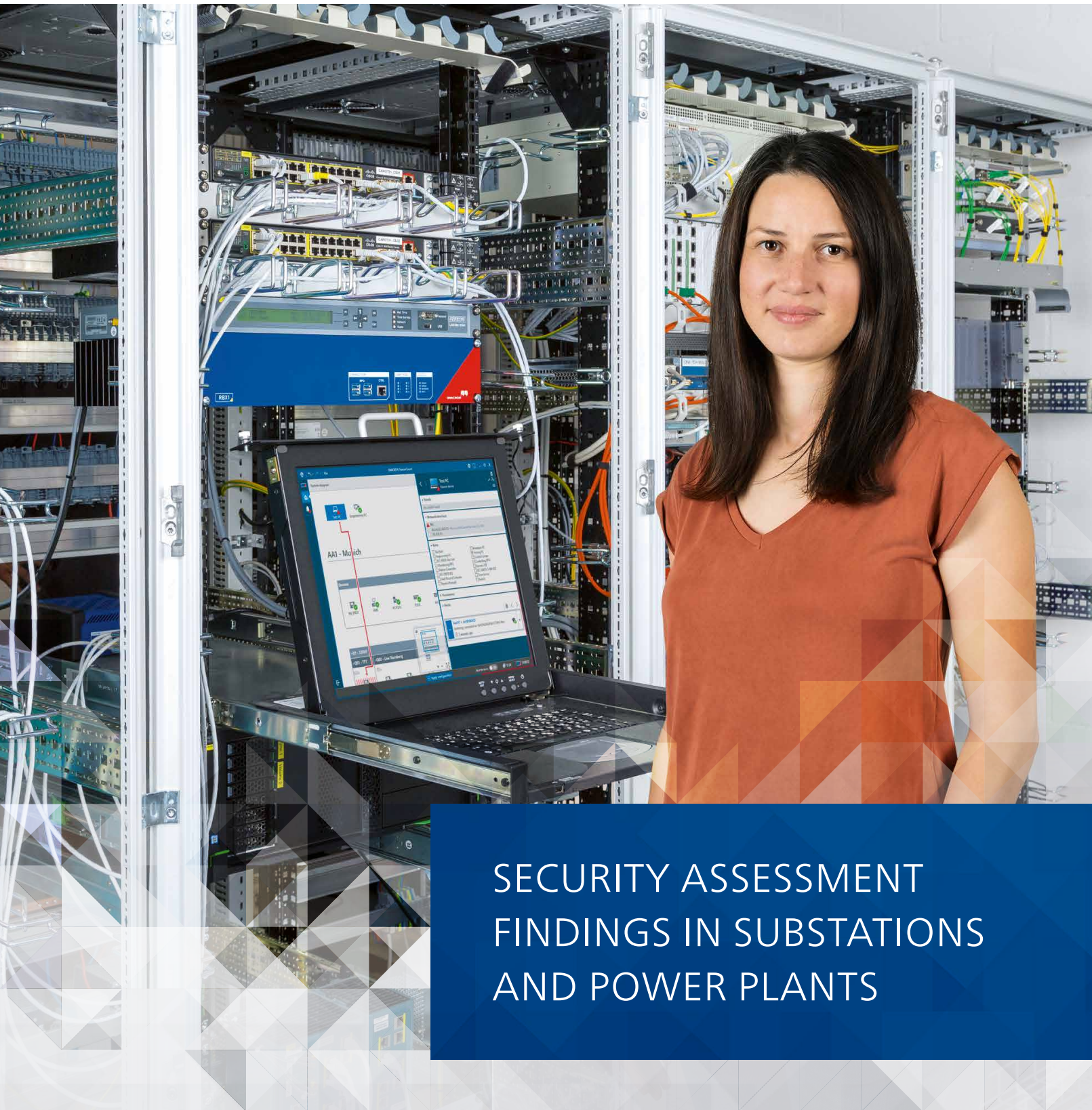


OMICRON Magazine



SECURITY ASSESSMENT
FINDINGS IN SUBSTATIONS
AND POWER PLANTS



DEAR READERS,

Nigeria, Saudi Arabia, Kuwait, and Turkey may not all be near each other geographically. Still, one thing that connects them is the energy industry's interest in the compact, battery-powered COMPANO 100. In the interview on page 14, we talked to our Sales Partners in the Middle East and Africa about why the compact test set is in such high demand.

Our international OMICRON Academy team has developed an entire portfolio of webinars in a short amount of time. So now you can access our learning content anywhere, anytime. Read about what you can learn from more than 45 free webinar recordings on page 21.

When you began working in the energy industry, I'm sure you learned about the critical factors that go into reliable condition assessments. E. g., performing tests correctly and evaluating the results with precision. So that's nothing new. However, what is new is that machine learning makes it possible to compare test results using algorithms based on expert knowledge and large amounts of data. Would you like to know more? Then turn to page 40.

As much as machine learning can open new doors for us, knowledgeable experts are just as significant. In the article on page 6, we spoke to Ozan Dayanc. He discovered some rather alarming results when running security assessments with the StationGuard Intrusion Detection System (IDS). Learn more about Ozan's journey and how to avoid the most common security risks.

As you know, we love discussing a wide variety of topics with our customers and colleagues. So we're thrilled to announce that our Energy Talks podcast has reached more than 3,400 subscribers this year!!

We want to thank you for the attention our podcast has been receiving! On page 12, you can find exciting facts and figures about previous episodes.

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

Enjoy reading!

Lia Thum

OMICRON Magazine Project Lead

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magazine@omicronenergy.com

«*What we know
is a drop. **What
we don't know
is an ocean.***»

Isaac Newton

TABLE OF CONTENTS

6



Security assessment findings in substations and power plants

14



COMPANO 100 – Rocking the Middle East and Africa

21



Application knowledge “to go”

40



Higher data quality with artificial intelligence

PRODUCTS AND TECHNOLOGY

6 Security assessment findings in substations and power plants

Frequently occurring risks encountered while traveling around the world

9 Digital transformation

Ongoing changes caused by digital technology

18 From newcomer to technology leader

10 Years of CIBANO 500

24 When an outage is costly

Efficient testing for ensuring fault-free high-speed transfer systems

27 A powerful combination for power transformer testing

In-depth on-load tap changer analysis with TESTRANO 600 and PTM 4.90

30 Reducing the network load in digital substations

With configurable datasets in Sampled Values according to IEC 61869-9

32 Observing partial discharge over time

MONTESTO 200 is our portable system for temporary online PD monitoring and trending insulation status between diagnostic checks.

40 Higher data quality with artificial intelligence

CUSTOMER STORIES

14 Rocking the Middle East and Africa

COMPANO 100 captures new markets in a flash

NEWS

36 ... it just keeps on growing

15 Years of our Protection Testing Library

BACKGROUND

12 Prick up your ears!

Energy Talks celebrates one year on the air

21 Application knowledge “to go”

Webinar recordings from the OMICRON Academy

REGIONAL

38 On site: OMICRON in Slovenia

David Bucaj from ACINEL gives us his insight into the power sector

EVENTS

44 What's going on

SECURITY ASSESSMENT FINDINGS IN SUBSTATIONS AND POWER PLANTS

Frequently occurring risks encountered while traveling around the world



About the author

Ozan Dayanc is an OT security engineer, product specialist, and technical support member at OMICRON. He shares his insights about the protection of power utility automation networks, which he garnered assessing OT networks around the globe.

At the end of 2020, I was contacted by a colleague who tasked me with creating a security assessment report for one of our customers using StationGuard our Intrusion Detection System (IDS). I received engineering files from said customer and was familiarized with the utility's network architecture. These

documents always constitute the conventional basis for a security assessment before my colleagues and I continue our assessment on-site.

The data from my first security assessment proved highly unexpected to substation engineers and

IT specialists. Among the risks which our assessment brought to light were multiple unnoticed external connections, unexpected devices in the network, outdated firmware, unsuccessful RTU operations, configuration errors, and issues with the network and its redundancy protocol (RSTP).

Since then, we have conducted (and improved on) many security assessments worldwide. In addition

to substations, we've also conducted these assessments for power plants and control centers, including utilities with IEC 61850, IEC 60870-5-104, DNP3, Modbus TCP/IP, and many other IT protocols.

The findings from our security assessments were always interesting and, sometimes, alarming. In the following text, I've highlighted some frequently occurring risks that I have encountered in recent years:

Are you interested in our security assessments? Scan the code or message us at
✉ info.puc@omicronenergy.com



OUTDATED FIRMWARE

with known vulnerabilities

26 updates
available

In every security assessment, I come across outdated firmware versions. As part of our assessment, we provide a passively discovered asset inventory to the utility engineers and IT experts. We augment the asset information by importing engineering files with more details, like the software version, hardware configuration, and serial numbers.

This asset inventory is a sound basis for performing vulnerability and risk analysis.

EXTERNAL CONNECTIONS



Power plants and control centers with remote connections from the corporate IT network always have the highest risk of a cyberattack. While assessing a Latin American substation network, we captured the activity of multiple clients with external IP addresses. This utility allowed their engineers to connect and configure IEDs from home using a remote connection (VPN tunnel). One finding that concerned the IT security officers was an IP and a MAC address which weren't recognized or documented by anyone in their team. Eventually, we could track the IP address and find where this connection originated from and blocked its access to the system.

Pay closer attention to potential security risks by making all connections in your network visible. ▶

UNUSED SERVICES



Open/unused services offer a disproportionate increase of opportunities for hackers to attack your automation or SCADA system. Thankfully, we can easily detect these unused services through network monitoring. Here are some common unused services we found during our assessments:

- › IPv6: Mostly activated on PCs, sometimes on IEDs. IPv6 was never actually used but provided several attack vectors in the network.
- › Windows file sharing: The file sharing service was always activated on PCs and Windows-based RTUs and Gateways, but not used.
- › PTPv2: It was enabled by default on some industrial switches, even if it has never been used.

Simply turning off these open/unused services will decrease the number of cyber risks to your assets.

DETECTING CONFIGURATION CHANGES



In a North America substation, we detected misconfigured GOOSE messages. This problem occurred because two individual engineering parties configured the devices. In turn, this lack of communication between engineers caused communication problems between these OT devices. We discovered that certain remote command activities in the substation didn't function properly due to invalid interlocking conditions. This means they wouldn't have been able to operate their switchgears remotely in urgent scenarios.

This case showed me that minor GOOSE communication issues could cause more significant plant problems. Therefore, we still offer these basic security assessments for free, allowing us to contact other power plants, substations, and control centers to further our knowledge.

SCADA COMMUNICATION CONFIGURATION ERRORS



Misconfiguring RTU and SCADA devices can slow down communication and might result in failed transmissions for critical on-site events. For example, in a European substation, MMS Reports were configured to be sent to the wrong client IP address. After resolving these configuration errors, there was a verifiable improvement in the IED's communication speed.

Checking impeded communication speed will lower the operational risk of obstructed response processes.

MOST FREQUENT SECURITY RISKS in plant networks



Undocumented external connections
accessing IEDs & switches directly

Outdated firmware with known
vulnerabilities

Unused services

Unauthorized access

Usually, these security problems are fostered by functional problems, such as:

Configuration issues in IEDs, RTUs, and
network switches

Time synchronization failures

Network redundancy issues

DIGITAL TRANSFORMATION

Ongoing changes caused by digital technology



Digital transformation is on the tip of everyone's tongue. Are you already in the middle of restructuring your company? Or are you just planning the first steps to start the digital transforma-

tion? That's great! – Listen to our latest podcast series about "digital transformation in the power industry".

The term digitalization is often used to describe the digital transformation. However, it's misleading because digitalization refers to transforming existing analog content and processes into digital data and procedures. You could say it's one of the first steps in follow-up automation

processes. Digital transformation, by comparison, is a much broader concept: it's a process of ongoing change caused by digital technologies. We in the power industry and other industry sectors have to cope with these fundamental changes and the restructuring of entire areas. In our latest podcast series, our experts share some ideas and knowledge about how the digital transformation affects our profession. ▶



**Juan Carlos Sánchez-Calle and
Martin Pfanner,**
Product Managers, OMICRON

In the **first episode** Martin Pfanner and Juan-Carlos Sánchez-Calle give us a **general overview and their insights about digital transformation in the power industry**. Below is a summary of their statements from the first episode.



1. Digital transformation should begin with a clear goal. The goal is usually a process that needs to be improved or a new business opportunity that should be realized.
 2. Data and digital transformation create a virtuous cycle that pushes innovation. More data creates the need for new digital solutions, and the latest digital solutions generate more data.
 3. Digital transformation changes how value is created and delivered to customers.
 4. Digital transformation is a cultural change that requires companies to change how their tasks are completed.
 5. To be successful in the age of digital transformation, creating a culture of teamwork and breaking down functional, geographic, or departmental silos is essential.
- „The digital transformation opens the door to an exciting evolutionary phase in our industry that creates opportunities for new solutions that result in improved power systems, satisfied customers, and better business results. A sound data management strategy must be implemented for the transformation to succeed.
- We're here to support you in this process and provide all the tools necessary for digitally transforming the testing process in electrical power systems.”



Lukas Klingenschmid,
Product Manager, OMICRON

Lukas Klingenschmid discusses the **challenges of implement-**

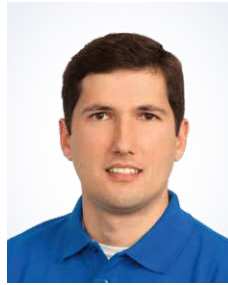
ing digital transformation and **data validation**. A summary of his main points is as follows (you can hear more detailed information in **episodes 2 and 4** with Juan Carlos Sánchez-Calle and David Gopp):

1. Digitalization adapts offline tasks to the online world with a harmonized and standardized ruleset.
2. Automating (repetitive) tasks is crucial for relieving the work-
- force, leaving more time to focus on the core tasks.
3. Data quality is essential for building up meaningful digitalized systems from the start. Automating the validity of test results helps ensure that the correct information is processed.
4. Incorrect test results can have severe (monetary) consequences for the operator.



Thomas Friedel and Eugenio Carvalheira,
Product Managers, OMICRON

In the **3rd episode**, OMICRON cyber security experts Thomas Friedel and Eugenio Carvalheira



discuss the importance of **cyber security** in the digital transformation and how it plays a critical role in power system infrastructures:

“When considering the changes that the digital transformation will have on power industry, it’s imperative to keep the utility’s cybersecurity up to date with

the latest technology. Attention should be paid to the fact that solutions primarily developed for office IT cannot be used in the power industry’s Operation Technology (OT) networks due to their different requirements. Ignoring aspects of OT puts the energy system at risk in regions or entire countries. Therefore, involving OT experts in the selection process for power grid cybersecurity solutions for the power grid is not simply an option, but a necessity.”



David Gopp,
Product Manager, OMICRON

Listen to the **4th episode** about **data validation**, where David Gopp explains how tricky data management can be. Below is a summary of his thoughts.

1. Data quality tries to provide faultless data through the entire process from collection, changing, and distribution.
2. Data validation considers the data in the context of the

application and tries to identify invalid/insufficient quality data.

3. Data validation is an essential part of any data handling task whether you’re in the field collecting information, analyzing or assessing data, or preparing to present data to stakeholders.
4. Analyzing measurement results based on invalid or insufficient quality data won’t produce a reliable assessment.

LISTEN TO THE PODCAST

Interested in this topic?



Be sure to listen to our first Energy Talks podcast series about digital transformation in the power industry. Scan the QR-Code or visit:

omicronenergy.com/digital-transformation-series





PRICK UP YOUR EARS!

Energy Talks celebrates one year on the air

This year we are celebrating one year of **Energy Talks**, our regular podcast series that features discussions with experts and peers about power system testing topics.

We started Energy Talks in January 2021 with the goal of sharing knowledge, which is a very important value for us. We want to share with you some interesting statistics about our podcast series over the past months.

Energy Talks is available on our podcast page, on YouTube and all popular podcast platforms. If you are not already listening, we invite you to tune in and subscribe to Energy Talks as not to miss an episode.



EPISODES

>38



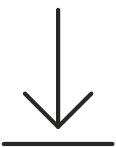
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EXPERT GUESTS

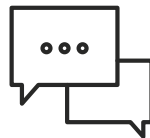
51



DOWNLOADS & STREAMS

>33,247

(Including numbers from all podcast platforms & YouTube)



20 DISCUSSED TOPICS

Top topics:

1. Digital Transformation in the Power Industry
2. Partial Discharge Testing and Monitoring
3. Cybersecurity

TOP COUNTRIES

1. United States
2. India
3. Germany
4. Australia
5. Austria

Although our podcast is only available in English, we are proud to have listeners from

160
COUNTRIES





This is just a short note to say that I'm regularly listening to the OMICRON Energy Talks podcast series, and I highly appreciate the topics and speakers. At Maschinenfabrik Reinhausen, I'm responsible for the digital twin representation of a transformer from engineering to documentation and performance monitoring, along with integrating it into our customers' ISO 55000 process. So, I was very curious listening to your Digitalization podcasts series. In addition, I found the novel approaches that Dr. Karsten Viereck and Christoph Engelen discussed about diagnosing and monitoring transformers and OLTC with vibroacoustic sensors extremely valuable. It's always great to hear the story behind the stories. Since I'm an active and regular listener to your series – time has always been well spent and insightful with new perspectives.

Bastian Fischer, Head of Portfolio- and Business Development, BU AUTOMATION



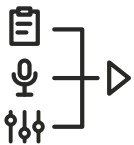
I just emailed to say that I've been listening to the podcast series, and so far, I've found it extremely interesting. I'm an Electrician based in Glasgow, Scotland, and my current job involves carrying out controls upgrades on diesel generators and switchgear throughout the UK; I have been listening to podcasts while driving long distances. I found episode 3 with Gustav Lundqvist of Kraftdiagnos particularly interesting. It was great to hear the story of someone using the OMICRON test kit in the field and get an insight into the type of work out there.

Feedback from a podcast listener



As a switchgear technician, it is nice to hear about this topic on YouTube in podcast format, just like some of my other favorite shows!

Feedback from a podcast listener



PRODUCTION TIME

~10 hours per episode



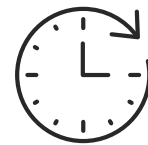
INVOLVED EMPLOYEES

~6 per episode – like the fixed ensemble cast of "Friends"



MATERIAL AVAILABLE FOR LISTENING

>14.5 hours – corresponding to two complete days of work, free of charge



EPISODE LENGTH

~26 minutes – like watching one episode of "Big Bang Theory"

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omicronenergy.com/podcast



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ROCKING THE MIDDLE EAST AND AFRICA

COMPANO 100 captures new markets in a flash

Nigeria, Saudi Arabia, Kuwait, and Türkiye are four countries with very different power system infrastructure and diverse testing requirements. Still, one commonality is the interest of the energy sector in the small, battery-operated COMPANO 100. The feedback

from many enthusiastic customers confirms that the device meets a whole slew of different basic testing applications perfectly. Why is that? We talked to our Sales Partners in the Middle East and Africa and asked them why the compact test set is in such high demand.



*«COMPANO 100 is not a simple test device, **but the way it communicates with the user has been simplified, and that's what I like.**»*

Serhat Tatal, Marke Elektronik, Türkiye

Serhat Tatal: "In Türkiye, COMPANO 100 is the right product at the right time. The electrical grid structure in our country was split into generation, transmission, and distribution roughly 25 years ago. As a result, the distribution sector has to cope with the loss of test experience in some cases. Furthermore, distribution utilities rent the grid from the government for a specific period of time. Therefore, some of them have a limited budget for testing. With its multi-functionality and easy-to-use user interface, COMPANO 100 is the perfect match for this industry in Türkiye. Large utilities use this device intensively in their daily business. For example, we delivered 125 units to Enerjisa. This is an impressive demonstration of the fact that customers with simpler applications can also benefit from the quality that OMICRON is known for.

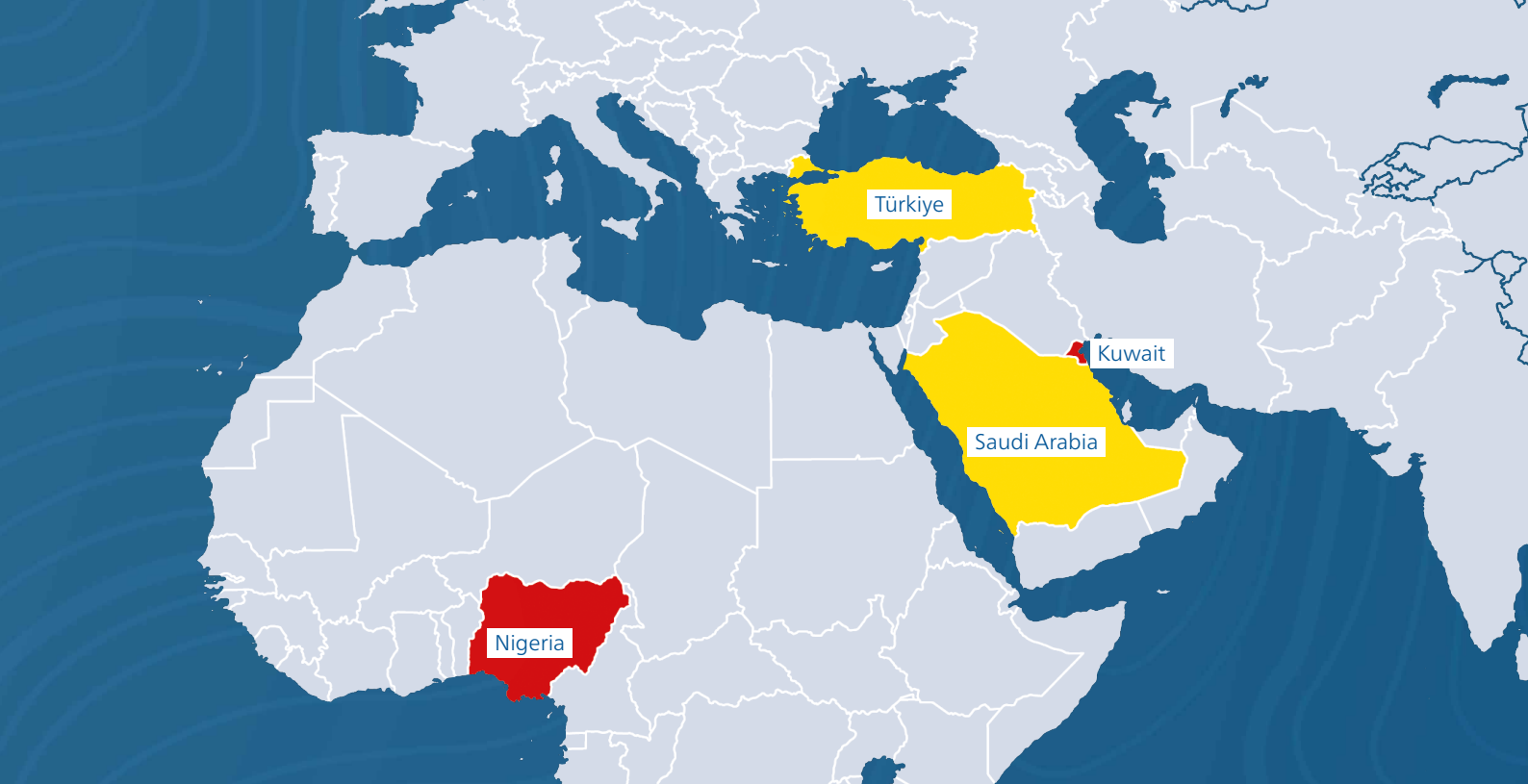
This is also true of COMPANO 100's battery – we've had zero battery-related complaints. Of course, battery

operation is a game-changer. In my opinion, continuous software improvements and the great teamwork we've experienced with OMICRON are also important factors for success. Thanks to this, our customers benefit from outstanding after-sales support, for example, when they need a loaner test set quickly.

I'm very optimistic about the future of COMPANO 100 in Türkiye. With its wide application range, it's a perfect match for distribution utilities and an ideal fit for industrial plants."



High demand in Türkiye: Marke Elektronik had to empty their biggest meeting room to cope with the large amount of devices ready for delivery to their customers.



*«In Saudi Arabia, safety is a priority when it comes to power systems. It's great that **COMPANO 100** can also be used to perform grounding tests and step and touch voltage measurements.»*

Mohamed Taha, Mejdaf, Saudi Arabia

Mohamed Taha: "COMPANO 100 comes with an unbeatable cost/performance ratio. For most customers, the device's functionality is sufficient, which is probably why most utilities in Saudi Arabia are already working with it. Large companies appreciate it. For example, Saudi Electricity Company ordered 100 units for their staff.

Our customers mainly perform single-phase relay tests, CT and VT ratio tests, measure circuit breaker resistances, and check the polarity and wiring. When it comes to power systems, safety is a priority in Saudi Arabia. Thus,

contractors are searching for reasonable and safe solutions. It's great that COMPANO 100 can also be used to perform grounding tests and step and touch voltage measurements. Therefore, the device is also interesting for panel builders and service providers.

One of our customers uses COMPANO 100 for a very simple one-phase test. 50 Amperes have to be injected for just 1 second. Up to now, two test engineers were needed to carry a large 30 kg (66 lb) generator and a 25 kg (55 lb) current injector to the site to perform the test. With COMPANO 100,

they only need one compact 10 kg (22 lb) test kit, and thanks to the digital output, they're also able to perform tests with a high level of accuracy. That's truly unique."



Customers in Saudi Arabia searching for both safe and versatile solutions appreciate the cost/performance ratio of COMPANO 100.



*«In Africa, calibration is a challenge. **COMPANO 100** can maintain a high level of accuracy over a long period of time. That's a major benefit.»*

Nitin Mahajan, T&D Technologies, Nigeria

Nitin Mahajan: "Nigeria is a very large country with a lot of transmission stations. The primary energy transmission utility in Nigeria, TCN, ordered 40 COMPANO 100 units for daily tests throughout the country.

Its user-friendly software is beneficial for the single-phase test set. It's effortless to handle, even for testers without much technical competence. After defining a few test settings, you can already start testing with the device. What I also like about COMPANO 100 is that it can maintain a high level of accuracy for an extended period of time. This is a significant benefit since calibration can be quite challenging on the African continent.

This is especially true in the northern part of our country, where there are a lot of soil and grounding problems. With COMPANO 100, our customers no longer require different testing equipment. With a single handy device, they can test the grounding impedance, step and touch voltages in addition to various other tests for their assets. With auxiliary power unavailable in many areas of Nigeria, battery operation is also a significant advantage.

COMPANO 100's extensive application package is fantastic. It also makes the device very interesting for privately-held distribution companies in Nigeria. I see a bright future for this test set in our country."

«I'm impressed by the battery performance. There haven't been any complaints so far – despite the very high temperatures in Kuwait.»

Mohamed Al Saleh, Energy Solutions, Kuwait

Mohamed Al Saleh: "I'm impressed by COMPANO 100's battery performance: despite having to cope with very high temperatures at testing sites in Kuwait, there haven't been any complaints regarding the battery so far.

Our customers value the test set because it's diverse, lightweight, and mobile. This makes it easy to carry from one site to another within a short period of time. There is no other product that combines protection relay testing, micro-ohm measurement, polar-

ity checks, and grounding resistance in one device. This is why we consistently receive positive feedback whenever we present the COMPANO 100 to local authorities or distribution and transmission utilities.

Thanks to our close collaboration with the OMICRON team, our customers also appreciate the fast responses they receive to troubleshooting issues. Due to these factors, the market is being boosted in the right direction for COMPANO 100, and we expect to see significant orders in the coming months."



With COMPANO 100, the Ministry of Electricity and Water in Kuwait conveniently tests various protection functions with pre-defined test sequences and output parameters.

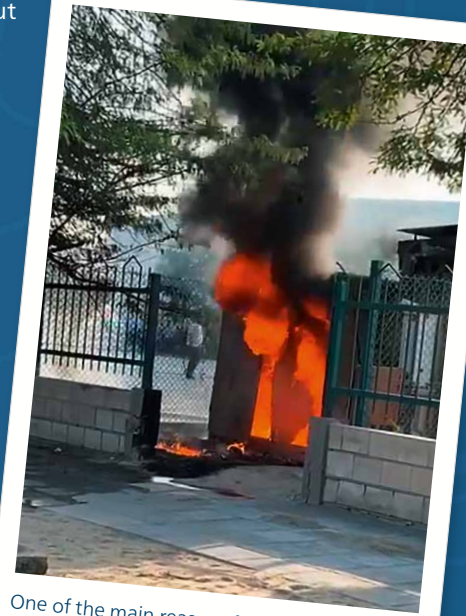
AN EXPLOSION OF SUCCESS – HOW IT ALL STARTED



Ahmed Abdelwahab,
Engineering services,
OMICRON Bahrain

Ahmed Abdelwahab: "Burning ring main units in the medium-voltage level are a common problem for many distribution utilities worldwide. One of the main reasons for this is incorrectly parametrized protection relays. When the circuit breaker doesn't trip during a fault, the fatal consequences can be cable fires or burning power transformers due to overload and oil overheating. Therefore, testing the protection equipment is essential. This can be challenging when self-powered relays are supplied by the current transformer, especially when an electrical power supply is unavailable on site.

With COMPANO 100, Saudi Electric Company (SEC) in Saudi Arabia found a convenient solution for overcoming these problems and reducing the associated risks. The battery-operated device allows them to test the proper function of their various self-powered protection relays on site. SEC was already working with COMPANO 100 to evaluate its performance. We contacted them about the possibility of testing self-powered relays in ring main units. With the compact test set, the test engineers could perform this test for the first time. Thanks to its intuitive interface, a demonstration wasn't even necessary. Aside from that, the evaluation at SEC showed that the versatile test set could fulfill all of their daily basic testing requirements. That's how the overwhelming success of COMPANO 100 in Saudi Arabia began. We're pleased that we could improve the test engineers' routines with many more devices that have since been delivered throughout the kingdom."



One of the main reasons for burning ring main units in the medium-voltage level is incorrectly parametrized protection relays.



CONTINUOUS IMPROVEMENT

We are striving to implement your feedback quickly to constantly improve both the functionality and usability of COMPANO 100. The new software version 2.31 contains several improvements based on feedback from customers in 13 countries around the world. It's available free-of-charge in our Customer Portal. Download it now:

 my.omicronenergy.com

FROM NEWCOMER TO TECHNOLOGY LEADER

10 Years of CIBANO 500

In the previous edition, we asked a Dutch testing provider why they chose our circuit breaker test system several years ago and whether they were satisfied with it. Today, we're going to look at CIBANO 500's history over the last ten years. OMICRON Application Engineer Stefan Achberger is someone who knows all the ins and outs of the system for years. In our interview, he explained the development of the device from its launch to the present day.

Was the CIBANO 500 designed specifically for testing high-voltage circuit breakers?

Stefan Achberger: The focus on high-voltage equipment resulted from stringent demands placed on testing these circuit breakers. Connecting large breakers is very time-consuming. The terminals are several meters above ground, so we have to use ladders or risers. It quickly became apparent that the tests had to be feasible without any rewiring, with as few cables and components as possible. To ensure the safety of our customers at all times, we also must be able to test the circuit breakers with both sides grounded.

The result was a modular concept using the CB MC2s. These modules only weigh 1.2 kg (2.64 lb) with a single

connection to the main device and short connecting cables to the breaking elements. Compared with other systems, this concept was simpler and needed less than half the testing time required by typical circuit breakers in a high-voltage application.

Nowadays, we can also **test more sophisticated breakers with four or more breaking chambers per phase without any rewiring.** We produced a video that shows how a breaker like this is connected and tested:

 youtu.be/V4jGvV94Fvk





MISSED THE FIRST PART?

In Part 1 you can read why leading testing providers are opting for CIBANO 500. Scan the QR code or visit:

 omicronenergy.com/Part-1-CB



What's the situation with gas-insulated switchgear like?

Having both sides grounded is a safety requirement that also applies to gas-insulated switchgear. Three years after the device was launched, we developed a new measurement method that could guarantee it. Current sensor measurement (CSM) uses Rogowski coils to measure the time when the current in the ground path changes.

The **CSM method** has rapidly established itself as the new standard for timing analysis in GIS, and other manufacturers are now offering it as well. The measurement method is described in this video:



 youtu.be/0BPBmtg7ieY

What advantages does the CIBANO 500 offer for medium-voltage circuit breakers?

It's also been possible to test medium-voltage breakers with efficiency. Since its market launch in 2013, it has tended to be more straightforward. The internal voltage source was beneficial, as the breakers are often fully withdrawn. However, its functionality has been extended dramatically in recent years. A measurement method for voltage-based timing (VTM) measurements in sealed installations was introduced, followed by tests for undervoltage coils and overcurrent releases. In the latest 4.90 version of the Primary Test Manager™ (PTM) control software, the VTM measurement is also analyzed automatically via the capacitive taps. ▶

All these tests are included in the medium-voltage package, along with motion measurements using the CB TN3 module (via digital and analog sensors). The following video illustrates **how medium-voltage circuit breakers are measured:**

 youtu.be/COvybldgmWw



documents in Excel format and a common database for the entire team.

What other trends can we expect to see in the future?

As a result of these volatile times, we're seeing more and more customers returning to perform previously outsourced measurement activities themselves to remain independent. The modular nature of the CIBANO 500 hardware allows it to be upgraded easily to meet future testing requirements. In light of the digitalization of many processes, having a modern database application with cloud functionality will better equip customers to meet future challenges. If you're interested in expanding your expertise, check out the OMICRON Academy, which offers a wide range of relevant training courses.

Thank you for speaking with us. ■

What's unique about the way CIBANO 500 operates?

Smooth operation is always a key factor for users. The Primary Test Manager™ (PTM) software provides guided test sequences and automatically stores all the results in the integrated database. As the PTM software is continuously being developed and refined, the CIBANO 500 system remains state-of-the-art. In addition to controlling the device, this modern interface does much more. For example, it also attaches photos using the PTMate app to user-defined test

**VISIT THE
OMICRON ACADEMY:**

 omicronenergy.com/academy-webinars



APPLICATION KNOWLEDGE “TO GO”

Webinar recordings from the OMICRON Academy

Wide-ranging topics concerning our testing and diagnostics solutions are explained clearly by our Academy instructors in more than 45 selected webinar recordings. The free recordings convey technical knowledge from a theoretical perspective all the way to real-world applications with ease. Thanks to the efforts of our global team, the recordings are available to anyone interested in them. Everything from the production of live webinars to the distribution of the recordings has

followed one overarching principle. That principle is giving our customers access to the knowledge within the Academy, even when we're all faced with restrictions.

"Instructor-led training aims to impart practical knowledge and encourage a lively exchange of ideas within the group, which is always appreciated. Before Covid, we didn't see a demand for online webinars. However, during the first lockdown, everything changed

very quickly", explains Claudia Brich from the Process Management team at the OMICRON Academy.

Global webinar offer

An international team extending well beyond the OMICRON Academy set to work immediately, making a monumental effort to develop an entire webinar portfolio in a short amount of time. These webinars can now be accessed from all over the world. "Our instructors and organizational team ▶





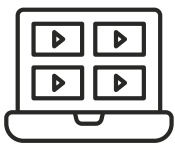
LIVE WEBINARS

344 in the
first 4 months of 2020



PARTICIPANTS

12,656
since 2020



WEBINAR RECORDINGS

>35 in English
>45 in German



AVERAGE DURATION

1h 12 min

Shortest webinar: 22 min;
longest webinar: 1h 55 min

*«I want to thank you
for your free webinars.
I learned a lot from them.
**I would like to request
a recording of the video
from this webinar.»***

Customer feedback

normally led courses in the Academy training centers or on customer sites. But now they were focused exclusively on delivering instructive live webinars for our customers”, explains Claudia. The organizational breakdown into different regions also made it possible to distribute various topics targeted around the globe. “We arranged the webinars according to key products in various time zones so that our customers always had access to a range of courses for eight months. We recorded these webinars and were surprised by what happened next.”

The webinars were enthusiastically received, and many viewers wanted to watch them again. “However, the demand for the Academy webinar recordings posed several problems for us. We wondered which recordings should we select, how we would make them available, and where people could go to find them?”, recalls Claudia.

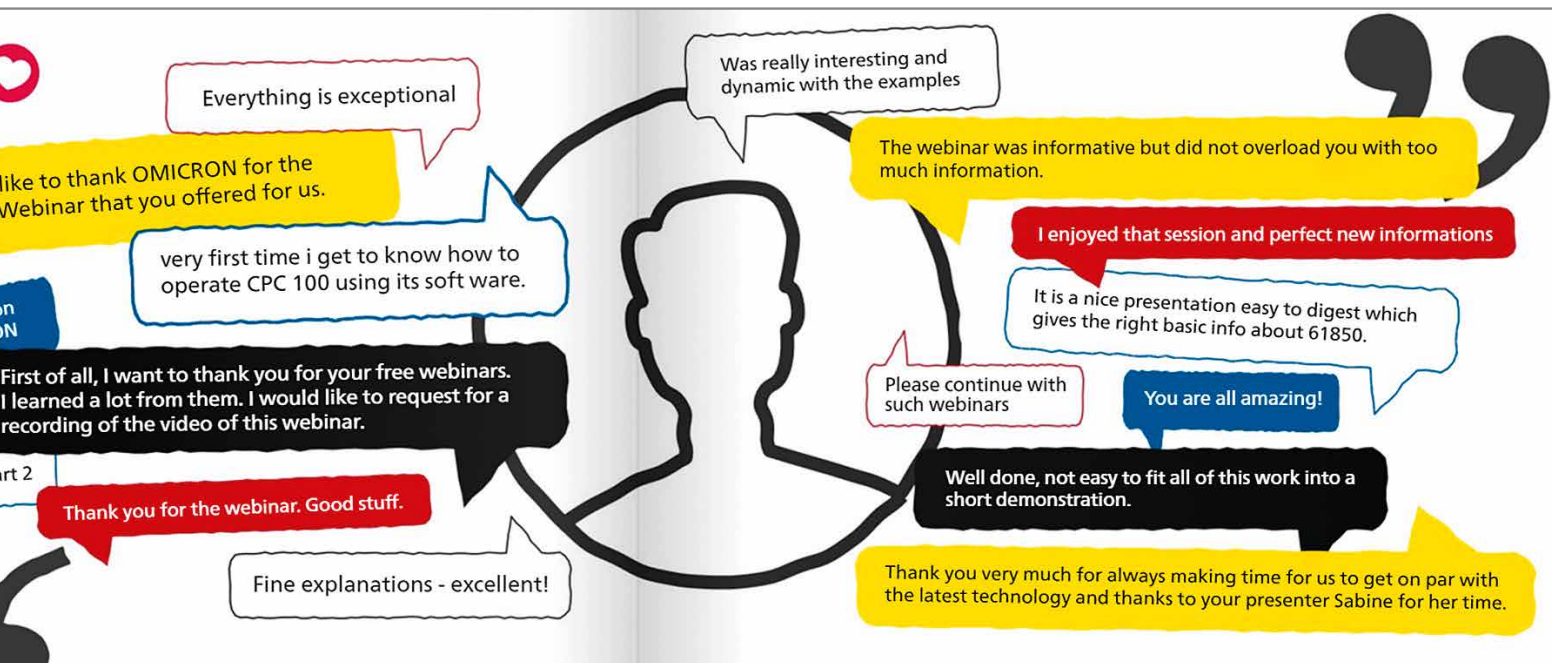
Quality First

We adopted a multi-stage quality process that helped us make the right choices. “We designed an evaluation form containing various criteria and critical factors such as the quality of the audio, language, and video image. At the same time, we developed a process that listened to the recordings and picked out the best ones. Next, our product managers checked every aspect of the products and the software, and only then was a webinar released. The process of a quality-check is very time consuming, so the recordings are currently only available in English and German”, explains Claudia.

Recordings on the Academy Website

The webinar recordings are available free of charge on the OMICRON Academy website. We use the Cisco Webex platform, which is also where the live webinars were recorded. There’s a short registration process to





Everyone involved in creating the webinars received a booklet as a small token of thanks. Among other things, the booklet includes positive comments from webinar viewers.

go through before the video starts, and then you can then dive right into the subject area of your choice.

"Naturally, we were a little worried that the free webinar offer would have an adverse effect on the interest level of our instructor-led and online courses. However, that's not been the case", summarizes Claudia. "It's had quite the opposite effect. The webinars offer a quick sample of various technical subjects. Course participants can then ask questions in a more targeted manner and use the expertise of the instructors and the time spent with them to optimum effect. We see this as a real benefit."

The flexibility of the package has been particularly well-received. More than 3,700 visitors have already viewed the English-language recordings alone. The webinars provide access to knowledge whenever and wherever it's needed.

Participants get a free first impression of our products and the wide-ranging Academy offer.

Powerful Teamwork

"We're delighted with the success of the program we've created together. It's only been possible thanks to outstanding global teamwork. We wanted to acknowledge the efforts of

our teammates appropriately, so we've created a booklet containing images, observations, quotes from chats, and some of the positive feedback we've received. The teams have all been pleasantly surprised by this material. So we want to extend an enormous and heartfelt thank you to everyone who helped get this project up and running", concludes Claudia. ■

Want to take a closer look at our webinar recordings? You'll find an overview at



omicronenergy.com/de/recorded-webinars



WHEN AN OUTAGE IS COSTLY

Efficient testing for ensuring fault-free high-speed transfer systems

Industrial facilities use motors on production lines that need to run without interruption to avoid severe financial impacts on business. Motors can also be critical to the continuous operation of power plants. These large motors are designed with two separate infeeds and a high-speed transfer system (motor bus transfer – MBT) to ensure production continuity and avoid damage. This system is tasked with switching between the infeeds when required. RelaySimTest 4.1 can be used to ensure that the MBT system also works properly in all situations.

Testing MBT systems during commissioning is challenging because the complex interplay between motors, infeeds, and loads must be simulated. The models must be able to accurately simulate the behavior of motors and the interaction of plant components during regular operation and faults. What happens to the voltage in the busbar if the infeed is disconnected? What happens when the new infeed is connected? RelaySimTest 4.1 reveals how the MBT system evaluates the method selection and execution used to transfer the old infeed

to the new one and shows how the MBT system functions.

An infeed transfer may be scheduled or may be required during an emergency. The busbar voltage's behavior must be calculated accurately by the MBT system before switching to the new infeed. Firstly, this is the only way to ensure that the transfer does not cause any damage to the motor, the coupling, or the connected loads. Secondly, it ensures that the motors' processes continue to run with as little interruption as possible. These



requirements result in the typical automated infeed transfer methods shown in Figure 1 (fast transfer, in-phase transfer, and transfer with under-voltage or a specific delay time).

In the event of fast transfer, the MBT system attempts to execute a transfer before the amplitude difference and phase shift between the motor and the new infeed are too great. This is only possible under specific conditions and requires the quantities in the motor bus and the new infeed to be measured within one cycle. In addition, a circuit breaker can connect the new infeed within one cycle. The in-phase transfer method connects the motor bus to the new infeed as soon as the phase angle between the motor bus

«RelaySimTest 4.1 can be used to ensure that the MBT system works properly in all situations.»

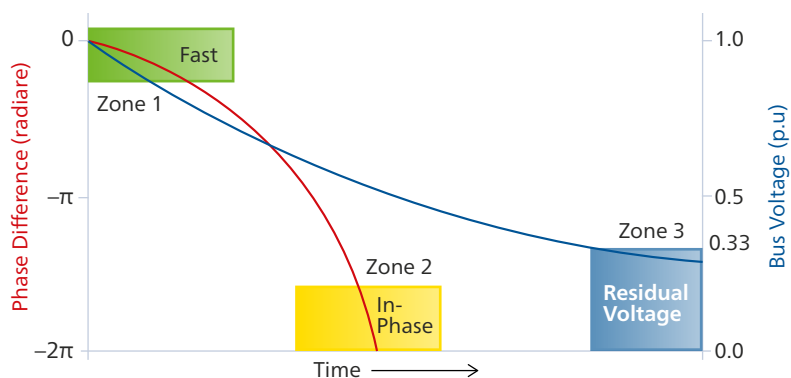


Figure 1: Motor bus transfer zones: Fast transfer, in-phase transfer and residual voltage transfer

and new infeed approximates zero or moves into this range. Suppose this type of connection is not possible. In that case, the MBT system will make the connection when the residual motor voltage has dropped to a particular value or a specific amount of time has elapsed. The logic integrated into the MBT system determines the best method during these circumstances.

The asynchronous motor model integrated with RelaySimTest enables realistic simulations. An initial MBT stability test is conducted by simulating start-up behavior. The motor start-up and the associated under-voltage must not initiate a transfer during this period. In other testing scenarios, the switch-off behavior or motor-inertia is simulated, as well as the circuit breaker, infeed, motor, and load components interplay. The software then calculates the currents and voltages for regular operation and fault cases. This allows both transfer methods to be tested and the integrated logic to determine the method that should be used.

During regular operation, it is possible to close the circuit breaker from the new infeed before the circuit breaker from the old infeed is opened. However, this “hot” transfer cannot be used during a fault. When a fault occurs, the MBT system will initiate an open transfer for this specific reason. This means it opens the circuit breaker from the old infeed before closing the circuit breaker from the new infeed so that both circuit breakers remain open momentarily. RelaySimTest simulates both “hot” and open transfers.

In the RelaySimTest grid editor, the primary system is replicated first. Figure 2 shows a typical industry topology with a coupling circuit breaker that can switch from one

«In addition to testing the behavior of the MBT system during transfer, the entire protection system can also be tested.»

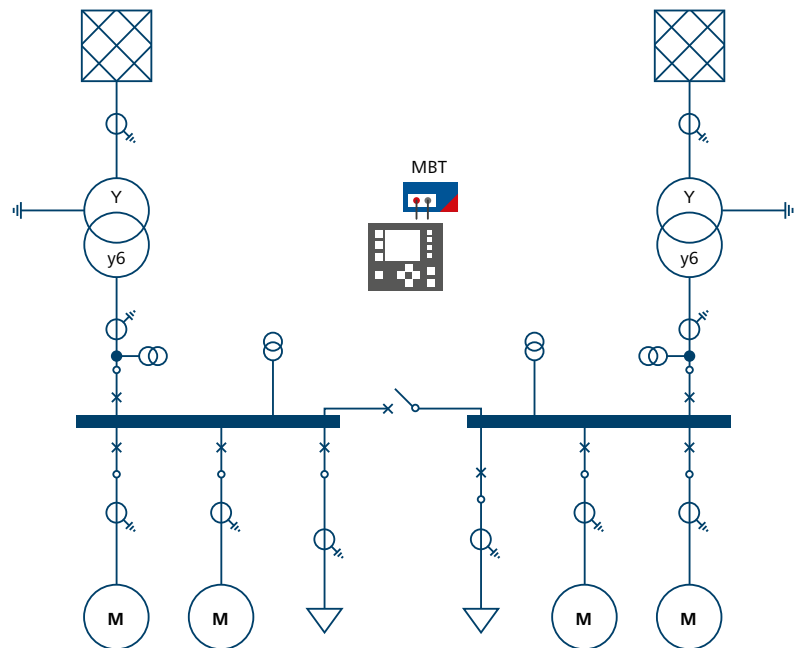


Figure 2: Example showing industrial motor bus with double infeeds and coupling circuit breaker

infeed to another with the infeed circuit breakers.

In addition to testing the behavior of the MBT system during transfer, the entire protection system can also be tested. This includes all protection relays in the system, such as the motor protection relay and the infeed relays. This makes it possible to verify whether or not the motor protection remains stable during the transfer. In addition to testing the transfer’s behavior, the entire motor protection can be tested, for example, by triggering a fault in the motor supply line or the motor terminals. The same test documents as

those used in the laboratory can also be used for commissioning in the field.

Further models integrated with RelaySimTest enable testing for feeder protection, busbar protection, line protection or transformer protection, and recloser systems. Version 4.1 can perform all these simulations, and a free download is available on:

omiconenergy.com/relaysimtest

A software license and an OMICRON test set are required for outputting test values. ■



A POWERFUL COMBINATION FOR POWER TRANSFORMER TESTING

In-depth on-load tap changer analysis with
TESTRANO 600 and PTM 4.90



Power transformers play a vital role in the electrical power grid. In order to avoid any unforeseeable outages, it is of utmost importance that the transformer and its internal components work reliably.

The on-load tap changer (OLTC) is one of the essential components. By adjusting the turns ratio of the transformer, a stable system voltage is maintained in the electrical grid. The OLTC has to withstand the electrical stress as well as the mechanical and thermal stresses that are imposed by the load current.

Many diagnostic tools have been developed to assess the condition of power transformers, ranging from oil analysis to static and dynamic resistance measurements (DRM). The DRM records the change in current during the switching operation. This way, the auxiliary contacts, and the commutating resistors can be evaluated, and a timing analysis can be performed.

With the release of PTM 4.90, two powerful OLTC-focused features

were added to the testing capabilities of the TESTRANO 600: The vibro-acoustic measurement (VAM) and the three-phase OLTC Scan option. In the following examples below, we'll take a look at both features and how they can be utilized to facilitate OLTC testing and lead to an in-depth OLTC condition assessment.

1st feature – VAM

The vibro-acoustic measurement (VAM) approach is based on recording vibration patterns produced during the tap switch operation. The new measurement module VAM1 has been developed in cooperation with the OLTC manufacturer Maschinenfabrik Reinhausen in Germany.

The VAM1 unit allows you to connect up to three piezo-electric sensors that are mounted on the transformer tank wall using magnetic fasteners. The vibration patterns produced during the switching operation depend on the internal design and the switching principle of the tap changer. Therefore, these patterns are considered unique

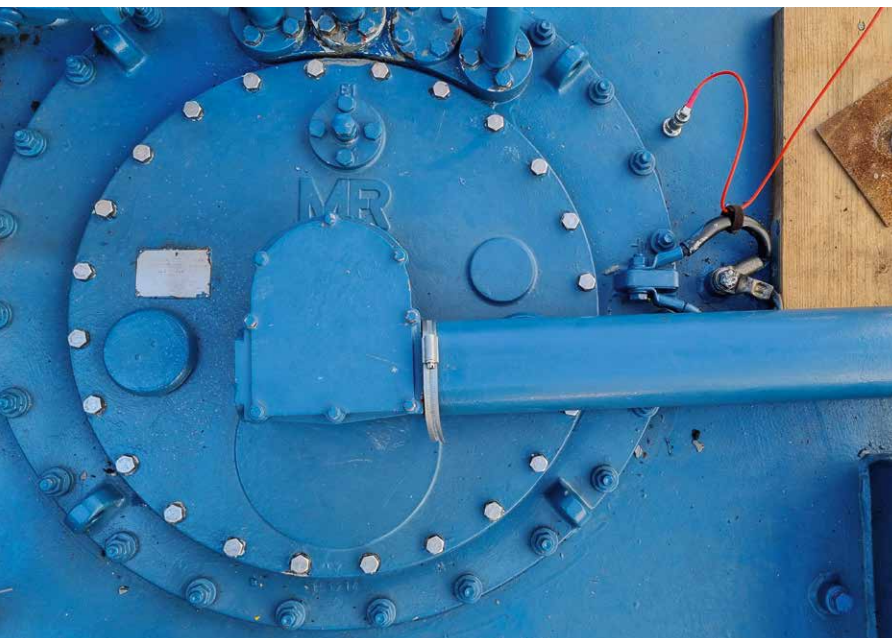
for each unit and can be used as a reference for future measurements.

The sensor placement plays a vital role in obtaining sufficiently strong readings. The best results are obtained when the sensor is placed as close to the OLTC as possible. The new test in PTM 4.90 supports the user by checking the data quality of the recorded traces. If it is unsatisfactory, e.g., due to weak signal strength, the software will mark the corresponding data set and suggest some troubleshooting advice.

There are two options for carrying out the VAM test. The first is performing the measurement during a transformer maintenance outage (offline). In contrast, the VAM test can be conducted while the transformer remains in service (online). The findings of such a vibration analysis can then be considered when prioritizing the maintenance activity of an OLTC fleet.

The raw data, sampled at 250 kHz, is transformed into the frequency-time domain using a continuous wavelet transformation. This so-called ft-diagram illustrates the various frequency components of the vibrations. It can be used to analyze the overall signal quality (signal-to-noise ratio) and identify possible external influencing factors such as disturbing noise sources. Figure 1 depicts an example of the ft-diagram, showing the start of the tap switch operation (left), the tap selector activity (middle), and finally, the diverter switch operation (right). The color coding indicates the signal strength, ranging from weak (blue) to strong (red).

The signal is integrated into the frequency domain, which results in the so-called envelope curve. This



curve is the actual fingerprint of the tap switch. The results' assessment is based on comparing these envelope curves with reference values. A comparison functionality in PTM 4.90 helps the test engineer check the results for any deviations which could indicate mechanical changes in the OLTC. Figure 2 shows the comparison of two tap switch recordings. On the top, two envelope curves illustrate the high reproducibility of the curves. The diagram on the bottom shows the comparison of the corresponding DRM curves.

The most complete data set can be obtained when performing an offline measurement, consisting of the VAM and DRM traces and the motor current recording. Both measurements yield complementary results, which help minimize individual diagnostic blind spots from either method. The synchronous recording of the VAM and the DRM curves allows you to assess the entire switching operation from motor start to finish.

2nd feature – three-phase OLTC scan

The other new feature for the TESTRANO 600 in PTM 4.90 is the three-phase OLTC scan that complements the existing single-phase OLTC scan solution.

By measuring all three phases simultaneously, as shown in figure 3, only one up/down test cycle is required, effectively reducing the overall testing time by 66%. Additionally, a continuous recording has been introduced, illustrating the current behavior throughout the entire tap range. To assess the results, the test engineer validates that there are no current interruptions and evaluates the timing of each switching operation.

The synchronicity between the phases can be measured using multiple cursors to identify possible linkage problems in the phases. ■

«The vibration patterns are considered unique for each unit and can be used as a reference comparison for future measurements.»

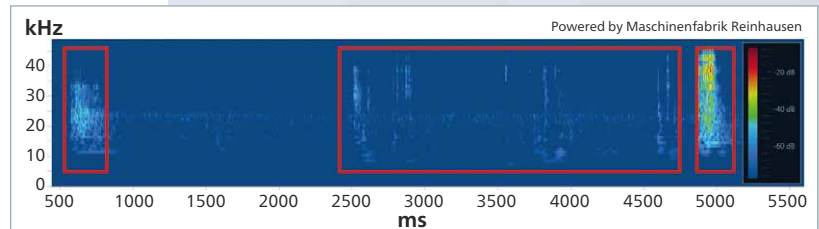


Figure 1: The frequency-time diagram helps to evaluate the overall signal quality.

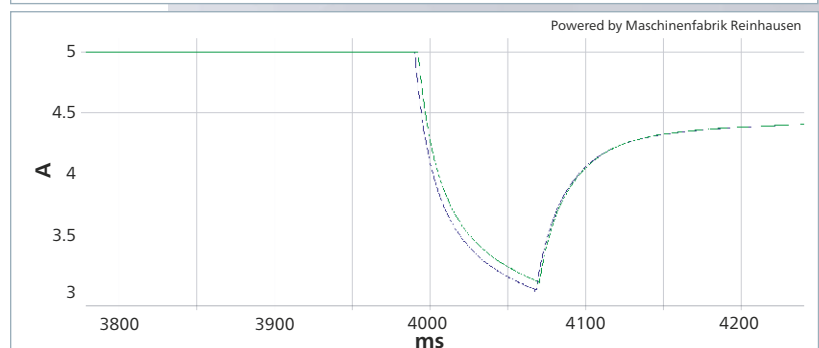
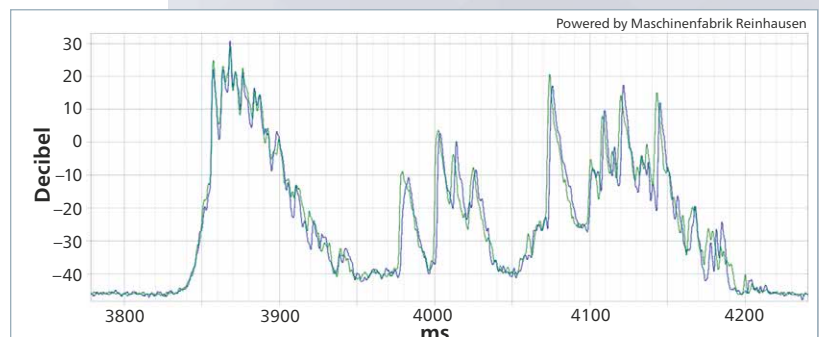


Figure 2: Comparison of envelope and DRM curves

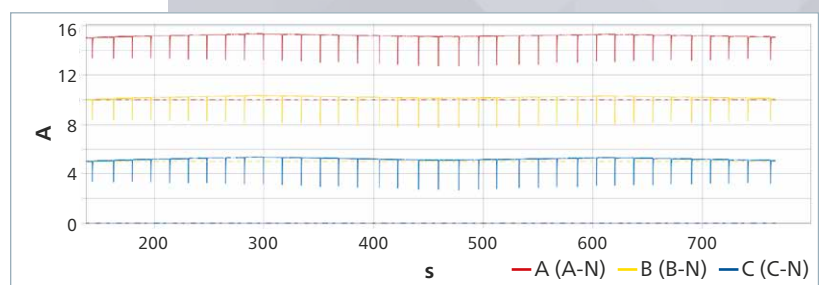


Figure 3: Three-phase OLTC scan measurement curve

REDUCING THE NETWORK LOAD IN DIGITAL SUBSTATIONS

With configurable datasets in Sampled Values according to IEC 61869-9

Following two decades of increasing acceptance and application, the IEC 61850 standard is now well-established, and network operators are increasingly deploying relevant devices in substations around the world. The prevalence of Sampled Values (SV) in the process bus of digital substations was significantly increased by the IEC 61850-9-2 Light Edition (9-2-LE). This guideline makes the configuration and interoperability of devices more accessible. This article explains how the IEC 61869-9 standard enables you to optimize the network load in the process bus.

Although the 9-2-LE guideline defines the process bus communication methods, it provides few options for changing the SV in the process bus. This guideline provides a fixed SV dataset for current and voltage values. This definition always contains four currents and four voltages. The current and voltage values for the phases and the neutral conductor of a three-phase system are sampled at 80 samples per cycle for protection applications and 256 samples per cycle for power quality applications. The data packet in 9-2-LE is understandable at first glance. However, it generates unnecessary data traffic if all the variables aren't used. Depending on the application, significant unused data volumes may arise that unnecessarily load the data network and the connected IEDs.

In 2016, the IEC 61869 standard superseded the previous IEC 60044 standard as the definition of current and voltage transformers. Section IEC 61869-9 provides a digital interface compatible with 9-2-LE. Further SV variants are also defined that enable multiple sampling values (ASDU – application service data unit) in a network packet. Having several ASDUs per package saves on bandwidth as the ratio of the payload to the header is optimized and the package rate on the network is reduced.

This interface also allows datasets to be configured such that only individual currents or voltages are transferred. It also enables multiple current and voltage systems to be combined into one SV dataset. The following is an example of how significant the overall savings can be.

One example is a 1½ circuit breaker system. This system transfers eight currents and four voltages via sampled values for one feeder. Suppose these eight currents and four voltages are sent using 9-2-LE datasets. In that case, two 9-2-LE SV streams are required as only four currents are possible for each 9-2-LE SV stream dataset. However, if it is implemented as an IEC 61869-9 dataset, a single SV stream containing the eight currents and four voltages

Transformer type	Fixed Dataset 4 × Current + 4 × Voltage (9-2 LE)			Flexible Dataset		Reduced Data Rate compared with 9-2 LE	
	Number of MU/Streams	Data rate 50 Hz (Mbit/s)	Data rate 60 Hz (Mbit/s)	Number of MU/Streams	Data rate (4,800/2 ASDU) (Mbit/s)	with 50 Hz (4,000/1 ASDU)	with 60 Hz (4,800/1 ASDU)
3-Winding	3	3 × 5.4 = 16.2	3 × 6.5 = 19.5	1	6.5	60%	67%
5-Winding	5	5 × 5.4 = 27.0	5 × 6.5 = 32.5	1	9.0	67%	72%

Table 1: Reduction in data rate in a transformer with three and five windings



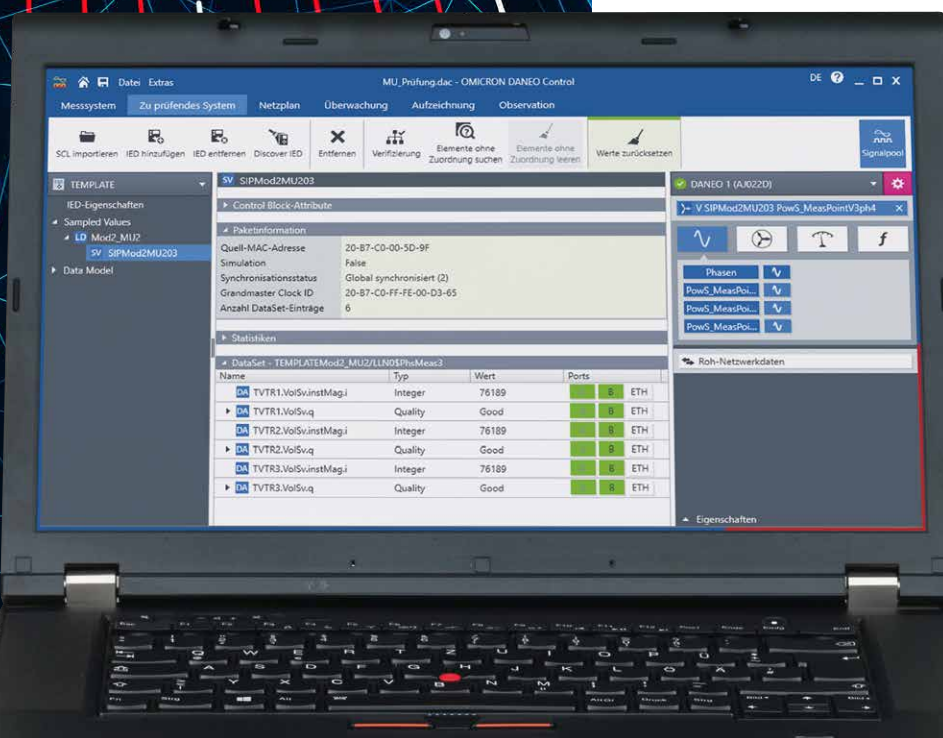
is sufficient. This reduces the load on the network by about 40%.

Power transformers result in even more significant savings in network load. For example, when using a three-winding transformer, the data rate can be reduced by 60% at 50 Hz or 67% at 60 Hz (Table 1). In addition, only one merging unit (MU), as opposed to three, is required. The more windings a power transformer has, the more the flexible datasets help reduce the network load. With a five-winding transformer, a 67% reduction in data rate can be achieved at 50 Hz or a 72% reduction at 60 Hz.

SIEMENS SIPROTEC 6MU85 are the first MUs to offer configurable datasets according to IEC 61869-9. This new generation of MUs loads the process bus network more intelligently, reducing the load in the network. It's compatible with all the standards referred to above. Depending on their application, network operators will decide whether they should use datasets subject to 9-2-LE or configurable with IEC 61869-9.

OMICRON offers the relevant testing solutions that support publishing and subscribing to SV streams of this type. CMC test sets using RelaySimTest or Test Universe allow MUs to be simulated and protection testing to be carried out. DANEO 400 now allows these new SV variants to be analyzed. It can also visualize and

record the signals along with all protocol details. 📄



DANEO 400 dataset with three voltages

OBSERVING PARTIAL DISCHARGE OVER TIME

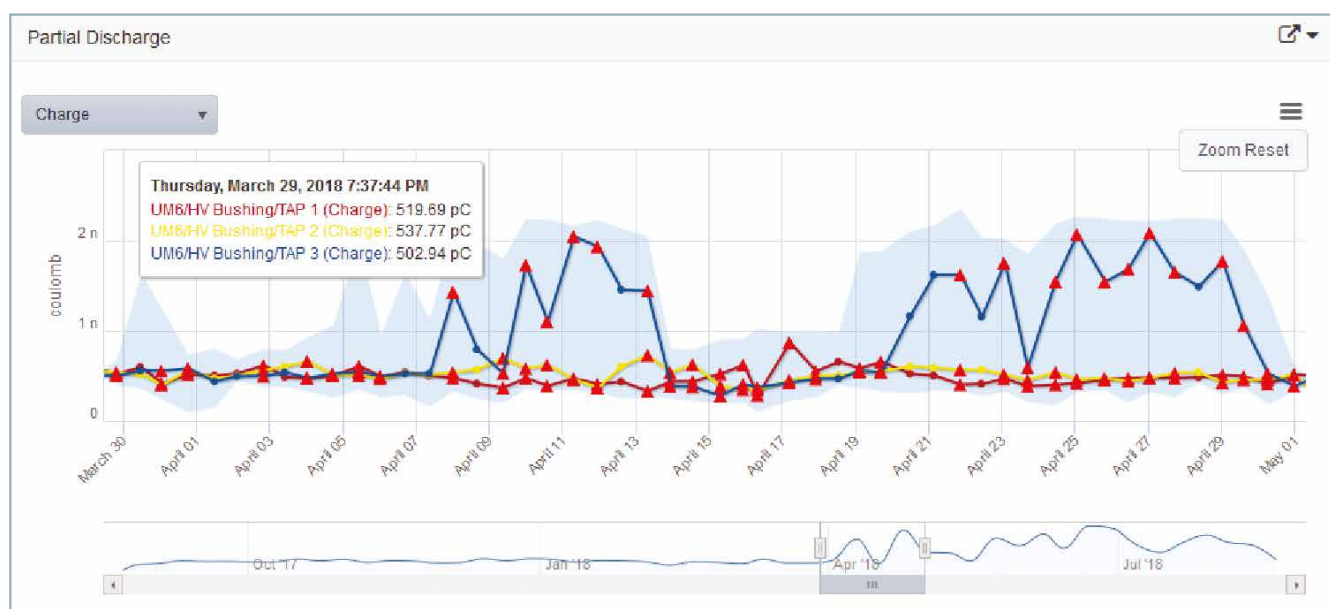
MONTESTO 200 is our portable system for temporary online PD monitoring and trending insulation status between diagnostic checks.

In this article, we interviewed our MONTESTO 200 Product Manager Bogdan Gorgan about how our temporary online partial discharge (PD) monitoring system helps you oversee PD activity in a wide variety of high-voltage (HV) equipment. He also presents a case study about how MONTESTO 200 was used for a two-week in-service assessment of an older rotating electrical machine's insulation condition.

Can you explain the importance of PD measurements and when they're usually performed?

Bogdan Gorgan: PD measurements are recognized worldwide for insulation diagnosis and are usually required for most high-voltage equipment acceptance testing procedures. Detected PD activity is often a sign of developing insulation defects. Based on the absence or presence of PD activity during routine tests, onsite tests, or periodic

in-service inspections throughout the service lifetime, conclusions can be drawn about the actual condition of the dielectric insulation system. Due to the ongoing aging of insulation systems in high-voltage components in service, PD testing and diagnostic methods are being used increasingly in condition monitoring on a temporary short-term or permanent long-term basis. We offer solutions for each of these PD testing and monitoring applications.



Trend visualization with time stamps generated by MONTESTO 200 temporary online PD monitoring system.

What is the difference between offline and online PD testing?

PD can be measured offline, such as with our MPD 800 PD measurement and analysis system. In this case, the asset is energized by a separate HV source. PD can also be measured or monitored online while the asset is connected to the electrical grid and in operation – either with the MPD 800 or our MONTESTO 200 temporary PD monitoring system – using permanently-installed PD sensors and a terminal box.

Please explain what PD monitoring means and how it differs from online PD testing.

Online PD monitoring is the process of continuously observing and trending partial discharge activity over time to assess insulation condition, identify potential weak spots, and determine the level of risk for a dielectric failure. The information from the PD sensors is synchronously measured by the multi-channel acquisition unit and stored in a database. The measurement synchronicity between the channels enables the separation of noise and PD signals. The data is trended over the specified time period and compared with user-defined thresholds to determine whether a problem is developing.

When it comes to temporary PD monitoring, an online PD measurement is continuously performed over a few days, a week, a month, or even a year to obtain a more detailed picture of progressive deterioration in the electrical insulation. Compared to periodic PD measurements, temporary PD monitoring allows you to observe the behavior of different PD defects over time and how they relate to different operating parameters, such as temperature, load, and humidity. It is performed to evaluate the overall insulation condition on assets with confirmed PD activity to ▶

«The data is trended over the specified time period and compared with user-defined thresholds to determine whether a problem is developing.»



Bogdan Gorgan,
Product Manager,
OMICRON



LISTEN TO THE PODCAST

Interested in this topic?

Be sure to listen to our Energy Talks Podcast Series Episode Number 38 about the temporary monitoring of partial discharge activity with Bogdan Gorgan. Scan the QR-Code or visit:

 omicronenergy.com/temporary-pd





MONESTO 200 can be easily mounted on the asset for continuous online PD monitoring for longer periods of time.

trend its rate of development and determine when a future repair or replacement is needed. It is also performed on repaired assets to check the quality and effectiveness of the repair and to oversee its condition for longer periods of time. The trend evaluation is therefore an addition to the classic offline diagnosis using an external voltage source.

Could you describe how our MONESTO 200 system is used for short-term and long-term continuous PD monitoring.

MONESTO 200 is a portable device that allows the user to perform temporary PD monitoring when and where it's needed on different assets, like power transformers, motors and generators as well as power cables.

Pre-installed PD sensors are connected to a terminal box, which enables plug-and-play PD measurements and temporary PD monitoring at any moment during operation. The MONESTO 200 acquisition unit is easy to transport to various locations and is compact enough for use in limited spaces. It can be used onsite with a laptop or mounted on the asset and operated remotely via the web-based user interface.

Users can set up the system in six easy steps with the accompanying Monitoring Software to perform temporary PD monitoring sessions. The MONESTO 200 acquisition unit measures and stores the PD sensors' data in periodic or continuous mode. The periodic measurements are

initiated based on what the user specifies in the monitoring session setup, for example, every hour. In continuous mode, the data is acquired every second and compared with defined user threshold values and shown in the web-based software user interface in real-time.

If needed, automatic alarms can be configured, and the user is notified when measurement values exceed defined threshold values. For automatic alarming by email, the MONESTO 200 must be connected to the Internet via a router and an SMTP server must be configured by the user. The results from monitoring sessions on different assets are stored in a single database, and specific data can be selected for visualization and a more detailed comparison and evaluation.

Bogdan, a major challenge when performing online PD measurements is dealing with external noise. How does MONESTO 200 handle this during temporary PD monitoring?

Measurement sensitivity is always a challenge when performing online PD measurements due to the high external noise levels on site. Like our diagnostic MPD 800 PD measurement and analysis system, MONESTO 200 can be tuned to the frequency that gives the best signal-to-noise ratio. Tuning the filter settings is the first step to systematically avoiding noise.

In addition, our 3-Phase Amplitude Relation Diagram method, also known as 3PARD, is applied in the monitoring software for removing disturbances and clearly distinguishing between multiple PD sources. Our unique cluster separation technique is applied when using the 3PARD method — this enables the precise separation of PD activity from other PD-like signals so that the most likely phase can be located.

CASE STUDY – TEMPORARY PD MONITORING ON A ROTATING ELECTRICAL MACHINE

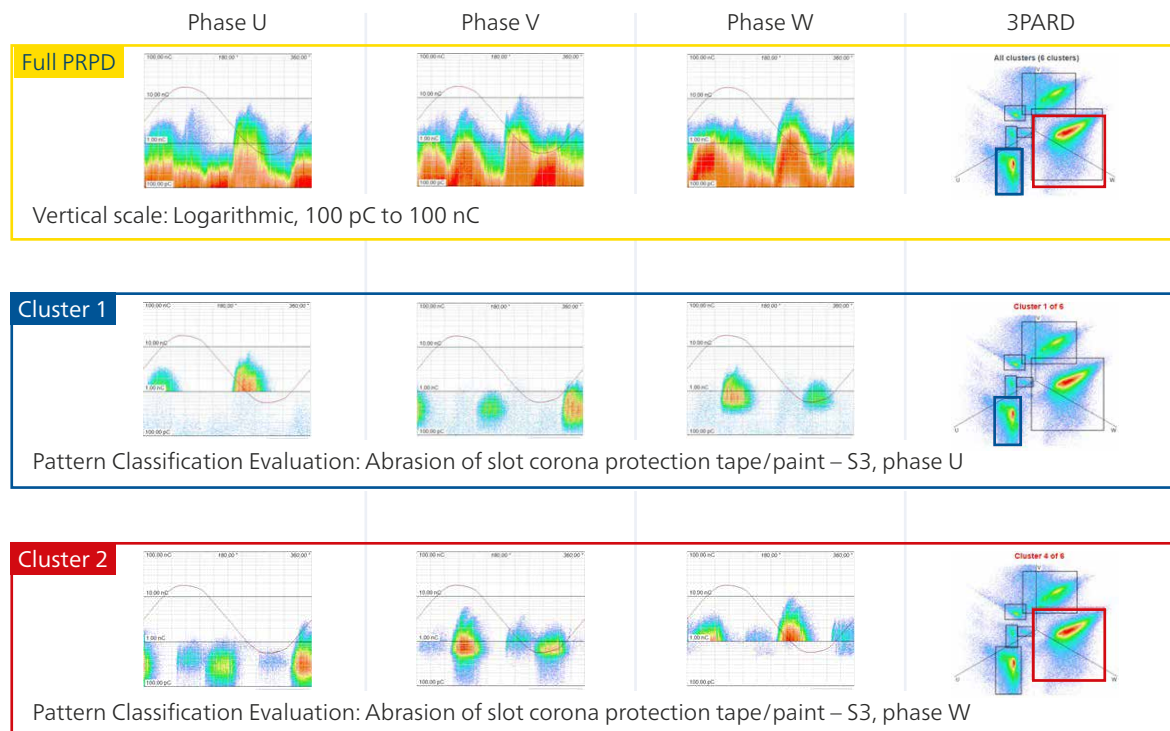
A two-week temporary PD monitoring session was recorded with MONTESTO 200 on an aging 6.3 kV synchronous generator with an output of around 10 MVA in an industrial plant. Coupling capacitors were permanently installed to enable periodic online measurements and temporary monitoring on each phase of the generator and connected to the terminal box. The MONTESTO 200 acquisition unit was connected via plug-and-play to the same terminal box. The PD charge and voltage trend were recorded over the specified two-week time period to determine the insulation's condition, which could then be compared with other generators of the same type, history, and age in the plant.

The Phase-Resolved Partial Discharge (PRPD) patterns for all three phases as well as the 3PARD diagram with automatic clustering were generated for selected time stamps in the trend chart. The clusters that appear in the related PRPD patterns were individually selected to evaluate possible PD defects, which were separated from any disturbance signals.

The probable type of the PD defect could be determined with a software feature specifically used for rotating electrical machines, called Pattern Classification. The monitoring software was then used to automatically generate a customized report with relevant data and charts.

The results showed a slight but steadily increasing charge trend. PD patterns showing surface discharge defect can be seen on the end winding, which can mainly be explained by dirt and impurities. The increase in the charge values shows that the PD activity is increasing. Therefore, a continuous aging process is taking place.

Based on the reported data, the user was able to document the stator insulation condition in terms of defect type and trend. The user decided that the documented results showed no immediate risk of machine failure. After a few months, a decision was made to repeat the PD monitoring sessions to observe the evolution and plan any necessary maintenance. ■



The resulting PRPD patterns for the three monitored phases are generated for each of the six clusters automatically identified in the 3PARD. This helps you identify defects in the insulation. Possible causes of the documented PD activity are indicated using the Pattern Classification feature for rotating machines.



... IT JUST KEEPS ON GROWING

15 Years of our Protection Testing Library

Officially, our Protection Testing Library (PTL) saw the light of day in 2007 for the first time. However, the foundations of modern testing had already been established two years earlier, when XRIO technology was introduced with the publication of Test Universe (TU) 2.0.

Since then, the XRIO test object has made it easy to automate tests, including calculating test values and characteristics using links and formulas. The effectiveness and efficiency of

protection tests have increased significantly in conjunction with tools like the OMICRON Control Center (OCC) and test modules such as the Advanced Distance module.

We put together the PTL to make the extensive features of TU easier to handle for all users. Ongoing development means the number of protection devices it contains is constantly growing. More than 435 test templates for protection devices from all the leading

manufacturers are now managed and maintained in the PTL.

Continuity and reliability

The XRIO converter continues to be the backbone of a test template. It reproduces the protection device settings as accurately as possible in accordance with the specifications from the associated relay software.

While the converter calculates the test values for the most significant

protection functions, the attached test template shows an example of how testing these functions might look. Due to the diversity of different installation concepts and protection philosophies, test examples are unavailable for all of a protection device's functions. However, smaller and larger adjustments can be made directly in the available templates.

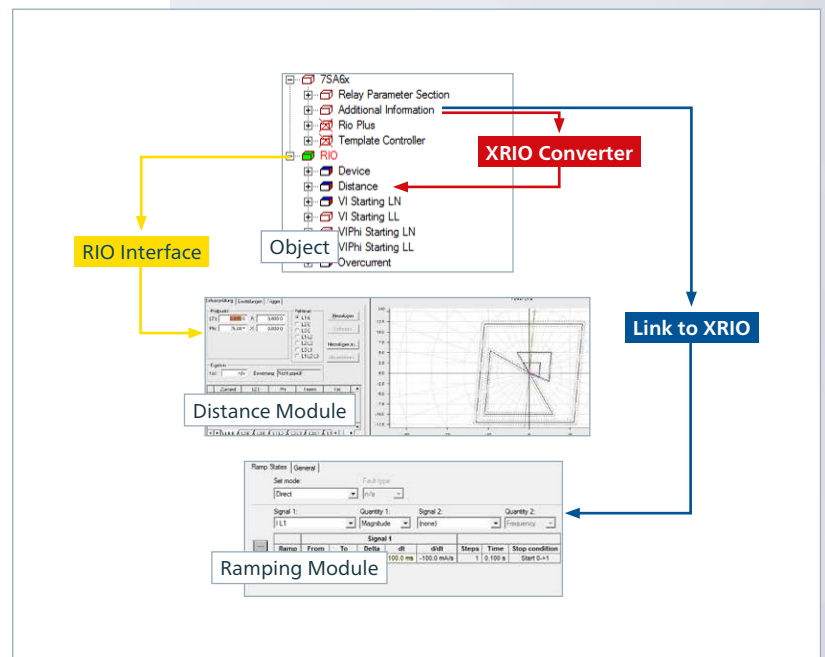
The picture looks slightly different when test templates are used for protection tests on decentralized energy generation facilities. Suppose national guidelines and standards are available that precisely describe the protection settings and the test. In that case, we can reproduce them in test templates. Examples include test templates for the VDE4110, TORD4, and G99 guidelines.

RelaySimTest (RST) – Increasing the range of PTL functions

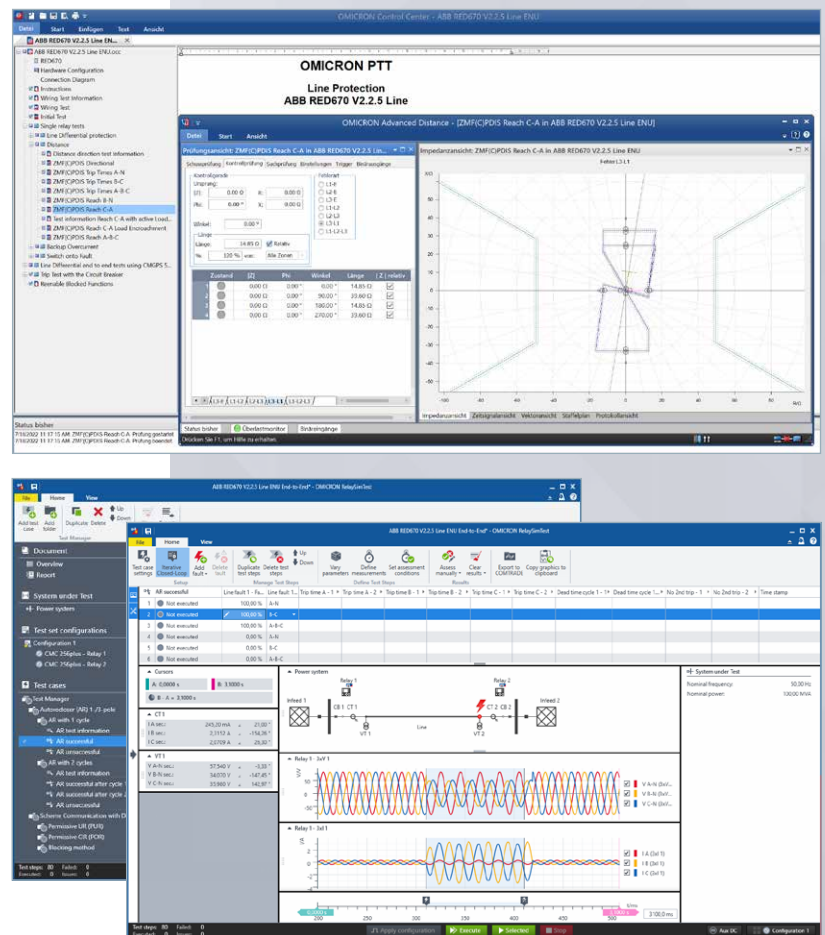
Since 2021, RST test templates have been under development for the latest generation of protection devices and managed with concise PTL documentation. The functional range of RST files has been selected to add more diversity to TU-based test templates in the PTL. For example, tests for autoreclosure (ARC) and signal comparison are briefly described in the documentation. They also provide a solid introduction to system-based testing using RST.

Always up-to-date

After 15 years of continuous development, the PTL continues to grow. We are constantly adding to the PTL with the latest generation of relays and keeping the existing content up-to-date. In the meantime, we're always looking for new features and applications that can be included in the PTL to make the tasks our users carry out every day easier. ■



Structure of XRIO Converter with RelayParameterSection



Protection Testing Templates (PTTs) – TU-based and RST-based

ON SITE: OMICRON IN SLOVENIA

David Bucaj from ACINEL gives us his insight into the power sector

ACINEL was founded in 2014 by four experienced engineers with a simple goal: to provide high-quality secondary system integration to customers in the industrial, power transmission, distribution and generation sectors. With the acquisition of DIVECO in 2018, ACINEL became an authorized distributor for the OMICRON test equipment portfolio and a certified OMICRON training partner in Slovenia.

How is the Slovenian energy grid structured?

David Bucaj: The Transmission System Operator (TSO) ELES operates the Slovenian energy transmission grid. It operates at 110 kV, 220 kV, and 400 kV and is connected with the neighboring electricity grids from Austria, Italy, and Croatia. The grid connects large power plants with the distribution grid or directly to large power consumers. 5 DSOs operate the distribution grid, connecting more than 900,000 consumers and small electricity producers with the transmission grid.

What resources are being used to generate power?

Hydro power plants produce 33% of the energy, 29% is produced by thermal power plants (coal, gas), and 36% is nuclear energy. Solar and other non-conventional power plants only produce 1%.

What are the current hot topics for the energy supply market?

- › One major topic is decarbonization. Energy suppliers are searching for alternative ways to replace thermal power plants that burn fossil fuels.
- › The goal of digitalizing the energy sector is to identify who needs energy, how much they need, and when they need it. Then, that energy must be delivered to the right place at the right time and at the lowest possible cost. Accomplishing that is going to be a challenge.
- › DER (Distributed Energy resources), such as household solar PV panels and storage, must be integrated into the existing energy infrastructure. This will be achieved by creating better incentives that make it easier for producers to store and sell surplus electricity to the grid.

What kind of challenges are your customers facing?

- › The digitalization process has its challenges. And while it will create many benefits, it can also make energy systems more vulnerable to cyber-attacks. Until now, the disruptions caused by reported cyber-attacks on energy systems have been relatively small. However, cyber-attacks are becoming easier and cheaper to organize. Digitalized equipment and the growth of the Internet of Things (IoT) are increasing the potential "cyber-attack surface" in energy systems.
- › The transition of the current power plant infrastructure to a large share of renewable energy production will also be challenging. A consequence of digitalization here could be the easier integration of renewables into the existing grid.
- › The impact of rapid e-mobility growth on the electricity grid must be considered when planning the future smart grid.

When looking towards the future, where do you see the biggest challenges in the power sector and in general?

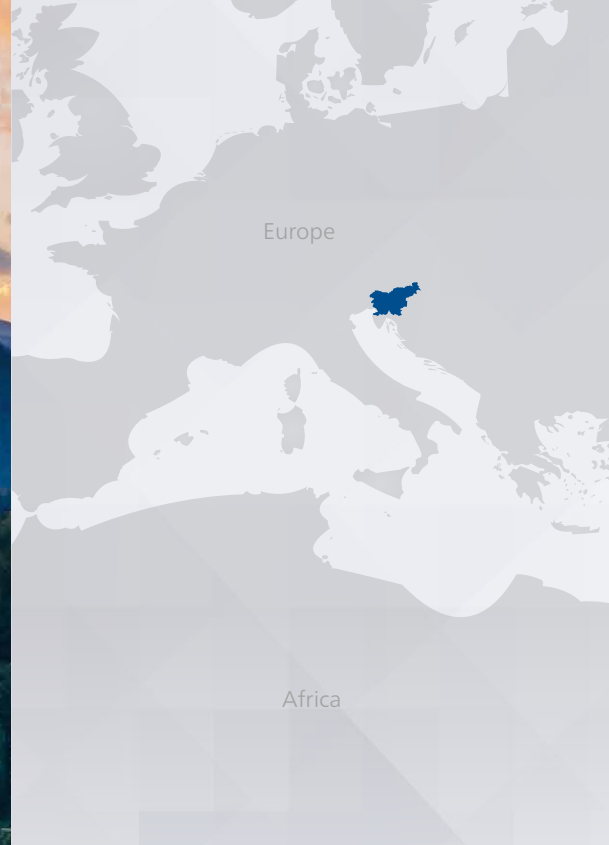
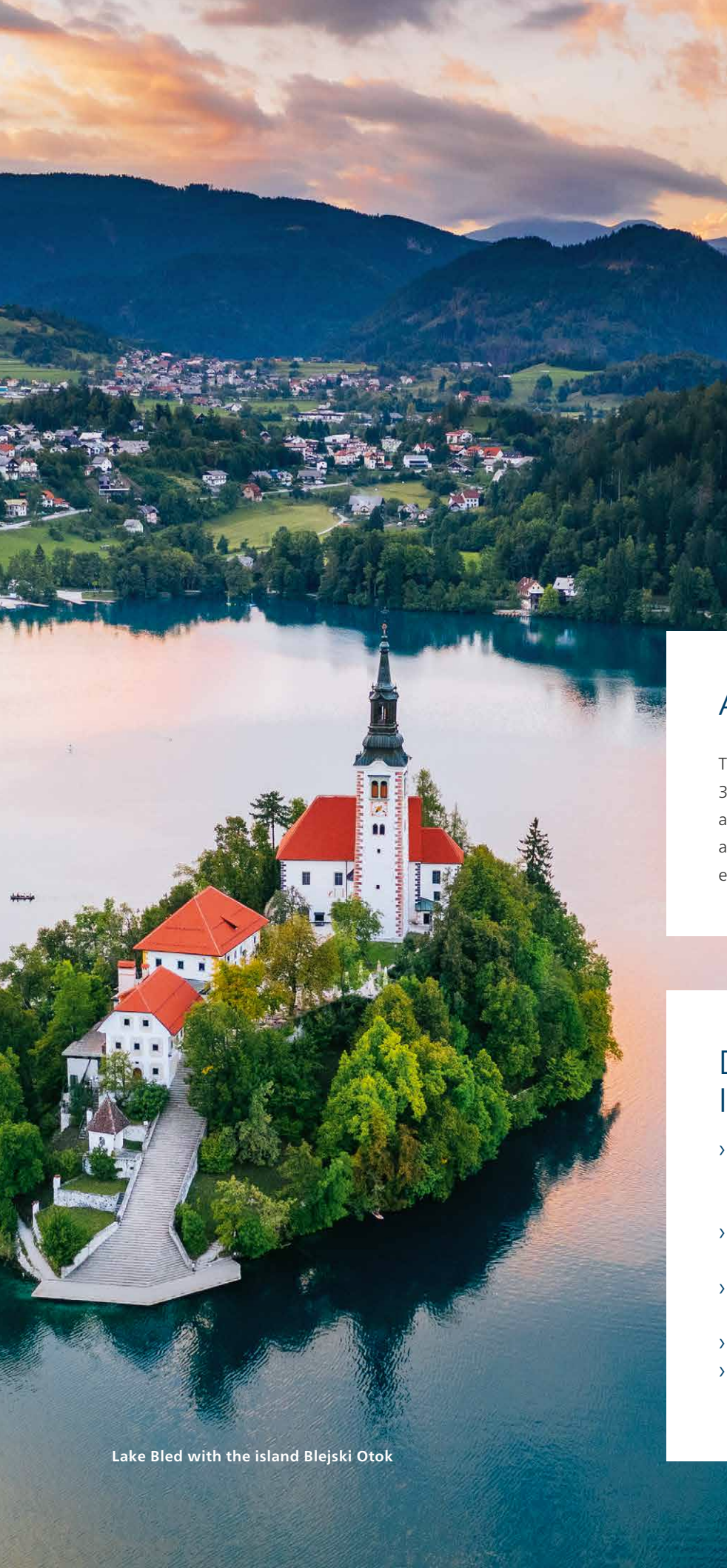
The biggest challenges in the power sector are the transition to green energy, meeting all the commitments related to reducing the carbon footprint, transitioning to zero-carbon electricity, and the active role of electricity consumers in the electricity market.

Thank you for the interview. 🗨️



David Bucaj,
CEO,
ACINEL

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



ABOUT SLOVENIA

The capital of Ljubljana has about 300,000 inhabitants. The national dishes are kranjska klobasa, potica, struklji and a variety of local wine & beer. Slovenia excels in all types of sports.

DOS AND DON'TS IN SLOVENIA

- › **Experience a wide variety** of landscapes, enchanting architecture and friendly locals.
- › **Enjoy Slovenian cuisine** – try kranjska klobasa & orehova potica.
- › **Participate in adrenaline sports** – they're safe & fun
- › **Don't confuse** Slovenia and Slovakia.
- › Don't forget to **buy a vignette for highway driving.**

Lake Bled with the island Blejski Otok

HIGHER DATA QUALITY WITH ARTIFICIAL INTELLIGENCE

Increase the relevance of your test data. Machine learning supports accuracy and exposes potential discrepancies in test results at an early stage.

Have you ever questioned the quality of your test data? Each of us knows that data, especially reliable data, is an essential tool for our daily work. Particularly, a test performed correctly, the resulting test data, and precise evaluation of test results are critical for a reliable asset condition assessment. To name one example: Sweep Frequency Response Analysis (SFRA) is a powerful and sensitive method for checking the mechanical and electrical integrity of a power transformer. Slight deviations between the fingerprint and the measurement can lead to an incorrect conclusion about an asset's condition. Therefore, validating the data upfront is crucial.



Layer 3
Assessed Data



Layer 2
Valid Data



Layer 1
Raw Data



The graphic shows a process of a reliable and trustworthy assessment.

What causes us to question the quality of measurement data?

There are enough reference values to which test results can be compared, such as Cigre data, fingerprint, or sister devices. However, the ever-accelerating energy transition is having a significant impact on the existing power grid infrastructure. Electrical energy is becoming decentralized due to renewable energy sources. Thus the number of feed-in points and nodes is increasing. The large inductive or capacitive loads in the power grid are being replaced by new regulated loads. As a result, the risk of dangerous effects such as short circuits, harmonics, and transients in the electrical power grid is increasing. Due to these changing asset conditions, checking carefully for possible measurement data changes is advisable.



«Machine learning, or more specifically artificial intelligence, makes it possible to compare one's test results with the help of algorithms based on expert knowledge and a large amount of data.»

New challenge: changing load conditions in the power grid

For example, consider the consequences of rapidly changing load conditions on a transformer. Power transformers are essential elements of the power grid that are exposed to new electrical load conditions and stresses from the energy transition. Appropriate maintenance measures are now needed to ensure installed power transformers' long and healthy life cycles. Offline measurements, online monitoring, and operating data are critical factors for condition-based transformer assessments. The Sweep Frequency Response Analysis (SFRA) method is a commonly used offline procedure proven to be the most sensitive and non-invasive method for detecting mechanical and electrical faults.

Machine learning with the SFRA method

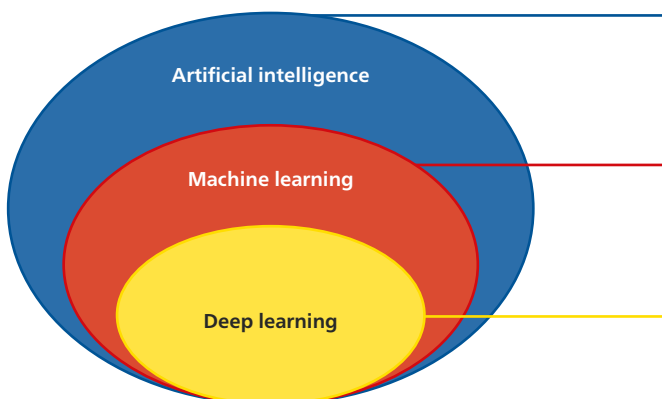
More specifically, the SFRA method provides results about the mechanical integrity of the core, windings, clamping structure, and electrical integrity, such as shorted windings and turns. A low voltage signal with variable frequency is injected into one power transformer terminal and measured in the other terminal. Comparing the output and input signals yields a frequency response that can be compared with previous measurements such as the reference one. New on the measurement scene: Machine learning, or more specifically artificial intelligence, makes it possible to compare one's test results with the help of algorithms based on expert knowledge and a large amount of data. Those models help detect device and application-related systematic measurement errors and quality issues very early. ▶



Machine learning – multiple comparison values – unique result quality

Deviations caused by the measurement setup, transformer state, transformer configuration, and external factors can lead to a misdiagnosis. Therefore, checking the validity and quality of the measurement results before evaluation is critical. Evaluating SFRA curves with reference data is performed by using one of the two standard algorithms, the NCEPRI algorithm (NCEPRI, North China Electric Power Research Institute) and the DLT algorithm (DLT, the Electric Power Industry Standard of the Peoples Republic of China,

DL/T 911 – 2004). 19,787 SFRA curves representing over 2,000 power transformers were available to train the algorithms. The results show that artificial intelligence-based algorithms are suitable for automatic qualification and validation of SFRA measurements. Currently, the algorithms are very well suited for auxiliary purposes. Users can pre-validate their own SFRA curves based on three different classes. The measurement results qualify as OK, Investigate, and Error. This possibility enables an enormous increase in the quality of your data and brings your asset into sharper focus. ■



Artificial intelligence

Any techniques that allow machines to solve a task the way humans do

Machine learning

Algorithms that allow computers to learn from examples without being explicitly programmed

Deep learning

A subset of AI which uses models and automatically builds a hierarchy of data representations

WHAT'S GOING ON

OMICRON-hosted Events



A Primer on Current Transformer Testing and Diagnostics

October 5, 2022

Virtual

events.omicronenergy.com/cttesting



North American Partial Discharge Symposium

November 1–3, 2022

Virtual

events.omicronenergy.com/pdtw



Canada Protection Symposium (CPS)

December 6–8, 2022

Toronto, Canada

omicronenergy.com/cps



Recloser & Distribution Automation Workshop

April 4–5, 2023

Houston, TX

omicronenergy.com/recloser



Protection Testing Online Series

Spring 2023

Virtual

events.omicronenergy.com/protectiontesting



Virtual



In-person



WHAT'S GOING ON

We are continuing to share our knowledge. We are going to reach out to you physically or digitally with our events, trade shows, conferences, webinars and training courses. Keep yourself up to date by checking out our events and training courses.

Scan QR-Code to get fast access to all links:



OMICRON ACADEMY COURSES & WEBINARS

omicronenergy.com/training
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OMICRON EVENTS

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OMICRON ENERGY TALKS

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WE ARE LOOKING FORWARD TO SEEING YOU.



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