 and IEC 61850-9-2, along with GOOSE messaging.

We immediately understood the importance of these protocols for protection applications in the future. Moreover, since most of our customers were active in the protection field at that time, we wanted to stay closely connected to this topic. I then joined the group to explore ways to support those protocols.

When did the first implementations occur?

The first Sampled Values prototypes were presented in 2004 during the CIGRE exhibition in France at the UCA International User Group booth. At the CIGRE session in 2006, we had a Sampled Values interoperability demo with products from four vendors, showing the feasibility of multi-vendor systems. We gained a lot of insight from these early prototypes and implementations. One notable outcome was that the Sampled Values features for the CMC test devices were released in 2008.

But the whole topic was somehow stalled – what happened?

Some obstacles had not been addressed yet. For example, the time synchronization method chosen in 2003 was cumbersome, and suitable network redundancy mechanisms had not been found.

In the meantime, time synchronization via PTP (IEEE 1588) and redundancy architectures like PRP and HSR (IEC 62439-3) have filled this gap. Today, we have everything in place to fully implement Digital Substations.



«We had to anticipate the use cases – we called this approach «walking in our customer's shoes.»»

Fred Steinhauser,
Digital Substation Evangelist, OMICRON

How have these findings been translated into practical testing tools?

Even though protection engineers were the first to require support during protection testing, the customers themselves had no experience with the new protocols, so they couldn't tell us what they needed. We had to anticipate the use cases – we called this approach "walking in our customer's shoes." As a result, the CMC test devices and Test Universe were the first products to support Sampled Values.

Now, RelaySimTest, our software for system-based testing, also works with Sampled Values. And the measurement system DANEO 400 became the communication and process bus analyzer used in almost every Digital Substation.

What are the newest additions to Sampled Values?

The bottom line is nothing is entirely new. For the most part, previous options from IEC 61850 that weren't used are being applied now. The "9-2LE" implementation guideline gave us some solid definitions that benefit ease of use and interoperability. "9-2LE" only decided to use one fixed layout for the dataset and defined optional fields for use.

This was very supportive of our implementations in the past, but its value was not apparent to everyone. With the upcoming configurable variants in Test Universe and RelaySimTest, users will have to configure and test what had only been implicit before.

What kicked off these new developments?

Firstly, there was the potential to streamline things by making configurations specific to particular applications. Secondly, there were some additional details that needed to be covered, e.g. proper time synchronization.

IEC 61869-9 suggested that we use configurable datasets. Another change is the definition and practical use of additional optional fields in the 2.0 and 2.1 editions of IEC 61850-9-2.

These new options are now supported by RelaySimTest 4.00 and Test Universe 4.30, so users can already work with them.

Thank you for the interview. ■



MASTERING THE ART OF UHF PARTIAL DISCHARGE MEASUREMENTS

Our new UHF 800 offers you an optimal signal-to-noise ratio

Partial discharge (PD) testing is a highly effective tool for medium-voltage (MV) and high-voltage (HV) devices that assesses their insulation condition and detects critical defects in them. Conventional onsite PD measurements, such as those specified by the IEC 60270 standard, are often affected by noise in the surrounding environment.

Measurement alternative for noisy environments

Unconventional PD measurements performed in the Ultra-High Frequency (UHF) range of 100 to 2,000 MHz are a reliable measurement alternative. These measurements are especially useful for PD testing on gas-insulated switchgear and lines, oil-filled power transformers, and HV power cable terminations.

This is because numerous noise sources, such as mobile communications, radar signals, and corona discharges, predominantly transmit in lower or narrow frequency ranges. By comparison, measurements performed in the UHF range result in a very high signal-to-noise ratio. Therefore, optimal PD measurement sensitivity is ensured with little or no interference from external noise.

Reliable UHF PD testing with UHF 800

The portable UHF 800 PD measurement system is our latest solution for performing off-line and on-line UHF PD measurements from 100 to 2,000 MHz on gas-insulated switchgear and lines, oil-filled power transformers, and high-voltage power cable terminations. Tunable bandwidth filters ensure an optimal signal-to-noise ratio for reliable analysis, even in noisy onsite testing environments.

The system's portable and flexible modular design enables fast and easy setup during type and routine testing in HV laboratories or test bays, onsite commissioning, and troubleshooting in the field.

Single-channel or multi-channel testing

One UHF 800 measurement device is used to detect PD activity in the UHF range of each measurement channel. Up to 12 measurement devices can be connected via fiber optic cables in a daisy chain for simultaneous, multi-channel PD measurement and analysis. Each UHF 800 measurement device is powered with our RPB1 recharge-

able external battery for hours of uninterrupted testing.

Powerful software for PD measurements and analysis

The UHF 800 is used with our MPD Suite software and includes the latest, time-saving PD measurement and analysis features. These features include recording and replaying PD measurements, user-definable testing profiles, and customized reporting.

Use it with or without MPD 800

The UHF 800 can be used as a stand-alone UHF PD measurement and analysis system. It can also be easily used with our MPD 800 universal PD measurement and analysis system. This allows you to combine conventional PD measurements using the MPD 800 with UHF PD measurements when the UHF 800 is in the same measurement setup.

The combination of UHF 800 and MPD 800 PD measurement devices – up to 12 measurement devices in total – can be connected via fiber optic cables in a daisy chain for simultaneous, multi-channel PD measurement and analysis using the MPD Suite software. ■



UHF 800 AT A GLANCE

- › Highly sensitive UHF PD measurements from 100 to 2,000 MHz.
- › Single-channel or synchronous multi-channel offline and online measurements.
- › Robust and flexible for use in laboratories, testing bays and in the field.
- › Adjustable filters for optimal signal-to-noise ratio in noisy environments.
- › Supports CIGRE "Application guide for sensitivity verification" (Brochure 654).
- › Configurable user interface for individualized PD testing and customized reporting.

 omicronenergy.com/uhf800

LISTEN TO THE PODCAST

Interested in this topic?



Be sure to listen to our Energy Talks Podcast Series episode about UHF partial discharge testing with our UHF 800. Scan the QR-Code or visit:

 omicronenergy.com/uhf-pd-testing





CPC 100 + CP CU1: PROTECTING PEOPLE AND THEIR SURROUNDINGS

Gustav Lundqvist writes about how he and his team at Kraftdiagnos test touch voltage levels on power lines in response to the growing demand for electric power in Sweden

During the past year, the power industry in Sweden has increased the speed of building 130 kV and 400 kV power lines by up to four times the previous rate. This is necessary since Sweden's estimated power production and power use are predicted to increase 120% by 2045.

Before a new power line with a system voltage over 100 kV can be energized, it needs to be tested with regards to touch voltages in the nearby low voltage grid to detect potential earth (also known as ground) faults. The power line is not allowed to be energized if the touch voltage is above 600 V with a 3 kΩ resistance. The test is performed when the power line is finished and installed, such as when a wind park is waiting to be put into operation. This means that every hour that the power line is not in service, the grid company and the owner of the wind park may lose thousands of euros per hour.

The test can also be performed on existing power lines, which can only be taken out of service for a few hours per year to avoid system disturbances. This means that the measurement must be performed quickly. At the same time, the measurement is highly dangerous. For this reason, there are very few engineers that perform these step and touch measurements.

I invested in my first CPC 100 multi-functional testing device in 2019, and in the Spring of 2020, I took my starting business to a new level with additional OMICRON devices and added ten employees. In 2021, we tested about 21 high-voltage power lines with the CPC 100 and the CP CU1 multi-functional coupling unit. During this time, my job changed from performing the measurements myself, to teaching and leading younger engineers in the field.

Performing the measurement

The test is performed by switching off breakers at both ends of the power line. We use a special earthing tool, called the JK51, which is attached to the power line. The measurement is unique, so we have to figure out and build many of the components ourselves, and they need to be in accordance with safety regulations.

When testing a power line, pylons within 1 km of each other are tested. This means that on average, up to ten pylons are subject to testing every ten kilometers (roughly 6 miles). When performing the test, we simulate an earth fault in the 150 kV grid and measure the touch voltage in the surrounding low voltage grid. Over the past few years, the short circuit power in the grid has increased to about 10 to 39 kA, depending on the location in the grid. This means buildings that were once safe may



«Touch voltage measurements must be performed quickly. **At the same time, they are highly dangerous.»**



Gustav Lundqvist,
Founder,
Kraftdiagnos



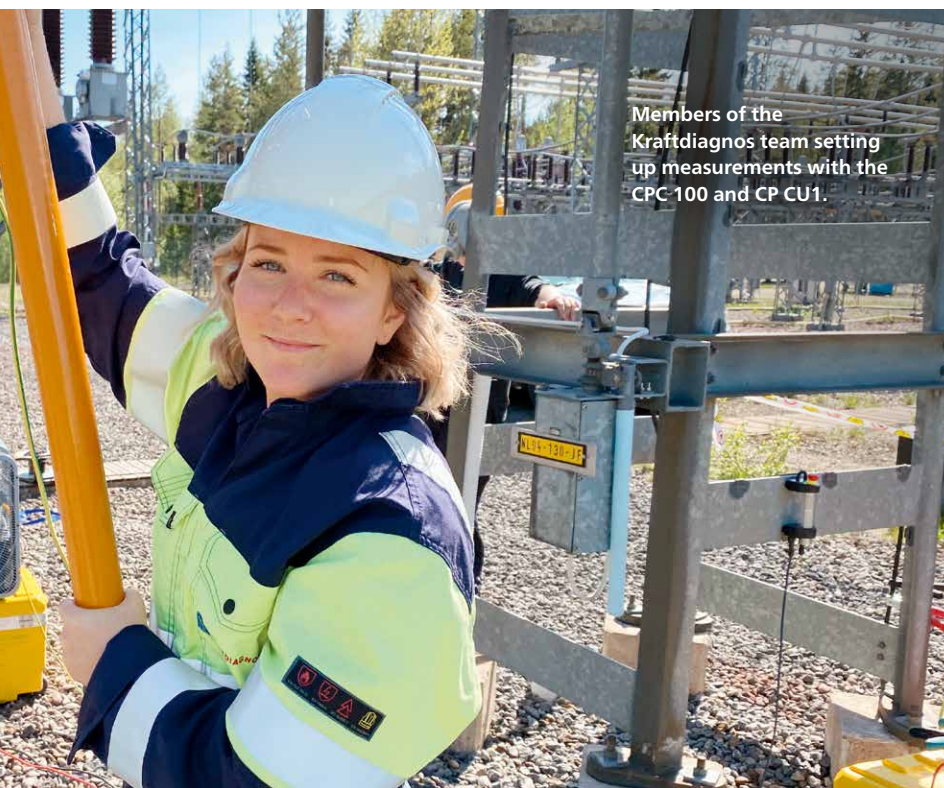
Performing measurements in the Swedish wilderness.

now be at risk for electrical fires or a dangerous touch voltage.

When it comes to getting an accurate touch voltage calculation when performing the measurement, an important detail is making sure that the 30 Hz and 70 Hz current pulsed by the CPC 100 and CP CU1 is measured in the pylon being tested. This is performed by the HGT1 handheld grounding tester and a Rogowskij coil.

Measuring new power lines is one aspect, but it also needs to be tested when an older power line is changed. For example, in one 130 kV power line, we found 40 instances of high touch voltages. The HGT1 also detected 7 kV touch voltages at a kindergarten caused by an earth fault in the grid.

Performing these measurements involves many risks, including induction and the influence of parallel lines. ▶



Members of the Kraftdiagnos team setting up measurements with the CPC 100 and CP CU1.

Testing equipment advantages

The CPC 100 has many advantages compared to a rotating generator test system. A generator will often start to oscillate if used on parallel power lines, which does not happen with the CPC 100. The CP CU1 has a 10 A setting, which means a 1:2 ratio is used, lowering the induced voltage sent to the CPC 100.

The CP CU1 is an amazing, comprehensive system, but we started to build a heavier 40 kg (88 lbs.) fixed 1:2 one-phase transformer. The CPC 100 could drive 15 A with the 1:2 ratio, which means 50% more power for measurements!

Adding more power with CPCSync

This specialized system has 3,000 V insulation. In the future, we aim to use the CPCSync which synchronizes up to three CPC 100 testing systems. For this application, we will use the CPCSync with only two CPC 100 devices and a 1:6 transformer, enabling us to do the job and handle an induction of up to 3,000 V.

One CPC 100 device can be used on each phase. The first CPC 100 device pulses for four seconds, after two seconds we start the next CPC 100 device that pulses for four seconds. Both CPC 100 devices can be set with the same rest time, for example 24 seconds. The two systems work together without disturbing each other.

Saving time and costs

This setup provides us with a big advantage, in that a power line can be tested in a third of the time, compared to using only one single CPC 100 system. This saves a lot of costs for the grid provider, who wants to minimize expensive outages.

Kraftdiagnos is a service company that performs diagnostic measurements on medium- and high-voltage equipment for electrical utility companies throughout Sweden.

kraftdiagnos.se



LISTEN TO THE PODCAST

Interested in this topic?

Be sure to listen to our Energy Talks Podcast Series Episode Number 21 about induction testing on power lines with Gustav Lundqvist. Scan the QR-Code or visit:

omicronenergy.com/power-line-testing



Did you know?

Gustav Lundqvist started Kraftdiagnos in 2019 travelling to remote locations in Sweden, mostly on foot, while carrying his measurement equipment in a backpack. Accompanied by his pet dog, Nisse, Gustav primarily performed earthing measurements, also known as grounding measurements, using our CPC 100 and COMPANO 100 systems. Since then,

he has grown his company and increased the types of measurements performed for customers.

Be sure to listen to our Energy Talks Podcast Series Episode Number 3, in which Gustav Lundqvist describes his measurement adventures on foot to remote locations in Sweden and why he believes that OMICRON is not a company but a lifestyle.



RELAYSIMTEST SIMPLIFIES CRUCIAL PROTECTION TESTING POINTS

What really counts on site



Adam Wójcik,
Electrical Engineer,
Polskie Sieci
Elektroenergetyczne

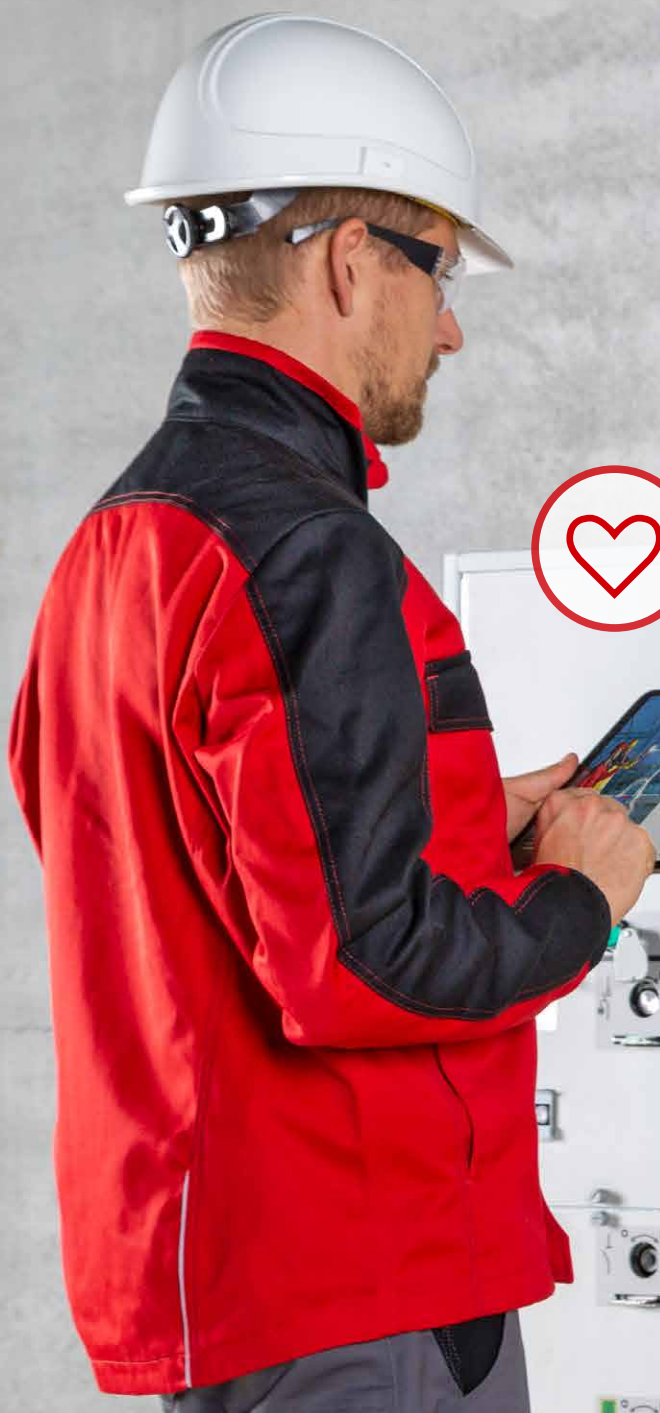
Adam Wójcik works as an Electrical Engineer for Polskie Sieci Elektroenergetyczne, a transmission system operator in Poland. He started using RelaySimTest two years ago and has shared his experience with us.

Adam Wójcik: My daily work consists of testing protection and automation systems. RelaySimTest has improved dramatically over time, and it's made my work more enjoyable and efficient. The ever-increasing development of protection systems makes classically testing them more problematic. This applies specifically to single-phase auto-reclose. When tested with steady-state test signals, some protection relay algorithms show operational errors or lack of any operations. Preparation for such a test requires a lot of time. Another

problem is the simulation of realistic 2nd and 5th harmonics in transformer protection systems. This is where RelaySimTest comes into play because it dramatically simplifies the problems mentioned above.

Since RelaySimTest can realistically simulate short circuits, it eliminates these problems. A fundamental aspect of the software tool is its operation, which is intuitive and straightforward. Setting up a test for a simple circuit takes about 15 minutes. Many automated scenarios can be simulated for one configuration, which is very helpful. If necessary, the scenarios can be reconfigured quickly. To sum it up, RelaySimTest has accelerated my workflow significantly. ■





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TESTRANO 600 – WHAT'S NEW

Listen to what your on-load tap changer has to say



A power transformer's on-load tap changer (OLTC) plays a vital role in maintaining a stable voltage level within the electrical grid. The OLTC is a mechanical switching device that regulates the system voltage by adjusting the transformer turns ratio. Due to the thermal and mechanical stresses generated when the load current is switched, various OLTC components such as the contacts can suffer wear and tear over their lifetime.

In order to reliably assess the condition of the OLTC, increasingly advanced diagnostic tools have been developed. Typically, a static resistance measurement is performed to check for increased contact resistances. Moreover, a dynamic resistance measurement (DRM) records the change in current during the switching operation to analyze the OLTC's timing and check for possible current interruptions.

In addition to these electrical evaluations of the switching characteristics, mechanical analysis of the OLTC operation can be performed. The new TESTRANO 600 VAM1 accessory measures vibrations produced during the switching operation with acceleration sensors temporarily mounted on the transformer tank. The vibro-acoustic measurement (VAM) allows measurements to be performed on an energized transformer to provide valuable information about the OLTC's condition without the need for outages. By recording a detailed vibration pattern and comparing it to reference data such as a fingerprint, it's possible to detect and track changes in the mechanical integrity of the OLTC.

Since the VAM can be performed without outages, it can be integrated into routine inspections, i.e., in-between scheduled maintenance intervals. Such regular tests will provide information about the current condition of the OLTC that prove invaluable for maintenance prioritization.

Furthermore, when performed on a de-energized transformer, the VAM method allows DRM traces to be recorded simultaneously. Combining the VAM and DRM methods gathers additional insights into the switching sequence. The VAM and DRM measurements on an OLTC represent mechanical and electrical time sequences, respectively, and provide an opportunity for a combined evaluation based on complementary data. Using the vibro-acoustic measurement enables all OLTC components that produce sufficient vibrations to be considered for the overall evaluation, from motor start to finish. On the other hand, every operation that causes a change in current is reflected in the DRM. By combining the two approaches, blind spots from the individual methods are compensated, and an in-depth assessment of the overall OLTC switching operation is achieved. ■



LISTEN TO THE PODCAST

Interested in this topic?

Listen to our podcast with the VAM expert from Maschinenfabrik Reinhausen to learn more about the measurement and its benefits. Scan the QR-Code or visit:

 [omicronenergy.com/
vibro-acoustic-measurements](https://www.omicronenergy.com/vibro-acoustic-measurements)





PG&E DEPLOYS RECLOSERS TO HELP MITIGATE WILDFIRE RISKS

It's not just about investing in equipment. It's also about investing in education.

Justin Henson has been a Distribution Line Technician (DLT) Specialist for the last 4 years in his 20-year employment at Pacific Gas & Electric (PG&E). He talked to us about how PG&E has invested in equipment and educated their employees to help prevent future wildfires. He also discussed his job and responsibilities as a DLT Specialist.

PG&E is a private utility founded in San Francisco over 100 years ago. Incorporated in California in 1905, it's one of the largest combined natural gas and electric utilities in the United States today. PG&E is responsible for the transmission and delivery of energy to approximately 15 million people throughout a 70,000 mi² (181,300 km²) service area in northern and central California. They have more than 141,215 circuit miles (227,300 km) of electric lines that serve approximately 5.3 million customer accounts ranging from the furthest little house on the prairie to some of the world's largest tech companies.

Could you share your insight about a DLT's responsibilities and your role as a DLT Specialist?

Justin Henson: A DLT is responsible for maintaining all the pole-mounted, pad-mounted, and underground line control devices (LCD), such as line reclosers (LR), switches, interrupters, capacitors, and regulators. I call them the "Fab 5".

My job as the DLT Specialist is maintaining all the training, procedures, testing, and technical work management for the DLTs when it comes to LCDs. One of the major roles I take the most pride in is creating pre-commissioning test plans for PG&E's distribution, protection, and automation LCD

field equipment. What it all comes down to is that if we're going to run a safe, reliable, and efficient distribution grid, not only are these test plans the means to achieving that goal, in some cases, they're our last line of defense.

Can you tell us more about PG&E's LR implementation?

We have a rich history of installing all kinds of electric LCDs in our distribution grid. Today, we have roughly 10,500 line reclosers or LRs in our system. Some of our earliest installations date back to the mid-1960s, and back then, we only installed a few per year. Today, we average roughly 500 new installations each year. These devices cover a variety of applications such as new business for expanding circuits, maintenance and upgrade programs,

customer co-generation applications, and of course, our specialized projects related to wildfire risk programs.

PG&E made headlines a few years ago during the California wildfires. How is PG&E's LR deployment going to help reduce wildfires in the future?

Great question, this is something we are passionate about. Since 2017, the beginning of some of the most destructive wildfires California has ever seen occurred, PG&E has made a commitment to our customers and the California Public Utilities Commission that we will do everything in our power to prevent wildfires. Part of that commitment was the accelerated installation of hundreds of additional SCADA sectionalizing devices each year for our Public Safety Power Shutoff (PSPS) program. ▶

«PG&E has made a commitment to our customers and the California Public Utilities Commission that we will do everything in our power to prevent wildfires.»



Justin Henson,
Distribution Line Technician (DLT) Specialist,
Pacific Gas & Electric (PG&E)

 [pge.com](https://www.pge.com)

«As technicians, we feel it is essential to test the actual file instead of a generic template that validates just the controller. This way you prove the microprocessor relay and the engineered site-specific settings application.»

At PG&E, our LRs are all multifunctional devices that can be used as reclosers, interrupters, switches, or sectionalizers. Having this kind of versatility gives us the ability to fine-tune, protect and coordinate our system.

Since 2018, the PSPS program has contributed roughly 1,000 additional devices to this effort. In conjunction with the 1,300 weather stations PG&E has installed since then, we can now better monitor and forecast severe weather threats that inform our operational decisions like shutting down power before disaster strikes. The more SCADA LRs and other sectionalizing devices we have in the grid, the smaller these impacted shutdown areas become.

It sounds like PG&E places a significant emphasis on customer safety and reliability. How do you make sure your equipment is functioning correctly?

Not long after the DLT group formed, I worked with our standards team



to create a formal work method for installing new LCDs. We broke it down into three LCD procedures: Pre-commissioning, Commissioning, and Data Management.

The Pre-commissioning of LR requires running all diagnostic and functional tests on the LR apparatus. More importantly, the LR controller receives a detailed test that validates the actual settings file being utilized in the field. As technicians, we feel it is essential to test the actual file instead of a generic template that validates just the controller. This way you prove the microprocessor relay and the engineered site-specific settings application. After all, we're only human, and even technicians and engineers are not perfect. Human performance errors are no stranger to failed ARCO tests.

After the line crew installs the LR in the field, in the bypassed position, the DLT can then validate all the SCADA DNP points during the Commissioning pro-

cedure. Once complete, the DLT places the LR in service.

Data Management is the third and ongoing procedure in the LCD process. When the need arises, a DLT will visit an LR to program, inspect, and test when necessary. As outages and other events occur in the system, it's important to retrieve event reports from the LR. In some cases, the controller is tested by reproducing event conditions to confirm expected behaviors in the relay.

ARCO 400's plug-and-play design allows DLTs the comfort and ease of performing shop type testing 30 ft (9.1 m) in the air with bucket trucks. The product's versatility allows users to quickly recreate events to ensure the controller is fit for service. What started as just a shop tool for Pre-commissioning years ago quickly evolved into our partner riding in the passenger seat on our trucks for field use as well.

How can you increase the reliability of the distribution grid?

First off, take it from me, the simple hometown family man who expects to have the lights on in the living room, food cooking in the kitchen, and the air conditioning blasting on those hot

summer days. The same guy however who understands that as essential as those things may be, they're not always guaranteed in our current environment. I say this as someone who has seen firsthand the destruction that wildfires brought to California communities. There is no light in a house, steak on a grill, or cool air passing through vents worth a single life that could have been saved by preventing just that one wildfire spark.

Now take it from Justin the DLT Specialist. At PG&E we have a zero-tolerance policy for wildfire sparks caused by downed electrical facilities. It's something we take very seriously. However, what's of equal importance to the safety we run our system with, is the reliability of a self-healing grid. The more LR's and other sectionalizing devices we put in our system, the better we do at keeping our customer's lights on. So when it becomes necessary to shut them off, it will be as safely, as quickly, and with as little restoration downtime as possible. Investing in intelligent technology, and having tools like the ARCO 400 to validate them, is how we're going to make that happen!

Thank you for talking to us. ■



VIEWPOINTS

How did you become an engineer and what's your passion for daily work?



"I became interested in engineering after seeing how my favorite film series of all time, Star Wars predicted the future. That imagined future is the present we're living in today. Afterward, I pursued science courses and excelled at them. I then studied Electrical and Electronics Engineering to realize my dream. Coupled with my passion for community development, I sought to bridge existing inequalities. I am currently working with the IEEE Smart Village organization to empower off-grid communities with clean energy, education, and enterprise development. My passion for my daily work is getting to see livelihoods transformed through innovative power solutions that seek to solve energy poverty. Through productive uses of electricity, local villages can take advantage of enterprise opportunities and create value using abundant existing resources. I advocate for SDG7, which ensures universal access to affordable, reliable, modern energy services and includes women's voices in energy value chains."

Mercy Chelangat K,
Business and Fund
Development Director,
IEEE Smart Village



"When I was about 14 or 15 years old, I enjoyed subjects like math and science. I didn't have any role models that were male or female engineers, but one of my teachers explained to me that engineering was a way of using math and scientific principles to build things like infrastructure or machines. I found it fascinating, and I began studying to become an engineer."

I've remained curious about learning how devices work and why they fail. This interest has driven me to learn about OMICRON test solutions, and helping our customers handle them is part of my daily work. My main tasks consist of supporting customers who use OMICRON test solutions: training them when they're using new equipment, answering their questions when they're performing new tests, and determining whether or not a device needs to be repaired when problems arise.

The best part for me, is that after our customers have become familiar with our test sets, I see that what they've learned is allowing the power network to work reliably."

Ana García,
Technical Support,
OMICRON



100 YEARS OF CIRCUIT BREAKER TESTING EXPERIENCE

Qirion Netherlands –
a CIBANO 500 power user

In 2021, OMICRON sold its 1,000th CIBANO 500 device worldwide. To figure out why customers appreciate this new generation of circuit breaker test sets, we talked to a service provider with a century of circuit breaker testing experience. Mick Huisert, a Component Engineer at Qirion and Rick Tiemessen, a Component and Maintenance Engineer at Qirion answered our questions.

Thanks for taking the time to talk to me. Can you please briefly introduce yourselves?

Mick Huisert: I'm a component engineer in the Qirion Circuit Breaker division, and my focus lies in air-insulated switchgear. My work includes complete overhauls of 50 kV and 150 kV breakers in our workshop in Duiven.

Rick Tiemessen: I'm also in the Qirion Circuit Breaker division, where I work as a component and maintenance engineer. I specialize in medium voltage switchgear from 6 kV to 27.5 kV and handle general maintenance questions for Qirion's customers.

How did Qirion become the circuit breaker experts in the Netherlands?

Mick: Qirion and our legal predecessors have been maintaining the electrical grid for about 100 years. Our team of experts absorbed a vast array of knowledge about all kinds of breakers. Our main clients are two large grid operators, Liander and TenneT, but we also perform commissioning and maintenance for other power plants, railway operators, and offshore plants. This puts us in the unique position of maintaining all kinds of breakers from different manufacturers, different types, and ages.

How important do you think circuit breaker testing is for a reliable energy grid?

Rick: Circuit breakers are one of the most important devices in the grid because they can switch off short circuits. They are designed and used ▶



«If we get the chance to influence testing cycles, **we take a hybrid approach between time-based and condition-based maintenance.** In general, we test medium-voltage breakers at least every four years.»



Rick Tiemessen,
Component and Maintenance Engineer,
Qirion

to prevent catastrophes and damage to components. Without breakers, most faults would lead to widespread and long-lasting outages, not to mention the damage and repair costs that come with them.

Mick: Testing helps us make proper maintenance decisions at the right moment. Recently, we had an older Brown, Boveri & Company (BBC) breaker with an oil leak. A motion measurement revealed that the motion went up and then abruptly stopped during the closing operation. So, we concluded that the damping wasn't working.

When we opened the damper, we saw that the inside was completely broken, and the hydraulic oil was empty. After fixing it, the measurement showed that it was damping again. You can identify these types of issues with measurements, and of course, we're very excited about that.



How often do you test your customers' breakers?

Rick: That depends on the environment in which the breaker is being used, how often it is switched, and many other factors. Some customers have fixed cycles, but if we get the chance to influence those cycles, we take a hybrid approach between time-based and condition-based maintenance. In general, we test medium voltage breakers at least every four years.

Mick: We also perform a functional test on high voltage breakers at least every three years, and every six years, we include measurements.

You replaced your breaker test set fleet a few years ago. Can you explain why you did that?

Rick: Our former test system was developed in the nineties, which are long gone and the application needs have diversified and increased. We wanted a more digital variant and the ability to test with grounding on both sides for

safety, but the information technology support tipped the scales for us.

Did you go through a unique selection process?

Rick: Yes, first we asked our colleagues who work with the devices what they would need from a new device. Our technicians wanted an easy-to-use, compact system that could perform all measurements. Our engineers also preferred one system for all tests. For them, the price and good customer support were also important. In addition, they wanted onsite training to help our technicians use the device as quickly and efficiently as possible.

We made a pre-selection with three devices, which we took to a workshop for a week. Our experts tested them on a variety of breakers – 20 kV vacuum, 150 kV air-insulated, 150 kV gas-insulated, and 380 kV air-insulated. The two best devices were then tested on-site with our most unique breakers. Then we summarized both testing

sessions and put together the results. In the end, the CIBANO 500 came out on top, so the choice was easy.

What is the most significant advantage that the CIBANO 500 offers you?

Rick: It's easy to use, and compared to other test sets, you have to mount fewer devices to perform a complete measurement. If you have the correct template made, you can perform rapid measurements, measure one breaker after the other and save a lot of time.

Can you give advice to anyone that has less experience with circuit breaker testing?

Mick: Aside from all the inconvenience that comes with a failing breaker, it's essential to understand the cause of the failure, because that understanding will increase your knowledge. So, if you repair as much as you can by yourself, your knowledge will continue to expand.

Thank you for the interview. ■

«Aside from all the inconvenience that comes with a failing breaker, it's essential to understand the cause of the failure, because that understanding will increase your knowledge.»



Mick Huisert,
Component Engineer,
Qirion





Test ramp-up
network

READY FOR AN EMERGENCY

Ramp-up networks as an alternative
to rapid grid restoration



MISSED THE FIRST PART?

The first part of the article dealt with the initial situation and test preparations. Scan the QR-Code or visit:

omicronenergy.com/ramp-up-network



After a blackout in the transmission network, the power supply must be restored as quickly and safely as possible. In October 2020, an alternative grid restoration strategy using a ramp-up network was used in a prepared island network by German transmission grid operator 50Hertz as part of a pilot test. In the first part of the paper (published in the OMICRON Magazine 2/2021), we introduced you to the initial situation and preparations for the test. Now you can find out more about how the practical test was carried out, the unexpected results, and the knowledge gained from it.

Ramping up to nominal voltage

In the first part of the grid restoration test, the de-energized test network was continuously ramped up, considering the available water volume in the Goldisthal pumped storage power plant. In doing so, the generator voltage was increased from 0 kV to 18 kV nominal voltage in the “Manual excitation current control” operating mode. The resulting voltage curve in the Altenfeld substation can be seen in Figure 1.

As expected, the continuous voltage ramp-up to the power station

site in Lippendorf was carried out within roughly 40 seconds. To balance out the switching operations in the next test steps, the operating mode of the generator excitation

system was switched to “Automatic voltage control” (time point 1). The subsequent voltage dip was a result of not all signals being updated within the controller ▶

«The initial change in the excitation system operating mode should occur with a delay in the future, so it doesn't have to leave its stable operating state.»

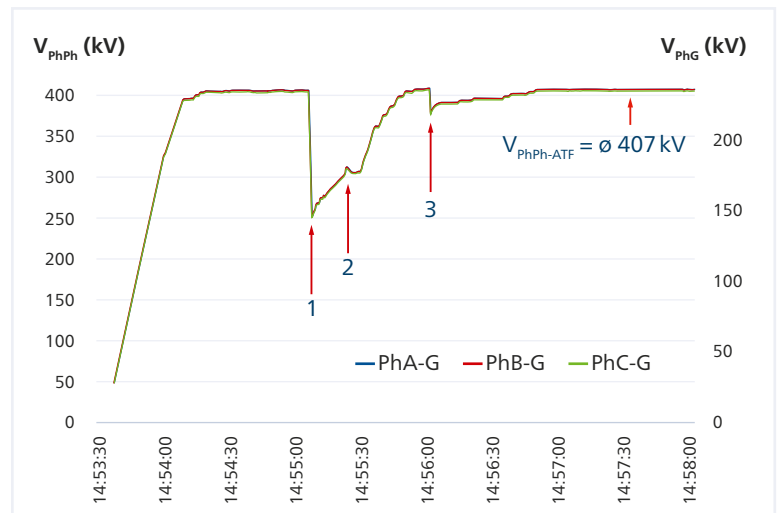


Figure 1: Voltage curve in the Altenfeld substation; ramping up of generator voltage.

when the operating mode was changed. Switching to the "Manual excitation current control" operating mode and ramping up the voltage again was necessary (time point 2). Approximately 3 minutes after the start of the voltage run, the controller was switched to "Automatic voltage control" again (time point 3). A much less significant drop in voltage then occurred, which could be corrected by the automatic system.

Ramping up the test network corresponded with expectations and demonstrated similar behavior with simulations carried out during preparation. However, the initial change in the excitation system operating mode should occur with a delay in the future, so it doesn't have to leave its stable operating state. Remaining at a low rate of active power delivery for too long and the connection of large transformers is critical in this state. On the other hand, timely loading of the generator, e.g., through starting up a storage pump, appears to be useful.

Connecting the load

In the second part of the test, the required switching operations for load pickup should be implemented from the distribution network and assumptions from the preliminary stage should be confirmed. However, this part of the test did not quite proceed as expected.

Firstly, after increasing the voltage level, the automatic stepping of the unit transformers in the Lippendorf power plant became active. This func-

tion is usually linked logically with the island operation of the power plant and used to control over-voltages in the nearest substation at Pulgar. As the voltage threshold was exceeded and the signal link was missing, the generator transformers in the power plant were stepped up, which, in the

case of a "missing" generator, increased the already high voltage in the on-site power further.

As shown in Figure 2, the over-voltages tripped the 380 kV machine line between Lippendorf and Pulgar. The discovery of this defect confirmed

«The occurrence of these unexpected results confirmed that a practical run-through of the test offers significant advantages over pure simulation and is therefore necessary.»

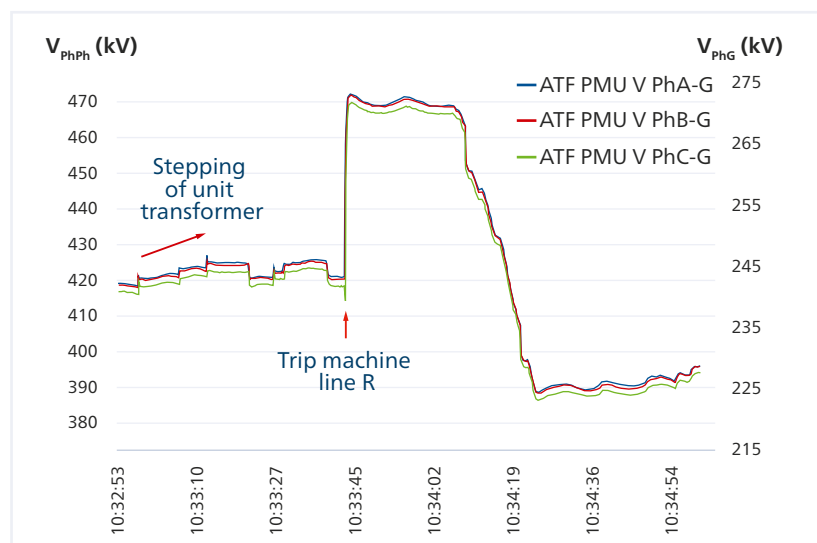


Figure 2: Voltage curves during unit transformer stepping trigger machine line R.

that a practical run-through of the test offers significant advantages over pure simulation and is therefore necessary.

Secondly, after switching on the unloaded 380/110 kV transformer, a further anomaly was revealed: due to the severe voltage drop after closing the transformer circuit breaker, the excitation system of the Goldisthal pumped storage plant switched to Fault-Ride-Through (FRT) mode. This means that in the event of a network fault, the voltage is supported by the generator. While the target values of the excitation system remained at 18 kV nominal generator voltage, the voltage at the generator terminal dropped significantly due to the engagement of trans-

former inductance. The excitation system delivered reactive power to the idling island network to support the voltage.

Approximately 6 seconds after switching on the transformer, a change in the excitation system operating mode can be detected from the curves in Figure 3. Consequently, the voltage rose further, which led to over 420 kV on the nodes in the test network and finally to the protective tripping of the 380 kV Pulgar–Vieselbach line.

In the final step, the now loaded island network was synchronized with the integrated European power grid. To do so, the speed and frequency target value for the turbine controller in the pumped

storage station was adjusted to 50.06 Hz. Thus, the ramp-up grid ran asynchronously to the European power grid and the synchronizing device in the Vieselbach substation could be activated. Following successful synchronization, the control type of the turbine controller in the pumped storage station was switched from speed-dependent to power-dependent.

Summary and outlook

Grid restoration using a ramp-up network was tested successfully in 50Hertz's territory. A prepared area of the network consisting of several lines and substations was ramped up to nominal voltage within minutes. During an emergency, this delivers a significant time advantage compared with grid restoration strategies that use sequential connection and loading.

There are also plans for further comparable field tests using the Markersbach pumped storage power plant. The aim of these tests is to supply extensive parts of the network with voltage to secure the on-site power structure of power plants. Connecting several ramp-up networks established independently of one another at selected sites in the network forms a part of this concept. Grid restoration with generators producing electricity from renewable energy sources will play a key role in the changing generation industry as a result of the energy revolution. ■

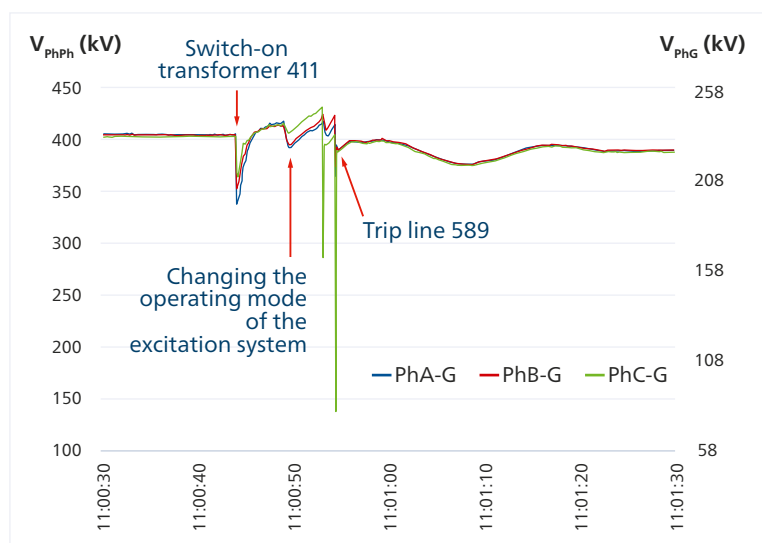


Figure 3: Voltage curves in the Altenfeld substation; switch-on attempt transformer 411 and subsequent events.



LOOKING BACK

Marko Ruotsalainen looks back on his time as a OMICRON sales partner in Finland

Marko Ruotsalainen has been working for Siemens as the OMICRON Sales Partner in Finland for more than two decades. In this article he describes how he has seen OMICRON grow from a small startup company to a big enterprise with close to 1,000 employees.

Hello Marko, thank you for taking the time to speak to us. Why did a giant like Siemens become an OMICRON Sales Partner – a small startup at the time?

Marko: Thirty years ago, Siemens' brand-new fully digital protection relays were technically years ahead of the competition. These relays created an urgent need for a fully digital secondary test set. At that time, OMICRON entered the market with the CMC 56, and Siemens soon decided to sell the device via their worldwide sales channel. It was a win-win situation for them, as the CMC 56 was the only tool that allowed relays to be tested properly. I started working at Siemens in 1993, and soon after that, the first CMC test sets were delivered to Finland. In 1998, I became an OMICRON Sales Partner.

*«It was a win-win situation for Siemens, as the **CMC 56** was the only tool that allowed the brand-new fully digital protection relays to be tested properly.»*

Marko Ruotsalainen, former
OMICRON Sales Partner, Siemens Energy



Did you stay focused on secondary test sets?

No, the idea that the market for secondary test sets would be saturated soon became a matter of discussion between OMICRON and its Sales Partners. Satisfied OMICRON users had also requested primary test sets. OMICRON responded with another innovation – the CPC 100. Siemens bought the device immediately, as we knew that the best way to sell new products is to use them yourself. I specialized in promoting ground impedance measurements with the CPC 100, as there was a growing demand to increase distance protection selectivity with impedance measurements.

What happened next?

In 2006 I got to know the OMICRON MPD analysis system. I remember how excited I had been about a completely new and innovative partial discharge (PD) measurement system. The purchase of a PD analysis system is a significant investment, so many customers want to see the MPD system in practice in their environments. PD measurements are very noise-sensitive, so it can be very difficult to absorb disturbances. In many cases, we had to demonstrate the functionality of the equipment in highly demanding conditions.

Do you have a concrete example?

Yes, I do. I still remember when Alexander Kraetge from OMICRON and I demonstrated the MPD 600 at a transformer factory. Several vendors had already been there before us, and their results were less than successful. So, the customer's expectations were not high. The demonstration took place in an open testing field inside the production area. We managed to carry out the measurements successfully, and the customer decided to order the system immediately. That convinced me that the MPD 600 is probably the most advanced PD measuring system on the market. Since then, several such systems have been delivered to customers in Finland, including transformer manufacturers, cable manufacturers, and service companies.

What is your personal plan for the future?

Today I'm working at Siemens Energy High Voltage Transmission product business. From that perspective, I'm still following what's happening in the market in terms of primary testing solutions, and I think OMICRON still has a lot of potential for a great future there.

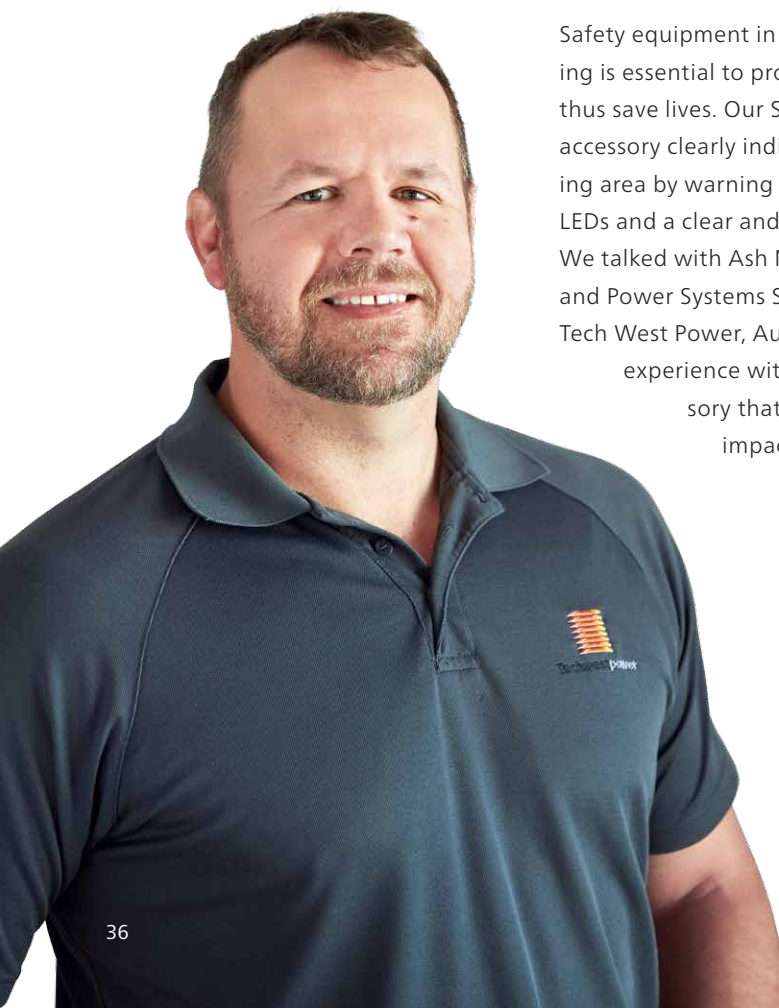
Thank you for talking to us. ■





SAA2 – A SMALL ACCESSORY WITH SIGNIFICANT IMPACT

The importance of safety products during testing



Safety equipment in high voltage testing is essential to protect people and thus save lives. Our SAA2 safety lamp accessory clearly indicates the testing area by warning you with flashing LEDs and a clear and noticeable tone. We talked with Ash Murphy, Director and Power Systems Specialist at Tech West Power, Australia, about his experience with a small accessory that had a significant impact on him.

Thank you for taking the time to be interviewed. Why did you want to deploy another safety tool in your company? Or, more precisely, for high-voltage equipment testing?

Ash Murphy: In our industry, we are often tasked with performing complicated and hazardous activities in live substations. Working in this type of environment requires significant attention to detail when it comes to controlling the work boundary or permitted area. The isolation verification, executing comprehensive testing procedures, and most importantly, having a "Safety First"-mentality.

The consequences of an incident and injury to personnel, damage to equipment, or an unwanted substation trip can be severe. As a result, we are always searching for innovations or ideas to improve our safety systems.



SAA2 in use onsite during transformer testing.

An incident occurred in our industry about 18 months ago, and we paid close attention to it, as this could be something that would be relevant to our team. A utility technician was performing tests on a transformer as part of a two-person team. There was a communication breakdown whereby a team member prematurely accessed a test clamp. The neutral bushing with the asset was still under test, which resulted in an arc flash that burned that person. It raised a few questions: What was the communication like? How was the testing team controlling the equipment? Did the technician have any awareness of the test status?

How did you become aware of our safety products, especially the SAA2?

I was browsing the OMICRON website and came across the SAA2. It made

me think about the technician who was unaware that the test was being executed in the incident mentioned above. The SAA2 is the perfect device for ensuring that each team member can remain aware of a test's status. They can apply their own emergency button when required and can only release their "safety emergency off"

when they are clear of the apparatus. The flashing LED, and audible tone also serve as reminders or warnings that the test is still running and all personnel need to stand clear. We discussed this in the team at Tech West Power and were eager to have this device as part of our test setup. So we ordered a set. ▶

«Working in this type of environment requires significant attention to detail when it comes to controlling the work boundary or permitted area.»

Ash Murphy,

Director and Power Systems Specialist, Tech West Power

Which assets and voltage levels is the SAA2 lamp used for in your company?

We use the SAA2 predominantly for running diagnostic tests on current transformers, voltage transformers, and power transformers between 11 kV and 220 kV. We've also used the SAA2 while performing injections on large switchboards located in switchrooms. We found that placing a SAA2 at the end of the switchboard closest to an entry point makes it very clear to anyone who might enter that a test is in progress, and they need to remain clear of the device.

Which features of the SAA2 lamp are indispensable for you and have the most value?

Although we certainly appreciate the flashing LEDs and the clear alert tone, personally, it's the "emergency off" feature that I value most. The commissioning engineer or technician controlling the test is often alternating between their laptop or interface and the test equipment, communicating with the test team and their test plan. The SAA2 allows team members to take control of their safety by using the "emergency off" feature when interacting with the asset instead of relying on communication. In addition, they're able to isolate the current test if they see something that's not right. That's a valuable addition to a test setup and provides a safer working environment.

Which future trends do you see regarding safety in HV testing?

- › Future trends include the further integration of test sets and test plans. Reducing the amount of setup time between tests by performing a variety of measurements with the same equipment and set.
- › We would like to see continued discussions with asset manufacturers about providing accessible test points for the connection and disconnection of testing equipment.
- › Being able to combine the SAA2 with more products would be fantastic.
- › Quite often, multiple connections are required for test leads and clamps that are supplied. Perhaps a package of test leads and clamps could be made available, one that's suitable for high voltage and heavy current testing with the same specs as OMICRON issued leads?
- › Longer communication cables (or a variety of cable lengths) between SAA devices.
- › I'm also interested in the continued development of Arc Flash protection.

Do you have anything else that you'd like to add?

I feel fortunate to work as a commissioning engineer within an industry that's constantly evolving and growing. It's a privilege to be challenged regularly and stimulated in our technical roles. At the same time, we feel rewarded by our contribution to playing

an essential part in supplying power to communities. In saying that, the most important thing is that each commissioning engineer or technician can perform their tasks safely and return to their families and loved ones each day. Safety must always remain the number one priority in our industry.

My colleagues and I are thankful that we have aligned our business with OMICRON. It's clear that OMICRON is a company that shares our safety values and seeks to continuously improve the use of their products. Adopting the SAA2 in our business has already resulted in using testing equipment more safely and has improved testing methodology for our team. As this device is used more widely in our industry, I think it will create a safer environment for everyone.

Thank you, for talking to us. ■

 techwestpower.com.au

«The SAA2 allows team members to take control of their safety by using the «emergency off» feature when interacting with the asset instead of relying on communication.»



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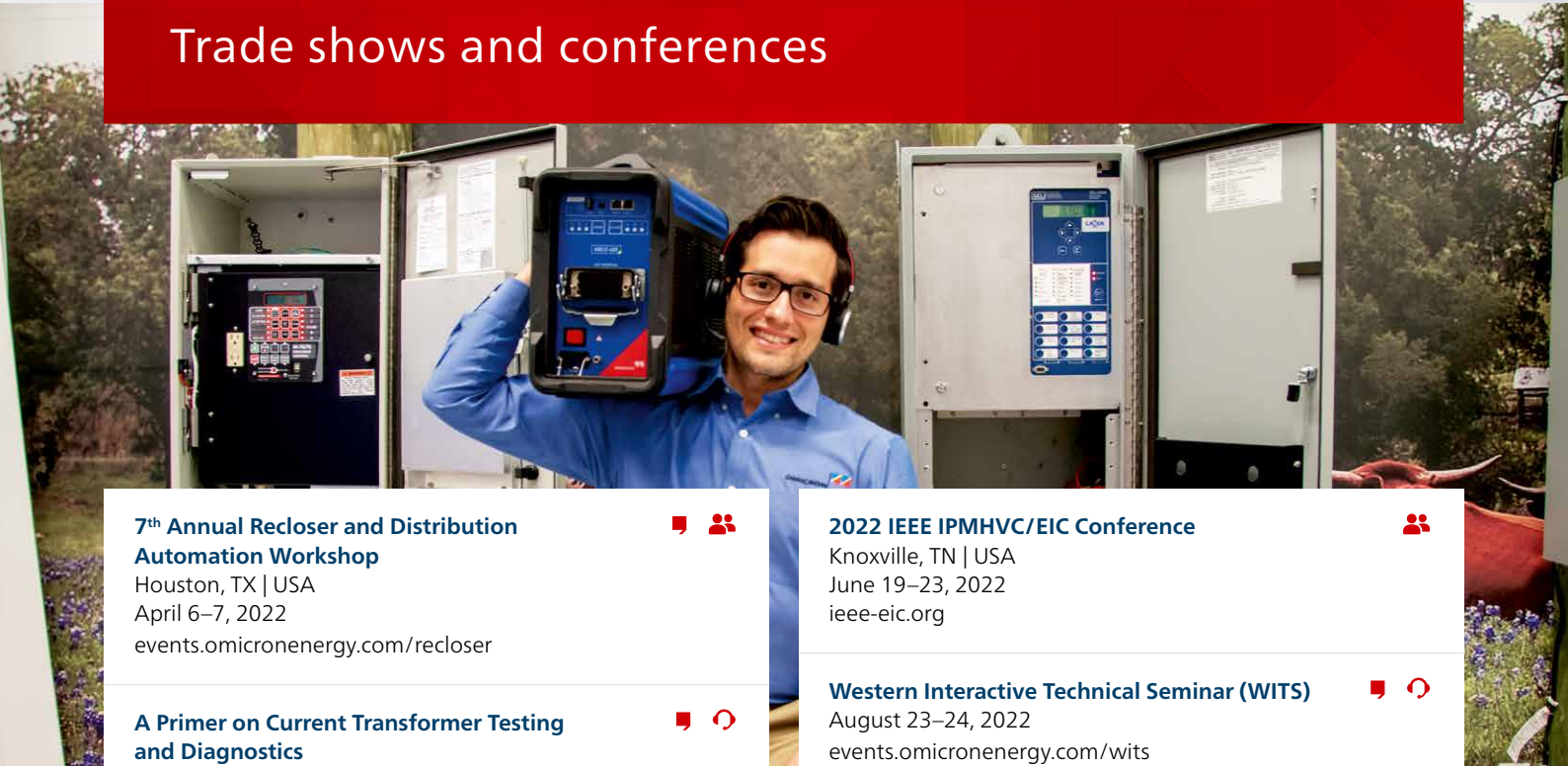
"In a 2020 North American Customer Feedback Survey, 99.2% of our customers rated us as excellent. You can reach our expert engineers for all your support needs – 24 hours a day, seven days a week."



Donatello Salvucci,
Technical Support Engineer,
OMICRON

WHAT'S GOING ON

Trade shows and conferences



7th Annual Recloser and Distribution Automation Workshop

Houston, TX | USA

April 6–7, 2022

events.omicronenergy.com/recloser



A Primer on Current Transformer Testing and Diagnostics

April 20, 2022

events.omicronenergy.com/cttesting



IEEE T&D

New Orleans, LA | USA

April 25–28, 2022

ieeet-d.org



Circuit Breaker Testing Primer

May 10, 2022

events.omicronenergy.com/cbtp



7th Annual Northeast Power and Energy Conference (NEPEC)

Portland, ME | USA

May 17–19, 2022

events.omicronenergy.com/nepec



DISTRIBUTECH

Dallas, TX | USA

May 23–25, 2022

distributech.com



5th Annual North American IEC 61850 Tutorial & Workshop

Houston, TX | USA

June 7–9, 2022

events.omicronenergy.com/na-iectw



2022 IEEE IPMHVC/EIC Conference

Knoxville, TN | USA

June 19–23, 2022

ieee-eic.org



Western Interactive Technical Seminar (WITS)

August 23–24, 2022

events.omicronenergy.com/wits



PAC World Americas Conference

August 2022

pacw.org



Protection & Traveling-Wave Testing Workshop

September 14–15, 2022

events.omicronenergy.com/ptw



Transformer Diagnostic Workshop (TDW)

September 27–29, 2022

events.omicronenergy.com/tdw



T&D World Conference & Exhibition

Charlotte, NC | USA

October 5–7, 2022

events.tdworld.com



CIGRE Canada

Canada

October 2022

cigre.ca/en/cigre-canada



OMICRON-hosted



Virtual



In-person



L4353