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TESTINGLY

Testing, Inspection & Certification Magazine

Testing solutions for sustainable energy

magazine by KEMA Labs

Testingly
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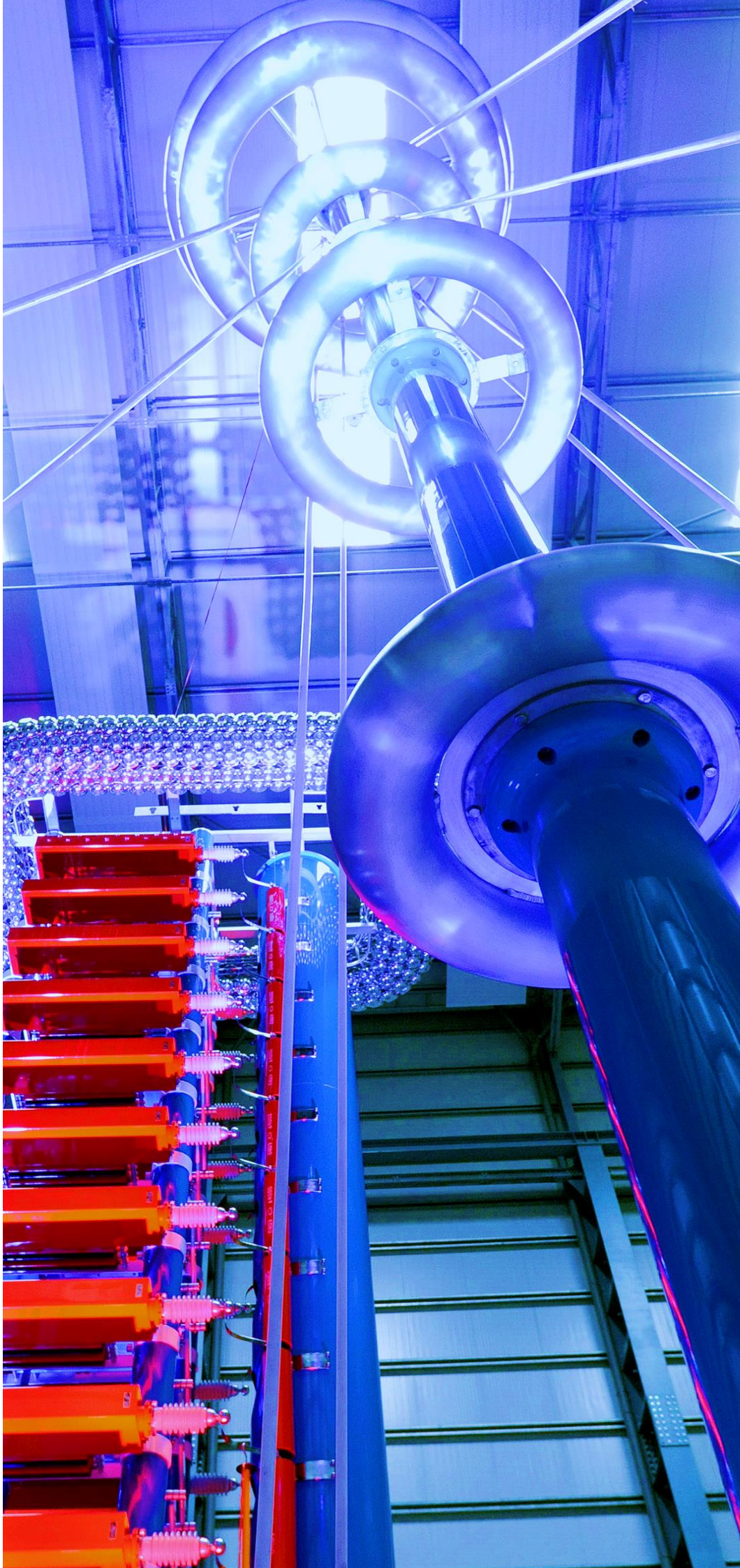

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> Our first goal is to help our customers win the challenges of the energy transition

Matteo Codazzi
CESI Group CEO

Testingly, the KEMA Labs magazine, is Born

Ever since KEMA and CESI joined forces in testing to form KEMA Labs, in December 2019, we had one priority in mind: to combine our skills in order to further improve the way we serve our customers.

Our first goal is to help them win their energy transition challenges, especially in coping with the real needs of markets and sustainable innovation.

In this respect, new and revolutionary technologies are being introduced and researched worldwide. Virtual and augmented reality, digitalization, smart technologies, and so on. Such innovations are disrupting well-established, traditional paradigms in the power sector.

At KEMA Labs we focus on staying in tune with such changes. We are leveraging new technologies to offer even more innovative services to our clients.

That is why we decided to provide you with an overview of key trends in the sector: from exploring cutting-edge testing laboratories, to interviews with renowned engineers and experts, from notable case histories to recently introduced innovations.

"Testingly", the KEMA Labs magazine, was born in response to such needs. This is an editorial tool through which we provide you with updated news, highly diverse points of view, and juicy insights on the main trends in the world of Testing, Inspection, and Certification.

Moreover, if you are curious about what we do every day at KEMA Labs for our clients, our magazine will guide you through our activities, stories, and technologies.

> This first issue of Testingly aims to provide you with an overview of the challenges and innovations that the sector is currently dealing with.

Domenico Villani – KEMA Labs, Executive Vice President

This first issue of Testingly aims to provide you with an overview of the challenges and innovations that the sector is currently dealing with.

Following this Editorial, you will find the "Latest News TIC," where five stories related to testing, inspection, and certification will be briefly presented.

Furthermore, "Our Innovative Services" is dedicated to efficient alternatives to SF6 gas for insulation and switching, aimed at replacing a highly-pollutant solution with sustainable ones. The "Case History" section focuses on ground-breaking exemption tests to prevent the ignition of flammable vegetation in an area where surge arresters are installed, in a delicate location such as California.

Through Testingly, you can also get in touch with TIC experts on social media by clicking on the link in the "Join the Conversation" section. Moreover, in "TIC Events," you will be reminded of the main upcoming events that could be of interest to you and to the entire TIC sector. In the "KEMA Labs Facilities" section, you will experience a virtual tour through the new organization of our Division, as well as an exploration of our global laboratories.

Finally, the "Interview with…" section features an in-depth conversation with the Head of our Dutch Flex Power Grid Lab, the most advanced and cutting-edge facility in the world for the integration of VRES into the power grid.

Vincent Van Gogh once said that "Great things are done by a series of small things brought together." This is precisely the philosophy we embrace at KEMA Labs and across the entire CESI Group.

We hope you will enjoy reading this very first issue of Testingly!

Matteo Codazzi – CESI Group CEO
Domenico Villani – Executive Vice President CESI TIC Division – KEMA Labs

Latest news

Koncar Power Transformers Ltd.

KEMA Labs Arnhem has performed short-circuit tests on a three-phase transformer rated 400/226/226 MVA – 230/66/66 kV manufactured in Croatia by Koncar Power Transformers Ltd, a Joint Venture of Siemens Energy and Koncar.

The transformer will be used on an offshore platform in the North Sea to transport the energy from the Windfarms to the electricity grid on land.

Artificial Line

In 2020 and 2021 KEMA Labs Arnhem performed Short Line Fault testing for our customer GE T&D India Ltd.

The object was rated 800 kV – 50 kA – 50 Hz. For this test our newly designed Artificial Line has been used.

This new artificial line has been designed to be used for ratings from and above 420 kV Short Line Fault testing.

Shanghai Sieyuan High Voltage Switchgear Co., Ltd.

This Shanghai Sieyuan High Voltage Switchgear Co., Ltd. is performing at KEMA labs in Milan an extensive testing program for the certification of their equipment. The program includes testing and certification of the 145 KV and 420 kV gas-insulated metal-enclosed circuit-breakers, disconnectors and substations.
The type test certificates of short-circuit and switching performance have been already achieved for the circuit-breakers while the activity on the substations is still in progress.

The certification of the substations includes the verification of the dielectric performance, temperature rise performance, short-circuit and switching performance and internal arc performance. Additional tests such as the mechanical operation at ambient temperature and temperature limits, EMC tests, IP and IK test are also part of this extensive program.

Testing for Smarter Grids at S&ST – MPSA in Arnhem

Together with the KEMA Labs High-Power and High-Voltage Laboratories, this is exactly what the S&ST department with the KEMA Metering, Protection and Substation Automation Laboratory offers: trusted and impartial standards-based testing of MPSA equipment.

In our facilities, energy meters, protection systems and ancillary systems or devices, substation automation equipment are tested and certified with the ISO 17025 accreditation according to a range of international standards. For energy meters the laboratory is Notified Body for the European Measurement Instruments Directive. MID 2014/32/EU.

In particular, we offer testing and certification of all kind of MPSA equipment, from electromechanical to electronic and digital.

User Device – Open Meter Integration Tests

E-Distribuzione has started a collaboration with certification laboratories, that have proven experience in the world of electronic equipment tests, with regard to data transmission via powerline, for the execution of integration tests of User Devices (UD) with intelligent electricity meters "Open Meter" supplied by E-Distribuzione.

Due to its expertise and state-of-the-art certification laboratories, KEMA Labs (CESI's Testing, Inspection and Certification Division) is one of the key partners of E-Distribuzione in this initiative. In this respect, in our Smart Metering Laboratories, in a space of less than 400 m2, we have created a test bench system with more than 2,000 electrical loads running simultaneously, including household appliances, lights, various electronic devices and typical industrial equipment, equivalent to a town of around 1,400 residents, to test how meters interact with real power loads.

SF6 alternatives at KEMA Labs – image courtesy of Hitachi ABB Power Grids

OUR INNOVATIVE SERVICES

SF6 Alternatives are Knocking on the Door

Since decades, SF6 gas has been the workhorse of HV technology, combining a "close to ideal" combination of excellent insulation and superior current interruption. Its dark side, however, is also outstanding; it is the most potent greenhouse gas on earth, having a CO2 equivalent (GWP - Global Warming Potential) of 23,500. In terms of mass, the world wide SF6 emission of around 9,000 tons per year is totally dwarfed by the 34 billion tons of CO2 emission, but its ugly equivalent still makes SF6 emission contribute to around 0.6% of the global greenhouse gas emission.

80% of SF6 is stored in switchgear, mainly GIS, which means the electrical industry is moving away from SF6 and searches for alternatives, accelerated by articles in the general press, like the BBC calling SF6 the "electrical industry's dirty secret" in a multi-quoted article. In addition, taxation of its use, and fines on leakage of SF6 are likely to increase.

Bans of complete categories of SF6 switchgear by 2022, to begin with the secondary distribution level, are under discussion by the European Commission. Most utilities set clear green targets, first on leakage reduction. Though the IEC standard sets a limit of 0.5% leakage per year, many strive for 0.1% per year, which is feasible as Japanese utilities demonstrate. Longer term utility targets aim to eliminate SF6 completely from their assets, some already by 2050, which is very ambitious since the lifetime of SF6 filled equipment is still in the 30 - 40 years range.

Therefore, the manufacturing industry has understood the concerns and is developing SF6 free technologies. At present, the innovation in this field focuses on the one hand on low-GWP alternative gases for insulation and switching, and on the other hand on vacuum for switching with compressed air for insulation. In recent years, two candidates emerge as alternative gases, which have been implemented into

high-voltage switchgear products running in pilot projects up to 170 kV. The first one is a gas mixture of around 5% of a newly developed fluoronitrile gas, 5% O2 and 90% CO2, having the commercial name g3™. The second gas is a mixture, called AirPlus™, of similar content of natural gases, but with around 5% of a fluoroketone gas. Both synthetic components have a far higher condensation temperature than SF6, which means that for high-pressure application in HV switchgear they must be diluted with a carrier gas, like CO2. Fluoronitrile being more volatile than fluoroketone, the g3 mixture enables lower temperature application in switchgear, whereas the AirPlus mixture has a much lower GWP.

Another difference with SF6 is the fact the effective (synthetic) component is consumed by arcing in switchgear. Whereas SF6 recombines after arcing, in the alternative gases the decomposition is irreversible. The amount of the synthetic component should be carefully considered during the lifetime of switchgear, especially that with high arcing activity such as circuit breakers. A common feature of both mixtures is that a higher filling pressure (of around 1 bar) is required and that the design – and often the footprint – of switchgear must be adapted to the type of gas used. In no way existing switchgear can be retro filled with any of the new gases.

By 2023, development is expected to touch the 420-kV level enabling "green" GIS stations, including busbars, GIL, instrument transformers etc. Circuit breakers applying only CO2 and O2, suitable for very low temperatures, have been developed as well, albeit with a significant higher pressure. The other alternative approach is using vacuum for fault current breaking and compressed air as outside insulation, marketed as CleanAir™ circuit breakers by one company. GIS/dead tank products up to 170 kV are reported, with development towards 245 kV progressing fast.

For testing, the present IEC standard, though developed technology independent, is strongly based on SF6. Whether the SF6 alternatives come with features that might need changes, is under study in CIGRE working groups, one dealing with switching explicitly, and another one dealing with dielectric performance. Both groups will publish their results over the course of this year.

KEMA Labs, in various locations, have ample experience in testing all types of SF6 alternative technologies in the medium- and high-voltage range. Many new products have been tested in our labs. The availability of the SF6 alternative gases is transferred to most existing manufacturers in the industry and is not the exclusive ownership of the product launching manufacturers. Newcomers and start-ups can come with innovative prototypes, but only thorough testing can turn these into solutions.

Our test engineers are aware of the complications that the new gas mixtures bring in, can handle the gases, and dispose the decomposition products safely.

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Erik De Jong

HEAD OF THE FLEX POWER LAB

Erik De Jong

Head of the Flex Power Grid Lab at KEMA Labs, Arnhem.

- Customer relations
- Key projects
- Testing in times of COVID

Hi Erik. We would like to get to know more about your role in KEMA Labs. Could you please describe it to us? What are your main responsibilities as Head of Flex Power Grid Lab at KEMA Labs in Arnhem?

"Sure, no problem. I have been working in the Flex Power Grid Lab since its inception in 2007. My main tasks have consisted of making the activities in the facility feasible by creating a commercially active environment. Today, as the head of the lab, I am responsible for all the activities carried out in the laboratory, which are dedicated currently to the testing (and - hopefully in the future - to the certification) of grid compliance for renewable energy sources to be connected to the grid. In short, my job has mostly to do with smart grids and RES implementation into the energy system. In this respect, my commitment is divided between two main tasks: on one side, there is the research part of the job, as the laboratory is a development area where cutting-edge technologies related to renewables and battery storage are being studied and assessed.

In fact, with the help of my team, we make sure that the industry chooses KEMA Labs' expertise to be able to facilitate the change of the grid with confidence. On the other side, I am required to keep the facility's testing activities relevant and up to date with prevailing (inter)national standards, in order to provide our customers with all the relevant test reports, for them to be able to sell the products that comply to the relevant grid codes. Furthermore, I take part in the standardization processes around the globe by contributing to the development and officialization of international standards in the field of interconnected grids. Moreover, I am an Associate Professor of Power Electronic Dominated Grids at the Technical University of Eindhoven, from which I usually select the most promising young engineers for CESI Group and to recommend them to customers globally."

These sound like multi-faceted and important responsibilities. For the readers to understand your tasks better, could you please share with us a couple of examples of crucial projects you are supervising?

"Well, now I am involved in two very big projects. One of them is lining towards the academic side: amongst the various EU Commission-funded projects, this project started in April last year and combines the knowledge and expertise of different European laboratories to improve the resilience of power grids. This project is particularly important to me, as it helps learning from each other on the different strengths and issues the power system is currently facing. In fact, I believe such cooperative initiatives are key for our business, as they allow us to stay ahead of the curve in terms of dealing with the ever-changing electric market and energy system.

The second big project mentioned involves the performance testing of battery storage system, in particular, a storage system of 2 MW/h we started testing on July 21st. Specifically, this project revolves around power quality and performance measurements that are compliant with the international regulations. The success of such activities will allow for an exceptional development in terms of battery storage systems."

What are your biggest desires and aspirations related to the activities you carry out at KEMA Labs?

"One of the best aspects of my job is that I can travel around the world and visit places that are usually off the beaten track (such as customer factories or laboratories in industrial areas and other undiscovered locations) for work. In this regard, I truly appreciate that my job allows me to travel around the globe, where I can discover new locations and spots that, as a regular tourist, you would not get the chance to see."

But today this is not quite as easy...

It really isn't, unfortunately. However, KEMA Labs is always committed to ensure the maximum support to manufacturers and utilities to achieve the goal of a resilient network by performing the top-quality type testing on T&D equipment according to global standards and customer specifications. In the current "new normal" times, we are committed to offer even more cutting-edge services that allows you to conduct testing campaigns without moving from wherever you are, saving budgets, and taking care of your employees' health and safety, such as the new revolutionary Remote L@b experience."

Flex Power Grid Laboratory – Arnhem

Aerial view of the KEMA Labs Facility in Arnhem, The Netherlands

TIC facilities: The driving force of power innovation

A journey through KEMA Labs facilities in the world.

Born simply as KEMA in 1927, with the main task to verify the safety and compliance of electrical components in The Netherlands, KEMA Labs has since grown into a worldwide network of industry-leading testing facilities and a trusted partner to the global power industry. At the end of 2019, CESI has acquired KEMA Labs and, since then, the Testing, Inspection and Certification (TIC) businesses of the KEMA and CESI SpA legacies have been fully merged to operate as one integrated Division under the CESI group.

Since the end of 2019, this newly formed Division operates under the brand name of KEMA Labs.

In order to enable complete harmonization between the laboratories with different historical background and legacies, a vertical approach has been adopted in the forming of the new organization. The whole of TIC business has been divided into three business units (BU), namely High-Power Laboratories (HPL), High Voltage Laboratories (HVL) and Service and Smart Technologies (S&ST).

The BU High-Power Laboratories, basically, perform all short-circuit and switching tests on power transmission and distribution equipment whereas the BU High-Voltage Laboratories are responsible for dielectric, temperature-rise, mechanical, climatic, environmental and include on-site testing as well. Moreover, the Service & Smart Technologies perform all kinds of tests on low voltage equipment, metering, protection, substation automation, digital, electrical vehicle equipment and, also, carry out inspection and certification activities at other external laboratories and in field.

Grouping the similar business activities of the legacy companies under a unique business unit gives us the possibility to operate them as fully integrated businesses and shape them to deliver. The teams in similar businesses spread across the legacy companies in several locations form a borderless technical and operational team under an operational Business head.

> *This helps to ensure uniformity in testing, evaluation and reporting at all locations*

by providing the customer with a service of the same high value and quality in their delivery. The customers can enjoy the same experience, irrespective of the individual laboratory/location.

Also, our Sales organization is fully integrated with a centralized process for making quotations and receiving orders from our customers. The test location is chosen based on the optimal suitability of the laboratory to the requested tests, test objects and customer needs.

For all the Testing, Inspection and Certification activities performed in our TIC Division, KEMA Labs Type Test Certificates and Reports will be issued.

The Arnhem Laboratories

KEMA Labs has evolved from an improvised installation in the annex of an old hotel in Arnhem in 1927 to the 2017's inauguration of the world's first facility for testing ultra-high voltage super grid products. Throughout the years, KEMA Labs has implemented cutting-edge technologies and innovations for the energy sector: from the first Short-Circuit and High-Voltage Laboratories, to the introduction of three-phase synthetic testing, which can test the circuit-breaker at a reasonable cost, i.e. a number of tests using a limited number of circuit-breaker specimens for the entire series of type tests.

In Arnhem have been introduced new facilities and techniques for testing automation systems, smart grid and HVDC products, as well as implemented continuous investment to deliver the highest power and voltage levels in support of the industry's migration to ever-higher transmission voltages.

Today, the KEMA Labs testing and inspections facilities include the world's largest high-power laboratory, with the highest short circuit power, the world's first laboratory capable of testing ultra-high voltage products for super grids; the Flex Power Grid Laboratory, for advanced testing of smart grids components.

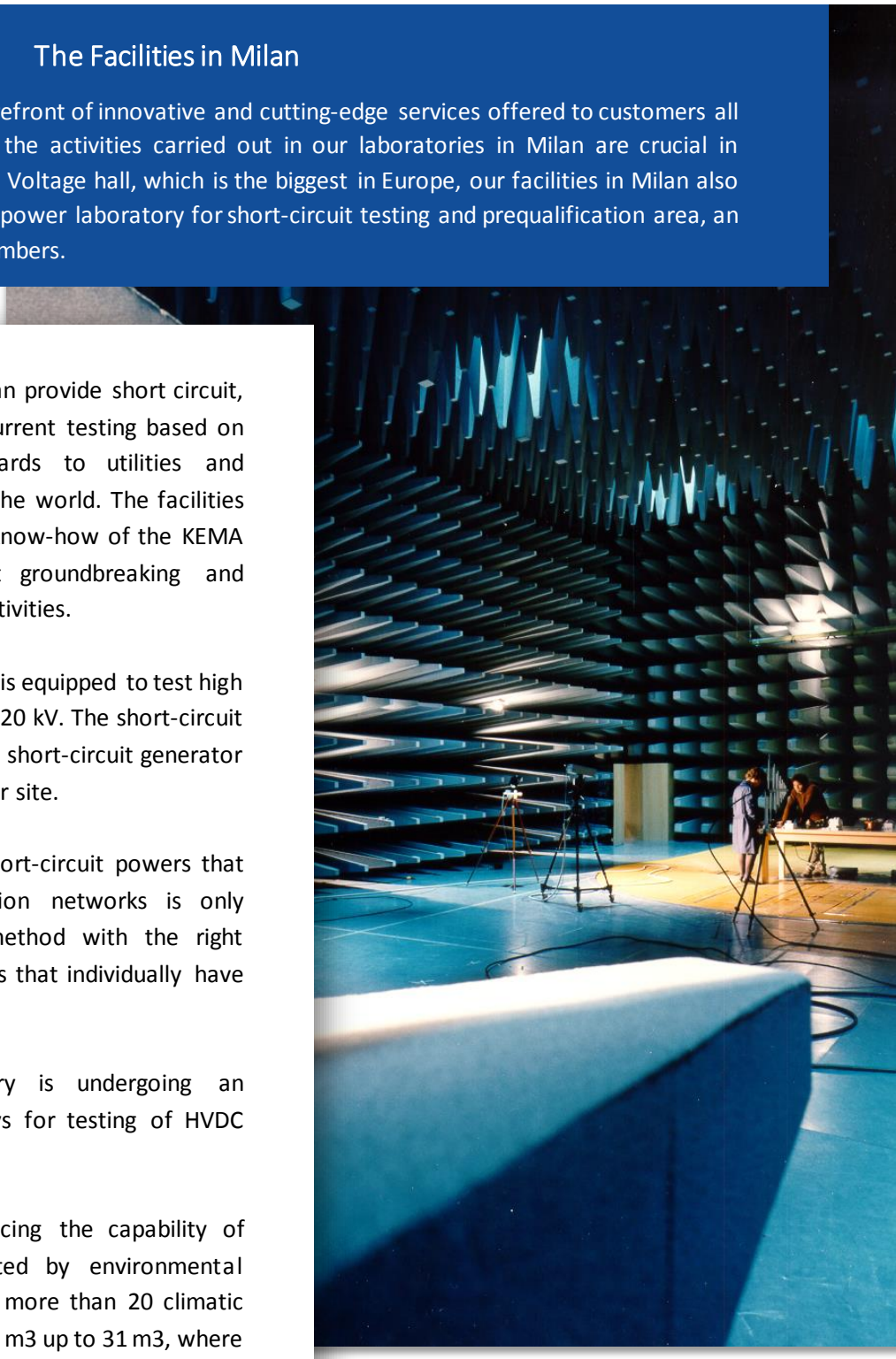
The High-Power Laboratory in Arnhem has recently extended its capabilities to 1.200 kV, which makes it the first facility in the world to offer extreme high-voltage and ultra-high-power testing.
Furthermore, it features the industry's highest short-circuit power (15.000 MVA), delivered by six generators in parallel: 800 kV power transformers and HVDC circuit breakers can be tested by reproducing the heaviest real network conditions.

In addition, the KEMA High-Voltage Laboratory guarantees medium-, high- and ultra-high-voltage testing by using state-of-the-art equipment and computerized control systems within a high number of flexible test bays.
The High Voltage laboratory is highly specialized for cables, transformers, insulators and instrument transformers. Outdoor testing bays are available for pre-qualification tests on high voltage cable systems Moreover, a third laboratory in Arnhem is dedicated to Metering Protection and Substation Automation: the facility offers complete range of testing for metering, protection and substation automation (MPSA) equipment.

In fact, KEMA Labs is a Notified Body for energy meter type testing according to the EU's Measuring Instruments Directive (MID) and accredited for testing according to many other standards.

The Facilities in Milan

Our KEMA Labs Division is at the forefront of innovative and cutting-edge services offered to customers all around the globe. In this respect, the activities carried out in our laboratories in Milan are crucial in different fields: aside from the High Voltage hall, which is the biggest in Europe, our facilities in Milan also include synthetic laboratory, a high-power laboratory for short-circuit testing and prequalification area, an anechoic chamber and climatic chambers.



Our High-Power Laboratories in Milan provide short circuit, switching testing, and short time current testing based on international and regional standards to utilities and equipment manufacturers all over the world. The facilities at our disposal, together with the know-how of the KEMA Labs experts, allow us to adopt groundbreaking and innovative approaches to various activities.

The High-Power Laboratory in Milan is equipped to test high voltage switchgear of ratings up to 420 kV. The short-circuit power for testing is obtained by both short-circuit generator and a 230-kV transmission line at our site.

In this regard, reaching the high short-circuit powers that are achieved in actual transmission networks is only possible using a synthetic test method with the right combination of two different circuits that individually have a relatively low power.

The main high-voltage laboratory is undergoing an extension project to include 2 bays for testing of HVDC cables.

Moreover, in order to avoid reducing the capability of equipment, which can be affected by environmental conditions, KEMA Labs can rely on more than 20 climatic chambers of different sizes, from 0.3 m3 up to 31 m3, where several kinds of electric and electronic devices can be verified, as well as two thermal chambers of 400 m3 and 750 m3 where ice and climatic tests on transformers, insulators, and high-voltage alternating current disconnectors can be performed.

Furthermore, as power transformers are the key components in the power production, transmission and distribution sectors, our laboratories play a crucial part in guaranteeing a precise and effective monitoring of the power grid's behavior and to keep high reliability of such systems in cases of extreme faults.

We can carry out complete type tests on Category I oil-immersed and dry-type transformers, short-circuit tests on Category II transformers up to 220kV and on Category III transformers up to 600MVA, 220kV, and 400kV, structural tests (vibration and seismic), according to recognized international and national standards.

In Milan, KEMA Labs implemented also a series of "light" laboratories dedicated to functional testing, as well as tests on communications protocols used in substation automation, monitoring systems, metering and e-mobility applications.

To complete the portfolio a new laboratory has been recently set up for proving batteries. Finally, among several accreditations KEMA Labs is Notified Body according to ATEX Directive 2014/34/EU - Equipment and protective systems intended for use in potentially explosive atmospheres.

> *The Berlin Laboratory is ahead of the curve in terms of Low-Voltage testing, inspections, and certifications.*

Inside our German facilities

The Berlin & Mannheim labs

Moving in the middle between Netherlands and Italy, we see that also Germany houses two of our KEMA Labs facilities, which play a crucial role within our business: The Low-Voltage Laboratory in Berlin and the High-Voltage Laboratory in Mannheim.

Located in the North East of Berlin, the KEMA Labs Berlin laboratories were founded in 1956 as a national German high-power test laboratory, also known as IPH Institut Prüffeld für elektrische Hochleistungstechnik, which evolved into a worldwide network of industry-leading testing facilities and a trusted partner to the global power industry. In 2005, the facility was acquired by CESI S.p.A. and it has now become a fundamental part of the recently born KEMA Labs division. Today, the Berlin Laboratory is ahead of the curve in terms of Low-Voltage testing, inspections, and certifications. In this respect, the Low-Voltage test facility comprises testing of switchgear and control gear, assemblies' components for railway applications and instrument transformers. In addition, KEMA Labs laboratory in Berlin is a house of innovative testing of automotive components aimed at supporting sustainable and electric mobility, as well as carrying out tests of DC and MV-products.

Furthermore, the facility includes several test rooms for different types of testing: high power and high-voltage tests, temperature-rise, mechanical and electrical endurance, dielectric, prequalification and environmental with DC and AC ($16^{2}/^{3}$-50-60Hz).

On the other hand, the Mannheim Laboratories are in the South East of the city of Mannheim. Founded as Studiengesellschaft für Hochspannungsanlagen (SfH) in Berlin back in 1921, the facility was relocated to the current placement in 1956 and renamed in FGH Engineering & Test, when the high-voltage and the modern high-power test laboratories were built. After the merger with Berlin Laboratory, which occurred in the early 2000s, the FGH Engineering & Test laboratories were acquired by CESI in 2005, to become part of KEMA Labs in 2020. The Mannheim facility includes the largest HVDC cables and accessories test laboratories in the world, where development tests, type tests, and prequalification tests can be carried out on a HVDC cable systems for power transmission up to 600 kV DC.

The outdoor facilities can hold several prequalification tests for AC cables and the indoor laboratories are suitable for dielectric and environmental tests. The laboratory is equipped with cutting edge testing equipment, which includes the main High-Power Laboratory, fed from the 400 kV Grid and the Short Circuit Power up to 600 MVA available, and three HVDC generators (800 kV, 1.200kV and 1.600kV; 20mA).

> *The Mannheim facility includes the largest HVDC cables and accessories test laboratories in the world*

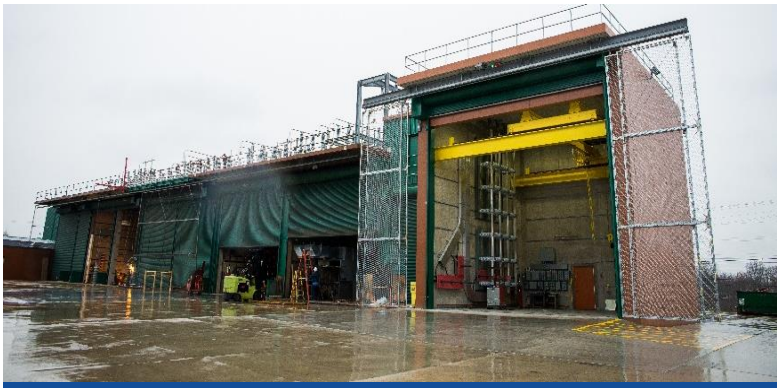
Aerial view of the Mannheim facility

KEMA Labs Chalfont

In March 2020, CESI completed the acquisition of the KEMA Labs facilities in Chalfont (Pennsylvania, USA). Chalfont's testing laboratories are the largest in the Americas and have 1,000 MVA and 2,500 MVA short circuit generators, a 1,500-kV pulse generator.

The KEMA Labs Chalfont Laboratory is a 68,417 ft2 facility located on seven acres in Pennsylvania, where the facility was established in 1972 by ITE Imperial Corporation of Philadelphia. The laboratory was later acquired by KEMA in 1990 and expanded to its current size, which includes a High-Power Lab, a High-Voltage Lab, test bays of various sizes and capabilities, control rooms, full-service machine shop, full-service material handling capabilities, and customer assembly facilities. The facility is fed by PECO 34.5kV service from the North Wales 366 feeder. The nominal apparent power consumption is determined by the PECO line and the sizes of three transformers in the 34.5kV substation rated 2.5MVA and 1.5MVA.

> *The KEMA Labs Chalfont Laboratory is a 68,417 ft2 facility located on seven acres in Pennsylvania*



Inside Chalfont's High-Power lab

HPL in Prague

Prague Laboratories, situated 15km east of the city, was founded in 1953 as part of the Research Institute of Czech Technical University. Its first synthetics installations and laboratories were commissioned in 1964. It specializes in testing low- and medium-voltage devices and has state-of-the-art high power and high-voltage laboratories.

The KEMA Labs facility in Prague, the capitol of Czech Republic, features two identical generators for parallel operation with power up to 2,500 MVA and the cutting-edge Static Excitation System up to 5 kA / 1,100 V. In addition, in the laboratories there are two transformers: a step-up transformer and a short-circuit transformer. Thanks to its test yards and test bays, the Prague facility can perform tests on HV disconnectors (80 kA / 3 s), Power Transformers (40 MVA 3-ph / 80 MVA 1,5 Un), MV components (12 kV / 50 kA; 24 kV / 25 kA; 36 kV / 20 kA), MV Fuses (12 kV / 80 kA; 24 kA / 63 kA; 36 kV / 40 kA), line traps and reactors (0,5 mH / 50 kA; 1 mH / 40 kA), and DC Test (200kA/2,25kV/330ms; 100kA/4,5kV/330ms).

Aerial view of the KEMA Labs Berlin laboratories

"Thanks to its Division KEMA Labs, CESI is the world leader for the independent Testing, Inspection, and Certification activities in the electricity industry."

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Aerial view of the KEMA Labs facility in Chalfont, USA

Cal Fire exemption tests

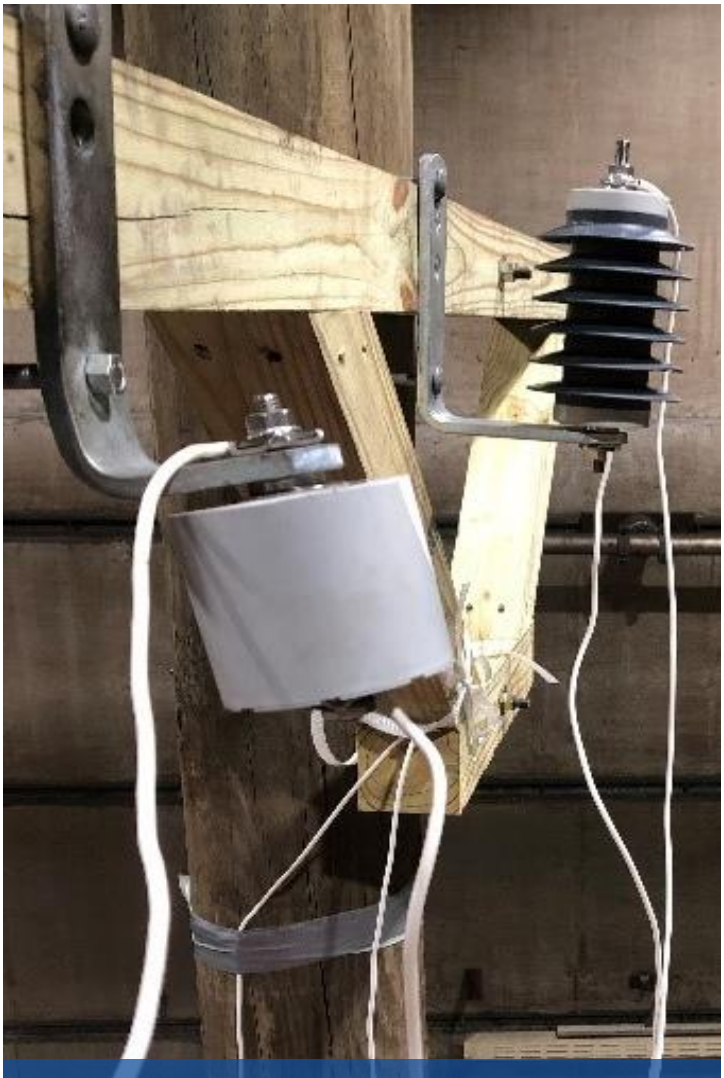
CHALFONT

KEMA Labs Chalfont was approached by Hubbell to perform exemption tests on transmission lines in California

Everybody around the world witnessed the deadly forest fires in California in 2018 which left over a hundred people dead and damaged countless structures and homes. One of the fires, called the Camp Fire named after its place of origin, was particularly catastrophic. It was the deadliest and most destructive wildfire in California's history and the most expensive natural disaster in the world in 2018 in terms of insured losses. Upon investigation, it was determined that the fires resulted from the utility's failure to maintain its electrical transmission infrastructure. Going forward, everybody around the world realized how important it is to properly choose electrical transmission and distribution equipment and maintain the installed infrastructure. In a continued effort to avoid situations like this, KEMA Labs Chalfont was approached by Hubbell to perform exemption tests for certain equipment installed on transmission lines in California. The California Department of Forestry and Fire Protection (Cal Fire) maintains a Power Line Fire Prevention Field Guide. The Guide provides for certain electrical components or installations which are exempt from the PRC 4292 Code which dictates a minimum clearance for pole/tower and also assigns additional restrictions depending on the potential fire hazard the equipment may pose. A manufacturer can however, request their equipment to be added to the exempt list after passing some rigorous tests in very specific conditions (as defined in the Section 9 of the field guide (2008 Version) and verified by a Licensed Professional Electrical Engineer. Hubbell approached KEMA Labs Chalfont with a request to do these CAL FIRE exemption tests in 2019 on their device, Hubbell

Fire Protection Disconnector (FPD), which gets installed along with Surge Arresters on power lines. The disconnect itself does not have any voltage rating but was to be tested with a 7.65 kV MCOV Surge Arrester. Generally, a surge arrester is placed in parallel with a device that it is protecting. Under normal circumstances, an arrester is a high impedance device, which allows only a few milliamps to pass as leakage current. When an arrester is exposed to an electrical voltage rise due to lightning or a surge, the metal-oxide varistor (MOV) - a protection component used to protect the circuit from high voltage spikes - blocks switch into an electrically conductive, low impedance state, and the surge current is diverted to ground.

Inside the Chalfont facilities



Surge arrester with disconnect

This action of the MOV blocks limits the voltage across both the arrester and the protected device, preventing damage due to overvoltage on the protected device. Following a surge, the arrester returns to the normal high impedance state. During a sustained overvoltage event exceeding its capability, the arrester leakage current is greatly increased.

As a result, the arrester may heat up to the point where it cannot recover and where it will thermally run away, at which point it will short-circuit, allowing all available fault current to flow through the arrester and expelling hot materials risking fires. For the exemption test, Hubbell requested KEMA Labs to test their proprietary disconnect that is installed between line (high voltage) side of the supply connection and the arrester.

When the arrester reaches its thermal limit, the disconnect will disengage the ground connection to the surge arrester permanently from the circuit before it fails completely upon reaching its thermal instability. The purpose of this test was to prove that the arresters equipped with this disconnect will limit any such arcs, sparks or hot materials sufficiently to prevent the ignition of flammable vegetation in the area of the installation. For the test, the circuit was configured to deliver approximately 6,800 Amps for 0.170 seconds (approx. 10 cycles) at a voltage of 12 kV. As previously described, Cal Fire exemption tests also required very specific high-risk conditions, which KEMA Labs achieved:

A 21 x 21 blanket fuel bed made with hay having a moisture content of 5%, to simulate flammable vegetation around the installation. The fuel bed was dried in the environmental chamber at Chalfont.

An ambient temperature between 70 and 89 ºF. Since KEMA labs is in Pennsylvania and the temperatures in October are lower than required, the test was performed in an enclosed cell heated to 85 ºF via portable heaters.

The wind speed required to perform the test is 10 MPH or more. A bank of six 42-inch industrial fans were used to generate the required wind speed.

The arrester was installed at an elevation of 22.5 feet on a wooden pole in an enclosed test cell as required in the field.

After verifying the setup by a third party Professional Electrical Engineer, KEMA Labs prepared to execute 2 tests on the unit, which were also monitored on High Speed Video, Digital Video and Infrared Camera (to trace any hot areas/projectiles).

In both cases, the surge arrester with the disconnect installed was energized at 12 kV L-G. Approx. thirty seconds after being energized, the disconnect operated without compromising the arrester. The fuel bed did not ignite and there were no indications of any hot material thrown from the arrester and/or disconnector during the test. The test was determined to be successful.

KEMA Labs compiled a Test Report that was sealed by a Professional Engineer. Hubbell submitted the certified Test Report to Cal Fire.

This brief case history demonstrates how important it is to be testing electric grids components to ensure that the grids themselves are more and more resilient. This at a time when extreme weather events due to climate change have increased considerably.

> *“The purpose of this test was to prove that the arresters equipped with this disconnect will limit any such arcs, sparks or hot materials sufficiently to prevent the ignition of flammable vegetation in the area of the installation.”*

The importance of seismic testing ...

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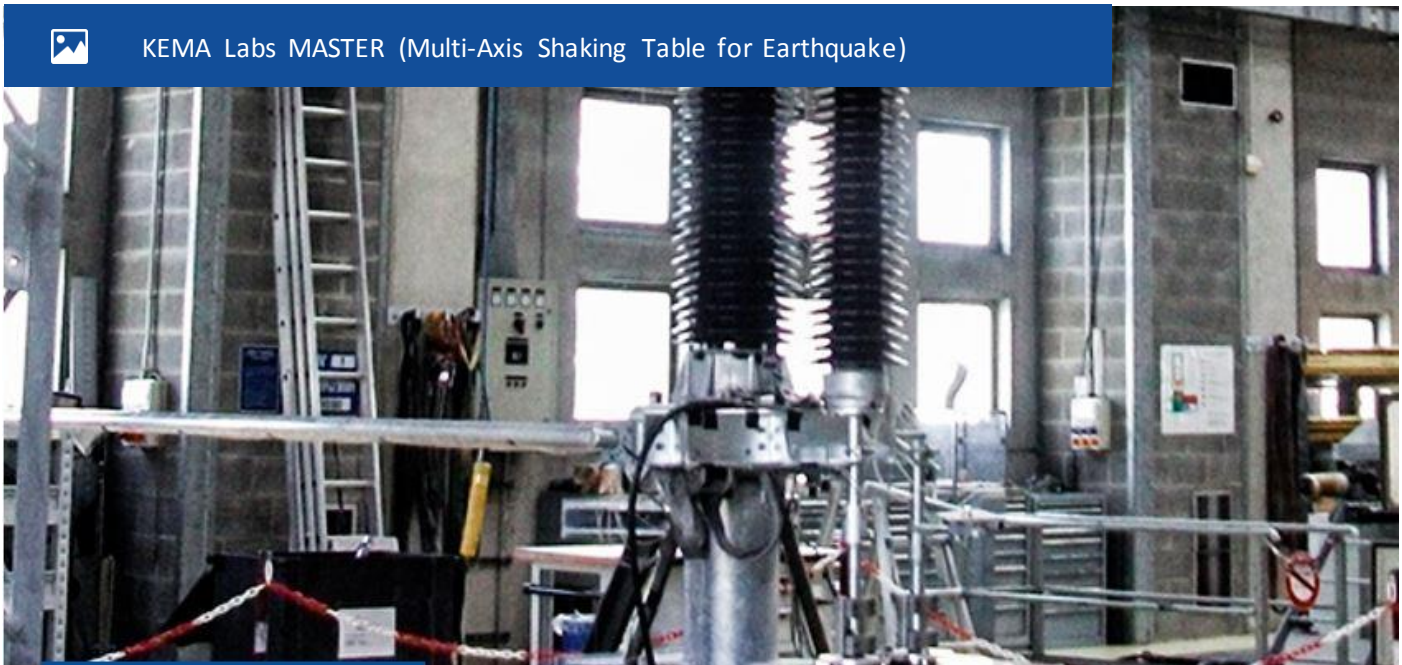
KEMA Labs has been performing seismic tests for more than 40 years

Seismic testing has a fundamental role for scientific research, which involves structural identification and performance definition of systems and components, amongst other fields. Within the structural and seismic engineering framework, the importance of experimental activities is assuming a key role in exploiting the development of new technologies, both for test execution and data acquisition and processing.

In this respect, the KEMA Labs MASTER (Multi-Axis Shaking Table for Earthquake Reproduction), one of the few 4000 x 4000 mm six-degree-of-freedom shaking tables in the world, can simulate an earthquake, the vibrations experienced by an automotive component on the road, the vibration of a transformer installed on the top of a wind turbine or other heavy vibration stresses. Indeed, KEMA Labs (CESI's Testing, Inspection and Certification Division) has been performing these tests for more than 40 years, as it is the earthquake test reference lab for low-voltage switchboards installed in several nuclear power plants under construction in France and UK.

Let us know your opinion by clicking on this link.

KEMA Labs MASTER (Multi-Axis Shaking Table for Earthquake)



Upcoming events

Europe Energy Week

June 15-17, 2021

Online

Europe Energy Week is a three-day virtual conference that will tackle the tough challenges the entire energy industry is facing today. During the three-day session, sector experts will discuss the regional challenges and opportunities in the journey of evolution and transformation towards decarbonized energy systems.

ENVEX 2021

July 8-10, 2021

Seul, South Korea

The 42nd International Exhibition on Environmental Technology & Green Energy. ENVEX is the biggest environmental exhibition in South Korea, hosting 43,000 visitors from around the globe. This year's exhibition will focus on the upcoming technological trends to boast renewable energy.

Smart Grid Forums
IEC 61850 Week, 2021

October 18-22, 2021

Gothenburg, Sweden

This year's programme will assist utilities in managing their IEC 61850 deployment programmes with 'replacement' placed firmly at the heart of their strategies, as the need to implement digital technologies and infrastructures has become paramount for the energy sector.

Experience Power

October 18-22, 2021

San Antonio, USA

The event will cover the full energy value chain for the power industry, delivering the best content and several relevant sessions and technology discussions.

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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