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# TESTINGLY

Testing, Inspection & Certification Magazine

Powering the Future:  
Testing Industry Evolution

magazine by **KEMA** Labs



**Testingly**  
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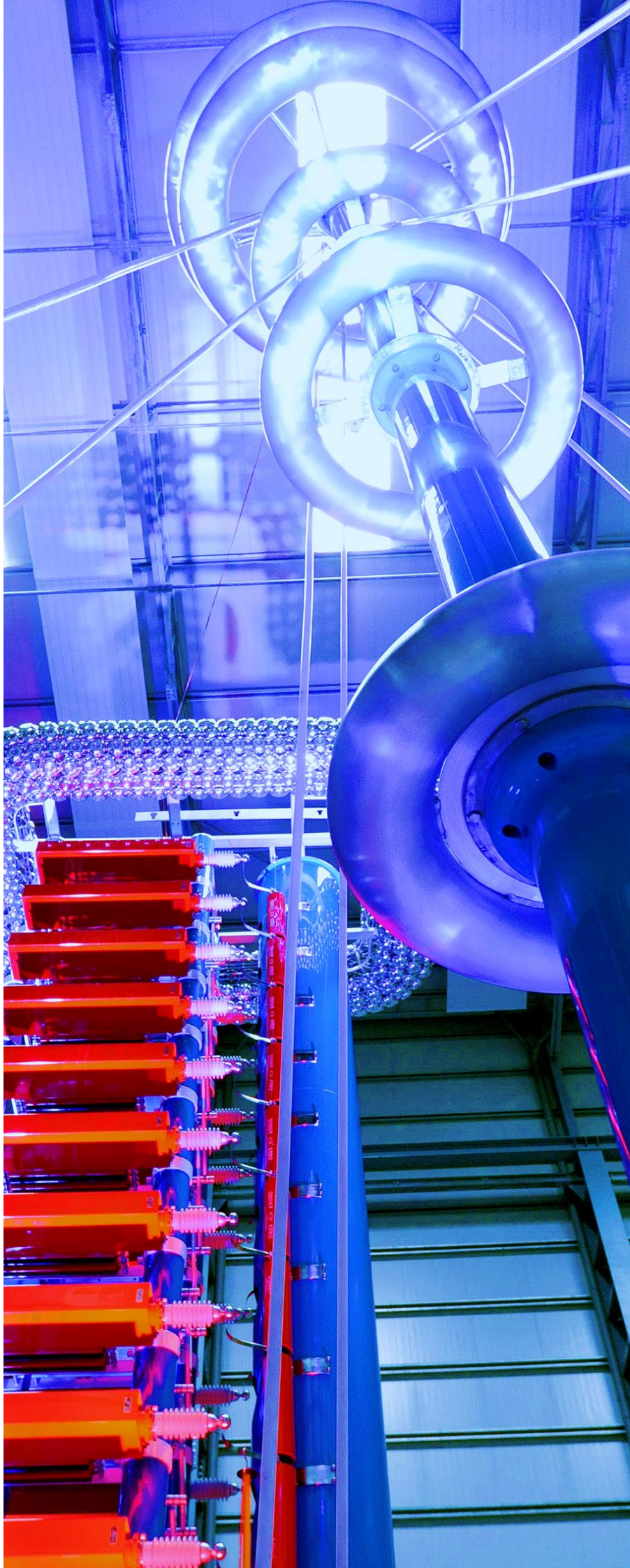
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“All the stakeholders, such as governments, businesses and individuals, must work together to ensure reliable access to resources and create a reliable and efficient power distribution system”

*Domenico Villani*  
*CESI Group CEO*

## The Digital Evolution in the Energy Sphere

Dear Readers and Visionaries in the Energy Sphere,

In this transformative period where the boundaries between the physical and digital realms are blending, we are thrilled to present to you the latest edition of *Testingly*, where we unravel the intricate tapestry of the Testing, Inspection, and Certification (TIC) industry with a keen focus on its digital evolution.

As we stand at the helm of KEMA Labs, we are proud to spearhead conversations and explorations into the most cutting-edge developments that are shaping the energy landscape. From the robust dynamics of the Testing Industry in the T&D sector to the ground-breaking advancements in HVDC test laboratories, our content is curated to not only inform but also inspire.

Digitalization is more than a buzzword within these pages; it is a tangible reality that we explore through articles such as 'IEC61850 Server 2.0: Digital Substation Reliability,' which dissects the critical role digital solutions play in enhancing the resilience of our energy infrastructures but also of the active role of KEMA Labs with the new Certification under KEMA Labs brand. The 'Evolution of the Testing Industry in the T&D Sector' offers an eagle-eye view of the transformation within our industry, where traditional methods are being complemented by innovative digital practices.

In a special feature, 'TenneT - North Sea Wind Farms Cables Field Testing,' we examine the pioneering efforts in renewable energy and its implications for a sustainable future showcasing our capabilities for Onsite Testing of Cable Systems and how we helped important TSO in Europe to enhance the reliability of their infrastructures with premium testing



“

e invite you to immerse yourself in the contents of this edition, which is a testament to our dedication to leading the charge in the TIC space

”

*Bas Verhoeven – KEMA Labs,  
Executive Vice President*

This edition also brings you exclusive insights from Floris Schulze, our Global Key Account Utilities Director, whose interview sheds light on new trends and strategic directions.

As we navigate through these exciting times, our commitment to excellence and foresight remains unwavering. We are not just observers but active participants in the energy revolution, continuously pushing the boundaries of what is possible.

In closing, we invite you to immerse yourself in the contents of this edition, which is a testament to our dedication to leading the charge in the TIC space. Let's journey together towards a smarter, more connected, and sustainable energy ecosystem.

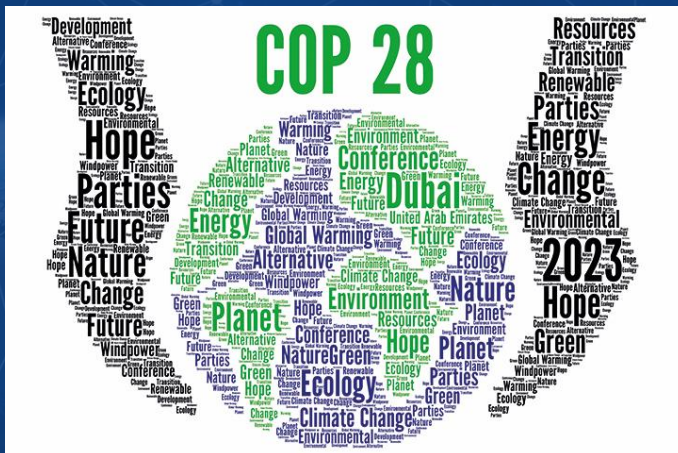
Charting the uncharted, together.

Enjoy the read!

Domenico Villani – CESI Group CEO

Bas Verhoeven – Executive Vice President CESI TIC Division – KEMA Labs





## CESI event at COP 28 on the GCC's Energy Future

On December 9, CESI spearheaded a pivotal event at COP 28 titled "The Sustainable Future of the Gulf Cooperation Council (GCC): Moving from Regional to Global Electrical Interconnections." This session underscored the significance of regional electrical interconnections and their potential to transform the GCC's energy landscape. The event spotlighted ongoing initiatives, such as Saudi Arabia's exploration of interconnections with Egypt and Jordan, exemplifying the region's dedication to sustainable energy advancements.

The conversation acknowledged the operational challenges and substantial investments essential for transitioning to a green power system. In this transformative journey, electrical interconnections were vital, enabling the integration of renewable energy and fostering a sustainable energy framework. These interconnections, bridging different countries and regions, were instrumental in diversifying power resources and adapting consumption patterns to manage the intermittency of renewable energy.



## KEMA Labs: New Tests to Enhance the EVs Affordability

KEMA Labs in Berlin has initiated a project to address the technical requirements for DC components in electric vehicles (EVs).

In detail, the project features a system consisting of 14 control cabinets equipped with bidirectional DC power supply, enabling the charging and discharging of a 1500 VDC capacitor bank. The bank provides the necessary energy for testing. The system incorporates an impulse generator with resistors and safety systems that can reliably set the current up to 35 kA. Notably, this system can deliver a high, nearly constant current at up to 1500 VDC for milliseconds



## KEMA Labs Testing a Wind Power Plant Transformer



KEMA Labs' High Voltage Structural Testing Laboratory in Seriate (BG) conducted extensive long-life vibration tests on a Wind Power Plant Transformer.

These specialized tests aim to replicate stress cycles on components, simulating years of mechanical stress within a matter of hours.

The success of these tests is attributed to the collaboration between ENERCON, the plant manufacturer, and J. Schneider Elektrotechnik GmbH, the equipment supplier, working seamlessly with the expert team of test engineers.



## CESI Group's donation to UNICEF

This year, CESI Group's collaboration with UNICEF has made a significant impact as we joined forces to donate 11,000 packets of therapeutic food.

This contribution aims to address the urgent issue of severe malnutrition among children. It represents a small yet meaningful step toward our commitment to social responsibility and the well-being of vulnerable communities. This partnership exemplifies the power of collective action, highlighting the importance of coming together for the greater good.

Through ongoing collaborations with UNICEF and other impactful organizations, we strive to be a positive force for change on a global scale, contributing to a more inclusive and supportive world for everyone.





# Evolution of the Testing Industry in the T&D Sector

The Transmission and Distribution (T&D) industry has always been at the forefront of technological advancements.

In recent years, the sector has experienced a significant shift towards renewable energy, demanding higher network flexibility to manage power flow and seamless grid measurement and response to change in network configurations.

In such challenging background HVDC networks, digitalization, and smart metering are revolutionizing the way power systems are operated and maintained. This article explores the key digitalization trends in the T&D industry and the subsequent evolution of the testing industry. We will delve into the advancements in digital substations, smart metering, power electronics, and the integration of onboard smart sensors for switchgears and transformers. Additionally, we will highlight other important trends that are reshaping the landscape of the T&D industry.

Electricity generation worldwide is forecast to triple in the next three decades, when compared to 2020, reaching 83 thousand terawatt hours by 2050. Global electricity generation is projected to surpass 30 thousand terawatt hours by 2025, according to a McKinsey report. This exponential growth in electricity demand necessitates the adoption of digitalization trends in the T&D industry to ensure efficient and reliable power transmission and distribution.

## 1. Digital Substations: Enabling Intelligent Grids

Digital substations are a critical component of the modern power grid, bringing numerous benefits such as enhanced monitoring, control, and automation capabilities. By leveraging standardized communication protocols, such as the IEC 61850, digital substations enable seamless interoperability between devices and systems. This allows for real-time data exchange, improved situational awareness, and efficient fault diagnosis, ultimately enhancing grid reliability and stability.



## 2. Smart Metering: Empowering Consumers

Smart metering systems have revolutionized the way electricity is measured, billed, and consumed. These advanced meters provide two-way communication capabilities, enabling real-time data exchange between utility companies and consumers. Smart meters offer accurate and timely consumption information, facilitating demand response programs, dynamic pricing, and load management. In 2019, smart meter investments amounted to 21 billion U.S. dollars, out of a total of 271 billion U.S. dollars spent on smart grids worldwide. The global smart electricity meter market was estimated at 10.5 billion U.S. dollars in 2020 and is forecast to grow to surpass 15 billion dollars in 2026.

## 3. Onboard Smart Sensors: Enhancing Asset Management

Switchgears and transformers play a crucial role in the T&D infrastructure. The integration of onboard smart sensors within these devices allows for real-time monitoring of critical parameters, such as temperature, vibration, and partial discharge. By continuously collecting and analyzing this data, operators can gain valuable insights into the health and performance of these assets. Early detection of faults or abnormalities can prevent catastrophic failures, minimize downtime, and optimize maintenance schedules.

In 2021, global investments in grid battery storage were estimated at roughly 4.7 billion U.S. dollars, marking a 34 percent increase compared to the previous year. The United States accounted for more than 40 percent of grid battery investments [^4]. These investments reflect the growing importance of energy storage systems in supporting the integration of renewable energy sources and enhancing grid flexibility.

## 4. Evolution of the Testing Industry: Challenging Paradigms and Embracing Opportunities

As the Transmission and Distribution industry undergoes digital transformation and incorporates power electronics into electromechanical equipment, the testing industry faces both challenges and opportunities. Traditional testing methodologies must adapt to the changing landscape to ensure the reliability, safety, and performance of these advanced systems. Here, we explore the key considerations for the testing industry in this evolving paradigm.

- a. **Integrated System Testing:** The integration of power electronics into electromechanical equipment, such as switchgears and transformers, demands a holistic approach to testing. The traditional isolated testing of individual components may no longer suffice. Instead, comprehensive integrated system testing is essential to assess the interoperability, performance, and reliability of the entire system. This requires collaboration among different stakeholders, including equipment manufacturers, utilities, and testing laboratories, to develop standardized testing procedures and ensure seamless integration.
- b. **Standardization and Certification:** With the advent of new technologies and devices, standardization and certification become vital for the testing industry. Establishing industry-wide standards and certification frameworks ensures consistency, quality, and safety across the T&D sector. Testing laboratories play a critical role in developing and implementing these standards, working closely with regulatory bodies, industry associations, and technology providers. By adhering to standardized testing protocols, the industry can instill confidence in the reliability and performance of digitalized T&D systems.
- c. **Embracing Data-driven Testing:** The digitalization of T&D systems generates vast amounts of data that can be leveraged for testing and analysis. Data-driven testing approaches, coupled with advanced analytics and machine learning algorithms, enable testing laboratories to extract valuable insights, identify patterns, and optimize testing processes. By harnessing the power of data, the testing industry can enhance testing efficiency, improve fault diagnosis, and contribute to the development of predictive maintenance strategies.

The testing industry plays a crucial role in ensuring the reliability, safety, and performance of digitalized T&D systems with integrated power electronics. To meet the evolving needs of the industry, testing methodologies must adapt to the complexities of power electronics, embrace integrated system testing, adhere to standardized protocols, and leverage data-driven approaches. Continuous training and collaboration with industry stakeholders are essential for the testing industry to stay ahead of technological advancements and effectively address the challenges and opportunities brought by the digital transformation in the T&D sector. By doing so, the testing industry will contribute to the development of a robust, resilient, and efficient power grid for the future.







## The world's largest HVDC test laboratory

At a critical juncture in global efforts to decarbonize and adopt renewable energy, high-voltage direct current (HVDC) infrastructures stand out as pivotal enablers.

Playing a crucial role in Europe's energy transition, HVDC facilities facilitate long-distance connections and efficient transmission of electricity from offshore wind farms to consumption hubs. With the ability to significantly reduce energy losses over extended distances, HVDC acts as a superhighway for clean energy, supporting Europe's ambitious decarbonization goals

Search results reveal that HVDC cables outperform high-voltage alternating current (HVAC) counterparts, with losses around 3% per 1000 km compared to HVAC's 7%. This substantial reduction, over 50%, positions HVDC as a key solution for clean energy transmission. The growing market demands increased production capacity to meet soaring requirements.

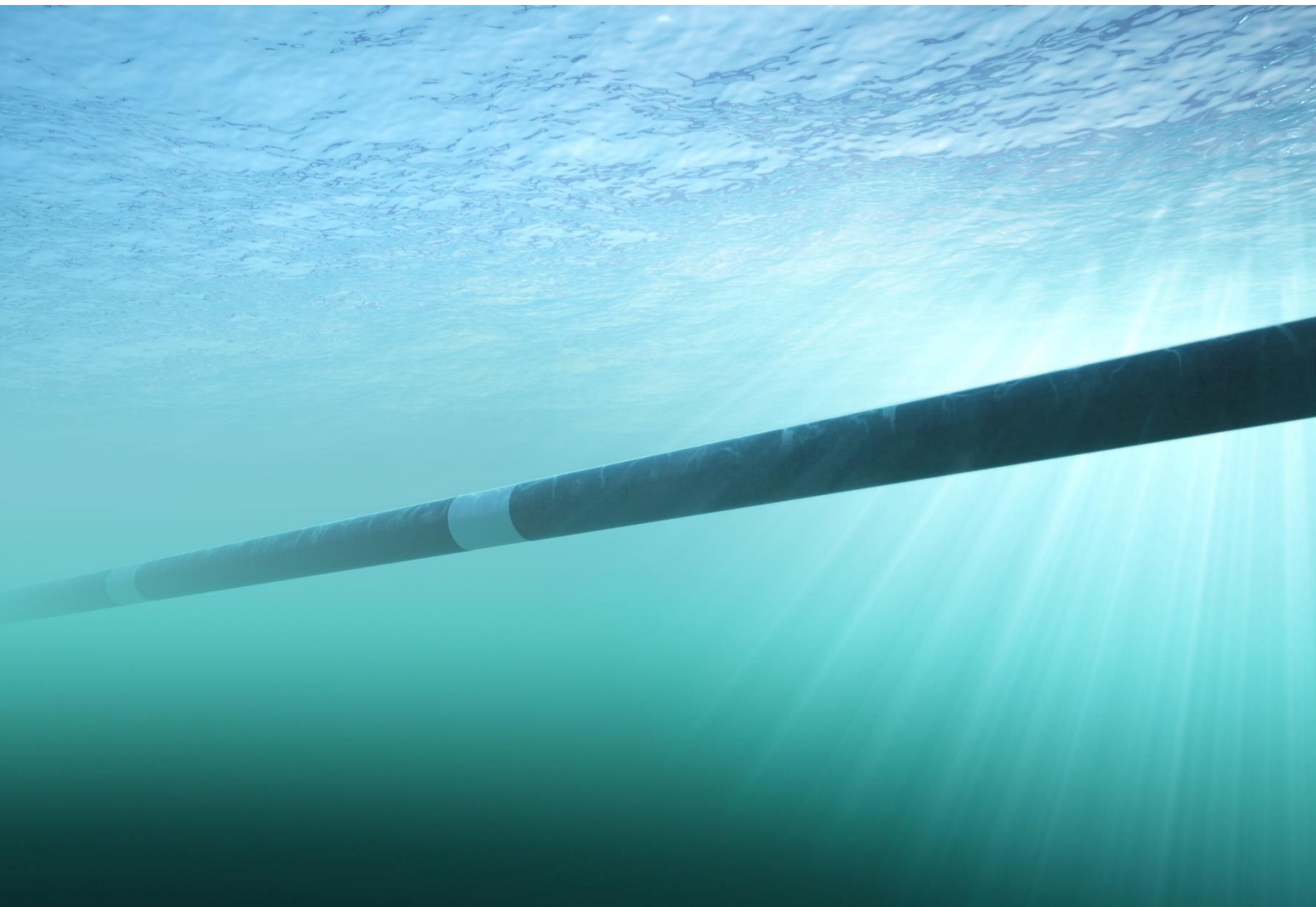
In response to this evolving landscape, KEMA Labs, the Testing, Inspection, and Certification (TIC) Division of CESI Group, has expanded its testing capabilities to propel HVDC technology growth. With over ten independent test bays worldwide, including a revamped synthetic laboratory in Milan featuring three specialized HVDC test zones, KEMA Labs is at the forefront of testing technology.

The upgraded facility boasts cutting-edge HVDC generators, automated control systems, and state-of-the-art impulse generators, providing unparalleled testing capacity. This expansion equips KEMA Labs to conduct extensive testing, totaling more than 78,000 hours and qualifying up to nine different cable designs. The rigorous testing program simulates the entire 40-year lifespan under demanding technical conditions. Beyond testing capacity, KEMA Labs has actively participated in notable HVDC projects, such as the German Corridor project. In 2017, the lab conducted prequalification testing on the German Corridor HVDC cable system, one of the world's longest and most powerful

This, along with testing various HVDC cables, contributes to pioneering technology transformations in the industry. With over 10 independently operated test bays, KEMA Labs solidifies its position as the largest HVDC cable testing laboratory globally, playing a crucial role in advancing clean energy infrastructure.

CESI has also participated in more than 40 HVDC consulting projects globally, covering over 30,000 km of overhead lines, 7,000 km of submarine cables, and 50 GW of installed capacity. One of the most recent projects is ongoing in Chile with the company ISA Interchile, which CESI has supported in participating in the auction for the development of the Hvdc Kimal-Lo Aguirre transmission line. This project is strategic for enabling the South American country to achieve carbon neutrality by 2050. With its length of 1,500 km and a capacity of 3,000 MW at  $\pm 600$  kV, the Kimal-Lo Aguirre line is the largest transmission project implemented in Chile. CESI's contribution includes the basic design of the conversion stations for the Kimal-Lo Aguirre line, estimating the budget needed for the project, ongoing review during construction, and selecting the manufacturer of the stations.

Before this, CESI secured a contract with the Saudi Electricity Company (SEC) to develop a high-voltage direct current (HVDC) electrical interconnection system between Riyadh and Mecca, covering the central and western regions of Saudi Arabia. The new 800 km HVDC connection passes between the Dharma and Bahra stations, connecting Riyadh and Mecca, increasing the capacity of local distribution networks by over 3,000 MW. This helps address frequent blackouts, providing a reliable reserve energy supply in emergency situations.







## IEC61850 Server 2.0: Digital Substation Reliability

KEMA Labs offers IEC 61850 Server 2.0 equipment compliance certification under its brand once again. The UCA International Users Group (UCAIug) has granted third-party accreditation to KEMA Labs for our IEC 61850 Test Laboratory, reaffirming our dedication to excellence and client service.

Digital substations are driving advancements in the energy sector, harnessing cutting-edge technology to enhance efficiency, reliability, and safety. At KEMA Labs, we understand the pivotal role Intelligent Electronic Devices (IEDs) play in realizing the potential of digital substations.

Our IEC 61850 Ed 2.0 Server Testing Services are designed to ensure that your IEDs meet the highest industry standards, facilitating seamless integration within the digital substation environment.

As an impartial third-party laboratory, KEMA Labs is committed to providing dependable testing services.

Our team of industry experts possesses extensive experience in Control, Protection, Automation & Communication systems, enabling us to conduct rigorous IED testing.

Our assessments comprehensively evaluate safety, reliability, performance, and interoperability, ensuring your devices are fully compliant and capable of supporting the evolving requirements of your power plants and substations.

Furthermore, KEMA Labs recognizes the dynamic nature of the T&D industry and the ever-evolving demands of power plants and substations. Consequently, we continually expand our service portfolio to keep pace with rapid technological advancements. By selecting KEMA Labs as your partner, you gain access to a comprehensive range of testing, certification, and consultancy services tailored to address your unique challenges and promote success in your operations.

# CASE HISTORY

## TenneT North Sea Wind Farms Cables Field Testing

TenneT and its subcontractors have achieved a momentous milestone with the successful completion of a cutting-edge transformer substation in Wijk aan Zee.

This groundbreaking facility integrates three new North Sea wind farms into the Netherlands' high-voltage network, comprising the Hollandse Kust Noord land station and the Wijk aan Zee 380kV substation. The substation's core components are the land station, converting green electricity from the wind farms from 220kV to 380kV, and the substation, expertly directing power to various customers, including Tata Steel, and integrating it into the national 380 KV grid via the Beverwijk substation.

KEMA Labs conducted meticulous release tests on behalf of TenneT's contractors, assessing the substation for the occurrence of Corona—crackling discharges near high-voltage electrical installations. The extensive assessment, spanning several weeks in an area equivalent to 23 football fields, utilized specialized cameras to detect air discharges, enabling prompt resolution of any identified issues.

Additionally, KEMA Labs carried out critical high voltage tests on 12 circuits, using multiple Series Resonant test sets. This demanding setup, requiring two days to assemble, allowed testing at a voltage 1.7 times higher than the cables' operational voltage, efficiently detecting any manufacturing or assembly faults.

Looking ahead, the project faces its final significant challenge in November—a 69km long submarine cable test to the wind farm park using five test sets. Intensive coordination between KEMA Labs and TenneT ensures smooth execution within the set timeframe, addressing safety concerns related to high voltage tests, construction activities, and on-site transport.

Despite the project's complexity, all tests were executed flawlessly as planned, with several cable circuits now operational. KEMA Labs remains committed to future collaborations, as TenneT paves the way for innovative and sustainable projects ahead.





# FLORIS H. SCHULZE

## KEMA LABS

### Global Key Account Director Utilities



**Floris Hendrikus Schulze** has studied in The Netherlands. He holds a Bachelor, Master and Advanced University Degree in System Science Engineering, Applied Mathematics and Management. He has been a leading actor in the energy value chain for over 28 years, of which 12 years in the Middle East.

As Global Director Utilities he supports Utilities, Industries, and other entities worldwide to increase performance, opportunities, growth and to strengthen their position during energy transition.

1. From your perspective as a seasoned expert in the field, how do you see the market for utilities evolving over the next decade, especially considering the ongoing technological advancements and the increasing demand for sustainable energy solutions?

The energy sector is in midst of transformational change. Emerging technologies, new components, and societal demand promise to reshape not only the energy we use, but also how we use, produce, and distribute it. In the midst of these changes Utilities are looking for ways to deal with tight deadlines for delivering their projects.

This requires a strict scheduling and control of activities without affecting quality and reliability, while at the same time suppliers are fully booked and utilities find themselves searching and qualifying new suppliers from other regions in the world to meet their tied lead times.

The energy transition will rely on two key pillars:

- a) (R)evolution of the generation fleet that shall rely on renewable energy sources, notably sun and wind, possibly coupled with storage facilities to ensure continuity of power supply. In other words, “keep the light on” irrespective of renewable sources volatility. Generating companies who manage to change first their generation portfolio offering carbon free electricity will be the winning position;
- b) Fast upgrading of T&D infrastructures: renewable energy sources (RES), water, sun or wind resources, are geographical dependent. Whereas coal, Nuclear and natural gas resources can be transported and electricity be generated relatively close to consumption centers, RES generation call for the construction of new transmission corridors to transmit massive volumes of energy to the final users. This is witnessed by the growth of System Operators investment plans. Just think Italy, where the National Transmission System Operator, Terna, was foreseeing € 6.4 billion in its ten-year development plan formulated 15 ago, against more than € 21 billion in the last ten-year plan published in March 2023. TenneT awarded around € 30 billion contracting package for security of supply, the energy transition and climate protection. This is a common trend across the whole Europe and other regions in the world. A similar pattern is followed also by the distribution grids, which are increasingly impacted by distributed generation (see solar rooftops), combined with a deeper electrification of the final users, from the residential sector where heat pumps will replace gas boilers to road transportation that will evolve to e-mobility.

What above mentioned clearly highlights outstanding market opportunities for utilities and system operators. We can mention cable manufactures: the request of power cables both submarine and underground largely exceeds the manufacturing capability and the business of cable manufacturers is steadily growing.

This profound and fast transformation of the power sector shall rely on new environmentally friendly technologies; for instance power transmission will increasingly rely on HVDC a technology that, beside making power flows more controllable, doesn't create variable electro-magnetic fields, which are a concern for the population. Furthermore, the variable power flows from generation to offtakers shall be controlled and coordinated by a more pervasive digitalization of the whole chain linking generation, transmission, distribution and final users that will be playing an active role in the power systems of the future.

Linked with the above, digitalization is also opening up the smart sensor markets for smart grids (Internet of Things, IoT) to have a greater quantity of data that can be processed with new technologies e.g. data analytics, machine learning, AI. Increasingly complex control and automation infrastructures to manage the variability of the network (e.g. the distribution network which also becomes an active network and not just a passive one) and to strengthen resilience also considering the climate change. Digitalisation brings with it an increase in cyber risk, with the consequent need to invest at both IT and OT levels in cyber security.

All that calls for the identification of the best technical solutions and KEMA is namely involved in assisting electric utilities and system operators in this green revolution adopting a systemwide approach but having also a deep knowledge of the performances of each single component.



**2. KEMA Labs has recently completed a project on field cable testing with TenneT, an important player in the European energy sector. Could you elaborate on how this project has delivered value to TenneT, and what it demonstrates about KEMA Labs' capabilities and innovation in the TIC landscape?**

TenneT, has achieved a momentous milestone with the successful completion of a cutting-edge transformer substation in Wijk aan Zee. This groundbreaking facility, which encompasses both the Hollandse Kust Noord land station and the Wijk aan Zee 380kV substation, plays a pivotal role in integrating three new wind farms from the North Sea into the Netherlands' high-voltage grid. The commissioning of this central project was preceded by meticulous release tests conducted by KEMA Labs. To ensure a thorough assessment, KEMA scrutinized every part under tension throughout the vast expanse of the substation, equivalent to an astounding 23 football fields, making it an undertaking of considerable magnitude that spanned several weeks. Furthermore, KEMA Labs conducted a critical high voltage test on multiple 12 circuits using a Series Resonant test sets. This sophisticated test subjected the cable circuits to high voltage, necessitating the combination of two, three, and even four test sets due to the length and capacity of the cables. The meticulous setup, which took two days to assemble, enabled a test voltage of 374kV to be applied—1.7 times higher than the actual operational voltage of the cables—facilitating the detection of any potential manufacturing or assembly faults.

Around the world, the growth of high-voltage power networks is driving a proliferation of new high-voltage transmission and distribution components. Before installing these new components in the power network, utilities must be confident they are reliable and function correctly to minimize risks of outages. Faulty T&D component is the second most common cause of outages in the World. These failures can be reduced by adequate asset management and by selecting T&D components with a proven technical performance. Type testing per international (IEC) standard is the best way to prove this technical performance. But even when compliance of cables and their accessories with standard requirements has been proven at the end of production, there is still a long way from factory to installation and final operation. This process includes critical phases such as storage, transport, handling, laying and assembly. These activities are mostly performed on-site and sometimes under adverse ambient conditions and are therefore susceptible to causing failures, which must be identified and solved before commissioning of a circuit. As such, so-called On site Commissioning tests are critical to guarantee the safe and smooth operation of cables under the rated operating conditions to which they have been designed.

**3. KEMA Labs has been a pivotal player in the energy sector. As the T&D (Transmission and Distribution) utilities are faced with the monumental task of decarbonization, how can KEMA Labs leverage its competitive position to become an even stronger partner in this journey, and what initiatives are already in place to support this transition?**

Managing fast-paced replacement, expansion, and operation of the grid, the largest man-made machine on earth, in a controlled and safe manner will be crucial. Linked with the above, digitalization is also opening up the smart sensor markets for smart grids (Internet of Things, IoT) to have a greater quantity of data that can be processed with new technologies e.g. data analytics, machine learning, AI. Increasingly complex control and automation infrastructures to manage the variability of the network (e.g. the distribution network which also becomes an active network and not just a passive one) and to strengthen resilience also considering the climate exchange. Digitalisation brings with it an increase in cyber risk, with the consequent need to invest at both IT and OT levels in cyber security.

All that calls for the identification of the best technical solutions and KEMA is namely involved in assisting electric utilities and system operators in this green revolution adopting a systemwide approach but having also a deep knowledge of the performances of each single component.

As it happens, KEMA Laboratories have the largest impartial electrical test capabilities in the world, complemented with a cyber-physical environment, using hardware and control in the loop techniques. This unique facility, combined with our systemwide approach, allows KEMA to take the lead in the energy transition, enable a fast and swift and affordable roll-out and safeguard the future stability and safety of the electric power system.

# Upcoming events

## DISTRIBUTECH

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January 26-29, 2024

 Orlando, USA

The premier annual event for transmission and distribution, showcasing cutting-edge technologies that power our homes and businesses. The conference and exhibition offer a wealth of education, information, and solutions that drive the industry forward.

## MIDDLE EAST ENERGY

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April 16-18, 2024

 Dubai

Middle East Energy, formerly Middle East Electricity, a 45+ year legacy as one of the most reputable and long-established events in the energy industry.

## BIXPO 2024

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May 29-31, 2024

 South Korea

BIXPO2024, a comprehensive global expo on the energy sector, will take place at the Kimdaejung Convention Center

## INNOTRANS

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September 24-27, 2024

 Berlin

InnoTrans is the leading international trade fair for transport technology, which takes place every two years



## KEMA Labs is the CESI Testing, Inspection and Certification Division

Through its Division KEMA Labs, CESI is the world leader for the independent Testing, Inspection and Certification activities in the electricity industry. With a legacy of more than 60 years of experience, CESI operates in 70 countries around the world and supports its global clients in meeting the energy transition challenges. CESI also provides civil and environmental engineering services.

The company's key global clients include major utilities, Transmission System Operators (TSOs), Distribution System Operators (DSOs), power generation companies (GenCos), system integrators, financial investors, and global electromechanical and electronic manufacturers, as well as governments and regulatory authorities.

CESI is a fully independent joint-stock company headquartered in Milan and with facilities in Arnhem (NL), Berlin (DE), Prague (CZ), Mannheim (DE), Dubai (AE), Rio de Janeiro (BR), Santiago de Chile (CL), Knoxville (US) and Chalfont (US).

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