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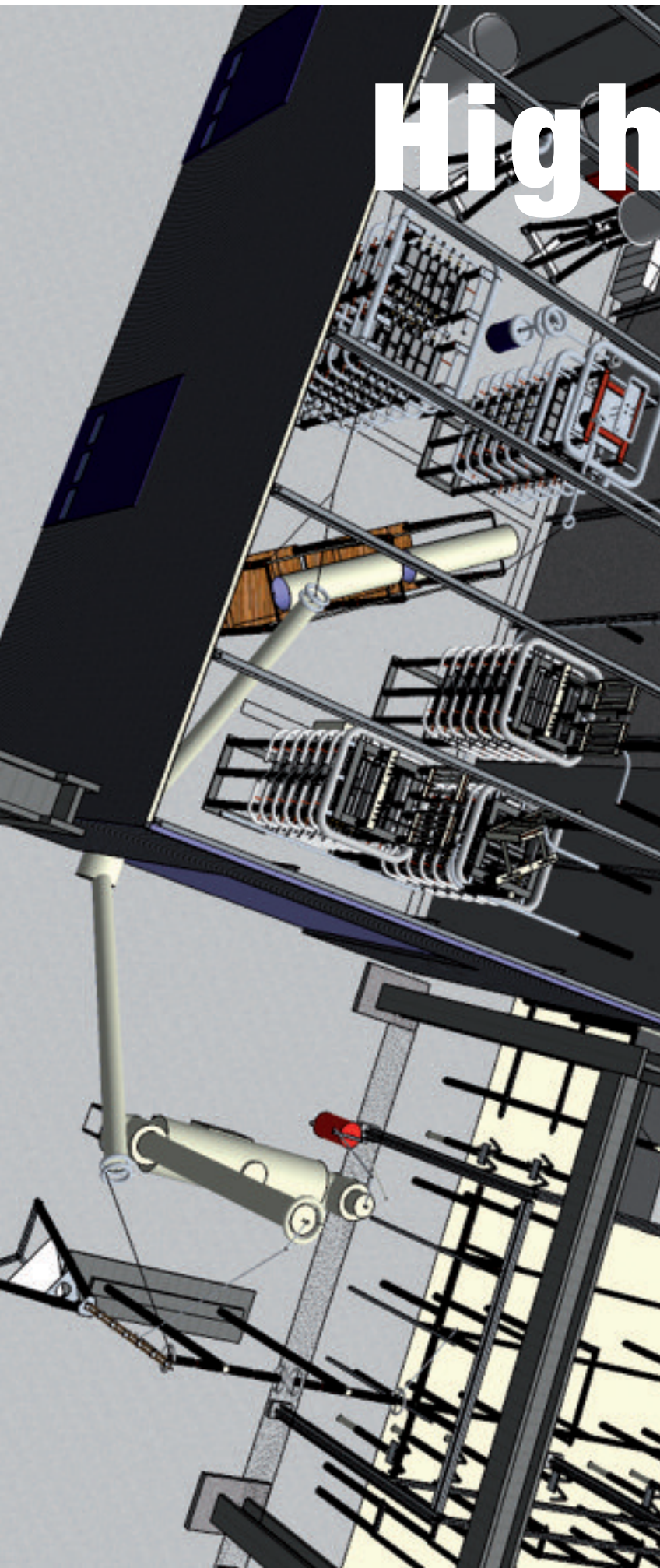
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Energy Storage Performance Testing – Grand Opening

On March 3, 2011 KEMA officially opened the new Energy Storage Performance Testing (ESPT) business in Chalfont, PA the home of KEMA Powertest.

KEMA hosted a grand opening celebration to commemorate the new business venture. The celebration included a day of presentations and panel sessions discussing energy storage and the benefits associated with independent testing. The event was attended by leaders in the energy storage field including those from manufacturers, utilities and governmental agencies.

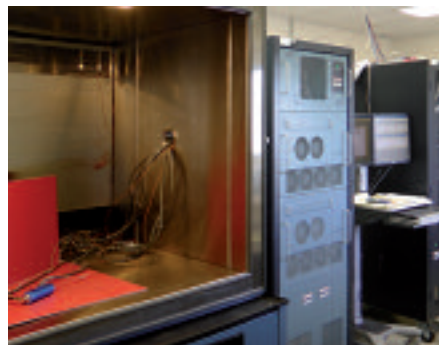
The ESPT business is designed to be much more than just a lab environment for testing. It is a comprehensive business which incorporates existing testing standards along with newly developed applications based testing protocols to allow testing of energy storage devices from the small component level up to the multi mega-watt system level. As defined in the testing service line name, ESPT focuses on performance testing of energy storage devices. The performance testing works

to validate technologies for their intended applications. For example, an energy storage device that is intended to support a solar farm would be tested using profiles and models generated from actual solar installations.

The system level testing lab is a truly unique testing facility. The lab is capable of testing up to a 2 MW size energy storage

system. It is interconnected to the local utility and has access to pricing and frequency regulation signals from the electric grid. The data acquisition system allows for the capturing of over 200 data points. This high number of data points will allow the comparison of data gathered from individual components to data generated from the overall system.

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Flex Power Grid Laboratory (FPGLab) turns up the heat for transformers and harmonics

An increasing number of distributed energy resources (DER), which include storage systems, are being connected to the grid by means of inverters. This is already evident in countries with dedicated stimulus programs, such as Germany who has seen the amount of PV-production increase significantly over the last few years.

Distribution grid equipment such as MV/LV transformers could be exposed to more severe power quality phenomena such as increased total harmonic distortion (THD) when inverters, especially those with sub-standard emission levels, become commonplace in low- and medium-voltage distribution grids. In this situation the transformer (and remaining grid equipment) will be exposed to extra losses due to the harmonic content, which will, apart from the audible noise and vibration, result in increased operating temperatures and a reduced power capacity.

The FPGLab in cooperation with Alliander has performed research to quantify the thermal effect of an extensive range of



individual harmonics (all harmonics up to the 15th with the maximum allowed voltage amplitudes according to the EN50160) on specific parts of a 250 kVA, 10/0,4 kV distribution transformer in detail. The FPGLab facility provided the harmonics on-demand on both the MV and LV side of the transformer at full-load. Temperature sensors (fibre-optic as well as PT100) specially installed throughout the transformer internal structure recorded the various temperatures.

Power loss contributions up to 11% of the total power for the 9th and >5% for the 3rd harmonic were recorded. Notably, the combination of 5th and 7th harmonic (six-pulse bridge) resulted in a relatively low 4% loss contribution.

The results obtained are used together with other transformer data to verify specific models for use in grid-planning and asset management. <<



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New facility for ultra-high-voltage testing

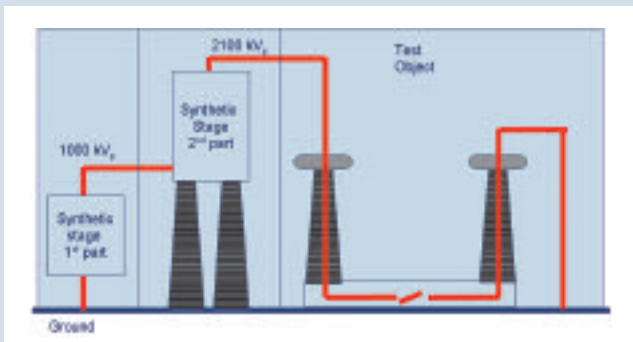
Investment in this new facility is needed in order to anticipate new market developments in North America, China, India and South Africa. In these regions, electricity is transmitted over extended distances. Power plants, such as large-scale hydro plants, are often in remote locations, far from the densely populated areas where the demand for energy is still growing. To transmit the electricity without excessive losses, HVDC lines are being erected and UHV AC lines are being installed or renewed.

In 2008, KEMA tested a Siemens 1100 kV circuit-breaker full pole for the first time. Short-circuit tests with a transient recovery voltage peak of 2,1 MV_{peak} had never been tested before. Now it's time for the next step. It takes a lot of space and time to build and dismantle UHV circuit-breakers and test equipment. Therefore, it makes economic sense to have a dedicated facility to house the test equipment. Test objects – which can be up to 14 meters high – can then be prepared and tested on the open test location. This makes both 'normal' testing and UHV testing more efficient. A fixed setup in a separated facility also significantly increases safety conditions. In the new synthetic plant, the capacitor banks and reactor are mounted on isolators several meters high, preventing flashovers to the ground.

The new synthetics plant and the existing facility are together capable of generating transient voltages up to 2,1 MV_{peak}. The test circuit is designed so that the full voltage is on one side of the circuit-breaker and the other side and the tank of the circuit-breaker connected to ground potential (see inset item). This simulates the field conditions in the most realistic way. The IEC 62271-100 is preparing an amendment especially for rated voltage levels of 1100 and 1200 kV. This will be decided by a taskforce in which KEMA is also participating.

The new building will be completed this spring. Over the summer, the UHV equipment will be moved to the new location, ready for the first circuit-breaker tests in the autumn. KEMA's new synthetic plant will be used for more than just UHV circuit-breaker testing. Three-phase synthetic tests on circuit-breakers will also be possible at rated voltages up to 245 kV.

Construction of the test facility is in line with our strategy of reinforcing our leading position in short-circuit breaker testing and offering our clients higher-voltage test capabilities. <<



Principle test set up of the ultra-high-voltage testing solution demonstrated by KEMA up to 1200 kV rated voltage.

In this diagram, a two-stage synthetic set up is given for full pole short-circuit tests on circuit-breakers with a metal enclosure. The first stage is made by the existing synthetic plant. The maximum transient peak voltage of the first stage is 1000 kV_p. The second stage is made with the new synthetic plant. The maximum transient peak voltage of the second stage is 1100 kV_p. When both stages are triggered at the same time, two parameter transient voltage peaks of 2100 kV_p can be made. By delaying the second stage, four parameter transient voltage forms can be made as well. With this solution the full voltage is supplied to one side of the circuit-breaker. The other side of the circuit-breaker and the metal enclosure are connected to earth potential. The voltage to the metal enclosure is tested correctly as well. This is an important requirement for short-circuit testing of circuit-breakers with a metal enclosure.

Autorecloser type testing: circuit-

Automatic circuit reclosers (autoreclosers) are a good solution for protecting overhead medium-voltage power lines. Given the increase in voltages and currents and the use of power electronics, the testing of switches has become an increasingly big challenge. As the KEMA laboratories are well equipped for high-voltages and currents, manufacturers of autoreclosers have come to the right place for a complete type test at the High Power and High Voltage Laboratories.



In Europe, most of the medium-voltage network is underground. In places like the United States, Australia and Brazil, overhead MV lines are still common, particularly in remote and rural areas and where the ground is solid. These circuits are prone to transitory faults such as nearby lightning strikes, wind-borne debris, animals climbing the insulators, and extreme weather conditions. With a conventional circuit-breaker or fuse, a transient fault would open the breaker or blow the fuse, disabling the line until a technician could manually close the circuit-breaker or replace the blown fuse.

An **autorecloser** is a circuit-breaker equipped with a mechanism that can automatically reclose the breaker after it has been opened due to a fault. An autorecloser can make several pre-programmed attempts to re-energize the line. These steps are repeated several times in accordance with the sequence O-t-CO-t'-CO-t''-CO. If the transient fault has cleared, the autorecloser's circuit-breaker will remain closed, and normal operation of the power line will resume. If the fault is some sort of permanent fault – downed wires, tree branches lying on the wires – the autorecloser will exhaust its pre-programmed attempts to re-energize the line and remain tripped off until manually commanded to try again.

The majority of faults on overhead power lines are transient and can be cured by autoreclosing. The result is increased availability of supply. There is also a tendency among network managers to increasingly install these automatic switches in the masts of the medium-voltage network.

Electronic protection and control circuits

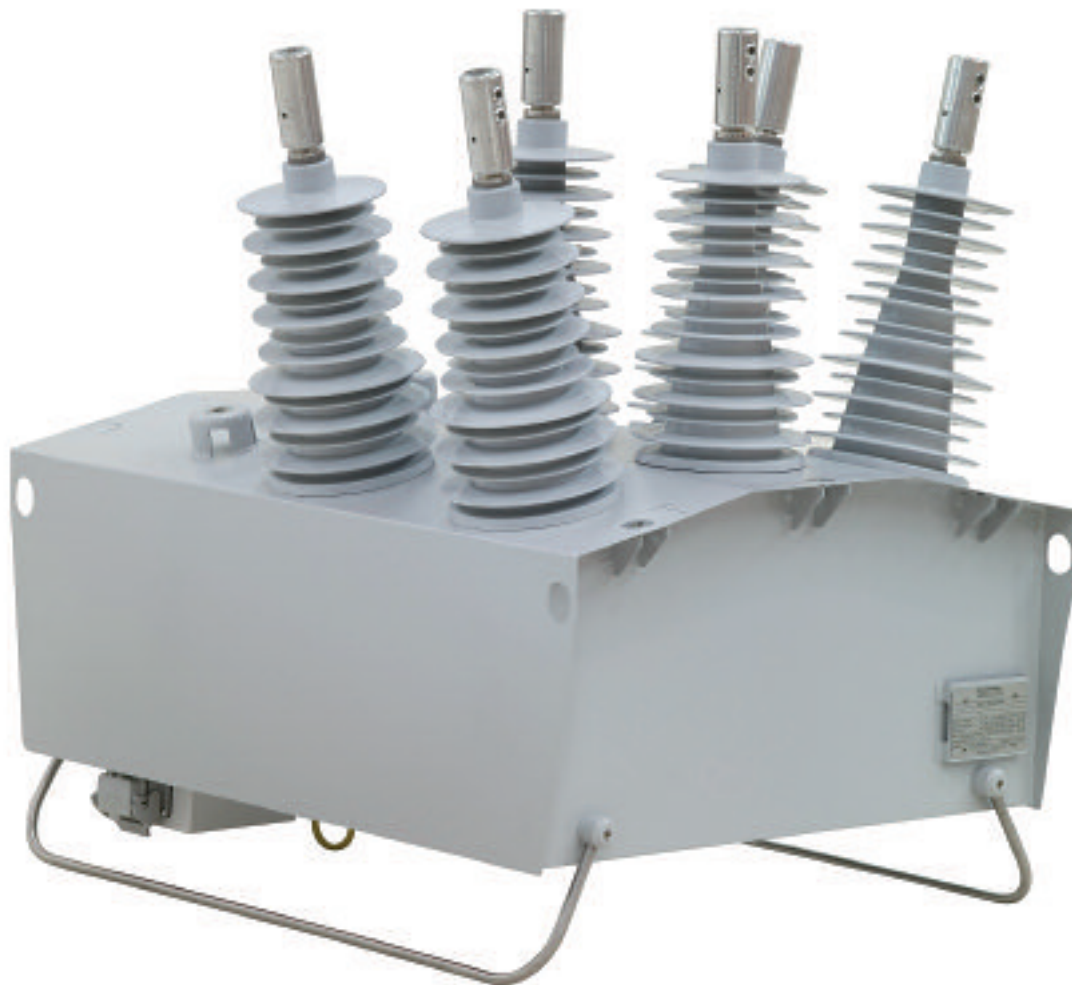
Autoreclosers must as a matter of course be extremely reliable. Not only must the primary component, the switch, do what it is supposed to do, but the controller, the secondary system, must also be such that the hardware carries out the correct action at the right time. Testing and certification was initially governed only by the IEEE standard. This was taken over one-to-one by the IEC in 2005.

Testing and certifying these autoreclosers is a specialist undertaking. Over recent years an increasing amount of

Special features for protection and control testing

- **Test programs for all types of protection relays and substation automation equipment based on international standards (IEC and IEEE)**
- **Automatic conformance testing: static and transient accuracy and reset ratio, static and transient operating time and reset time, influence of DC-component, frequency and harmonics**
- **Automatic performance testing: influence of SIR, high-resistive faults, influence of CT transient due to core saturation with and without remanence, influence of CCVT transients due to sudden voltage collapse, influence of arc faults**
- **Extensive test capabilities for EMC tests, climatic tests and mechanical tests**
- **Extensive test capabilities for product safety tests: dielectric performance, degree of protection, dynamic and thermal tests of measuring inputs, electrical and mechanical endurance tests for output circuits**

-breaker meets power electronics



digital electronic equipment has been added to the operation of the autoreclosers. These intelligent electronic devices are slowly but surely replacing electromechanical operation and are thereby providing meaning to the concept of smart grids. In addition, voltages and the current being passed through the medium-voltage networks are increasing.

Total system

All of this means that testing these components is becoming increasingly complex. After all, the primary and secondary systems cannot be regarded separately. These Intelligent Electronic Devices control the autoreclosers by means of digital interfaces. The characteristics of the hardware and software impact on each other. Whenever something in the electronics and/or firmware changes – and this occurs regularly – this has consequences for the characteristics of the switch in combination with the control unit. And whenever current is increased, this can influence the behavior of the electronics, such as switching time. The important thing is thus to apply the type test certification to the entire system. This involves both short-circuit testing

and voltage testing. For higher power capacities – up to 38 kV/ 31,5 kA - KEMA is one of the few companies that has independent laboratories that are able to conduct all of these tests in house. For the short-circuit trials, power has to be kept at the same level for a longer period of time. Powerful short-circuit generators are needed for this, which few laboratories possess.

Fingerprint

The tests conducted in the High Voltage Laboratory include, among other things, (efficiently) determining the time-current characteristics and the electromagnetic compatibility (EMC). KEMA has developed the ‘fingerprint’ as an addition to the existing drawing verification. This is a method to ascertain the typical characteristics of the autorecloser (combination of switch and control unit) in such a way that it is possible to compare earlier readings in the case of changes to the hardware and/or firmware. This is the more relevant, as the electronics have a shorter lifecycle than the switch. By conducting tests on a spot check basis, it can be determined whether the same product is involved. <<

New MID Notified Body number for our Calibration and Metering Laboratory

The Calibration and Metering Laboratory (C&M Lab) received a new number as Notified Body according to the European Measurement Instrument Directive (MID) from Brussels. Consequently, C&M Lab is now authorized to issue our certificates for energy meters showing:

CE **M11** 2290



Looking at Type Testing of kWh meters, all knowledge and most of the equipment needed for these tests were concentrated at the C&M Lab. New EU legislation (2010) obliged us to also have a 17020 accreditation to get a NoBo appointment.

There are 100-dreds of millions kWh meters to be installed all over the world: smart meters. And there are even more meters already installed; you will find it in every house or building connected to an electricity supply.

Each meter should do its job in a reliable way for at least 20 years or more, as there is a lot invested.

Our lab can Type Test and certify new kWh meters, both the mechanical and electronic ones according to IEC, ANSI and EN standards. IEC is used worldwide; ANSI in the USA and MID give access to all European countries. The C&M Lab can support you in choosing the right test program, focusing on your markets of interest. Like test according to MID and you get an IEC certificate.

Apart from Type Testing we also offer other services concerning (smart) meters. We mediate in disputes concerning meter readings; we can calibrate meters on location and assess measurement installations. We also developed statistical methods to control large amounts of energy meters and correct functioning during the years. <<

Events

CIRE
6-9 June 2011
Frankfurt – Germany

JICABLE 2011
20-23 June 2011
Versailles - France

KEMA Academy

Training course Switching in power distribution and Transmission systems
20-22 June 2011
Elektrum Arnhem - The Netherlands

More info:
KEMA.academy@kema.com



Universal Cables Industries Ltd

The cable company Universal Cables Industries Ltd., from India executed a prequalification test on a 220 kV cable system. For them this is a milestone being their first ever performed prequalification test. The test was executed at the laboratory of the State Grid Electric Power Research Institute in Wuhan, China. KEMA inspectors witnessed the execution of the test during a total period of 13 months. They visited SGEPRI on a monthly basis to check and evaluate the progress. In November the complete PQ test finished successfully and the Inspection Report was handed over by René Blokhuis to Mr R.C. Agrawal of Universal Cables Industries Ltd. <<



Taihan Electric Wire Co., Ltd

Taihan Electric Wire from South Korea successfully completed a one year long pre-qualification test on a 2500 sqmm enamelled copper 400kV XLPE cable system. The test was witnessed by KEMA in accordance with IEC 62067. <<



TECO Electric & Machinery Co., Ltd.

In February 2011 TECO Electric & Machinery Co., Ltd. from Taiwan successfully tested their 15 kV-12 kA SF₆ load break switch (LBS) for short-circuit performance at KEMA Powertest in Chalfont, PA, U.S. <<



Zenergy Power Inc.

Zenergy Power Inc. of Burlingame, CA, U.S. tested their fault current limiter at KEMA Powertest Chalfont, PA, U.S. for AC voltage withstand, insertion impedance, loss measurement and short-circuit withstand. The fault current limiter is used to protect electrical equipment from damaging power surges caused by short-circuits, power generation disturbances, or lightning strikes. Fault current limiters enable load growth and generation expansion without the need for expensive electrical upgrades or replacements. <<



BHEL India

Inspection Services witnessed the successful routine test and visual inspection after short-circuit tests on BHEL India's 220,6 MVA, 16,5 to 420 kV three-phase step up generator transformer.

The generator transformer was tested at KEMA's High-Power Laboratory and will be placed in a Pragati Power Company Ltd. power station in India. <<



Elsewedy Cables (Transformer Factory)

Last year Elsewedy Cables (Transformer Factory) successfully tested a 125 MVA transformer, rated voltage $220 \text{ kV} \pm 8 \times 1,25 \% / 72,5 \text{ kV} / 24 \text{ kV}$. The short-circuit tests were performed in the KEMA High-Power Laboratory and Inspection Services witnessed the routine tests and the visual inspection at Elsewedy Cables, Egypt. A Type Test Certificate of Short-Circuit Performance will be issued. <<



Siemens India

The Siemens transformer factory in India successfully short-circuit tested its first 315 MVA 400 kV autotransformer at KEMA's High Power Laboratory. Whereafter the routine tests and the visual inspection at the factory were also successful. The transformer will be placed in Powergrid Corporation of India Limited, 400/220 kV Gwalior Substation, India. <<



Virginia Transformer Corp.

Virginia Transformer Corp. Roanoke Virginia, U.S. successfully short-circuit tested their 1.638 kVA dry type 34.5 kV, 170 kV BIL, 3 winding transformer for extra heavy duty traction application at KEMA Powertest Chalfont, PA, U.S. per IEEE/ANSI standards. Virginia Transformer Corp. manufactures both dry and liquid filled traction power transformers in addition to utility and other application transformers. <<

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