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TRANSFORMER TECHNOLOGY MAG

INNOVATIONS IN DESIGN, MANUFACTURING AND SUPPLY CHAIN

Interview with **Alberto Cracco**, Westrafo
Kristy McDermott: Turning Data into Decisions: AI's Role in Next-Gen Utility Asset Management
Lance Lewand, Paul Griffin, Harry Heulings: DGA as a Tool for LTC Condition Assessment

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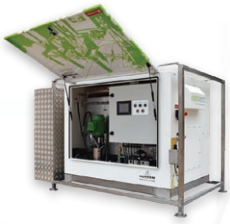

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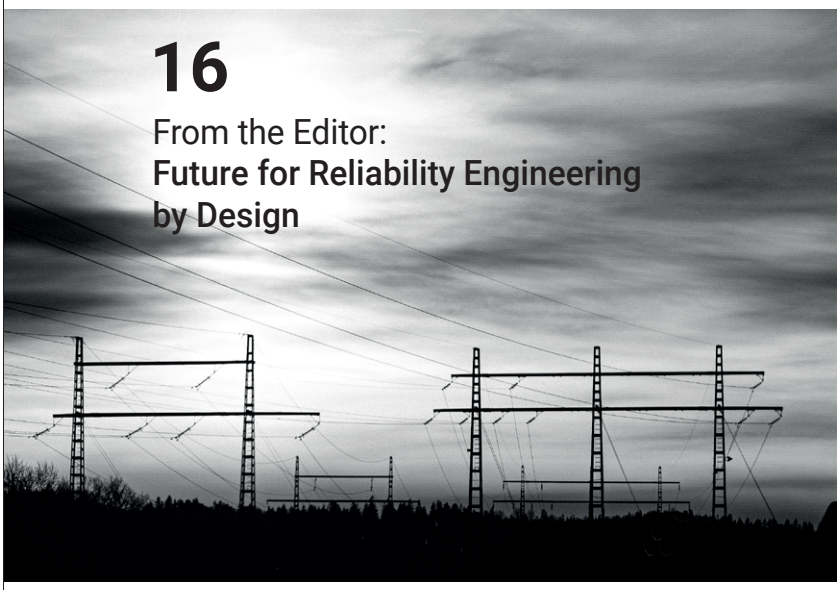

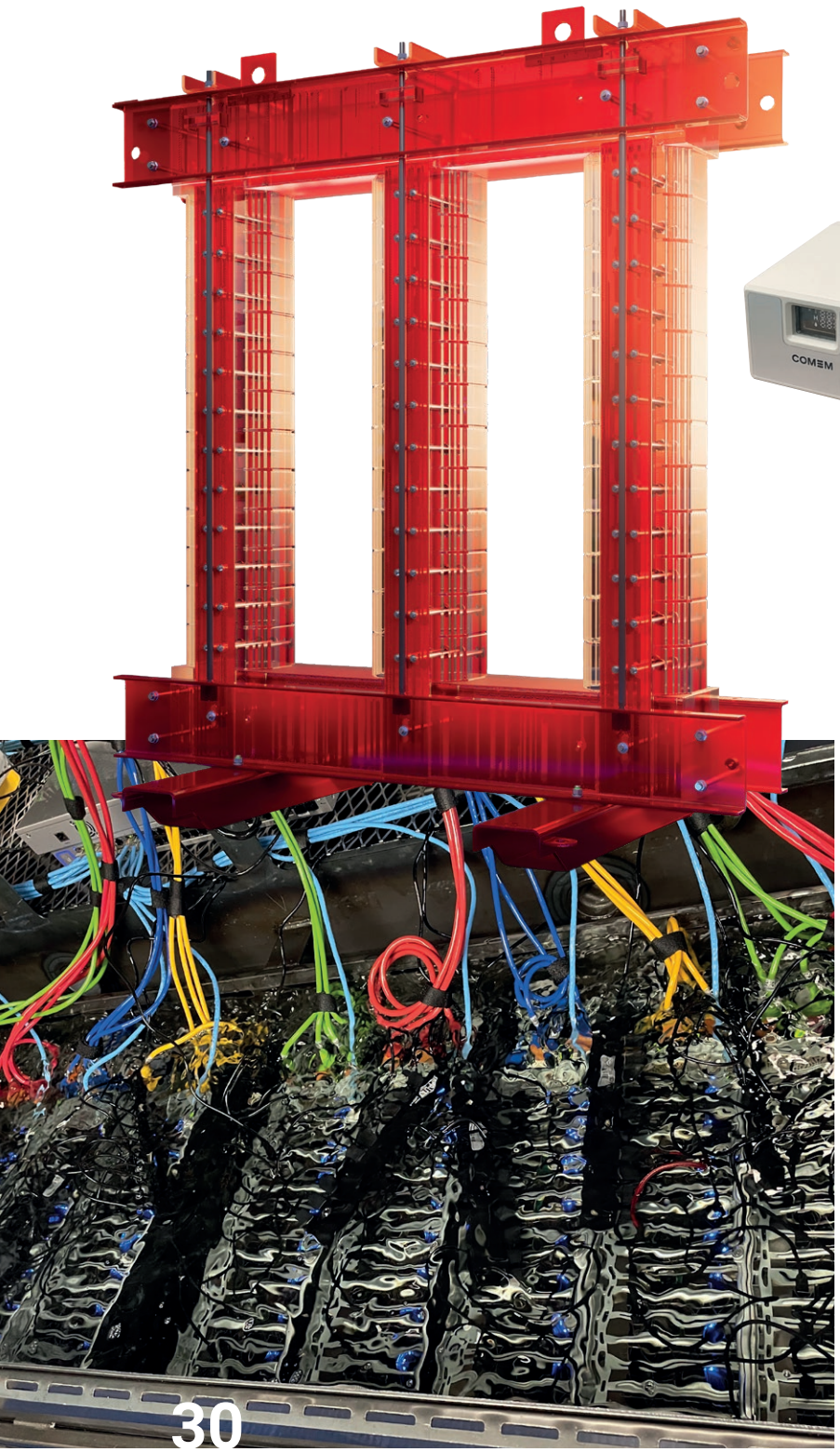

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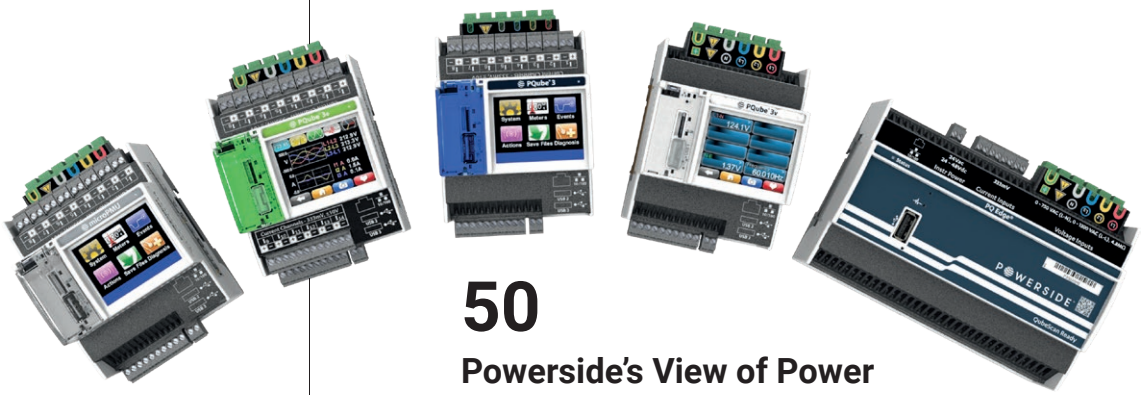

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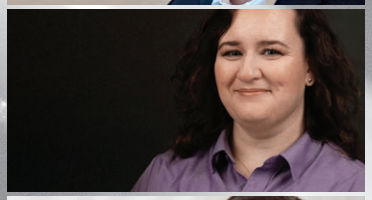

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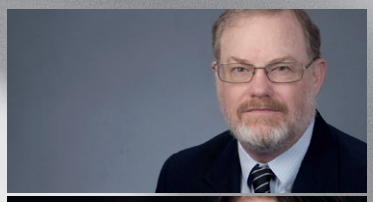

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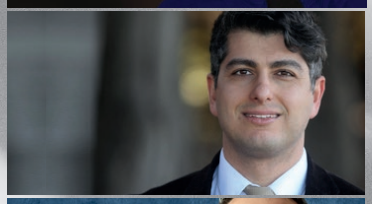

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POWER, WATER & LABOR

MIKE DOOLAN ON THE PHYSICAL DEMANDS OF AI

RED TALKS

We tend to think of AI as abstract—software, clouds, algorithms. But as Mike Doolan makes clear in his RED Talk, the reality behind our digital world is anything but weightless.

"I think it's very true that we are all on our phones and our laptops and our devices… and nobody really thinks what's going on somewhere worldwide to make all that happen," Doolan says. *"And it's all happening in data centers, vast huge buildings full of computers humming away doing all the applications and all the processing and running all the large language models that are now powering the growth of AI."*

Doolan, who has spent 30 years working in critical infrastructure, walks viewers through the physical pressures driving today's data centers—from surging electrical loads to immersion cooling systems. *"Some of these data centers are 100 megawatts plus now in size. Some are even up into the gigawatts. They're using a lot of power and a lot of water and they need trained technicians to build and operate them."*

Hitting the Cooling Ceiling

With AI workloads ramping up, conventional infrastructure is struggling to keep pace. *"I think some of the physical parameters that we just talked about around the power and the water and the cooling of those chips are probably some of the things that are going to max out and mean that we can't go much bigger."*

To manage rising heat density, new technologies are being adopted fast. *"We're starting to see direct liquid cooling, which is getting the water much closer to the chip... and we're even starting to see more immersion cooling where you're actually putting the servers in baths of oily liquid to make them even more efficient."*

Unpredictable Loads, Uncertain Grids

"I think the emerging threat is really power," Doolan warns. *"We're starting to see that these AI loads and the GPUs that are… very different characteristics to some of the computers that we've seen before."*

He describes how demand can spike unpredictably: *"They're experiencing very large load swings literally from 10 megawatts to 50 megawatts." These surges ripple beyond facility walls. "That can have a significant effect on some of the grids that the data centers and all the other consumers in those areas rely on as well."*

Meanwhile, the internal systems that support cooling are evolving too. *"The CDUs, the cooling distribution units that are providing the water to cool all this equipment, they're all new now. So, we're having to learn a new asset class and how to maintain and operate that and look for failure modes and how we can do condition monitoring and predictive maintenance on a whole new asset class."*

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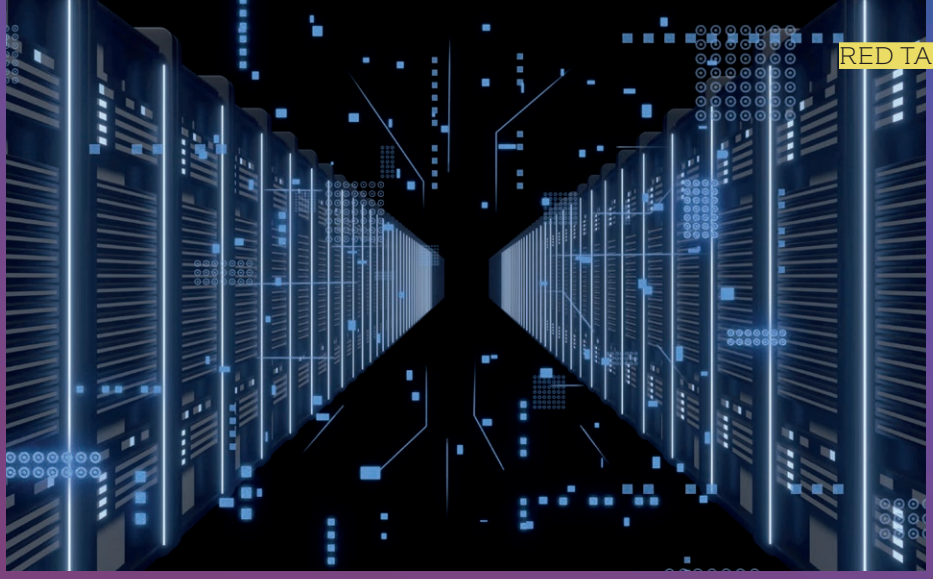

The Human Factor

Asked about outages, Doolan doesn't point to hardware first. *"So there's really, I think, two things that can cause data centers to go down and cause the big headlines of various applications going off… sometimes it's the equipment that fails. But it often is the processes and the people that fail as well."*

That's why he pushes his teams toward relentless preparation. *"I always say plan, plan, plan, plan twice, switch once."*

The Workforce Gap

"The industry takes hundreds if not thousands of people to build the data centers and then it requires a lot of people to operate the data centers meaning that it takes a long time to bring them up to speed."

And that learning curve matters. *"So, if we do suffer with attrition then obviously that increases the risk as well."*

Want the full picture?

Watch Mike Doolan's RED Talk on data center reliability, AI demand, and operational resilience at redtalk.com

RED TALKS

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Future for Reliability Engineering by Design

In this issue we have the continuation of Red Talks, a series of interviews with subject matter experts. We have asked the leader of Red Talks, Lee Murray, to continue to provide his Red Talks with SME's central to issue within the power system. The idea of Red Talks came from discussions with leaders in so many disciplines within industry, blossoming this year with the official launch of Red Talks and we are proud to present them as a Byline. But what is Reliability by Design?

Reliability Engineering in Asset Design: Ensuring Long-Term Performance in Power Systems

Let's first look at the design and operation of critical infrastructure, particularly within the power sector. Reliability is not just a desirable feature-it is a necessity. Reliability engineering plays a foundational role in ensuring that assets such as power transformers, substations, and entire power systems operate effectively over long periods under a wide range of conditions. With so many extreme conditions affecting the energy grid, there is a need not only for the science of reliability, but the art of reliability. Given the centrality of electrical power to every facet of modern society, ensuring that these systems are robust, predictable, maintainable and resilient is both a technical and economic imperative.

With so many extreme conditions affecting the energy grid, there is a need not only for the science of reliability, but the art of reliability.

What is Reliability Engineering?

Let's begin at the beginning. What exactly is the discipline of Reliability Engineering? It is a discipline focused on ensuring that systems and components perform their required functions under stated conditions, which might change well after you have set things up for a set of circumstances that no longer exist, and for a specified period of time. In the case of transformers that period was thought to be 20 years. With transformers in the grid at 40+ years old, now what? Did we over-engineer? Will that continue so that the transformer designed today will meet the same fate as the over-designed one made in 1976?

In the context of power systems, this means designing assets that can withstand environmental stresses, electrical surges, mechanical fatigue, and human error-without unplanned downtime or performance degradation. But will they last 40 years? Or should we begin to plan for the next generation asset aging more after 20 years and not expect them to last much longer? If I owned a transformer manufacturing plant, I would want to know, because the capacity that meets the needs of industry today might not be able to meet the needs in the future. Or vice versa, if I overbuild my capacity and must downsize to meet a smaller market, which happened in the late '70s and '80s, what impact will that have on the viability of my company.

Long-Term Reliability: A Design Priority

Long-term reliability is especially crucial for high-value, long-lifecycle assets such as power transformers. A single failure can result in extended outages, costly repairs, and significant economic losses. Therefore, reliability must be embedded at every phase of an asset's lifecycle-from conceptual design and material selection to manufacturing, operation, and maintenance planning. Since most major assets are purchased to meet specific expectations, reliability becomes a function of anticipating those specifications.

A key strategy in reliability engineering is the application of Failure Modes and Effects Analysis (FMEA) and Root Cause Analysis (RCA) to identify vulnerabilities early in the design process. These methodologies allow engineers to anticipate where and how an asset might fail and implement design features that either eliminate these failure points or reduce their impact.

Materials and Environmental Considerations

Material science plays a critical role in long-term reliability. We know that the insulation materials used in transformers degrade over time due to thermal and electrical stress. Selecting materials with proven long-term performance characteristics—and designing the system to minimize stress on those materials—can extend asset life significantly. Additionally, corrosion resistance, mechanical robustness, and thermal stability must all be considered, especially for outdoor components exposed to harsh climates.

Environmental considerations also guide design decisions. Power systems must remain reliable in the face of environmental variability, including temperature extremes, humidity, seismic activity, and lightning strikes. Reliability engineering involves designing for these scenarios using standards such as IEEE, IEC, and ANSI guidelines

Photo: Pexels

to ensure consistency and robustness. But will the environmental factors we will see in 2 decades be the same as what we are seeing today?

Predictive Maintenance

Predictive maintenance is a relatively modern evolution of reliability thinking. By using sensors and digital monitoring systems, operators can track asset performance in real time and predict when maintenance is needed before a failure occurs. This approach minimizes downtime, reduces the risk of catastrophic failures, and ensures the asset remains within its design performance envelope throughout its lifecycle.

The Future of Reliability Engineering

As the power grid evolves to incorporate renewable energy, distributed generation, and smart grid technologies, the demands on reliability engineering are growing more complex.
The integration of intermittent power sources and sophisticated control systems introduces new failure modes that must be accounted for in design and analysis.

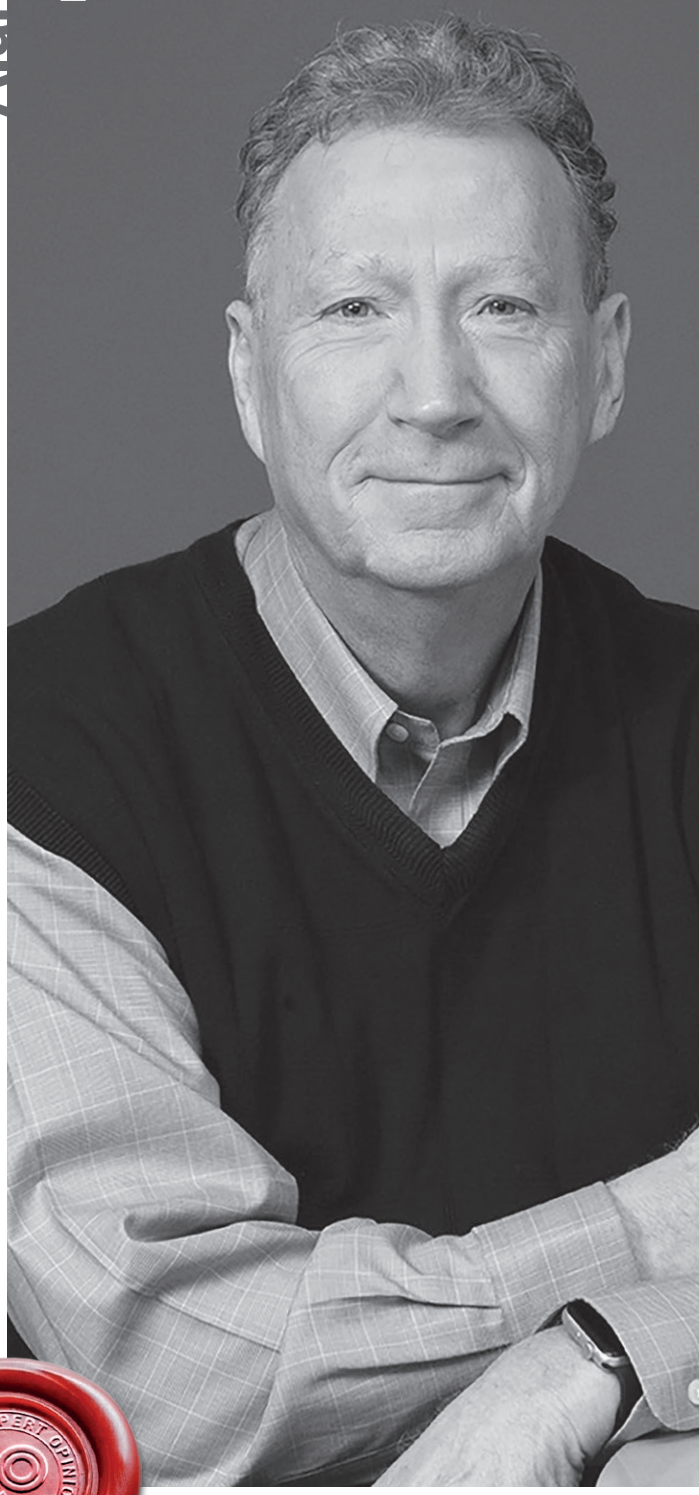
What do we see in the future for Reliability Engineering by Design? We will increasingly leverage data analytics, machine learning, and in some cases digital twins to simulate and predict asset behavior under a wide range of scenarios. These technologies will enable more accurate lifecycle planning and condition-based maintenance strategies.

Reliability engineering is not a one-time activity; it is an ongoing commitment embedded in the DNA of asset design, particularly in power systems where continuity of service is critical. Through thoughtful design, rigorous analysis, and proactive maintenance strategies, engineers can ensure that assets like power transformers remain reliable, safe, and efficient for decades—supporting the backbone of modern society.

Reliability engineering is not a one-time activity; it is an ongoing commitment embedded in the DNA of asset design, particularly in power systems where continuity of service is critical.

Alan M Ross
CRL, CMRP
Managing Editor
APC Media
Technical Director

Alan has decades of experience in the power systems industry and is one of the greatest reliability experts out there.



DGA as a Tool for LTC Condition Assessment

by **Lance Lewand**
Paul J. Griffin
and **Harry Heulings**

INTRODUCTION

In the early 20th century, there was a need for utilities to regulate voltage quickly. At that time, it could only be performed by deenergizing the transformer, changing the tap and then reenergizing the transformer. Not exactly a quick task. In response to this, Dr. Bernhard Jansen in Germany began to develop a system to change taps under load in 1926 and by 1929, the first load tap changer or on-load tap changer (LTC/OLTC) protype was developed by Dr. Jansen, Anton Schunda, and the Scheubeck brothers.

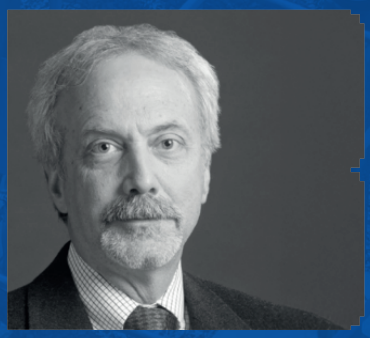
Ever since, LTCs have been critical in the operation of the electrical grid by enabling the transformer to maintain a stable output voltage despite fluctuations in input voltage or load changes. Today, there are many types and styles of LTCs including reactive, resistive, break-in-oil and vacuum types.

Since LTCs are mechanical devices and parts would wear or issues with contacts would develop over time, the operation count of the LTC was used as an indicator of when maintenance should be performed. The deterioration of LTCs overtime because of the mechanical issues makes them one of the weaker links in the utility network. Erosion of the contacts is expected due to the nature of their function. Coking of the contacts causes overheating, which can cause thermal runaway.

Today, transformers are expected to last way beyond their design life which is 20-25 years at rated voltage.

Photo: Shutterstock

Lance Lewand has been in the utility industry for 39 years, and with Doble Engineering for the past 32 years. He is the R&D and Technical Director for the Insulating Doble Insulating Materials Laboratories. Since joining Doble in 1992 he has published over 85 technical papers pertaining to testing and sampling of electrical insulating materials and laboratory diagnostics. He received his Bachelor of Science degree from St. Mary's College of Maryland. He is actively involved in professional organizations including the American Chemical Society, a representative of the U.S. National Committee for TC10 of the International Electrotechnical Commission (IEC) and ISO TC28, ASTM D-27 since 1989, is the sub-committee chair 06 on Chemical Tests, former vice-chair of D-27, recipient of the ASTM Award of Merit for Committee D-27, and is current Chair of ASTM D-27 committee on insulating liquids. He is also vice-chair of IEEE C57.146 and 155 and is the chair for the new IEEE committees on cellulose degradation and corrosive sulfur, as well as involved in several CIGRE technical committees.



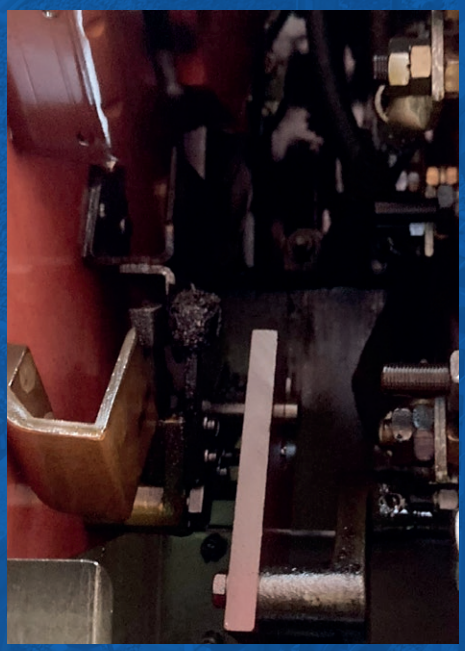
Paul J. Griffin, now retired, started working for Doble in 1979 and worked there for 42 years. He held the position of Laboratory Manager before becoming Vice President of Laboratory Services. While at Doble, Paul Griffin has published over 70 technical papers pertaining to testing of electrical insulating materials and laboratory diagnostics.

Harry Heulings is a Senior Chemist in the Professional Services group at Doble Engineering, focusing on condition assessment of critical electrical assets and large-scale fleet assessments using laboratory diagnostics. Harry was a member of the Doble Windfarm Sub-Committee and was the co-author of the Windfarm Subcommittee Report on Wind Turbine Step-Up Transformer Asset Management (2021). Prior to joining Doble in 2017, Harry held the position of Laboratory Manager at Morgan Schaffer USA and Intertek Testing Services and Research and Development Chemist at Rohm & Haas Company. Harry has a BA and MS in Chemistry from Rutgers University, and an MBA from Rutgers School of Business.

An LTC failure can easily cause collateral damage to the transformer and decrease its lifespan. Thus, there is much emphasis placed on making sure the LTC

Transformer life in the United States is much beyond that with the average life span currently at 45 years. In a 2025 Doble conference, it was reported that several large utilities are now expecting their transformer assets to last 70 years or more. But there is a catch, what about all the moving parts in an LTC that will not last 70 years. An LTC failure can easily cause collateral damage to the transformer and decrease its lifespan. Thus, there is much emphasis placed on making sure the LTC operates correctly over time.

There are a number of strategies to maintain LTCs, including periodic, time-based maintenance, condition-based maintenance, or some combination of both. Periodic maintenance can work if sufficient resources are utilized such that these activities occur at shorter time intervals than the gestation time of expected excessive wear and tear or development of problems into failures. To do this well, the time chosen must be conservative enough to catch most problems but increases cost of maintenance and often issues are not found. Condition-based maintenance relies on tools which can detect most problems early enough that maintenance can be scheduled and performed. In most cases, condition-based testing is performed while the apparatus is in-service so that any down time is reduced or eliminated.



Coking

Poor Surface Contact

Oil testing has long been recognized as an important tool for detecting incipient-fault conditions in the main tanks of transformers and is being applied to load tap changers. Some of the advantages of oil tests are that they:

- can usually be performed while the equipment remains in service
- can detect a wide range of problems in the early stages
- can be used to ascertain a reasonable sense of the severity of the problem
- have been shown to be very cost effective

This testing is used to provide one of the most important early warning diagnostics for LTCs.

OIL TESTS FOR LTCs

Although many of the common oil tests such as dielectric breakdown voltage, interfacial tension, acid content, particle count, metals analysis, etc. provide valuable information used in many LTC diagnostic programs offered by commercial and utility laboratories, this article will focus specially on DGA and water content.

Dissolved Gases in Oil: This is the most important oil test for LTC diagnostics. As insulating materials deteriorate byproduct gases are generated. Normal deterioration produces gassing patterns which are typical for a specific family which includes the model, type of breathing, and compartment. As problems manifest the gassing behavior changes which includes both the amount and most often the pattern or relative composition of gases in oil. Problems include localized overheating and/or excessive arcing and other abnormalities. Localized overheating of conductors and surrounding insulation may lead to carbonization and byproduct polymeric films forming on conductors, which creates a runaway thermal condition.

Water Content: Excessive water reduces the dielectric breakdown strength of the oil and can accelerate the aging of the contacts. Excessive water in the solid insulation can result in tracking and ultimately an insulation failure. The water content will vary depending on if the compartment is sealed to the air, free breathing or has a desiccant breather. Compartments with arcing contacts in oil will often be vented to reduce the combustible gas concentration generated in the operation of the device. In such cases, the relative saturation of the water in oil will be driven by the ambient humidity and altered by the difference in the temperature of the ambient air and the oil. Increasing the temperature of the oil above that of the ambient air lowers the relative saturation of water in oil. Under equilibrium conditions, expected amounts of water in oil can be quantified and therefore makes it possible to estimate what concentrations are excessive.

Condition-based maintenance relies on tools which can detect most problems early enough that maintenance can be scheduled and performed. In most cases, condition-based testing is performed while the apparatus is in-service so that any down time is reduced or eliminated.

Photo: Shutterstock, Doble

SAMPLING FOR LTCs

As the oils from LTCs can contain considerable byproducts from the deterioration process, it is very important to take care in sampling to avoid cross contamination and obtain a representative sample. Experts recommend flushing enough oil to remove condensation in the valve and excessive carbon and debris that has formed as sediment on the bottom of the LTC. If enough oil is not removed, then a "false positive" can occur where the analysis indicates a problem with the LTC where one really may not actually exist.

It is critical to use new tubing each time as plastic materials have a "memory effect" where some of the gases dissolved in the oil will adsorb in the plastic only to desorb in the next sample that contains less of the gas. This can be particularly troublesome as the gases are not visible and different types of LTCs have very different normal gas concentrations. Cross contamination is of concern when taking samples from LTCs and thus the use of clean compatible sample containers is required

Make sure the LTC is under positive pressure. This can be done by introducing a slug of oil into the tubing attached to the valve. Open the valve slowly and watch the movement of the oil slug. If it moves away from the valve, then there is positive pressure and flushing can continue. If the oil slug moves towards the valve, the valve should be immediately closed and the LTC should be brought back to positive pressure.

Evidence of Coke Formation

NOMENCLATURE FOR LTCs

As with any sample from electric apparatus, it is necessary to have sufficient identification that the test data can be linked to the equipment and proper diagnostics can be provided as many of the test results are based on the construction of the electric apparatus. This would include information from the nameplate such as manufacturer and serial number. For diagnostic purposes the minimum information that should be supplied with LTC samples is:

- Manufacturer of LTC
- Year of manufacturer
- Model
- Type – Vacuum or break in oil (this is often evident from the model information but not always)
- Compartment – selector, diverter
- Tank type – sealed, free breathing, desiccant breathing

Other information such as if the unit has a filtering unit on it or when the LTC was last maintained or oil handled is useful information for those performing the interpretation of results.

DIAGNOSTICS AND RANKINGS (CONDITION CODES)

The goal of diagnostics is to provide a ranking that prioritizes maintenance activities. This goes beyond the simple good/bad distinction, to provide some grading to permit different management options.

The primary test for LTC diagnostics and condition assessment is that for dissolved gas-in-oil as this detects most of the problems. There are three main types of LTCs, reactive with arcing contacts in oil, resistive with arcing contacts in oil and arcing contacts in a vacuum bottle. There should be differences in the gassing behavior between resistive and reactive types as the shorter time of arc extinction of the resistive type (5-6 ms after contact separation) should lower the concentrations of gases generated. However, it has been our experience that the gassing behavior of different models of LTCs are so different that generic rules for reactive and resistive LTCs are not adequate. The primary diagnostic gases used to develop condition codes are methane, ethylene and acetylene. In addition, three ratios are used:

- ethylene/acetylene distinguishes between thermal and electrical discharge activity in oil

- methane/acetylene distinguishes between thermal and electrical discharge activity in oil and can also detect partial discharge activity as a predominant gassing pattern
- (hydrogen + acetylene)/(TCG – carbon monoxide): Ratio of gases associated with discharges to those associated with overheating of oil. This is similar to a ratio proposed previously which included the carbon monoxide in the TCG.

A matrix has been developed for each model that includes concentration limits for each of the three diagnostic gases plus the three ratios. Points are assigned for each limit and then summed, with a total point range between 0 and 15. Condition codes are then determined from the points as shown in Table 1. A Condition Code of 1 indicates an LTC in the worst possible condition that should be the number one priority. A Condition Code of 5 would indicate an apparatus in good condition and the lowest possible on the list for sample frequency.

Condition codes 3-5 have a range for sample frequency. This is based upon the experience that the time from inception to complete failure, particularly for thermal runaway conditions, is shortened considerably if overloading significantly beyond nameplate on a regular basis.

The matrix is structured to find a variety of problems which may be detected by excessive gassing rate, change in gas ratios or both. For example, localized overheating of contacts or the reversing switch will generally show increasing combustible gas generation with ratios of gassing going from an arcing pattern to characteristics of high temperature overheating of oil. Excessive arcing between contacts is most likely to develop high gas concentrations until the later stages when heating occurs (causing the combustible gas ratios to change). Examples of causes of overheating include:

- excessive contact resistance due to the formation of organic films and carbon deposits
- metal fatigue causing poor contact pressure
- loss of direct contact surface area from misalignment or loss of contact material

Excessive combustible gas buildup can result when the vent becomes plugged. This eventually leads to low oxygen contents as it is consumed in oxidation reactions and is not replenished. Typically, the ratios will remain normal unless another problem is present at the same time.

Condition Codes and Maintenance Assessment	
Condition Code	**Assessment**
1	CRITICAL, Remedial action needed
2	INVESTIGATE to determine problem
3	Monitor – Resample in 3 months if loaded below nameplate or 1 month if loaded above nameplate
4	Monitor – Resample in 6 months if loaded below nameplate or 2-3 months if loaded above nameplate
5	Of No Concern – Resample in 1 year if loaded below nameplate or 4-6 months if loaded above nameplate

Table 1: Condition Codes and Maintenance Assessment

Various other thermal and electrical problems can also be detected depending upon the model of LTC.

The diagnostic matrix for selector compartments and vacuum type models that break under vacuum is different. The ratios do not apply in the same way for vacuum type LTCs and therefore, absolute concentration limits for the gases are relied upon to determine the condition codes. Condition codes are generated with the same type of ranking as for arcing contacts-in-oil compartments.

This diagnostic scheme has been very successful over the past years in determining which LTCs have problems that need remediation and many "saves" have been reported on an annual basis.

CONFIRMATION AND COMPLIMENTARY TEST

Oil testing is just the first step in the diagnosis of LTCs with potential problems. There are a number of non-oil tests that have been employed to confirm or identify LTC problems. These include the following:

Infrared thermography and temperature differential: A frequently used method to detect or confirm overheating of contacts or the reversing switch in externally mounted LTCs is to determine the temperature difference between the main tank and the LTC. Normally the main tank should be operating at a higher temperature than the LTC compartment except for the occasional transient such as when the pumps initially come on to cool the main insulation. As thermal problems develop in the LTC compartment the oil temperature will consistently be higher than the main tank. This difference in temperature can be detected using continuous temperature monitors mounted to the tank wall or by periodic inspections using infrared thermography.

Photo: Shutterstock, Doble

DGA has gained wide acceptance in the industry for assessing the LTC condition and has become standard practice electrical networks all over the world.

Electrical tests: There are a number of electrical tests that can be used to confirm or help identify the source of LTC problems before entering for visual inspection.

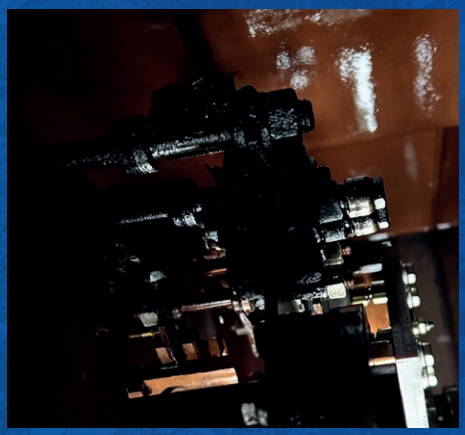
- Exciting current tests on all LTC tap positions can be used to detect shorted turns and core problems in the preventive autotransformer, contact problems and connection problems in the preventive autotransformer or in taps.
- Turns ratio can detect shorted turns in the preventive autotransformer.
- Power factor tests are used to detect insulation deterioration such as from water and partial discharge activity, including tracking and carbonization of solid insulation structures.
- Contact resistance is used to detect excessive contact wear, poor contact pressure, coking and polymeric films on contact surfaces.
- Sweep Frequency Response Analysis (SFRA) and leakage reactance (short circuit impedance) are both used to detect winding movement or deformation and contact problems.

Acoustic and vibration analysis: Some investigators have developed a database of LTC signatures using acoustic analysis to complement diagnostic programs for LTCs.

CASE STUDY

To illustrate the LTC diagnostic program several case studies are presented. The details of the LTC for this case are listed in Table 2. The DGA results in Table 3 show the combustible gas values were high and the ratios indicative of an abnormal condition. The OLTC was assessed as being in an emergency condition and immediate remedial action was needed.

The concentrations of the hydrocarbon gases associated with overheating were extremely elevated and the ethylene/ethane ratio was far more than what was considered normal.



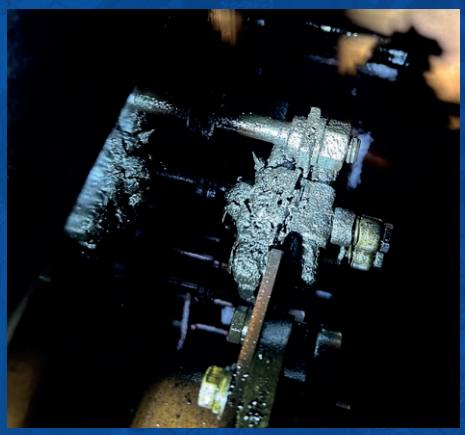
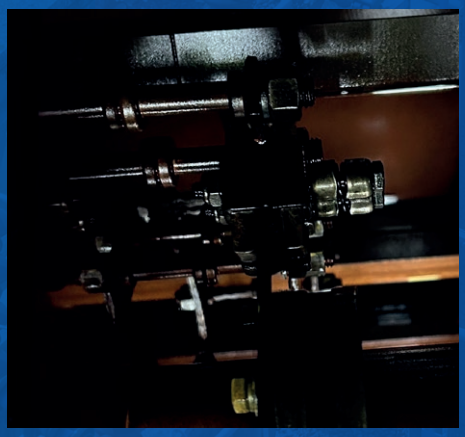


Figure 1: Burnt Reversing Switch from Outside Phase



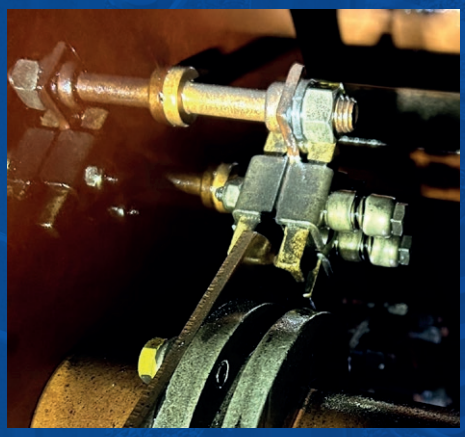


Figure 2: Good Reversing Switch from the Middle Phase

LTC Information				
Manufacturer	**Model**	**Type**	**Compartment**	**Tank Type**
Westinghouse	UTT-A	Break-in-oil	Selector and Transfer in one tank	Sealed

Table 2: LTC Information

Dissolved Gases-in-Oil (DGA) and Gas Ratios					
GAS	**LTC, ppm 11/8/24**	**Norms[3]**	**Gas Ratio and Code**	**LTC 11/8/24**	**Norms[3]**
Hydrogen	10,800		Methane/Acetylene	49.0	
Methane	38,500	<2,000	Ethylene/Acetylene	80.7	<1
Ethane	12,400	<1,000	(H2+Acet)/TCG- CO	0.09	
Ethylene	63,500	<5,000	Doble Condition Code	1*	
Acetylene	786				
Oxygen	235				
Nitrogen	52,600				
Carbon Monoxide	729				
Carbon Dioxide	6,420				
TCG	126,714				

**Based on Doble's criteria from Table 1, this was considered a "Critical" condition, and an immediate response was needed.*

Table 3: Dissolved Gases-in-Oil (DGA) and Gas Ratios

These markers pointed to a severe thermal condition. Based on the DGA, an internal inspection was performed. Figure 1 shows the issue was on the stationary side of the reversing switch on one of the outside phases. Two of the good phases showing normal wear are given in Figure 2.

The damaged part was replaced and the LTC returned to service.

CONCLUSIONS

DGA has gained wide acceptance in the industry for assessing the LTC condition and has become standard practice electrical networks all over the world. Doble has found that once oil diagnostic programs are started for LTCs, problems that were not being detected by other methods are revealed and, in many cases, sooner as the time intervals between sampling is shorter than most other maintenance or testing activities. After using oil diagnostics for all the LTCs in a system, the number of problems found the second time around is reduced showing the effectiveness of the program.

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Energy at work

A GLOBAL STRATEGY TO ENHANCE PRODUCTION CAPACITY AND DRIVE THE ENERGY TRANSITION

Photo: LTC Group

In a rapidly evolving industrial landscape, where the energy transition is a global priority, LTC Group stands out as a key player in the field of magnetic cores for transformers and reactors. With over 65 years of experience and an entrepreneurial vision driven by innovation, the Group continues to invest in cutting-edge technologies and in a global expansion strategy that integrates production capacity, quality, and a strong presence in strategic markets.

In 2024 and 2025, LTC Group launched a series of key initiatives to meet the growing global demand for transformer components, driven by infrastructure investments, the spread of renewable energy, and new projects related to electric mobility. These initiatives include the installation of a new slitting line, the opening of new production facilities in Italy and Dubai, as well as the development of a new site in North America, currently under construction, which will strengthen the Group's presence on the continent and represents a further boost to its overall production capabilities.

Expansion of Production Capacity: Italy at the Center of European Growth

LTC Group has recently announced the opening of its seventh production plant in Italy, located near existing facilities. The plant, covering an area of 8,000 square meters, will enable a significant increase in production capacity, estimated at approximately 10,000 additional tons of magnetic cores per year. This expansion represents a concrete response to the growing demand for high-performance magnetic solutions used in power transformers for electrical grids, industrial applications, and railway systems. The investment is not limited to quantitative capacity. The new plant is designed according to criteria of energy efficiency, operational flexibility, and digitization of production processes. It also integrates advanced quality control technologies that ensure precision, reliability, and compliance with international standards.

New Horizons: North America Project

Confirming its global strategic vision, LTC Group has initiated a significant expansion in North America. The new headquarters, located in Hamilton, in the Canadian province of Ontario, is the result of a greenfield project developed in 2023. The site is strategically positioned: only 70 km from Toronto and about an hour from the United States border, allowing optimal coverage of both the Canadian and U.S. markets. The North American facility will be equipped with modern, automated systems. The new plant will have a dual objective: to support utilities and transformer manufacturers in North America with faster delivery times and to actively contribute to the continent's energy transition and decarbonization plans. This project strengthens the Group's international presence, already active with plants in Italy, Dubai, and Taiwan, and consolidates its ambition to remain the global reference partner for transformer manufacturers.

Dubai: A Strategic Hub in Expansion

Another of the most representative elements of LTC Group's global growth strategy is the expansion of activities in the United Arab Emirates, where the company has been operating since 2010 with a production plant in Dubai. This hub was the first step in the internationalization process and allowed the Group to directly serve the Middle East market, strengthening competitiveness in a dynamic and rapidly growing region. Today, more than a decade later, LTC Group is taking a new step forward with the launch of a second production facility in Jebel Ali, one of the Gulf's most strategic logistics areas. The new plant is equipped with cutting-edge technologies designed to ensure production efficiency and meet the highest quality standards. This investment in Dubai not only strengthens the Group's industrial presence in the Middle East but also demonstrates the desire to combine production capacity, innovation, and proximity to markets. With enhanced production capacity, the new Jebel Ali facility represents a strategic asset in LTC Group's global growth plan.

Photo: LTC Group

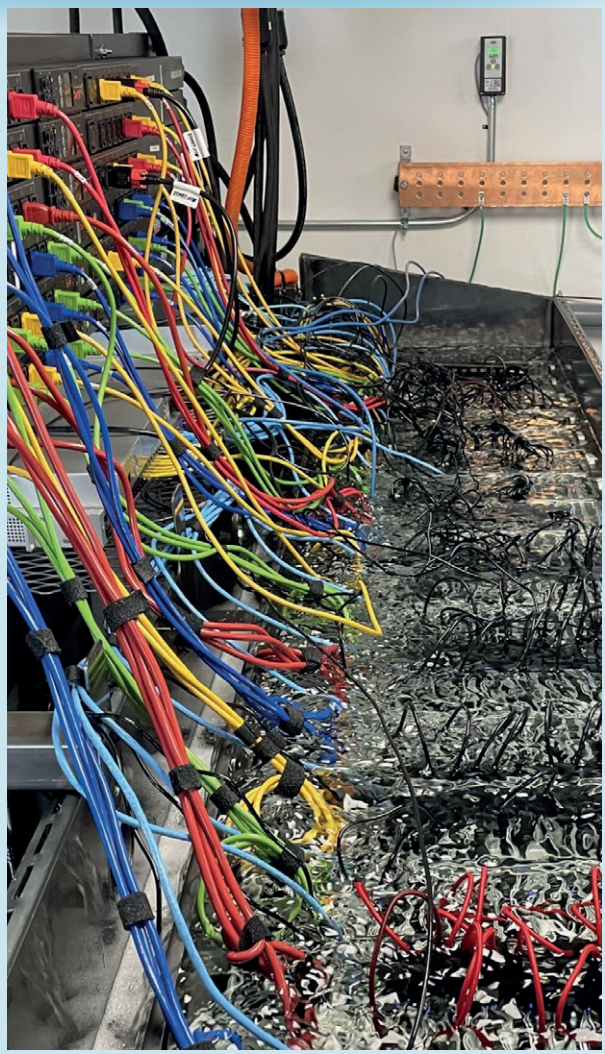
A Scalable and Sustainable Industrial Model

LTC Group has built its success on a scalable industrial model, replicable internationally, and based on technological innovation, product quality, and customer proximity. Every new investment—be it a plant, a facility, or a process upgrade—integrates perfectly into this framework. All the Group's production plants share common standards, both from a technical and managerial point of view, and adopt uniform monitoring and quality control tools. This approach allows for flexible and coordinated production, capable of adapting to the needs of a global and fragmented market. Among the most recent developments, LTC Group is installing a new high-performance slitting line, designed to provide speed and precision in responding to growing market demand. This investment aims to further improve internal process efficiency and proactively support increasing demand, while maintaining high standards of production continuity and quality control. The flexibility of the system will allow for quick adaptation to a wide range of customer specifications, reinforcing the Group's position as a reliable technology partner committed to continuous improvement. Moreover, attention to environmental sustainability is a transversal element: the Group adopts energy efficiency systems, waste reduction, and resource optimization in all its locations.

Growth Built on Value

The expansion path that LTC Group is undertaking is not just a response to a growing demand for magnetic cores but the concrete expression of an industrial vision projected towards the future. The strengthening of production capacity, the opening of new sites in strategic markets, and the adoption of cutting-edge technologies testify to the Group's continuous commitment to ensuring value to its customers, quality to its products, and sustainability to its processes. With solid industry expertise and a constant focus on the evolving energy landscape, LTC Group continues to innovate, grow, and connect the world of energy.

Cooling Innovation: Immersion Cooling Fluids Take Center Stage



Thermal management has become a limiting factor in the design and manufacturing of many electronic devices. Computing and telecommunications devices have become too power-dense to be cooled with traditional air-chilling methods. Air conditioning entails high sound levels, cooling water use and power consumption and limits the installation of new data centers near populated areas.

Computing and telecommunications devices have become too power-dense to be cooled with traditional air-chilling methods.

Now, a thermal management technique borrowed from the power transformer industry is being applied to data centers: immersion cooling, a cutting-edge method that submerges electrical hardware in a nonconductive heat transfer fluid. These specialty coolants can be about 1,600 times more efficient at the absorption and transfer of heat than air is. While immersion cooling has been used in electrical transformers for over a century, its application in electronics cooling has recently surged, fueled by the boom in data centers catering to artificial intelligence (AI), cryptocurrency mining and graphics rendering.

While immersion cooling has been used in electrical transformers for over a century, its application in electronics cooling has recently surged, fueled by the boom in data centers catering to artificial intelligence (AI), cryptocurrency mining and graphics rendering.

A key step in the growth and acceptance of immersion cooling technology is the development of standards for safety and performance of the coolant fluids themselves. Safety standards developed for transformer fluids and hydraulic oils have been evaluated, but are not suitable for application to electronics cooling.

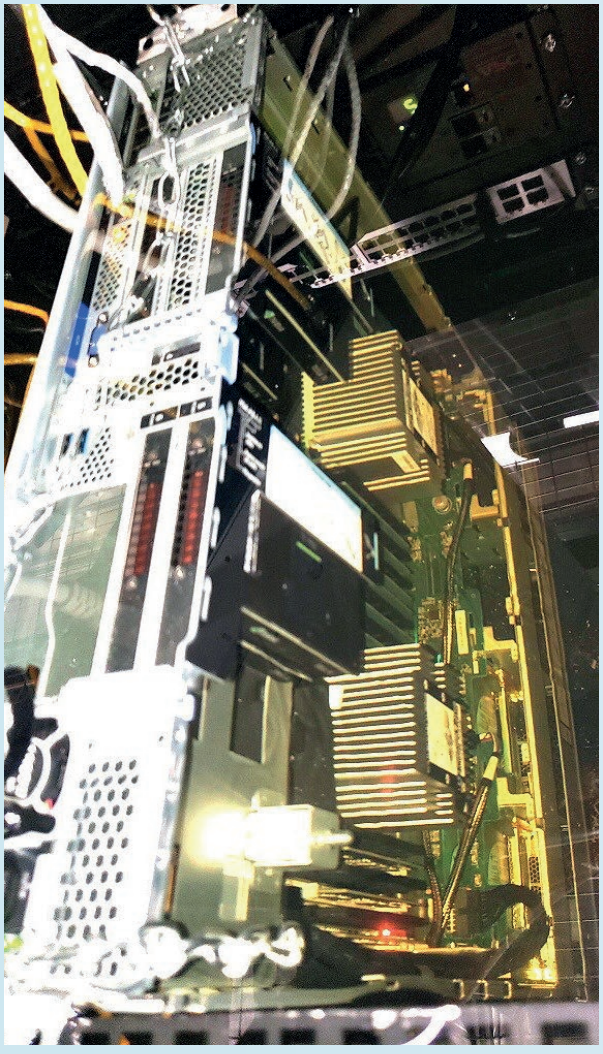


Photo: Engineered Fluids

UL Solutions is addressing this challenge with its new outline of investigation and certification program for immersion cooling fluids that are used with information technology equipment. UL 2417, the Outline of Investigation for Immersion Cooling Fluids for Use with Information and Communication Technology Equipment, is a comprehensive outline that assesses key flammability and performance characteristics of coolant fluids. Certification to UL 2417 not only streamlines compliance with safety requirements but also aids equipment manufacturers in selecting the right fluids, significantly speeding up time to market.

I had a chance to discuss the development and adoption of UL 2417 with Dejan Gakovic, business development manager in the Consumer, Medical and Information Technologies group at UL Solutions.

“The most critical part of the system is the fluid,” said Gakovic. “UL 2417 addresses the need for safety guidelines for the immersion cooling industry, and will help equipment manufacturers, asset owners and insurance companies evaluate the cooling and flammability properties of these products.”

UL Certified immersion cooling fluids have demonstrated that they meet UL 2417 requirements. These fluids bear the UL Mark and are cataloged in the UL Product iQ® database under the Category Code Number (CCN): NCOZ. This feature helps cooling system manufacturers choose compliant fluids more efficiently for their products.

“As immersion cooling technology is adopted by more products and industries, UL Solutions will continue to address critical safety challenges and help enable innovation in advanced cooling technologies,” Gakovic told me.

Personally, I know from my experience in the transformer industry that safety standards such as UL 2417 will promote the use of immersion cooling in applications where its adoption has been slow due to uncertainty around requirements. As the technology matures, it will be adopted by a wider variety of product manufacturers as a more efficient means of thermal management.

With these developments, we can look forward to advances in electronics design, with more powerful electronics in smaller packages, using less water and less energy to stay cool.

Author:
David Sundin
Chief Scientist
Engineered Fluids

Dr. **David Sundin** is Founder and Chief Scientist of Engineered Fluids, Inc., the leading provider of thermal management of batteries, EVs and data centers via Immersion Cooling. Dr. Sundin has over 40 years’ experience developing and applying specialty electrical cooling fluids and has held leadership positions in a variety of IEEE and ASTM Committees.

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Moisture: The silent threat to the transformer's longevity

Moisture is a silent but serious threat to transformer health, contributing to aging and failures in transformers.

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To limit moisture ingress, dehydrating breathers with hygroscopic salts are commonly used. These devices prevent ambient moisture from entering the conservator.

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Whether you are managing asset health remotely or on-site, our eSDB breathers provide continuous protection. Your transformer will be continuously protected from moisture intake, and you can collect the necessary data online for remote transformer health management.

Understanding the source:

While external contamination can introduce moisture, it is also essential to understand that moisture found in transformers can originate internally. As paper insulation ages, especially under hot temperatures, it decomposes and releases water. This means that even a perfectly sealed transformer can accumulate moisture over time. Therefore, **moisture management is not just about sealing the transformer—it is about monitoring and mitigating internal degradation**.

However, understanding moisture levels inside a transformer goes beyond external protection. Historically, moisture data could only be obtained through oil sampling and laboratory analysis, including Dissolved Gas Analysis (DGA). These methods, while helpful, offer only snapshots in time. Today, continuous monitoring technologies provide real-time insights, enabling predictive maintenance and early intervention.

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- **Oil diagnostic device type eDOC** that detects moisture levels in the oil.
- **Consulting services** and regular reports to support you with moisture management.

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Building a Scalable Transformer Services Business – Critical Elements of Success

by **Hassan Zaheer**
and **Chris Gerber**

The concept of transformer lifecycle extension through refurbishment is not a new one. With the electrification and rapid integration of renewable energy, the need to upgrade the power grid, and the power transformers within, is accelerating at scale.

At the start of this month, I had a chance to sit down with a good friend and advisor, Chris Gerber during CWIEME Berlin. While discussing the state of the transformers market and supply constraints, the topic of transformers services came up. Chris has a long track record of asset management and transformer replacement in utilities as well as leading the service business unit of transformer OEMs.

The concept of transformer lifecycle extension through refurbishment is

Hassan Zaheer is the Managing Partner & COO at PTR Inc. based in Abu Dhabi, UAE. With more than a decade of experience in the energy transition space, Hassan advises various Fortune-500 and blue-chip clients in the electrical infrastructure sector to sustainably grow their businesses, both through custom consulting work, marketing support services and tailored research reports by PTR, helping their executive management and boards make data driven decisions. Hassan is also a Member of Advisory Board for CWIEME Berlin and MENA EV Show, part of the Executive Editorial Board of APC Media and an advisor to the educational non-profit Better Humans Academy. Hassan has a tech background with a Masters in Power Engineering from the Technical University of Munich (TUM) and a BS in Electrical Engineering from the Lahore University of Management Sciences (LUMS). Additionally, he is also an Alumni of Center for Digital Technology & Management (CDTM).

Chris Gerber is a Founder & Managing Partner of Genesiss Consulting, a former Transformer OEM CEO with noticeable experience in the transformer industry having worked for some of the most significant independent transformer companies in Europe. He has worked for and with some of the most noticeable transformer utilities in Africa, the Middle East, and Europe. He currently consults, specializing in strategy, business development, mergers and acquisitions, and IP transfers. His experience in Mergers & Acquisitions in the transformer industry and his recent research on M&A ensures unique insights into this specialized field. He is the Managing Partner and founder of GENESISS as well as GENCON Consulting and a member of the Virtual Advisory Board. Chris advises PTR Inc. Yash HighVoltage, CWIEME Berlin, and STS Capital, and is also a member of CIGRE.

Photo: AI generated, Shutterstock

not a new one. With the electrification and rapid integration of renewable energy, the need to upgrade the power grid, and the power transformers within, is accelerating at scale. However, in some regions, the transformer supply is not able to catch up with the increased demand at this pace, resulting in lead times for new transformers being significantly higher. Utilities are therefore looking to extend the service life of their existing transformers, bringing transformers service business into sharp focus as a means to alleviate the long lead times for new transformers.

This article is a summary of our discussion on the basics of a transformer service business, and the critical elements needed to drive a high-margin and high-growth transformer service organization.

New vs. Renewed: Choosing the Best Path for Transformer Assets

For end-users, utilities and industry, the answer is relatively straightforward: if there is sufficient funding and no significant time constraints, opting for a new transformer is typically the preferred route, especially when long-term reliability and performance are priorities. However, in today's market, where lead times are extended and transformer prices have risen sharply, refurbishment has become an increasingly viable and attractive alternative for many utilities seeking to extend the life of their assets without the costs and delays associated with full replacement.

In today's market, where lead times are extended and transformer prices have risen sharply, refurbishment has become an increasingly viable and attractive alternative for many utilities seeking to extend the life of their assets without the costs and delays associated with full replacement.

A refurbished transformer is often preferred by utilities when two conditions are met:

- The total refurbishment cost, including some margins, falls on average between 60% and 75% of the price of a new transformer
- The lead times are significantly lower than getting a new transformer.

In such cases, provided the transformer ratings are to remain the same, the transformers are typically assessed, windings are rewound, cores normally stay the same, oils are replaced, as well as other auxiliary components are changed, typically taking between 6-12 months depending on the size of the transformer. The option to change the transformer ratings, through reverse engineering of the original design, is also possible. Such service can be carried out by the Original Equipment Manufacturer (OEM) brand supplying the unit, or by a brand agnostic third party transformer service provider, as discussed ahead.

Key Elements of a Transformer Service Organizations

Typically, there are two types of transformer service providers:

- OEM service organizations that offer reconditioning and servicing the transformers they produce, linked to the specific factories the units are produced in.

- Independent companies that specialize in transformer maintenance, repair, and life-extension services, typically started by people with roots in the OEMs.

While major OEMs have an advantage in this business, as often the utilities approach the original OEM for repairs and refurbishments, and for transformer components, standalone service businesses can also carve out a share through a competitive edge strategy, business plan and execution. Regardless of the fact as to whether a services organization is directly linked to a specific OEM or an independent services provider working on all makes of transformers, the following key elements are required to ensure competitive success:

- **Engineering-driven technical team:** A transformer manufacturing OEM often relies on a team of experienced engineers working behind the computers with complex designs, utilizing advanced tools and data to diagnose and resolve complex transformer issues. On the contrary, service organizations rely on skilled technicians who understand the product, its operations, and behavior under various circumstances and environmental conditions. They excel at the following without needing elaborate transformer designs:
    - Dismantling the transformer
    - Diagnosing and identifying necessary repairs
    - Implementing Innovative, practical solutions
    - All while executing work in a cost-effective and time-conscious way.

- **Efficient tools and equipment:** One of the most critical aspects of a transformer service organization is whether the work is performed on-site or off-site. This decision carries significant operational implications, particularly because transformer service often involves handling the oil. To make it work, the service team must be equipped with essential infrastructure, including:
    - Oil pump and vacuum unit
    - Dedicated storage space for reused oil
    - Oil filtration or regeneration plant
    - Capability to obtain and analyze oil samples
    - Winding machines and capacity
    - Sufficiently large cranes for lifting and untanking
    - High voltage test equipment to replicate the original factory acceptance test (FAT)

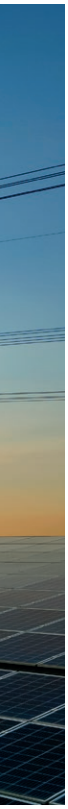
  Additionally, having the correct set of hand tools for performing precise repairs is equally essential to ensure quality and safety during the process.

What makes a service organization successful?

What separates a profitable transformer service provider from the rest goes far beyond technical capabilities. Typically, service businesses can offer relatively decent gross margins between 30-60% with an EBITDA between 10-15% if running properly. To achieve these and make a service business high performing, a company must master three core business elements:

- **Technical Operations:** A service organization must ace in its technical operations, supported by a competent, service-oriented, solution-driven technical team. Ideally, the team members should be the ones with experience in transformer manufacturing, end assembly, experience in building and disassembling transformers, and having a drive to solve complex technical challenges instead of a mundane job. A technical team that is proactively prepared, having no issues in "picking up the phone and responding to emergencies in the middle of the night", is critical for this business' success.

- **Operational Management:** The second element which is crucial for success is having an operational management that understands the scope of the project and its requirements. Especially in the case of refurbishment projects, where well-defined milestones are crucial for tracking progress and ensuring timely delivery, having strong project management skills to manage these projects for the cost, quality and timeline are essential. And lastly, strong communication skills for coordination with the customer throughout the process are key to



building trust and maintaining long-term engagement.

- **Marketing and Sales:** Lastly, having great marketing in place, to establish the credibility and visibility of a service organization, highlighting the company's capabilities, track record and credentials of the team is necessary. Difference in this case, from typical transformer OEMs is that, while the transformer OEMs are marketing to promote the brand and the product, the marketing in a service organization needs to focus on the organization, the technical team within the company and their experience and capabilities.

How does the future look like?

With increased lead times and skyrocketing transformer prices, the opportunity to grow the transformer service business is substantial, especially for refurbishing the large power transformer units. To capitalize on this momentum, it is essential to truly understand the customer base. If established relationships already exist, the focus needs to be on exploring their evolving needs in greater depth and tailoring the approach accordingly.

Lastly, the service businesses must think beyond repair, maintenance, and spare parts. A consciously formulated strategy around transformer refurbishment, including a technical team able to deliver complex refurbishment works, a project management team able to ensure timely delivery and a sales and marketing team that understands the intricacies of transformer refurbishment and confidently communicates its value, can really position a transformers service business for sustained growth in the current rapidly evolving market landscape.

It is essential to truly understand the customer base. If established relationships already exist, the focus needs to be on exploring their evolving needs in greater depth and tailoring the approach accordingly.

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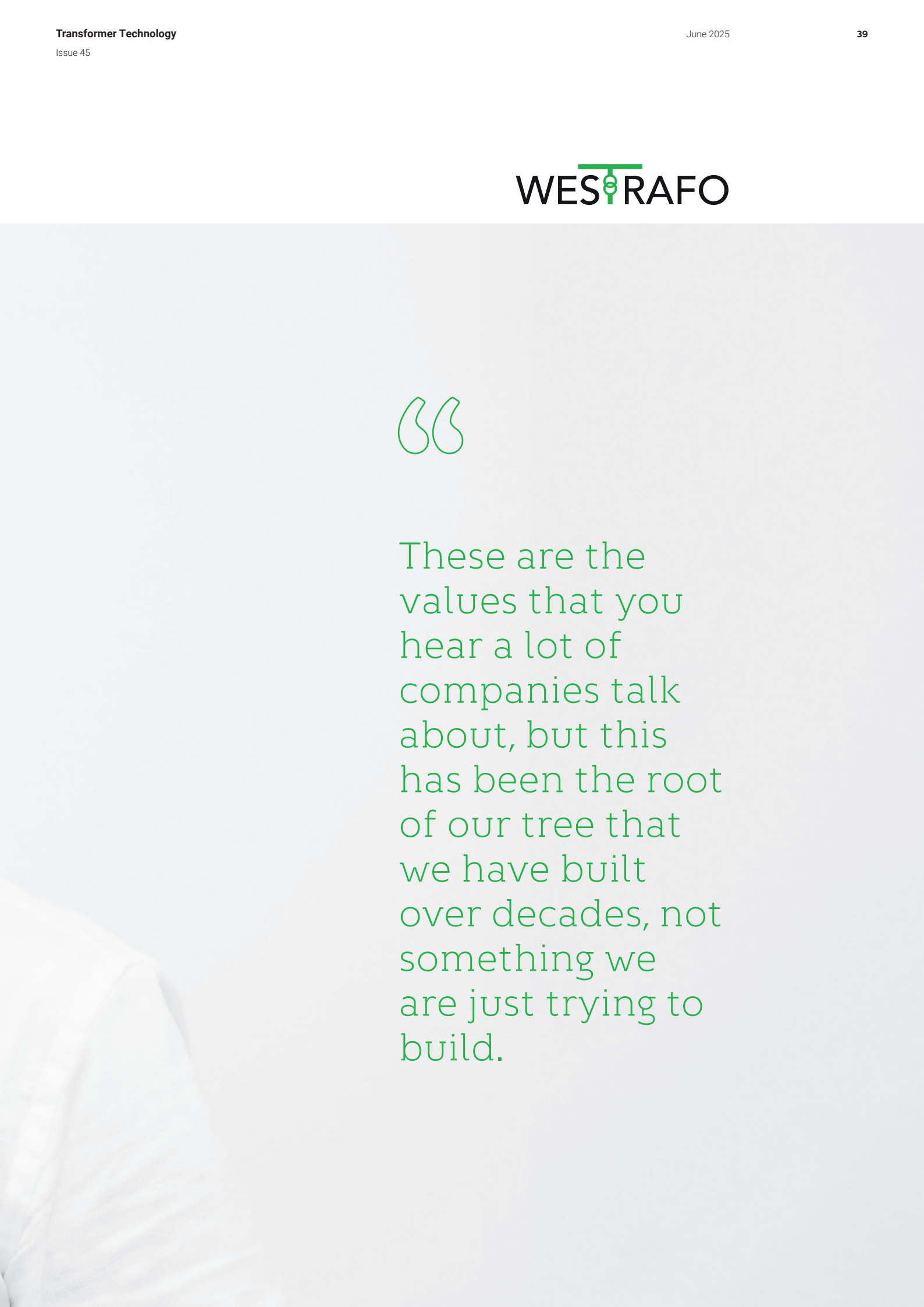
Alberto Cracco

CEO and Managing Director
of Westrafo Transformer Manufacturers

Interview with **Alberto Cracco**

Photo: Westrafo

WESTRAFO



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These are the values that you hear a lot of companies talk about, but this has been the root of our tree that we have built over decades, not something we are just trying to build.

Alan Ross: My guest for this interview is Alberto Cracco, the CEO and Managing Director of Westrafo Transformer Manufacturers, in Italy and America. Welcome Alberto.

Alberto Cracco: Thank you, Alan, it is my pleasure.

Alan Alberto, I believe every company has a culture, and the culture is set over time, not in an instant. I read somewhere where you said, "culture trumps strategy". When I look at the values at Westrafo they speak to me about building something for the long haul. But today we are in an environment where things like sustainability, innovation, and reliability are all important to what we do. Talk a little bit about the values that have been instilled in Westrafo and how you maintain them?

Alberto The actual values that the marketplace is asking for are reflecting what we have had with Westrafo from the beginning. Our mission is identifying reliability, innovation, and sustainability applied in the energy world to the transformer market specifically.

Photo: Westrafo

These are the values that you hear a lot of companies talk about, but this has been the root of our tree that we have built over decades, not something we are just trying to build. We started looking at the renewables market 10 years ago, with the goal to create a company that was able to support long term business growth with customers who are working in the renewable energy market.

Based on that is how we designed the company, and this is probably one of the reasons why we have been growing in such a consistent way, year by year.

Alan How did you get into designing and manufacturing transformers for the green energy market? Did you show up one day and say, "I want to build transformers for this specific market"?

Alberto (Laughing) No, it was not like that at all. Although Westrafo was founded in 2014, the company's historical background starts with my father who began manufacturing transformers and working in the transformer market in 1967.. That's over 57 years of experience.

My father worked as a technician at the beginning, working Saturday and Sunday when he was young making distribution transformers around Italy in order to be able to support the family.

Thanks to his technical and engineering background, he became Technical Director, then Sales Director, and finally became General Manager of a transformer company he led for almost 25 years before he retired. That was the day when we decided to start our entrepreneur activities as a transformer manufacturer. For eight years we had a minority share in a local company here in Italy and in 2014, we decided to step out and to create Westrafo: to start from scratch, to start from the ground up with a new company, was probably the best idea we ever had in our lives.

Beginning with almost 50 years of experience, with a blank sheet of paper where we can create whatever we want, allowed us to build exactly what we decide without constraints. This freedom to choose our path and focus on high-value markets is likely a key reason behind our success.

Alan That is excellent, a very inspiring story. You do not bring any of the mistakes that you make along the way to the new company. Is your father still involved in any way with the company?

Alberto My father is still the chairman of the company here in Italy. He is still an internal advisor for everything related to technical purchasing and strategic solutions. As a board member, he remains very active and continues to be one of the driving forces behind our company. I am very proud that we are be able to combine my optimistic approach and thinking completely out of the box with his experience, knowledge and his capacity to understand the transformer market.

Alan That is excellent, with a mix of the old guard and the new. While I know you are a global company, let's talk about your US efforts. The US market is hot. Right now, green energy in the United States provides on average about 38% of the power that we need, which is generational power. And if we could get a good energy storage system in place it is going to provide up to 60% with the existing infrastructure.

One of the big changes that we need is that we need a lot more transformers, a lot quicker. Is that part of your decision to get closer to the US market? Build them here and impact the supply to meet the current and growing demand?

Alberto Yes, that is why we decided to invest in United States by opening our production facility in Ohio.

As you know, we decided to enter the United States around 18 months ago.

We are starting from a base of solid information that we received from the market, from the growth. The Inflation Reduction Act expanded the renewable energy market, and many of our existing customers, whom we supply from

Europe, requested a local supplier.

A couple of years ago, we explored the opportunity to establish a US facility. We realized it wouldn't be easy since the supply chain for transformer components is still limited here — only a few components are available domestically. Nevertheless, we chose to invest, attract suppliers, and to do agreement with local suppliers that can grow with us.

> We have certified our design criteria specifically for transformers using FR3 fluid. These are high-temperature designs incorporating materials such as thermally upgraded paper and high-temperature gaskets. Through this process, we were able to consolidate our design approach.

The rationale behind the decision is not only to be close to the market but to be an alternative solution for the market in the United States. We are working in the renewable energy market, and the Data Center market, both of which we expect to grow significantly over the next decade.

Our target behind our decision was to invest in a local facility here in the US, to support our existing customer base and to attract new US customers, manufacturing products by US workers and serving the US. as a local supplier. I think this is a big challenge for Westrafo but we are confident that we will successful in the project.

Everything at the moment is on schedule, so we are very satisfied for the project. Production is expected to start during this summer and we are on track for that. We are already receiving orders that are filling our production capacity.

Alan And you are doing it in the Dayton, Ohio area, which has a great labor market?

Alberto Yes, the selection of the site was not easy: every US state wants to attract investment. When you say "investing in the US," it really means choosing a specific state like Ohio, California, or Texas, all competing to host us. Our idea was to be close to the customer, in southern states and Texas or California, or to be close to the supply chain.

We decided to be close to the supply chain, a lot of which is coming from Canada now, or Ohio, Illinois, or Wisconsin in the US. This part of the Midwest is very attractive from a supply chain point of view.

After much review, we chose Trotwood, Ohio which is close to Dayton. That is a town that had been destroyed by a tornado in 2019, and a lot of people lost jobs because of it. We feel as an entrepreneur that when we make an investment, we need to help people and the community. There was a lot of enthusiasm to support us in our initiative, and we feel that we are more part of the city every day we are there.

Alan The transportation infrastructure in that area is good as well.

Alberto Yes, I70 and I75 right near us and that is one of the reasons. Also, in Italy, we are 6 hours difference from the east coast time zone, so when we start work in Ohio, it is halfway through the day here in Italy. We have almost half a

Photo: Westrafo

day where we can work together. Also, flight connections and a good labor market made it attractive to us.

Alan I know you have a special relationship with Cargill FR3. I have talked to Javiera McGuiggan, who is one of our Executive Editorial Board members. She speaks very, very highly of you and Westrafo, so talk a little bit about that relationship with Cargill.

Alberto Our relationship with Cargill began in 2015, early in Westrafo's journey. We aimed to offer the market a better solution than what was available. Cargill was looking for a company that can support them as they developed their technology, to sell FR3 a better way.

The Cargill engineering team supported us in an incredible way during this journey. One year later, we shipped the first sustainable peak load (SPL) transformer that can operate at a higher temperature compared with current transformers in the market. This was sold to an Italian utility, was tested at CESI, together with another external laboratory, and based on that, we did a lot of other prototypes that we sold to German utilities and others. All the results were beyond our expectations.

We have certified our design criteria specifically for transformers using FR3 fluid. These are high-temperature designs incorporating materials such as thermally upgraded paper and high-temperature gaskets. Through this process, we were able to consolidate our design approach.

Installation costs are lower, and the performance of these transformers matches—or even exceeds—that of traditional mineral oil transformers, as this has been a key focus in our design criteria. Additionally, the use of FR3 fluid enhances fire safety. As you know, it's also environmentally friendly, making it a well-rounded, winning solution from every angle, especially from my perspective as a transformer manufacturer. On top of that, Cargill, an American company, operates production facilities worldwide, ensuring global availability and support.

Alan One of the things that you mentioned is their willingness to be able to invest in their customers, and by that, I mean time, talent and energy. What do you see for the next decade?

Alberto If we look at our market, we have a couple of factors that are making us positive about the future. First, there are Greenfield projects, new projects that are being approved and moving ahead, both in the renewable energy sector and data center sectors.

The volume of new projects that have already been approved, that must be built in the next 2, 3 years is incredible, higher than what we normally think about. We are speaking about gigawatt after gigawatt, one terawatt of projects that are going to be developed in the next 5 years.

There is one reason why we are investing in Italy and the US, because the US will be one of the of the States where there will be more projects for this type of application and Italy is in a good logistic position for all the projects in Europe.

All European countries are investing a lot on the renewable energy technology. The sum of both Greenfield and Brownfield projects is probably going to develop with a compound aggregate rate, that is, between 12 to 14% in the next 10 years. This is our expectation.

Alan Load growth in the United States was flat for the last 20 years, and about 4 years ago it started to peak. It's about 8 to 9% depending on who you ask. That is a huge problem because we have an aging infrastructure that must support this new load growth.

Alberto Yes, and when you compare the United States with a country like Sweden; where they are replacing transformers around every 20 years, even if the transformers are perfect, you see that they are continuously investing in better technology and better efficiency. I don't think that the United States has the capacity to do what Sweden is doing, but certainly we need to upgrade.

> Our vision is to be part of the energy transition by encouraging customers to adopt better technologies for a more sustainable world. This commitment is at the core of our mission.

Alan You mentioned data centers. Data centers are hot right now. The biggest areas are Northern Virginia, north of Atlanta, GA, and another one of the top five is right up there near you in Columbus, OH. Columbus is a big data center market. Talk a little bit about FR3 for data centers because they must not have a fire, and the cooling needs are especially higher for AI data centers. Talk a little about that market because that is a unique, fast-growing market.

Alberto Yes, that is the fastest growing market currently. In 2024 the market was less than 10 gigawatts worldwide, but what we see is that this type of market is going to be something around 19 gigawatts this year, close to double compared with the last year. We are expecting 7 gigawatts in Europe. This market is growing in a more consistent way compared with battery storage and the solar market. In the next 4 years it will probably become the number one market for FR3 transformers.

By leveraging the thermal capabilities of FR3 fluid, we can design a transformer with the compact footprint of a smaller unit, yet offering highly flexible load capacity.

Alan What the market needs is a transformer that is more reliable, more sustainable, and more resilient. These are some of your core values at Westrafo, correct?

Alberto Yes, when you speak about sustainability, to me it does not make sense to install a mineral filled transformer where you need renewable energy. That's why we are focusing on the FR3 Transformer.
Our vision is to be part of the energy transition by encouraging customers to adopt better technologies for a more sustainable world. This commitment is at the core of our mission.

Alan Thank you so much Alberto. I really appreciate you taking the time with me. Have a great day.

Alberto You too, Alan.

Photo: Westrafo

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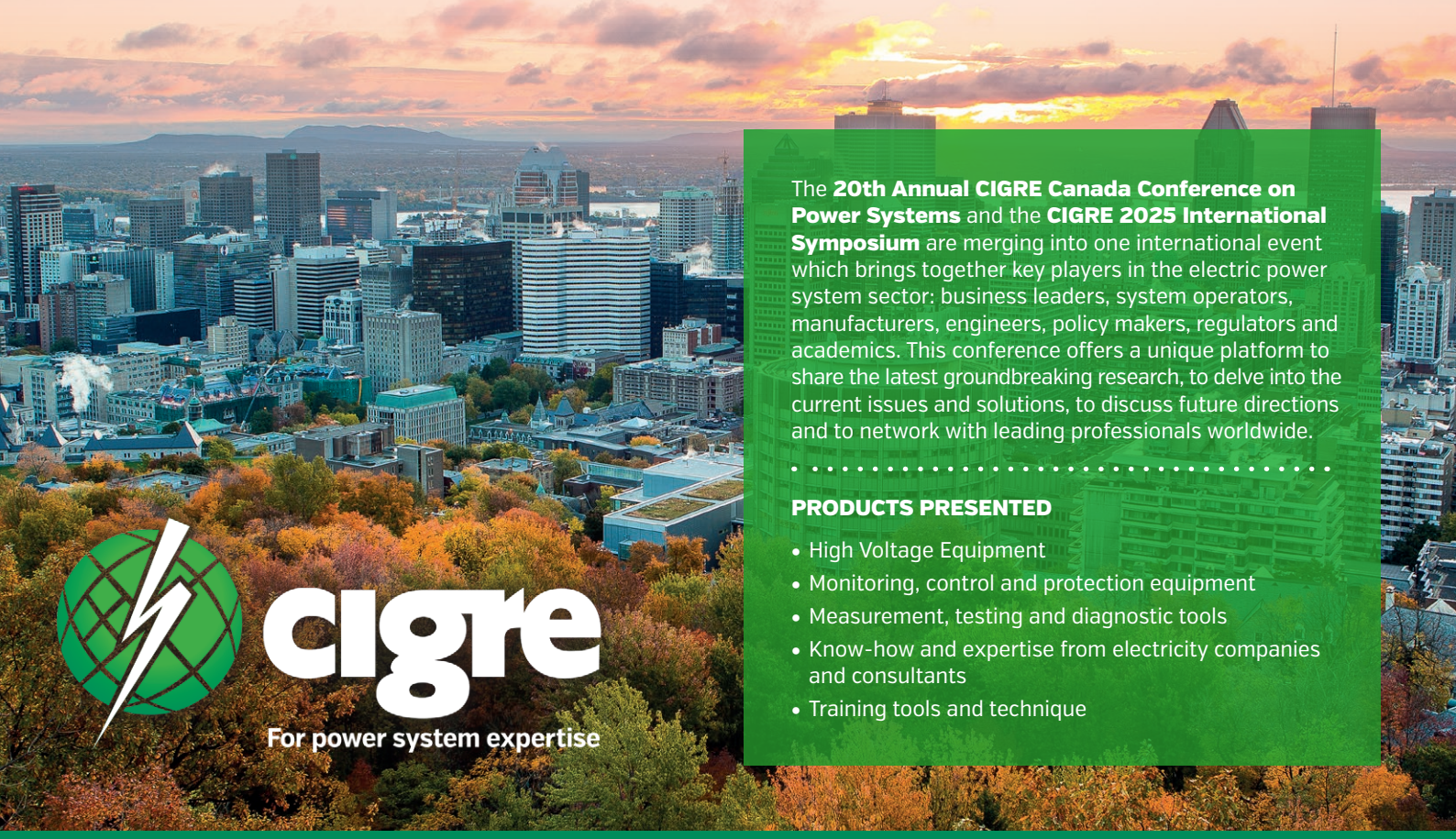

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Editorial Report: DISTRIBUTECH International 2025 AI Data Center's Impact on Power Industry

The power industry is undergoing a significant transformation, driven in part by the rapid growth of data centers and electrification, presenting both major challenges and compelling opportunities. At **DISTRIBUTECH 2025**, a leading annual conference and exhibition focused on the transmission and distribution of electricity held Dallas this year, we interviewed experts with knowledge about these transformative challenges and have compiled and highlighted what they perceive of this shift and the industry's response.

Challenges

The most pressing challenge is the unprecedented scale and speed of load growth. This surge is primarily attributed to data centers, EV charging infrastructure and large manufacturing facilities. **"The demand for power is outpacing supply,"** states Dave McGinley, EVP at Asplundh. **"The historical annual load growth of 1-2% in some areas has dramatically increased, with several utilities reporting an 8% growth rate."** This rapid escalation has left many feeling "caught by surprise".

Judson Tillinghast, Manager of Data Center Strategy at APS, highlights the magnitude, noting they **"have committed to serve 4.7 gigawatts of additional customer growth, two-thirds of which is data centers, over the next 10 years, but face an "uncommitted data center queue" exceeding 15 gigawatts for which they currently lack the resources"**.

This surge in demand places immense strain on existing infrastructure, including generation, transmission, and substations. Expanding capacity is, according to Brad Langley, CMO at GRIDX, as **"a very expensive proposition, complicated by long lead times for equipment like transformers"**. Casey Werth, who leads IBM's global industry for the energy sector, adds that **"permitting and sighting and supply chain as impacts on the ability to build new transmission"**. In some areas, the scale of interconnection requests for new projects has become so large that queues have had to be temporarily shut down.

Another key concern is that the costs associated with building this new infrastructure do not disproportionately affect residential consumers. Utilities are sensitive to the affordability question for their ratepayers. There is also the risk of cost shifts if anticipated demand doesn't fully materialize after infrastructure investments are made.

Photo: Shutterstock, APC Media

The proliferation of new technologies and automation is bringing concerns about physical and cyber security, making it more vulnerable. Protecting substations and automated systems is an "acute" focus, given the increasing sophistication of threats, potentially aided by AI.

The industry is also grappling with workforce and supply chain issues. Asplundh's Dave McGinley highlights the challenge from an **"aging workforce and the challenge of replenishing experienced technicians, linemen, and tradespeople"**.

Securing critical equipment like transformers, as well as other electrical equipment, also presents a significant challenge. Lead times for transformers alone can be three to five years or more. Recent tariffs will also impact transformer OEMs ability to meet the demand in materials such as copper, steel and other components. All of these are affected by trade negotiations under Trump administration. Without a stable supply chain, we will not have a stable supply of new transformers.

The proliferation of new technologies and automation is bringing concerns about physical and cyber security, making it more vulnerable. Protecting substations and automated systems is an "acute" focus, given the increasing sophistication of threats, potentially aided by AI. Additionally, ensuring that these various new technologies and smart devices communicate and integrate effectively is a hurdle, as in some cases, these systems are "not speaking to each other".

Opportunities

Despite the challenges, the demand growth presents significant opportunities for sector growth and revitalization. IBM's Casey Werth views this as providing **"more opportunities to grow the sector because we went through a pretty long period of stagnated growth"**. The rapid growth is also seen as **"a catalyst for some necessary transformation"** in how grids are run and how business is done.

There is also potential for partnership with large customers like data center operators. Judson Tillinghast, APS, notes that **"data centers seem to be willing to be a financial partner and potentially help invest in infrastructure to help expedite a time for service"**. This willingness suggests avenues for creative solutions.

The scale of demand and the associated challenges serve as a powerful driver for innovation. The industry is compelled to accelerate the adoption of new technologies and approaches.

Industry Response

The power industry is actively responding by implementing various strategies. Utilities are focused on maximizing the capacity of existing infrastructure rather than solely relying on new builds. This includes using technologies like dynamic line ratings on transmission lines based on real-time weather conditions and optimizing distribution transformer use by analyzing real-time AMI load data to identify and potentially swap over-built assets. Casey Werth, IBM, explains that **"by leveraging new data, utilities can safely operate T&D assets closer to their true capacity, extracting more value from existing infrastructure. This approach improves return on assets (ROA), especially critical when building new assets is constrained by time, cost, or regulatory hurdles"**. Condition-based maintenance is also being leveraged to extend the life of assets.

Utilities are focused on maximizing the capacity of existing infrastructure rather than solely relying on new builds.

There is a significant focus on leveraging data and analytics. Brad Langley of GRIDX highlights **"ingesting all the AMI data to do some really valuable cost insights, helping customers understand their energy costs and optimize usage"**.

The ability to capture and make decisions based on vast amounts of sensor and monitor data is crucial. Casey Werth, IBM, discusses the exploration of AI foundation models to analyze grid conditions, enabling **"far broader simulation capabilities for planning and mitigation beyond traditional physics models"**.

The industry is accelerating the adoption of new technologies and innovation. There is an increasing comfort with adopting Software as a Service (SaaS) in the cloud, which offers greater flexibility and faster updates compared to older on-premise systems. Casey Werth of IBM notes a push towards bringing virtualized capabilities into traditionally hardware-focused areas like substations **"to improve speed and interoperability"**. Vendors are embedding AI, described as "agentic AI," into their packages, requiring utilities to develop the "new muscle" of orchestrating these capabilities.

Collaboration and partnerships are becoming more common. Utilities are working with vendors, research labs, regulators, and customers. Casey Werth notes that there is **"a shift towards focusing on desired outcomes rather than just purchasing hardware". Common solutions, like industry-wide AI models, are being pursued for the "betterment of the industry"**. Partnerships are also essential to address workforce and supply chain challenges. Utilities are engaging more with engineering and trade schools with workplace experience

Photo: DTECH, Shutterstock

partnerships in hopes of impacting long term skills and experience shortfalls to drive more people into the trades and technical roles.

Efforts are being made to address the workforce and supply chain bottlenecks, including direct engagement with manufacturers to "secure production slots" for critical equipment like transformers and partnering on other initiatives to shorten delivery cycles.

Utilities are also implementing innovative rate structures and demand management techniques, including complex rates like time-of-use, dynamic pricing, and EV rates. The goal is to engage customers as **"active participants in the energy transition"** to help manage demand. For large customers, Judson Tillinghast of APS, states that **"demand minimums and sometimes even energy minimums will become the standard for utilities in contracts to cover infrastructure costs and mitigate risks"**.

Strategic planning and risk management tools are also being employed. Casey Kirkpatrick, Director of Group Strategic Engineering at National Grid, describes a **"GIS-based climate change risk tool or CRT used to assess the potential impact of climate hazards on assets over time and inform planning"**. Capital plans and integrated resource plans are being developed to accommodate committed load growth.

Efforts are being made to address the workforce and supply chain bottlenecks, including direct engagement with manufacturers to "secure production slots" for critical equipment like transformers and partnering on other initiatives to shorten delivery cycles.

Finally, there is an enhanced focus on security, with acute efforts to protect substations and automated systems against both physical and cyber threats.

The power industry views the growth driven by data centers and electrification as a significant and rapid challenge that necessitates accelerated innovation, extensive data utilization, strategic collaboration, and the evolution of business models to ensure a reliable, secure, and affordable grid for the future.

Being able to discuss a specific topic such as AI Data Center's impact on the power industry is why we do these types of interviews at conferences. Of course, we have greatly summarized the comments from these experts here. To access the full interviews, click HERE.

The Editorial Team

POWERSIDE®

POWERSIDE'S VIEW OF POWER QUALITY INCLUDES PQVIEW

PQView®

The evolution of the power grid, its reliance on decentralized and inverter-based technologies, plus increasing demand for electrification of new types of loads are introducing real challenges to grid stability. Grid operators must adapt, requiring more extensive, granular, and timely data to enable analytics for improved efficiency and development of proactive mitigation strategies.

The balance of cyber-risk and reward is often between on premise and cloud-based fleet analytics depending on the customer. Often seen as locked down on-premise systems, versus a system-learning cloud enabled architecture which we know can enable potential real time pro-active maintenance strategies. But at Powerside we believe both systems have merits and indeed can co-exist.

Maintaining reliability during black sky days and resiliency during blue sky days is relevant now more than ever in the rapidly changing grid. Moving from a reactive operation to a proactive operation is a key initiative in maintaining and improving grid resilience for grid operators.

So, let's explore how to evolve and navigate a path to effective use of the data we have, securely and effectively to identify and improve our grid edge using the best of both these PQ solutions.

Why Power Quality Monitoring data and not Smart metering?

Power quality is defined as the influence that voltage and current anomalies have on end-use equipment. Good power quality enables an optimal level of electrical health, providing assurance for operational stability and equipment efficiency. In contrast, poor power quality occurs when a disturbance interferes with the normal operation of equipment or the electrical system and involves deviations from a generated sine wave at the fundamental frequency. Disturbances such as voltage sags, voltage swells, harmonics, high frequency transients, and imbalance are examples of poor power quality. Later, we provide case study examples on the effects these power quality issues can have on equipment and systems.

Photo: Powerside

Power quality monitoring devices provide high fidelity information that allows the user to uncover issues that often go unseen by traditional power metering systems. Typically, power quality monitors adhere to an international standard on how the measurements are taken, the most common being IEC 61000-4-30 Ed3 [3]. Metering parameters, albeit accurate, have lower sampling rates and cannot pick up the short-duration transients or distortions that often plague modern inverter-based networks. We can use Smart Metering data for trending and general power consumption, but the insight is inadequate for determining root cause and analysis.

Power Quality Monitoring at Utilities. What are the basic goals and Standards?

Utilities typically install PQ monitors to provide visibility and data on grid conditions without having to physically be on-site to collect the measurements. The cost of running reactive, temporary PQ campaigns is relatively high and provides (by definition), only limited data visibility in a dynamic grid environment. Historically, permanent PQ analyzers have been installed at feeder sources or substations, but more recently this has been extended downline to critical customers (data centers, hospitals, renewable energy sites, etc.), generation sites, and grid edge locations.

In order to level the vendor playing field and improve data visibility – standards have been created by utility customers for PQ data formats and file transfer standards across multiple monitoring hardware devices. In particular PQDiff files (Power Quality Data Interchange format) and COMTRADE (Common Format for Transient Data Exchange) are used in common on-premise platforms to manage and consolidate this data. One of our industry challenges, however, is not the availability of data, it's the shortage of timely and actionable analytics of the data.

A key and powerful PQDMS – (Power Quality Data Management System) is the PQView4 platform; able to pull display and analyze data from multiple sensors in the network – and this is now part of Powersides PQ offering. Add to this its Fault location capability, compliance reporting and remote access – this brings a powerful suite of tools for not only visibility but useful analytics within the customers' network. Our vision is to add to it analytics capability and secure accessibility outside the network.

Many of the best cloud analytic suites developed for Power Quality (including our own QubeScan platform) provide excellent fleet management and enhanced, secure Power Quality trend analytic capability but sadly are also limited to their associated OEM hardware. This is where PQView can help…

Accessibility, Fleet Management and Analytic trends

Finally bridging the gap between a common multi-instrument file transfer capability and hosting a secure, powerful (and accessible) fleet analytics capability in real time to pro-actively assess changing transient conditions and predict faults without compromise to the security of the system is available.

From this visibility, utilities are able to see baseline conditions, allowing them to set notifications for when the system is performing outside of normal operating conditions. This can be brought directly to expertise familiar with power quality issues, capable of driving further action if required.

Power quality is also becoming more common for compliance verification (e.g., IEEE 519-2022 [1] for harmonics control). This enhanced visibility saves time with diagnosing grid issues, the detection of changing trends, and overall grid design limitations.

For larger system deployments, attempting to routinely inspect each power quality monitoring site for potential issues is very time consuming. This is where automatic analysis and event notification becomes a necessity for utilities. Automation allows for Power Quality Engineers to effectively utilize their time by focusing on critical issues and events, rather than manually filtering through data. These actions include compliance verification, event frequency tracking, and sustained power quality issues (e.g., voltage imbalance is sustained above 2% for a predetermined amount of time).

Power Quality Disturbances and Predictive maintenance benefits

The justification for secure, real time pro-active accessibility of PQ data to a utility network must be supported by real examples and system benefits. Simply adding data visibility without actionable insights is not a viable solution. So, what have we seen with an enabled high-resolution system with analytics capability? Examples below are well documented elsewhere in papers and customer testimonials:

Transients and High Frequency Impulse Applied to Pre-Fault Detection

Utility using primary metering VTs interfacing with our class A PQ monitor set the HF Impulse trigger to a sensitive threshold. Over time, the electrical behavior of the site changed, with a high volume of intermittent HF impulse events observed over a brief period, as shown in Figure 1. The voltage signature was consistently low in magnitude, oscillatory in nature, and on the same phase. One site suffered a catastrophic failure on the voltage transformer as a result. A recurring event pattern was recognized within the Utility, at a second site (Figure 2) and subsequently triggered proactive replacement of the voltage transformer equipment with similar behavior avoiding major loss costs. Proper analysis of the trended incidence in Figure 3 allows a progression learning model to normalize urgency and development of the issue.

Photo: Powerside

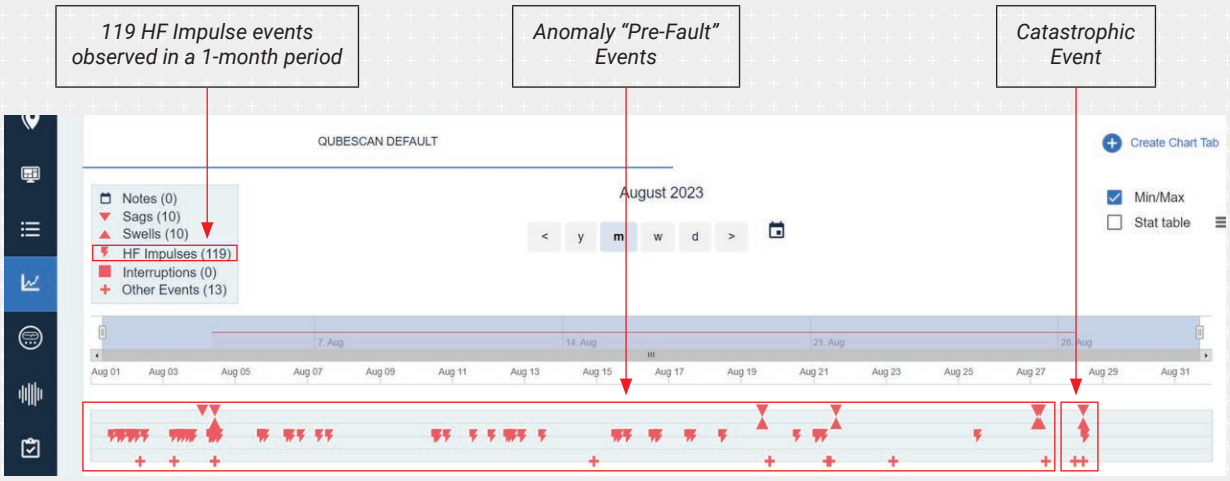


Figure 1: High Frequency Impulse "Pre-Fault" Events and a Catastrophic Failure

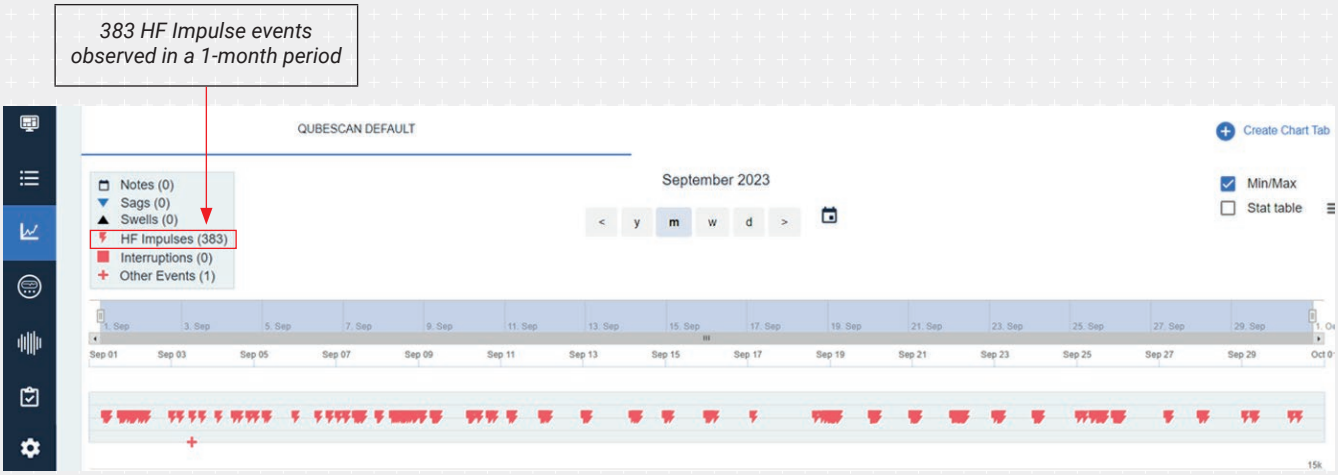


Figure 2: High Frequency Impulse "Pre-Fault" Events Prompting Proactive Maintenance

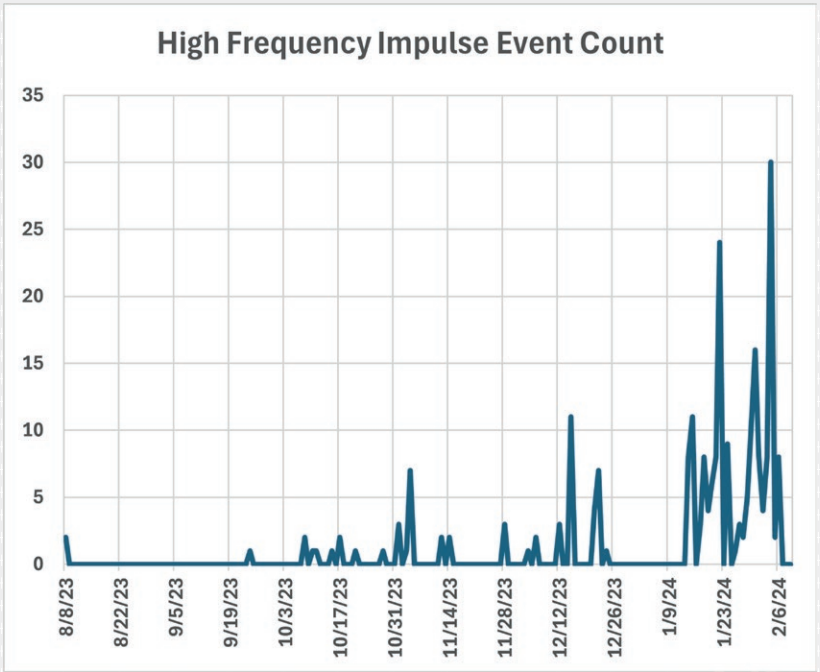


Figure 3: High Frequency Impulse Event Count Over Time

Harmonics and Compliance Reporting used in active Grid assessment

Harmonics are generated by non-linear loads that are prevalent in today's grid, and source examples include pulse rectifiers and variable frequency drives on the load side and inverter-based resources on the generation side. PCC compliance is not routine in many cases and proper analysis only carried out following issues or complaints by the parties.

High Order Harmonic Disturbances from a Utility Scale Solar Application

A residential customer complaint was reported to the local utility about malfunctioning lighting, GFCIs, and intermittent appliance issues, notably on sunny days. The configuration of the system can be observed in the one-line diagram shown in Figure 4. The Utility visited the site, confirmed the reported behavior, and consulted with the Power Quality Engineers to further investigate the issue. A permanently mounted power quality monitor installed at the point of interconnection (POI) in the solar farm had stored the power quality data needed to immediately diagnose the issue and run an IEEE 519 harmonics compliance report.

During the investigation, it was noted that the long-term flicker (Plt) and short-term flicker (Pst) were complying with the levels specified by IEEE 1453, and there were no voltage variation disturbances such as voltage sags. When observing the IEEE 519 harmonics report, there were no violations associated with higher order harmonics. Conducted emissions (Supraharmonics) values were however observed, although beyond current industry standards. The 3.4kHz, 10kHz, and 12kHz noise observed was steady state until the solar was isolated, while the 142kHz appears to be an intermittent distortion that occurred throughout the day, after solar was isolated from the feeder. The steady state high frequency distortion observed was determined to be due to the inverters utilized at the solar farm and suspected to be multiples of the inverter's switching frequency. The Utility isolated the solar farm to troubleshoot the issue, which can be observed when the high frequency distortion abruptly stopped in the conducted emissions graphs. Upon isolating the solar from the problem site, the symptoms from the problematic harmonic distortion subsided. Regarding preventative action, the Utility consulted with the inverter manufacturer to address the issue and resolved it by pulse shifting the switching frequency at the problematic bands. This in turn, cancelled out the higher magnitudes of distortion that caused the symptoms observed.

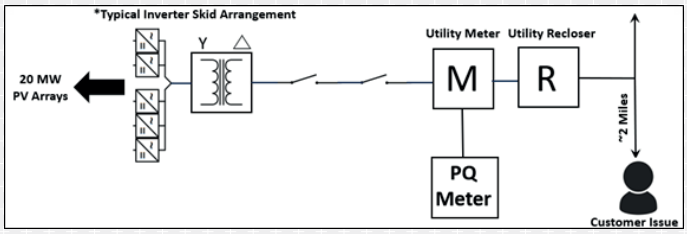


Figure 4: Harmonics Case Study Single Line Diagram

L1-N Harmonics Table

Odd Harmonics								Even Harmonics			
Not multiples of 3				Multiples of 3							
Order h	PQube Trend	95% value	Result	Order h	PQube Trend	95% value	Result	Order h	PQube Trend	95% value	Result
H5	6.0%	3.206%	PASS	H3	5.0%	1.619%	PASS	H2	2.0%	0.076%	PASS
H7	5.0%	2.044%	PASS	H9	1.5%	1.197%	PASS	H4	1.0%	0.118%	PASS
H11	3.5%	0.431%	PASS	H15	0.4%	0.109%	PASS	H6	0.5%	0.107%	PASS
H13	3.0%	0.260%	PASS	H21	0.3%	0.053%	PASS	H8	0.5%	0.086%	PASS
H17	2.0%	0.101%	PASS	H27	0.2%	0.129%	PASS	H10	0.5%	0.035%	PASS
H19	1.76%	0.110%	PASS	H33	0.2%	0.209%	FAIL	H12	0.46%	0.009%	PASS
H23	1.41%	0.107%	PASS	H39	0.2%	0.327%	FAIL	H14	0.43%	0.019%	PASS
H25	1.27%	0.103%	PASS	H45	0.2%	0.291%	FAIL	H16	0.41%	0.015%	PASS
H29	1.06%	0.149%	PASS					H18	0.39%	0.009%	PASS
H31	0.97%	0.290%	PASS					H20	0.38%	0.008%	PASS
H35	0.83%	0.176%	PASS					H22	0.36%	0.012%	PASS
H37	0.77%	0.325%	PASS					H24	0.35%	0.015%	PASS
H41	0.67%	0.095%	PASS					H26	0.35%	0.019%	PASS
H43	0.63%	0.437%	PASS					H28	0.34%	0.018%	PASS
H47	0.55%	0.076%	PASS					H30	0.33%	0.031%	PASS
H49	0.52%	0.319%	PASS					H32	0.33%	0.041%	PASS
								H34	0.32%	0.032%	PASS
								H36	0.32%	0.029%	PASS
								H38	0.32%	0.028%	PASS
								H40	0.31%	0.027%	PASS
								H42	0.31%	0.015%	PASS
								H44	0.31%	0.016%	PASS
								H46	0.3%	0.020%	PASS
								H48	0.3%	0.017%	PASS
								H50	0.3%	0.023%	PASS

Note the small values at higher order harmonics causing customer disturbances

Figure 5: Voltage Harmonics Compliance Chart (H33, H39, H45 non-compliant on Phase 1)

Photo: Powerside

Conclusions

As power system infrastructure and equipment continues to age and evolve, there are opportunities to get ahead of developing electrical problems with advanced tools that provide actionable, proactive information. High fidelity Class A power quality monitors are most powerful when combined with other PQ devices and a world class analytics capability. Interconnection and real time analytics enable actionable insights to be managed in real time by Power Quality experts across our industry in a pro-active grid. Continuous fleet monitoring and compliance reporting at critical infrastructure locations provide actionable data to help develop mitigation strategies before unforeseen issues develop into costly outages. The risk reward balance, however, often lies in our choices as to where and how we host this data and how we communicate; on site or within the cloud. Cloud networking each PQ device separately may present too large a risk for some clients but combining secure comms to an established and secure on-premise suite can also significantly reduce the access profile and bring enormous analytics capability improvement. Powerside are unique in holding the key to a tailored, flexible secure solution providing the best of both worlds.

As we look forward as an industry, more high-fidelity data provided in an intuitive and timely manner is critical to understanding grid health. These are essential factors in executing the reliability and resiliency initiatives that match dynamic, ever-changing grid conditions. Are you ready?

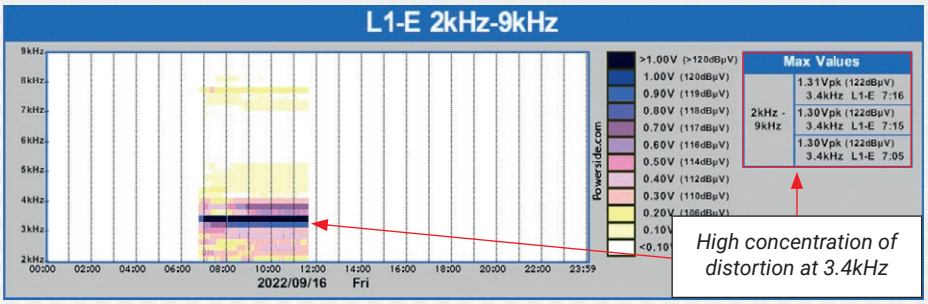


Figure 6: Conducted Emissions 2-9kHz Heat Map (high distortion in 3.4kHz band)

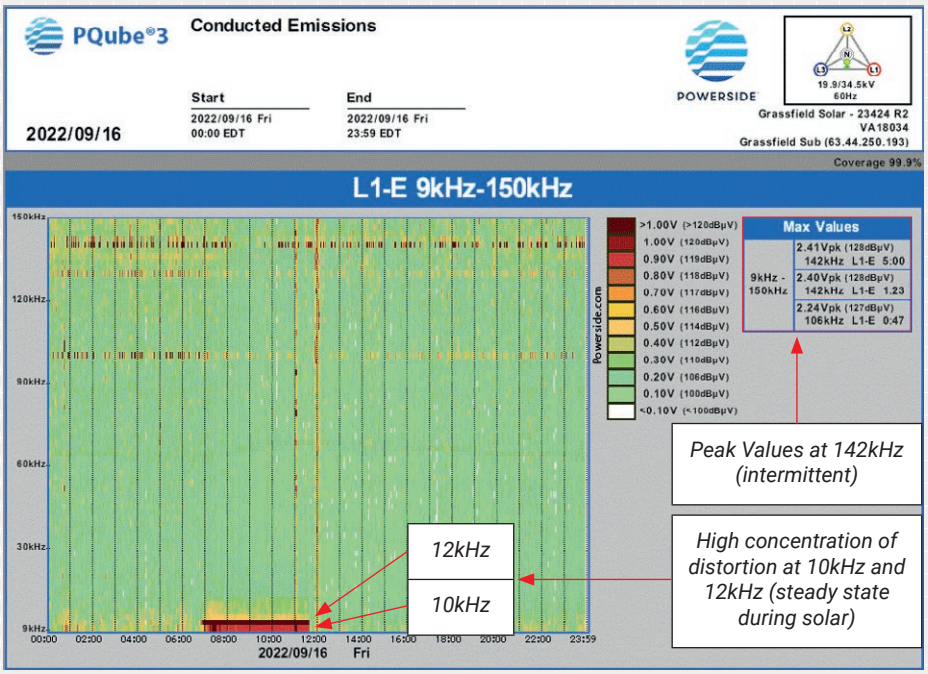
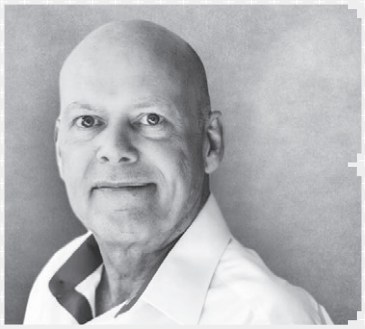


Figure 7: Conducted Emissions 9-150kHz Heat Map (high steady state distortion at 10kHz and 12kHz)



As Vice President of Marketing, **Tom Richardson** leads the Powerside Go To Market Strategy and positioning for Power Quality Analysis and Correction Solutions. He has several decades of experience in the Energy and Transport Sectors globally since starting out in the UK in Power Equipment Design with Alstom. Having led multiple teams across design, commercial projects and field installation within large power plant OEMs, transportation sectors, renewables and control system manufacturing, Tom brings a broad band of international experience to the Team.

Turning Data into Decisions: AI's Role in Next-Gen Utility Asset Management

by **Kristy McDermott**

In an era flooded with AI buzzwords, the utility sector faces a critical question: are we maximizing AI's potential or merely discussing it?

Utilities face significant challenges with aging infrastructure, extreme weather, rising operational costs and increased demands for reliability. AI offers a promising solution, but it's time to move beyond theoretical discussions, the 'what ifs?', to embrace the practical benefits, the 'what now?'.

AI tools like ChatGPT have already laid foundations as household names, receiving both good and bad reviews for varying applications and being used for everyday tasks. But the world is also abuzz with what feels like everyone pushing their latest and greatest AI solution that promises the world. This can bring AI fatigue. Without real, meaningful use cases of the benefits artificial intelligence can bring, we risk talking the talk but not walking the walk.

Recent advancements show how AI can revolutionize asset management for utilities. Automated systems can now accurately identify and assess components on utility poles, streamlining inspections and minimizing human error. These systems not only detect defects with high precision but also enhance maintenance efficiency, reduce downtime, and extend the lifespan of critical assets.

This shift from talk to action signals the next step towards the future of utility management. After all, actions speak louder than words.

AI in Action

To turn the theoretical into the practical, we can examine how AI

technologies are already impacting the utility sector through innovative applications. For utilities especially, AI technology is no longer merely an experimental tool, but a proven solution. At Sharper Shape, we've been embedded in automating asset management for utilities for over a decade, honing what AI can look like and what it can provide for businesses with hundreds of miles of powerlines in the most remote locations. And of course, the industry has come a long way in the past ten years. Comparably, think of the smartphone you carried with you in 2014 versus Apple's latest iPhone 16.

The most advanced software goes far beyond the machine learning that your summer intern could train in a couple of hours. And that's not to undermine the work of interns, but today we're deploying highly sophisticated tools that organize huge quantities of reality data into useable workflows.

In recent years, many utilities have already made the first step to limit reliance on outdated physical maps and instead found themselves relying on a digital equivalent – vast volumes of unorganized, siloed data which is unmanageable and expensive to store.

The next stage is truly AI-optimized systems which work through the entire inspection process from planning through to reporting, combining and interconnecting data as it does so, providing a clear and actionable plan giving utilities move oversight than ever before.

There are currently available platforms that automate the detection and assessment of infrastructure components, employing advanced machine learning algorithms to scan utility poles and other assets AI solutions provide exceptional accuracy. This technology not only identifies defects such as cracks or corrosion but also assesses overall asset health, allowing utilities to prioritize maintenance and repair tasks effectively.

The real world application of such technologies is already showing promising results. For example, utilities using AI-driven systems report a substantial reduction in both the time and cost associated with routine inspections. By automating these processes, AI helps utilities redirect valuable human resources towards more complex issues that require human insight.

Addressing the Challenges

While AI offers substantial improvements, adopting it in utility asset management is not without its challenges. Integrating advanced AI systems into existing operational frameworks often presents hurdles in the form of employee training and data compatibility and system integration.

Utilities, and AI service providers, must address these technical challenges head-on, ensuring that their existing processes can seamlessly connect with AI technologies to fully leverage their capabilities.

Merging AI technology with legacy systems poses a significant challenge. Many utility companies operate on outdated platforms that are not readily compatible with the latest AI software, requiring extensive customization and sometimes complete system overhauls. This integration process demands not only technical expertise but

Photo: Sharper Shape

Kristy McDermott is the Vice President of Sales & Commercial Processes at Sharper Shape, Inc. McDermott has over 30 years of experience in leadership roles with technology and utility companies. She has extensive experience in working with electric and telecommunications utilities, having held roles in operations, product, sales, and regulatory compliance. Before joining Sharper Shape McDermott lead product teams to build and maintain fiber optics networks and manage the products and services offered on those networks to serve telecommunications and electric utilities. She has extensive experience in delivery profitable solutions to exceed utility's needs. She is responsible for leading Sharper Shapes global sales activities and customer development. McDermott holds a bachelor's degree in business administration majoring in Accounting from the University of Iowa.


HIGH VOLTAGE
OLTAGE

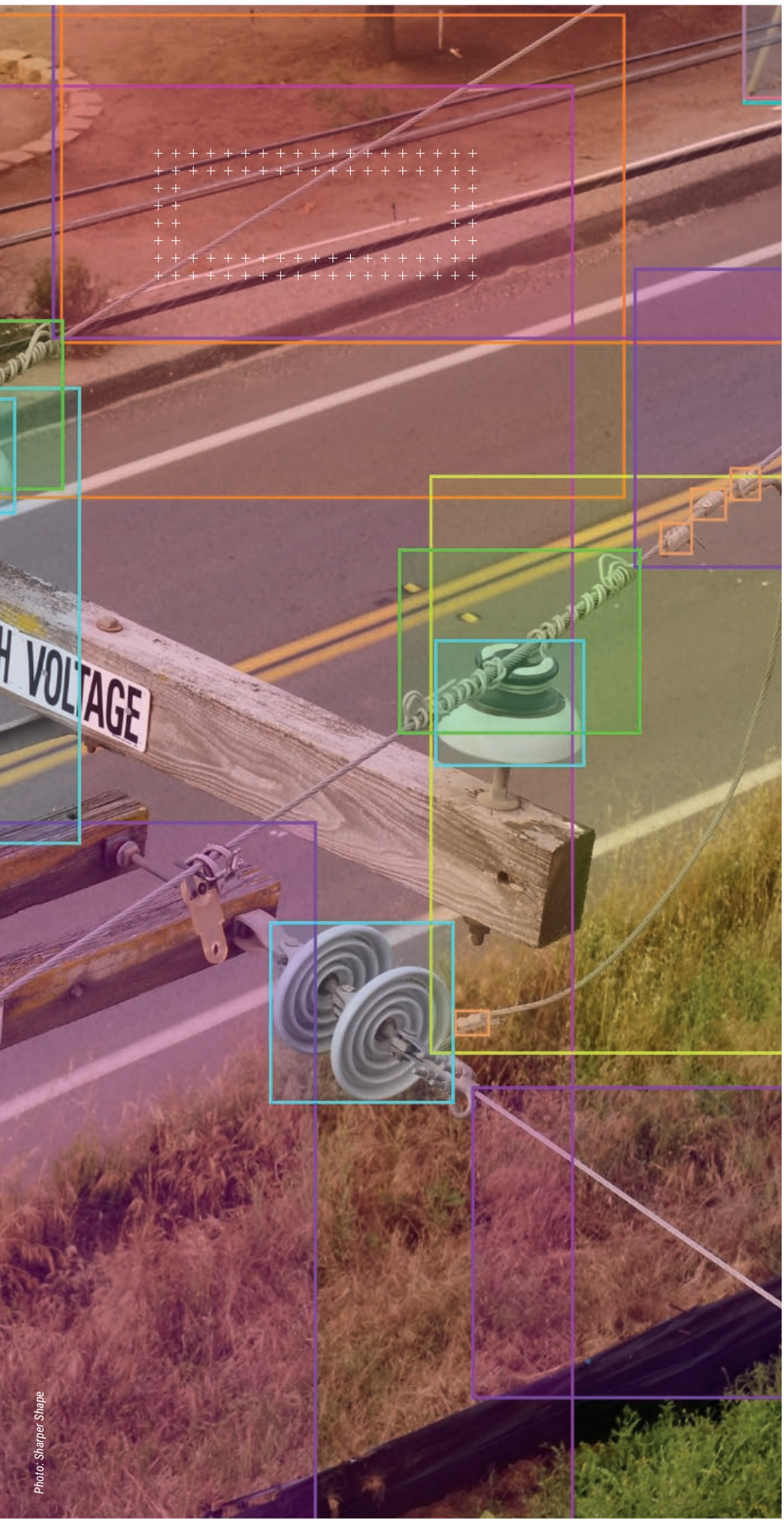


Photo: Sharper Shape

also a strategic approach to ensure that new and old systems communicate effectively without disrupting ongoing operations.

Additionally, for AI to be effective, it requires high quality, structured data. Utilities often have vast stores of unstructured or inconsistent data, making it difficult to leverage AI effectively. Establishing robust data governance and quality control is essential to prepare for AI integration. The process of cleaning and organizing data can be resource-intensive but is critical for maximizing the benefits of AI.

Training and change management also play crucial roles in the successful implementation of AI. Utility workers must be trained not only on how to use new systems but also on how to interpret AI-generated insights effectively. In an industry with an experienced workforce, the cultural

Establishing robust data governance and quality control is essential to prepare for AI integration.

Utility workers must be trained not only on how to use new systems but also on how to interpret AI-generated insights effectively.

shift towards data-driven decision making can be substantial and requires careful management to align staff with new technological processes.

Furthermore, the up-front cost of implementing AI can be a barrier, particularly for smaller utilities or regional cooperatives. However, the long-term cost savings, increased efficiency, and improved asset management performance justify the investment. To mitigate these costs, some utilities opt for phased implementation strategies, starting with the most critical assets to generate quick wins and establish the value of further investment. Overcoming these challenges requires a proactive coordinated effort between AI solution providers and utility companies, focusing on seamless integration, comprehensive training, and strategic investment to ensure that AI tools deliver on their promise o transform utility asset management, while remaining flexible and scalable to best suit the utility's needs. Such strategic integrations will enable early adopters to enhance their operational efficiencies without overhauling their entire systems.

Looking Ahead

Looking ahead, the role of AI in utility management is set to grow exponentially. Emerging trends such as the Internet of Things and smarter grids are expected to further enhance the capabilities of AI systems. These technologies will allow utilities to not only monitor but also automatically adjust their operations in real-time to optimize energy distribution and respond to potential disruptions before they escalate. Moreover, as utilities continue to face the challenge of extreme weather, AI will allow them to stay one step ahead of the status of surrounding vegetation that could fall onto powerlines or catch fire. Advanced data analytics powered by AI will provide enhanced decision-making, as AI algorithms analyze vast amounts of data to predict potential failures before they occur.

From Discussion to Action

In 2024, AI is already transforming utility asset management from a reactive to a proactive discipline. By harnessing the power of AI, utilities are not only improving their operational efficiencies but are also setting the stage for a future where digital resilience defines utility industry leaders.

The journey from theoretical AI applications to practical, impactful implementations is complex but achievable with strategic planning, robust partnerships, and a clear focus on long-term goals.

As we move beyond the hype, it becomes clear that AI is not just a tool for innovation but a necessity for the sustainable, efficient, and resilient utility operations of today and tomorrow.

By harnessing the power of AI, utilities are not only improving their operational efficiencies but are also setting the stage for a future where digital resilience defines utility industry leaders.

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FIELD-BASED TRANSFORMER EFFICIENCY TESTING NOW A PRACTICAL REALITY

Megger

When a transformer leaves the factory, its efficiency is recorded. But once it's installed in the field? That number often goes unverified. For most distribution and renewable energy sites, transformer losses are typically assumed, rather than measured.

That's a risk. Utilities need to reduce carbon emissions, extend asset life, and justify investment decisions using complex data, not assumptions. Without verified performance in the field, asset managers are left to make critical calls without the full picture.

The TAU3 changes that. It's a portable test set that can accurately measure total transformer losses — both load and no-load — on-site. And because it's integrated into the same device field teams already use for turns ratio and winding resistance tests, it fits naturally into existing workflows.

Why On-Site Efficiency Testing Matters

Transformer losses are one of the biggest contributors to inefficiency across the grid. Even small improvements, when scaled across thousands of units, can deliver major savings. But the reality is, most utilities don't test transformer efficiency after installation. It's simply not been practical — until now.

Factory tests are useful at the point of manufacture, but they don't account for transport damage, installation conditions, or early signs of deterioration. In a world where every kilowatt matters, relying solely on factory data isn't enough.

Photo: Megger

What We Mean by Efficiency

In this context, efficiency refers to how effectively a transformer converts input power into output power. Losses come in two main forms:

- **No-load losses:** caused by energizing the core, present even without load.
- **Load losses:** caused by current flow through windings and connections.

Lower losses mean better performance and lower running costs. For asset managers, understanding this data is critical — not just for technical evaluations, but for budgeting, planning, and environmental reporting.

The Practical Barrier — And Why It's Been a Blind Spot

Traditionally, measuring these losses required large, factory-based equipment and highly controlled environments. That's why field-based efficiency testing has lagged behind — the tools simply weren't there.

Instead, utilities have relied on nameplate data, assumptions, or periodic lab tests to estimate performance. That leaves a huge gap in understanding how transformers actually behave in real-world conditions — particularly in remote or renewable applications where access is limited.

Enter the TAU3: Built for the Field

The TAU3 from Megger is currently the only portable device that allows field teams to measure total transformer losses accurately. It's designed for use in the environments where most transformers operate — substations, renewables, and distribution networks.

Megger

It measures current and voltage inputs to calculate total losses. While it's not a full power analyser, it gives operators the key figures they need — quickly, safely, and without needing to reconfigure their test routine.

Critically, the TAU3 performs these measurements at the same time as standard tests like turns ratio and winding resistance. That means no extra setup, no additional hardware, and no new process to learn.

Use Cases That Add Real Value

Adding efficiency testing to field routines opens up several valuable use cases:

- **Verifying supplier claims:** Efficiency can be checked upon delivery, before the transformer goes into service.
- **Supporting condition assessments:** Efficiency data complements other diagnostics to give a more complete picture of asset health.
- **Planning replacements:** When budgets are tight, knowing which units are underperforming helps prioritise investment.
- **Carbon reporting:** As more utilities adopt ESG targets, verified loss data becomes a powerful tool for meeting regulatory requirements.

This is especially critical for distribution networks, where tens of thousands of transformers are deployed. These units represent a significant proportion of system losses and are often the least monitored.

Photo: Megger

Making Field Efficiency Testing Standard Practice

Field-capable efficiency testing shouldn't be a specialist task. It should be part of the standard testing workflow — easy to perform, easy to repeat, and easy to trust.

The TAU3 makes this possible. It integrates into existing routines, fits into the technician's toolkit, and delivers data that directly supports strategic asset decisions, without adding new complexity or equipment.

It's not a new device to learn. It's added value from the multifunction test set you're already using.

Utilities are under growing pressure to do more with fewer resources. In that environment, being able to measure actual transformer performance — not just estimate it — is a critical advantage.

Efficiency is no longer something you need to guess. With the right tools, you can measure it, manage it, and improve it.

Megger

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Shawn Shockey

Manager of Manufacturing, US
at ABB Electrification Service

Interview with **Shawn Shockey**

“

The industry has been around for 100 plus years, delivering power and keeping the lights on. This equipment is antiquated. It is very old. The technology is electro-mechanical. It is not smart. But the world has gone digital on us.

Photo: ABB

Alan Ross: My guest is Shawn Shockey of ABB, who leads the Aftermarket Products Group in Florence, SC. Shawn, as the leader of the Aftermarket Products Group, what does that role look like?

Shawn Shockey: Essentially, as the Director of the Aftermarket Products Group for our US Services division, I am responsible for our factories that produce aftermarket products, including older equipment or non-active products that support our installed base across the US and globally. We really focus on power delivery, specifically more switchgear, circuit breakers and relays.

Alan Talk a little bit about what you see as the most important and the biggest changes taking place right now in the industry.

Shawn I think the main change is the modernization of the power delivery or the transmission and distribution setup as a whole. The industry has been around for 100 plus years, delivering power and keeping the lights on. This equipment is antiquated. It is very old. The technology is electromechanical. It is not smart. But the world has gone digital on us.

Alan Yes. In this issue there is a summary report from DISTRIBUTECH Part Two where it is apparent that this may be the most significant time for change in the power industry since the 2000's and deregulation. So how is this impacting your efforts in Florence?

Shawn How customers upgrade their existing infrastructure to include this new modern technology that is out there, as opposed to just rip and replace – our service team is here to help with that kind of work.

Photo: ABB

At that time there were two major players making transformers in the United States.

Alan It makes it harder too, because you have got another aspect of service. You have a lot of people that you require. It is not just the subject matter experts that are retiring, it is service matter experts, people who are out there on rigs, on trucks doing truck rolls. We have an aging equipment issue, and a skills and experience gap issue which places you right in the middle of a tsunami. How are you handling these changes?

Shawn Our utility customers, or any customer really, start losing that team that knew how to do maintenance or repairs on the equipment. They could have 357 different types of products across their system because they have procured it or they have sourced it new. They have retrofitted it before, or they bought another company who entered their business, and now they have what we refer to as a "mixed salad" of power delivery equipment, and they are really looking to find a common line so as they bring on new people, it is a lot easier to keep them trained. Spare parts are easier to keep on hand because it is all common.

Alan In Britain, we call it a dog's breakfast of change. Let's talk about transformers. You are obviously a major point of the supply chain. You are the aftermarket. Talk a little bit about supply chain challenges.

Shawn We have a fairly broad supply chain setup. What we try to do is go back to standardization. The more custom you get in your supply chain, the harder it is to ensure a robust backup program.

When it comes to the development of our retrofit designs, we try to find commonality.

We try to make sure that we are balancing, using similar types of items so that we can build out additional supply chain measures. We also rely on ABB themselves. We make sure we use our core technology and really invest in that supply chain so that it is very much sustainable across that delivery system.

Alan One of the things that I have always recognized about ABB is the word collaboration. We did an interview with Doctor Luiz Cheim, who invented that little robot that goes inside. What struck me about that interview was how robotics at ABB had to work with him and his team. It was a four-year project and proved the importance of collaboration. How is everything impacted by the culture of collaboration that ABB has built?

Shawn It really has to do with us putting the customer first and knowing that we want to be part of that customer's full journey. In service, we are talking about the process from installation through decommissioning, if you will.
For us that vested interest of knowing what the trends are for wanting to go digital, we are willing to invest in newer companies, newer ideas that will be the future of service for the customer's system. We know that that it is a requirement for us to maintain that relationship with the customer throughout the life cycle of their equipment. That is why it is easy for us to make the decision to collaborate. It is hard to maintain it because you must have the long view, rather than just thinking short term.

Alan Do you spend a lot of time face to face with customers out in the marketplace, personally?

Shawn I don't get that opportunity as much anymore in the position that I am in, but I do see customers regularly, I would say, but when I was in product management, I was much more in front of the customers getting that pulse of not just satisfaction with current product but digging out those questions about where they are going with their system, what they are looking at. Their problems are going to be there in three to five years. We wanted to get ahead of that curve and develop those solutions or ensure that the solutions we had would still protect customers as they grew.

Alan Shawn, you just gave me the next set of questions we are going to talk about. You said to the customer, "where do you want to be in three to five years?" One of the things I am sure you heard was we need to go digital, right?

Shawn Yeah, I think digital is the easy answer, but I don't think it is a single answer. Providing the capabilities of

Photo: ABB

their system, circuit breakers, relays, switch gear, balanced against the affordability to standardize to maintain their system. They have affordability concerns as well as.

It is getting more and more expensive to maintain older gear. So, how do they upgrade? They are also looking at balancing security needs. We talk about digital and that is their underlying goal, but I think a fear around the digital is the security aspect of it. Is it hackable and the Internet of Things, so they are balancing affordability, security and finally, I would say, sustainability matters.

How do they do it in a clean way and really get a good mix? We are seeing a falloff in coal and natural gas growing. You mentioned the new nuclear plants in GA. There is one planned in South Carolina.

Also, clean energy solar fields; I see them pop up all over the place. We put one here at my site in Florence, SC. These are really exciting times and I think those are the three things that they are really balancing.

Alan What about microgrids? Do you see them as part of the new, modern grid?

Shawn I think about it as decentralizing these massive grids that are interconnected, they are always going to play together. I think about it like the Internet. The Internet started as a bunch of little micro sites and then we linked them and now look at where we are at and that is the brilliance behind microgrids. I think you get a very strong sustainable grid that can utilize a lot of sustainable energy.

Be it wind or be it solar, all of those things tie in at that micro level to build up to something greater.

Alan I want to switch gears a little bit because this really came up for me when I was looking at your background on LinkedIn. It says, "you are an inspirational leader". What does that mean?

Shawn The reason I put that out there is that I don't believe I can do anything alone and the only way to really help people around me is to inspire them to be their best and help them get there. I think we all face challenges every day and you need that bit of inspiration to kind of lift you up and help you get past the tough times.

A lot of that gear is just so antiquated. While it isn't smart, we do not need to rip and replace. I would just encourage people to do more retrofitting versus just maintaining older gear.

Alan What would be the one decision, that you would make as Shawn Shockey, in the power industry, trying to help the industry move forward?

Shawn That is a big question, right? I don't think there is one panacea, one solution out there, but I would say that I would encourage the industry to do more retrofitting of the legacy products. A lot of that gear is just so antiquated. While it isn't smart, we do not need to rip and replace. I would just encourage people to do more retrofitting versus just maintaining older gear. Get the new equipment in and really take advantage of what a smart product has to offer.

Alan That is an excellent point, because we can't replace it fast enough. Because of supply chain issues, which are happening with transformers right now, people are having to retrofit. Talk a little bit about this idea of retrofitting.

Shawn We agree that you cannot maintain your way to reliability, right? It is that predictability issue; you cannot be predictable with an old electromechanical product. You have no way to know how good that product is doing. You just trust it. Because it is a tank. We have been doing that this way for 40 years. With new products, though, you get digital input. You can actually monitor the voltage required to throw a switch. You can time it constantly and you can start to trend those micro trends to tell you how soon you might need to look at doing some kind of a maintenance or that you need to take it out of service to look at it.

Turbines have been doing this for years because they could monitor the vibration and you could really predict when it is time to shut that down because you have a blade problem.

Circuit Breakers and power equipment are starting to look in the switchgear for early signs of arc flash, that is all in its infancy. This new smart technology that you can install and the new smart breakers that monitor things really will help industries have more predictable or sustainable infrastructure, versus having to guess and check and just put a three-month maintenance window in place. You could do more damage than good.

Alan Any thoughts about AI data manage-ment? Is AI going to save us all?

Shawn Certainly AI is going to help us. I think humans are still going to be required to save us. But because of these large amounts of data being generated, AI is going to be super essential.

All of this data you and I could never sift through, these AI models are going to help distill that data and then allow the SMEs, the subject matter experts, to really be effective to go somewhere where their knowledge is needed.

There are a lot of red herrings out there if you take all this data; you could go down a bad rabbit hole, so AI, in my opinion, is going to help to direct our attention to the right places.

Alan Excellent. Shawn, thank you so much. You are very knowledgeable about the industry, and I appreciate your subject matter expert view of it.

Shawn Thank you, Alan.

All of this data you and I could never sift through, these AI models are going to help distill that data and then allow the SMEs, the subject matter experts, to really be effective to go somewhere where their knowledge is needed.

Photo: ABB

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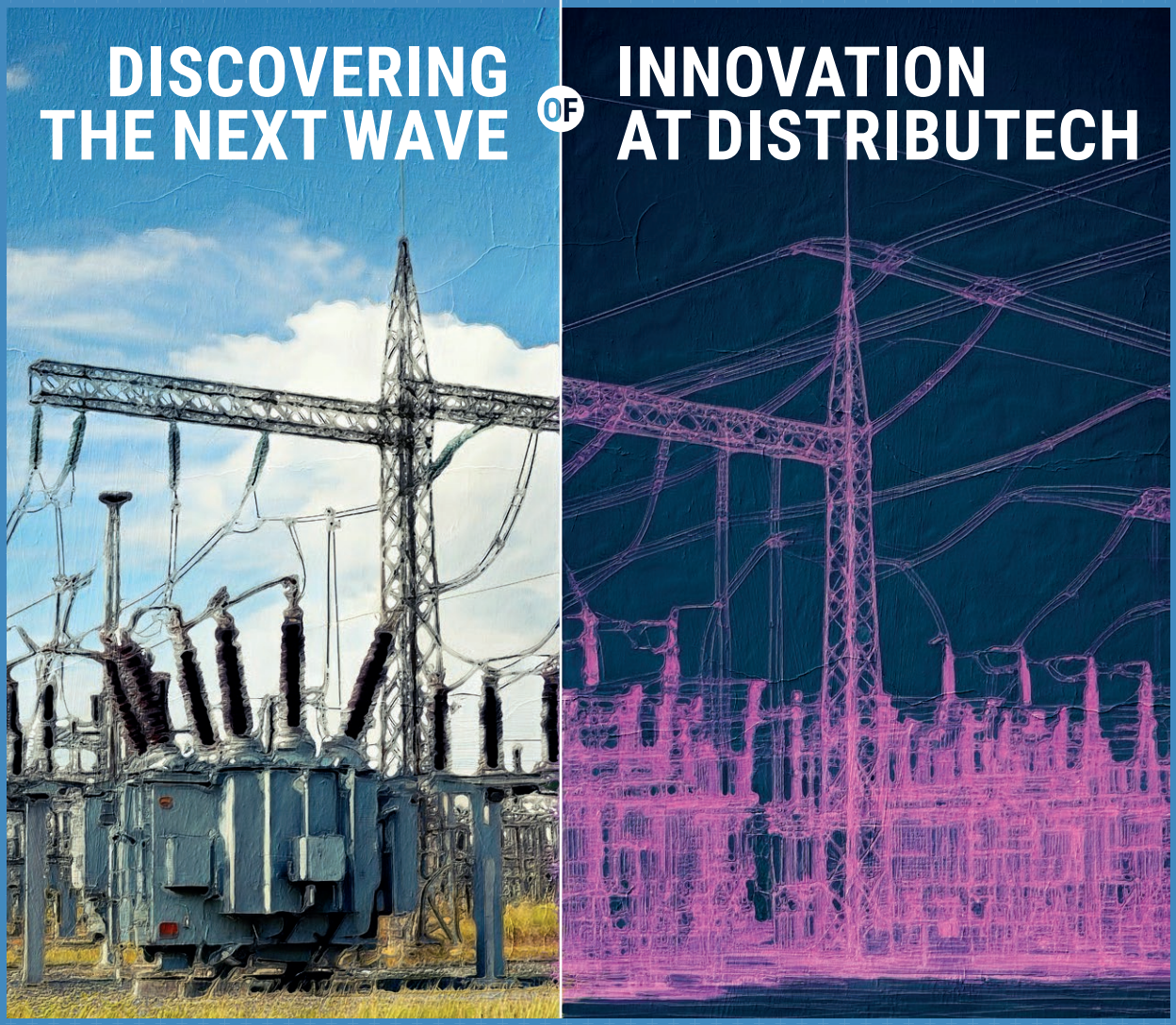


Editor's Note:
We are delighted to welcome Audra Dragza, President & Founder of Summit Path Advisory, to the APC Media team in a fractional leadership role, where she'll be focusing on Go-To-Market strategy and broader company direction. Formerly with Energy Central, Audra brings deep, hands-on industry experience and strategic insight.

To kick off her work with us, we asked Audra to explore emerging technologies at DistribuTech that she sees as potential game changers in the energy and utility space. One of her standout discoveries was Looq AI, which we're pleased to feature in the following showcase.

We're thrilled to have Audra on board and look forward to the impact she'll have as part of our leadership team.

DISTRIBUTECH 2025 was buzzing this year. You could feel the energy pulsing through the halls with new vendors, fresh innovation, and bold visions for what's next in the power industry.

After nearly three decades in this field, I can confidently say we're undergoing what I'd consider the second major transformation in our space. (The first? Deregulation — though some might debate that.) Today, the driving force is AI and exponential tech innovation. Tools are emerging faster than ever, giving the industry a major upgrade. Sure, adoption can be slower — but the technology is here, and the momentum is undeniable.

Meet Looq AI: From 2 A.M. Garage Build to AI-Enabled 3D Capture: Looq AI Makes Survey-Grade Imaging Scalable

This year's show wasn't just about big names and legacy players — it was also a showcase for emerging innovators who are rewriting the rules of utility fieldwork. One company that stood out was Looq AI — a startup combining camera-based data capture and powerful AI to enable smarter, faster infrastructure insights.

I had the opportunity to not only learn about their technology firsthand but also to meet several members of their team, including a sit-down conversation with Dominique Meyer, Founder and CEO. His passion for solving real-world infrastructure challenges with smart, scalable tools was clear from the moment we started talking.

Figure 1:
Courtesy of Looq AI

> ***"I had a hypothesis: if we built the cameras and algorithms right, we could map environments without LiDAR — just with cameras,"*** *Meyer shared.* ***"It would be faster, more scalable, and more cost-effective."***

That hypothesis turned into a working prototype — built in his garage at 2 a.m. alongside co-founder and research partner Shreyas Niradi — and has since evolved into the Looq Platform, a comprehensive system for survey-grade, AI-enabled asset capture and modeling. Designed for speed, scalability, and seamless integration into existing workflows, the platform combines hardware, software, and AI to turn raw images into intelligent infrastructure insights — without the traditional bottlenecks of legacy tools.

The qCam: Precision in the Palm of Your Hand

At the center of the Looq Platform is the qCam: a lightweight, four-camera system paired with a phone interface and a survey-grade GPS. It's powered by a battery you wear on your belt, making it mobile and incredibly versatile.

Whether it's under a car, over a fence, or mounted on a pole, the qCam captures data where drones or vehicles simply can't reach.

> ***"The flexibility of having a human walk a site is huge. And the camera captures the detail that drones just can't — especially in backyards, alleys, or FAA-restricted areas,"*** ***Meyer added.***

Figure 2:
Courtesy of Looq AI

Photo: Shutterstock, Distributech

Captured data is uploaded to the cloud, where Looq's AI-based image-to-model software kicks in. The output is more than just pretty pictures — it's structured, intelligent data that can be shared with CAD and GIS platforms or integrated with tools for pole loading analysis, empowering utilities with insights across planning, operations, and compliance.

Retiring the Measuring Tape

One moment in our conversation brought it all into perspective — and got a good laugh: the tape measure.

> ***"Every engineer I talk to still pulls out a tape measure to double-check if a transformer will fit,"*** *Meyer said.* ***"We have the tech now to do all that virtually — and accurately."***

Figure 3:
Courtesy of Looq AI

It was a lighthearted moment, but it spoke volumes. With the Looq Platform's digital twins and spatial AI, field teams can now virtually place equipment, measure clearances, and model upgrades — all from a desktop.

> ***"I'm excited to see the retirement of the measuring tape,"*** ***Meyer added.***

Digital Twins + AI: From Reactive to Proactive

Perhaps the most transformative potential of the Looq Platform lies in its AI-powered digital twins. These aren't just pretty 3D models — they're decision-making tools. By layering geometry with historical data and asset conditions, Looq AI enables utilities to shift from reactive maintenance to proactive resilience planning.

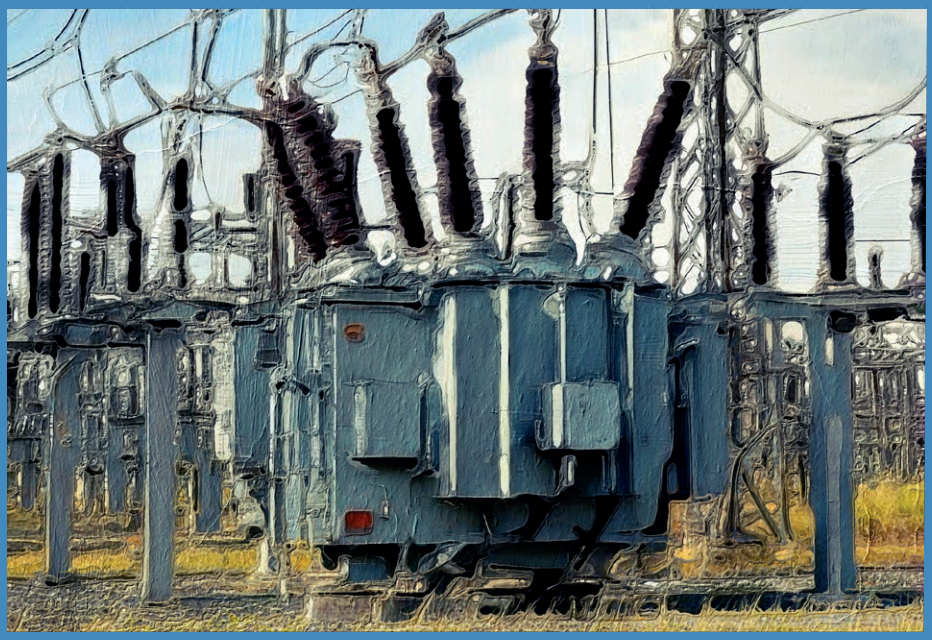
> ***"Which of the 100,000 poles in the Midwest do we upgrade before winter?"*** *Meyer asked.* ***"That's the kind of question digital twins can finally answer."***

It's a major leap toward data-driven capital planning and smarter infrastructure investments.

A Different Kind of Competitor — and a Collaborative Future

Unlike many in the space, Looq AI isn't trying to replace existing tools — they're filling a gap. Their solution augments drones, software, and traditional survey methods by providing rapid, ground-level capture and AI-driven insight.

Photo: Distributech



"We're not replacing anyone — we're augmenting the whole ecosystem," *Meyer emphasized.*

To that end, Looq partners with engineering firms, software platforms, and survey providers to inte-grate seamlessly into existing workflows — amplifying value without disruption.

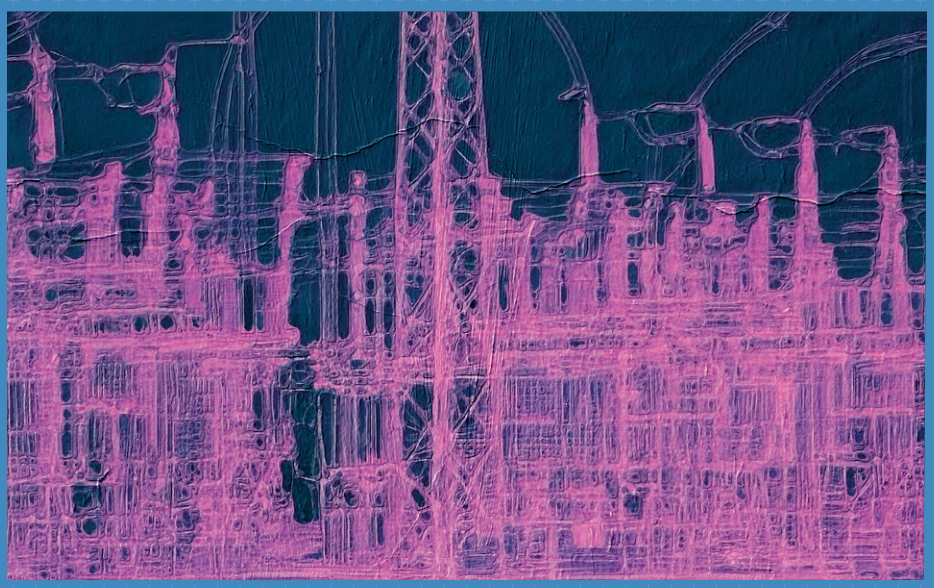
Final Thoughts: Powering the Industry's Next Leap

Looq AI is one of those companies that reminds you just how much change is happening — and how quickly it's accelerating.

From a garage-born prototype to a cutting-edge AI platform, they've built a solution that's faster, smarter, and more intuitive — not for some future use case, but for the way utilities work today.

They're not chasing flashy innovation. They're creating tools that solve real-world problems — with precision, speed, and scalability.

And yes, finally, they're giving engineers a good reason to leave the measuring tape at home.



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