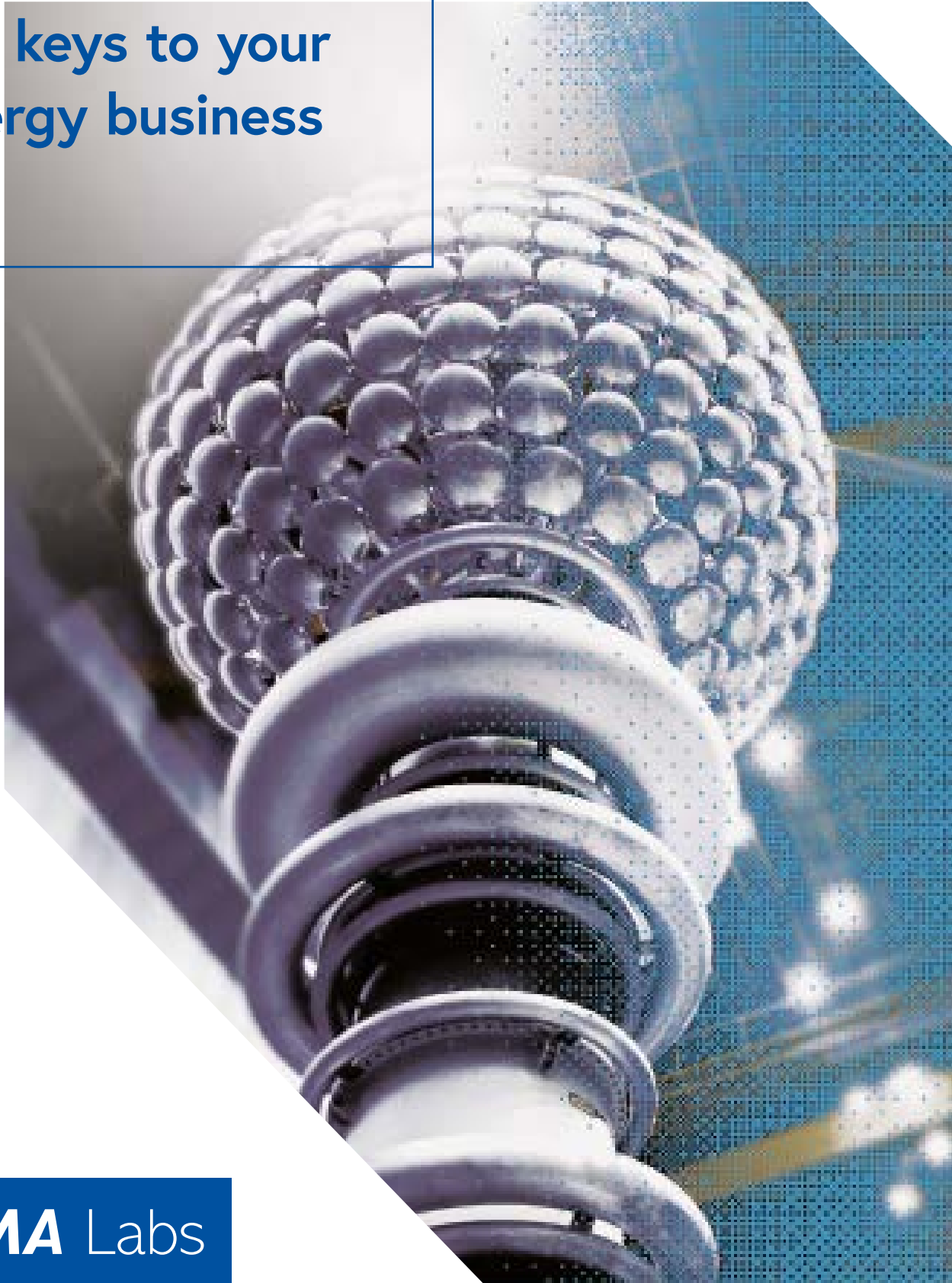


**Testing,
Inspections
& Certification:
the keys to your
energy business**



KEMA Labs

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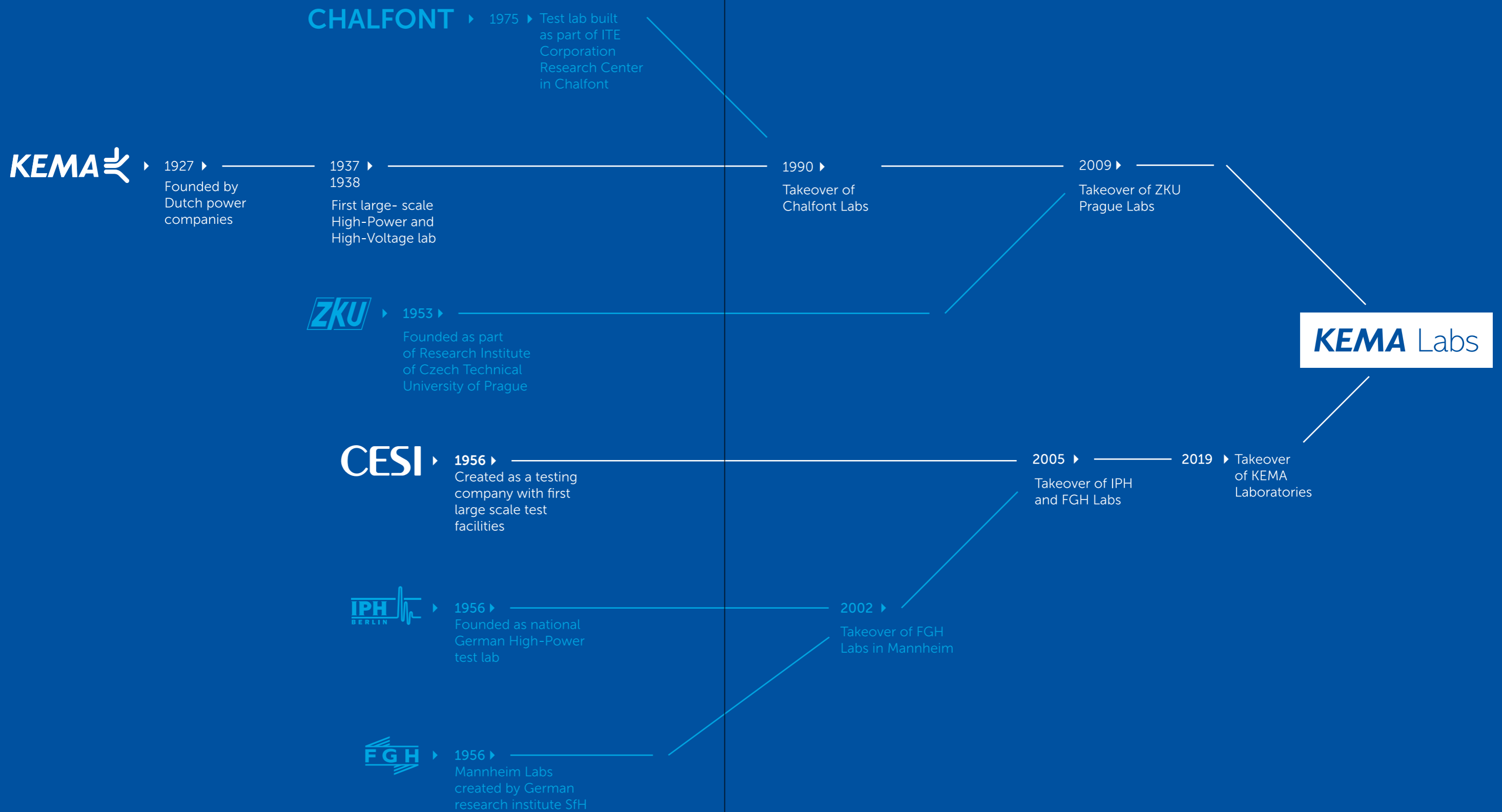
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Kema Labs and CESI history



Experts who share your energy future

KEMA Labs is CESI's world-leading Testing, Inspections & Certification Division. With sites across the globe, we combine tradition and experience with state-of-the-art equipment, meaning we can test all kinds of grid equipment, from low-to ultra high-voltage, satisfying today's increasingly demanding requirements for performance and safety.



▶ Never stand still

The energy industry never stands still and nor do we. We're continually investing in new facilities and innovative technologies to ensure that we can meet the ever-changing needs of the market. Manufacturers get the best resources for testing their equipment, and utilities can rely on the most up-to-date certification.

Our High-Power laboratory is the first facility in the world to offer extreme high-voltage and ultra high-power testing.

▶ Engineers who make a difference

With a long history of involvement in the world's energy grids, our test engineers understand both the equipment and the standards it must meet. They help you join the dots to see the bigger picture, offering manufacturers impartial advice on how to best interpret test results to help improve or enhance their designs.



Peace of mind for you and your customers

The modern world's dependence on electricity means power outages are simply not an option. They cause major issues for individuals, businesses and society as a whole. Service providers and utilities can take a hit to their reputations and suffer financially through fines and customers' costs. Outages can also result in health hazards, damage local or national economies, and have far-reaching effects on electricity trading.

The high costs of power outages

Society continues to demand more from electricity systems. The integration of renewables, international energy trading and cross-border networks mean longer transmission distances, which require higher voltages. They also require more complex MV systems and a change in philosophy around protection and control. In turn, this demands more advanced T&D equipment to deal with the changes. It is little surprise that the increasing scale and complexity of power grids makes outages more common, and more serious.



Proven reliability

Utilities have the challenging task of guaranteeing a reliable grid operation, while product manufacturers need to ensure their equipment performs to the highest standards. KEMA Labs offers competence, impartiality and a long history of technical experience gained through our testing activities and participation in technical committees, making us the ideal partner and the benchmark for testing in your sector.



Guaranteed impartiality

Our impartial services help ensure equipment operates to the highest international standards. Certification is based on testing to determine how equipment works in reality, not just in theory or with a simple computer simulation. It demonstrates that equipment will perform correctly under all network conditions, allowing utilities to provide the most reliable service possible.

First line of defence

Our globally recognised KEMA Type Test Certificates verify that all relevant performance and safety criteria are met. They provide manufacturers with proof of their components' quality and ability to comply with several international standards. By guaranteeing that certain standards are met, certificates make it easier to compare bids when looking for the most cost-effective solution, making doing business easier for everyone.



Certificates and reports

Whenever a component is tested at a KEMA Labs facility, the outcome is documented in a certificate or report. These test documents come in three colour-coded levels including the globally renowned KEMA Labs Type Test Certificate.



Gold seal

KEMA Labs Type Test Certificate

With its gold-embossed cover and gold seal, the **KEMA Labs Type Test Certificate is the hallmark of a high-quality component.**

It signifies that the component successfully passed all the tests according to the referred Standard's Type Test program, its technical drawings have been verified and a visual inspection has been carried out.

For utilities and network operators, **a gold KEMA Type Test Certificate says the component meets all requirements of the standard and no further effort is needed to assess it.**



Silver seal

KEMA Labs Report of Performance

A **KEMA Labs Report of Performance is issued when a component successfully passes a subset of a Standard's Type Test program**, its technical drawings have been verified and a visual inspection has been carried out.

Identified by its silver-embossed cover and seal, a KEMA Report of Performance tells the end customer that the component partly meets the requirements of the Standard's Type Test program.

The end customer may use these results and test program to determine if they are applicable and sufficient for their needs.

KEMA Labs Inspection report

For tests witnessed by our highly experienced inspectors outside our own facilities, we issue the **white KEMA Labs Inspection Report**. This kind of report covers a wide range of tests under ISO 17020 accreditation.

On request we even issue an **Inspection certificate**, one page, summarizing all inspections made on the component.



Grey seal

KEMA Labs Test Report

In all other cases where tests are performed at a KEMA Labs facility, a KEMA Test Report, with a grey-embossed cover and seal, is issued. This could mean **tests were performed according to the customer's specifications or that the tests did not fulfil the requirements of the Standard.**

It could also mean drawings were not provided or there was no visual inspection. When utilities and network operators see a grey KEMA Labs Test Report, they must read it carefully to assess the component's performance themselves.

This requires deep technical knowledge of standards and expertise on how to interpret them.

Circuit breaker testing

Safeguarding the electricity supply

No matter what actions and technologies are used to ensure safe and continuous grid operation, faults can still occur. When they do, it is crucial to limit damage and disruption to the grid by restricting faults to the affected part of the system. For this reason, circuit breakers are critical to ensuring a functional, reliable and safe network for transmitting and distributing electricity.

▶ Endurance tests

To ensure they fulfil their role of safeguarding the grid, circuit breakers need to be tested thoroughly and correctly. They must endure appropriate stresses replicating a variety of real-world conditions. The IEC and IEEE standards specify a host of short-circuit and switching tests, in addition to fundamental Type Tests such as dielectric, temperature-rise and mechanical tests.

▶ AC and DC

The number of HVDC interconnections is growing fast and the technology for HVDC circuit breakers is close to commercial use. KEMA Labs has the test facilities ready to test HVDC circuit breakers under the current and voltage stresses that occur in meshed HVDC networks.

▶ From LV to UHV

To short-circuit test circuit-breakers correctly requires extensive test facilities. KEMA Labs' facilities include the most advanced and comprehensive facilities for short-circuit and switching tests on circuit breakers, covering AC and DC, and everything from low to ultra high-voltages, including 1200 kV, 100 kA circuit breakers. We can also perform short-circuit tests on generator circuit breakers up to a breaking current of 300 kA rms.

▶ Unique facilities

Our state of the art facilities can recreate a wide range of normal and fault conditions, terminal fault conditions in a power network to apply the correct short-circuit stresses for even UHV circuit breakers.



Power transformer testing

Power transformers form the heart of electricity transmission systems. They need to perform with total reliability for decades at a time with virtually no maintenance. During their lifetime, transformers may experience extreme stress due to fault conditions that must not affect their normal service capabilities or life expectancy.

► No short-cuts to short-circuit tests

Testing power transformers for extreme fault conditions is very important in ensuring network reliability. The best way to verify the robustness of a transformer's design is full-scale short-circuit testing. This is because transformer performance depends not only on its design and theoretical limits but also, to a large extent, on the production process and workmanship. These latter factors simply cannot be verified by calculations, as confirmed by high failure rates during laboratory short-circuit testing.

KEMA Labs are equipped to test large power transformers with an extremely high short-circuit capability. Our facilities include a unit to fully cover 800 kV class transformers.

With power supplied by specially designed generators, KEMA Labs can offer excellent flexibility with a high degree of protection for the tested transformer. A very fast (a few milliseconds) protection system enables early identification of faults for easier design improvement.

► Objective testing

For even higher-rated systems, short-circuit tests can also be made on simulator transformers. These are carefully designed test objects that simulate stresses equivalent to full-scale testing, but only applied to the portion of the transformer to be tested.



Cable testing

Transmitting energy everywhere in a safe, reliable and efficient way

Today's T&D networks cover greater distances and carry more power, making cable quality even more essential to enable suppliers to meet the escalating demand for electricity. Power cables are becoming longer and larger in diameter, enabling higher voltages. Cable failures incur enormous costs, not just as a result of the power outage, but also because of disruption to roads and other services, and the length of time it takes to restore the system.



Quality matters

Cable systems may look simple, but they must function flawlessly for decades and withstand the harshest conditions. Stress on cables can affect their longevity, so the insulation must be high quality and joints and terminations must be designed to control the high electric fields.

Testing for a lifetime

To ensure quality we test the entire cable system, including joints and terminations. IEC standards define the most important test protocols. KEMA Labs can perform them all for you.

Type Tests verify normal operation. Experience shows that Type Testing every new combination is essential. Even when using separate cable and accessories that are certified, there is no guarantee the combination will work in the field. Therefore, we offer **pre-qualification for cable systems**, reproducing the complete lifecycle through 180 heat cycles at high voltage.

Our facilities can handle electrical tests on cable systems rated up to 550 kV, as well as non-electrical and **short-circuit withstand tests**. We can also test and certify HVDC **cable systems**.

Verifying installation

On-site testing of high-voltage and ultra-high-voltage cables is crucial when verifying correct installation. We operate two specialised series-resonant test facilities for testing (ultra) high-voltage cables on-site.



Low-Voltage assembly and product testing

Protecting the end user

For low-voltage (LV) panels and cables, quality means safety. These components are used in large industrial and residential applications and handle very high currents. Poor quality could lead to power outages or even fires. And any failure could be disastrous for the end user. Given their critical nature, verification is essential. However, not all verification processes give a true appraisal of a component's performance.



True appraisal by physical verification

KEMA Labs offers physical verification of LV panels and cables, based on actual testing under real-world conditions. Compared to simple “paper certification” – which only estimates performance based on documentation – physical verification provides a much more accurate assessment of panel performance and safety. This, combined with our KEMA Labs Type Test Certificate, provides the evidence you need to demonstrate that you deliver a premium product.



Global coverage in world class facilities

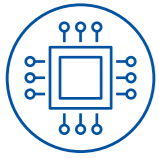
All assemblies are tested according to international standards, ensuring complete transparency. The tests cover mechanical, dielectric, short circuit and temperature rise effects. Tests can be carried out at both 50 and 60 Hz for global coverage. All testing is performed at our own world-class facilities.



Testing for digitalization

It's all about reliability

Electricity networks rely on the correct operation of intelligent electronic devices for energy metering, protection and control. As the world becomes ever more digital and the Internet of Things expands, the keywords for power stations and substations are functional performance, rugged electronic hardware design, real time communication, reliable data and data (cyber) security.



New technologies

New technologies are being introduced to develop digital substations and digital T&D components. Non-conventional instrument transformers with digital sampled value outputs are replacing conventional analogue devices. Circuit breakers have integrated intelligent electronic devices for protection, control and status monitoring. Power transformers are equipped with all kind of sensors to monitor factors such as temperature, oil pressure and current flows. New testing techniques have been developed to type test these integrated technologies in combination with the fundamental functional type testing.



Complete testing facilities

KEMA Labs are fully equipped for testing Intelligent Electronic Devices for their functional performance, communication requirements (IEC 61850), data integrity and data (cyber) security requirements, electromagnetic compatibility, product safety and environmental influences.



Additional testing

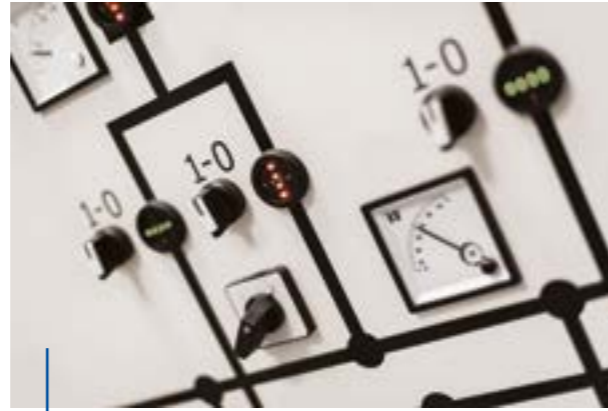
Covering the whole grid

Power grids rely on a lot more than just transformers, cables and circuit breakers. Because you can't leave anything to chance, our Testing, Inspections and Certification Services extend to a wide range of equally essential energy components, including, but not limited to:



GIS components

Gas-insulated switchgear (GIS) components – such as disconnectors, earthing switches and fast-acting earthing switches (FES) – can be tested for short-circuit withstand capability. We also provide several special assessments, including three-phase short-circuit making tests up to 420 kV rated FES, induced current switching and bus-transfer switching tests.



Medium-voltage switchgear

Our assessments for medium-voltage switchgear components include short-circuit, capacitive current switching, load-break and internal-arc tests. We also carry out dielectric and temperature-rise tests, meaning that all required tests for a complete Type Test Certificate can be performed.



Distribution transformers

We perform both routine and type tests for complete certification of both oil-immersed and dry (cast resin) distribution transformers, plus a range of additional tests that go beyond certification requirements.



Generator busducts

Characterised by their very high short-time current ratings, generator busducts efficiently distribute power to the system. Any problems with a busduct can lead to catastrophic damage and extensive downtime, so it is vital that networks can be sure of their quality.



Metering, protection and substation automation equipment

We perform standards-based certification of electronic and electromechanical energy (domestic and industrial) meters, electromechanical and digital protection systems and relays, and substation automation equipment. We also offer compliance testing for protocols, communications interfaces and cyber security measures.

Energy meter manufacturers wishing to sell their products can turn to KEMA Labs for assistance. KEMA Labs is one of the Notified Bodies authorized to grant certificates that are valid for most of the international regulations. The MID directive specifies the criteria that measurement instruments such as electricity, gas and water meters must meet according to international standards. KEMA Labs is notified body authorized to issue relevant certification to MID directive and more.

Fuses

Like circuit breakers, fuses clear over-current during fault conditions. We perform tests that can lead to full Type Test Certificates on both drop-out and current-limiting fuses, including dielectric tests and current-breaking test duties.



Surge arresters

Several of our centers can perform pressure-relief tests on both Design A and B type surge arresters. With our expanded facilities, tests can be performed with short-circuit currents up to 100 kA.



Seismic Testing

If you want to 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, you need 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.



Insulators and Bushings

KEMA Labs is the global leader in testing insulators and bushing to most existing standards. We have a long track record and deep range of skills, as well as a portfolio of pollution and salt fog test facilities. This includes one of the biggest salt fog chambers ever built.

Product inspection and certification

Given the constant innovation in component manufacturing, coupled with the tendency to design with minimal margins for error, component testing needs to keep pace. Manufacturers need to assure customers that their testing is carried out to the highest standards. We are your trusted partner to guide you through the quality assurance, conformity assessment and product certification process.

› High-quality inspections

Our experienced inspectors have extensive knowledge in the field of high-voltage testing. Their impartial reporting means manufacturers and utilities can trust the outcomes of test performances and the accuracy of test results.

Inspections are accredited according to ISO/IEC 17020 for all components used in transmission and distribution (T&D). We offer inspection services for Type Testing and Factory Acceptance Tests (FATs) according to internationally-recognised standards, and for tests conducted to your specific requirements such as main Utility Technical Specifications.

› Type Test

Type Tests are performed in accordance with a corresponding standard. They are executed in the same way, regardless of which laboratory they are carried out in. This is crucial to ensuring the standard's requirements are fulfilled. For this reason, assessment of the calibration system plus a review of the test set-up form part of the inspection.

› Factory Acceptance Test

FATs are among the most important checkpoints in the quality assurance process. While they are often based on international standards, they can also include some client-specific requirements. A completely new product may not be governed by existing standards, so test requirements are specified based on available information, completed by client approval.

› Globally trusted reports

Inspections can be carried out at any manufacturing, university or laboratory facility where international standards testing is possible. Having witnessed your tests, we provide a KEMA Inspection Report, recognised and trusted throughout the global industry.

› Explosive Atmosphere compliance Certifications

Safety is our paramount concern, particularly in fields such as explosive atmosphere certification, where KEMA Labs is the internationally recognised certification body. We assess and certify the compliance of your products and equipment, functional units and quality systems according to the requirements of European ATEX regulations and international IEC standards (IECEx scheme).





E-Mobility and Battery Storage

Powering our daily life as never before



▶ How would you run an entire country without oil?

Transportation will be the next sector to decarbonise, after electricity. There are a number of challenges to overcome before electric mobility becomes reliable and affordable. The rise of electric vehicles will bring huge changes to the electricity sector as well as the automotive industry.

These changes will not only involve vehicles. Mobility will need an interconnected, reliable and controlled infrastructure that can deliver energy to charge vehicles, known as Electrical Vehicle Supply Equipment (EVSE), while also interacting with the rest of the grid. KEMA Labs can help you navigate this new, uncertain and rapidly-evolving landscape and help you to prepare for the inevitable scale-up that is coming.

▶ Storing energy at the highest level

Energy storage allows you to use energy from the sun when it is dark and power from the wind when it is calm. As sustainable energy becomes more widespread, energy storage solutions are becoming essential to balance electricity supply and demand. Batteries are also the essential component that will enable the global roll-out of the electric mobility industry as a whole. Key factors that still need to

improve to allow the market to scale up are the length of time it takes to charge a vehicle, and battery range, lifetime and cost. Whether you are seeking to bring new products to market or improving an existing technology, the right partner is crucial.



▶ Don't bet on your future. FLEX it!

The combination of a growing proportion of power being generated from renewable energy and the imminent rise of electric mobility mean that voltage control is getting more complex and maintaining adequate levels of power quality for all users will be more onerous.

A small issue being underestimated during development or purchasing can cause large scale outages and unacceptable service interruptions. In the KEMA Labs FLEX Power Grid Laboratory, you'll take advantage of a fully controllable grid-equivalent Lab capable of operating over a wide range of frequencies, harmonics, voltages and power levels. Our facilities include a test bench for EVSE that can replicate electric vehicle charging operations, emulate the grid response to different events, test whether equipment has electromagnetic compatibility with the rest of the real world and reproduce a wide range of climatic, mechanic and heavy conditions. Building a more sustainable and green future is your challenge, but also our mission.

Global facilities



Milan

Headquarter offices of CESI Group and testing platform for synthetic testing, high power testing, cable prequalification area, anechoic chamber for EMC testing and more.



Mannheim

The facility boasts cutting-edge facilities for pollution testing, nine prequalification test lines for AC and DC cables and an HVDC test laboratory.



Arnhem

Arnhem's state-of-the-art facilities include high-power and high-voltage laboratories; metering, protection and automated substation laboratory; flex power grid laboratory and the material research laboratory.



Prague

This facility specialises in testing low-and medium-voltage devices, and also has state-of-the-art high power and high voltage laboratories.



Chalfont

The largest independent high-power test laboratory in the Americas, combining industry leading facilities with highly skilled and experienced test engineers.



Berlin

Our main facility for low-voltage testing and cutting-edge laboratories for high-power and high-current testing. The Berlin lab also has long experience in testing submarine cables, calibration testing and it has an on-site centre of excellence.

KEMA Labs

KEMA Labs, a **CESI** brand

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