

connect

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transformers across the grid



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Publisher

PFISTERER Holding AG
Rosenstrasse 44
73650 Winterbach
Germany
Tel: +49 7181 7005 0
Fax: +49 7181 7005 565
info@pfisterer.com
www.pfisterer.com

Editorial Team

PFISTERER Kontaktsysteme GmbH
Rosenstraße 44, 73650 Winterbach

Harald Cuber, Andreas Dobler, Natalie Fischer,
Volker Janzen, Leif Johansson, Bernhard
Kahl, Peter Kaiser, Michael Keinert, Andreas
Kussmaul, Lena Miunske, Peter Müller,
Martin Schuster, Martin Sossau, Christian
Späth, Frank Straßner

Text concept and text editor

Karolina Kos
www.xyzeiler.de

Sympra GmbH
Agency for Public Relations
Stuttgart

Art Direction

VISCHER & BERNET GmbH
Marketing and Advertising Agency
Stuttgart

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Michael Keinert

Editorial

Growth for strong grids

PFISTERER is growing – in output power on behalf of our customers: The acquisition of LAPP Insulators places us in a leading position in the insulator world market, with an unmatched broad range of products and even more expertise for advanced complete solutions (page 4).

We are utilizing our more than a century of experience with power networks in the new microgrids business. And that business is taking off with CrossPower: The hybrid energy system allows the provision of decentralized regenerative energy even in remote locations (page 8).

While our tried and tested connection solutions in the area of high voltage continue to expand (pages 18 and 19), the AVU Netz GmbH power transformers are being used in flexible ways – across the grid thanks to CONNEX (page 12).

We hope you enjoy reading about the exciting prospects. We are always prepared to be an effective partner for your power network needs!

Best regards,

Michael Keinert

Member of the Board
PFISTERER Holding AG



Concentrated expertise, complete systems and future plans

In October of last year, PFISTERER announced their acquisition of LAPP Insulators. The merger enables the company group to move into a leading position in the world market for medium and high voltage insulators. In an interview, Dr.-Ing. Bernhard Kahl, General Manager of LAPP Insulators and head of the Overhead Lines Technology division at Pfisterer, and Michael Keinert, member of the Board of Directors at PFISTERER, provide an outlook on future developments and draw initial conclusions about the collaboration so far.

Mr. Kahl, Mr. Keinert, you are both experts on high-voltage connections. How is the connection between the two companies going after the first six months?

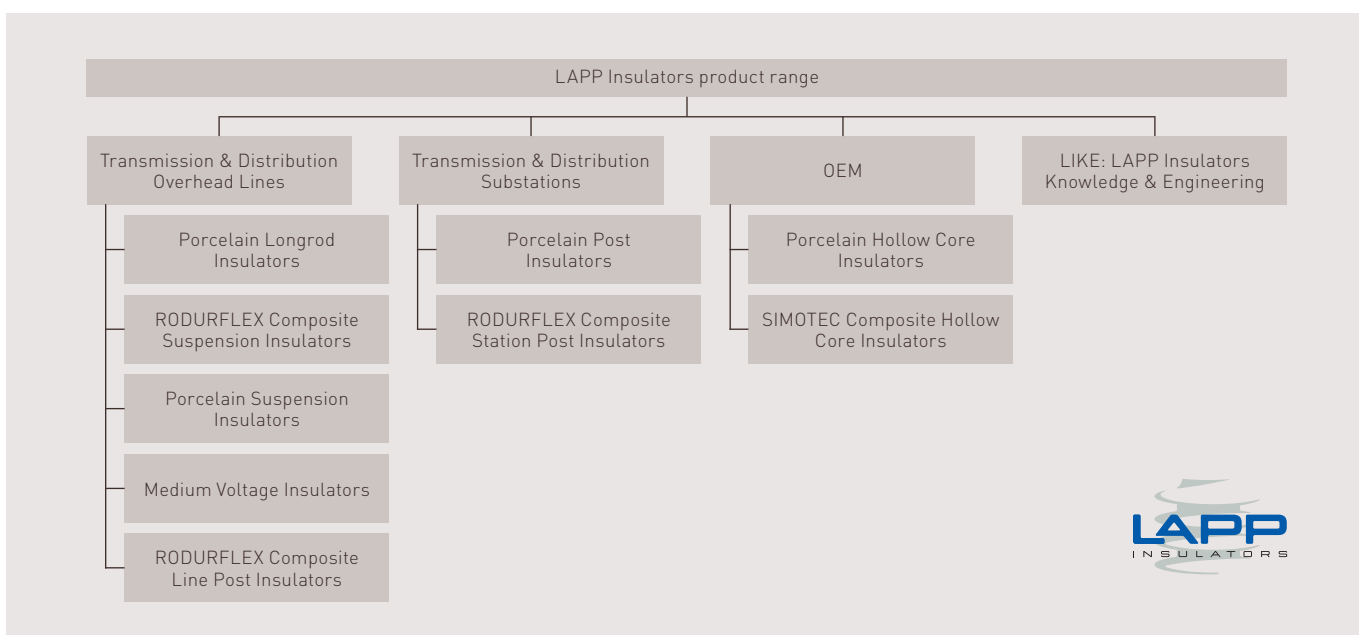
Bernhard Kahl: The personal interaction with the employees is very good. We felt a positive working atmosphere from the very beginning. Naturally, it's a big undertaking when two companies of about the same size merge. Our advantage is that the corporate cultures of LAPP Insulators and PFISTERER are quite similar. The customers' reaction has also been uniformly positive. LAPP Insulators had several changes in ownership, which also included financial investors. With PFISTERER we are now part of

«With PFISTERER we are now part of a family-run, industry focused company once again. That engenders trust and long-term security – and we are feeling the resulting momentum now.»

Dr.-Ing. Bernhard Kahl
Managing Director of LAPP Insulators Holding GmbH

a family-run, industry-focused company once again. That engenders trust and long-term security – and we are experiencing the resulting momentum.

Michael Keinert: We are already being broadly perceived as one company now, which we are very pleased about. What is important: The previous customer relationships will continue as usual, both at LAPP Insulators and PFISTERER – as innovative partners and reliable suppliers. We were already the two leading technology companies, and we have only become stronger through the merger: PFISTERER's product range now also benefits LAPP Insulators' customers and vice versa. Not all customers need everything we offer, but our comprehensive expertise can provide all customers with added value.



«We are already being broadly perceived as one company now, which we are very pleased about.»

Michael Keinert
Member of the Board of PFISTERER Holding AG

What were PFISTERER's motives for acquiring LAPP Insulators?

Michael Keinert: The acquisition was an important component of our growth and investment program "PFISTERER Next Level", with which we pursue the goal to grow in familiar areas, but also into new ones. That includes the area of overhead lines, and LAPP Insulators is an ideal match for us, both technologically and geographically. The addition significantly expands our worldwide strategic market presence.

What are the benefits to the customers?

Michael Keinert: PFISTERER and LAPP Insulators are both acknowledged as technology leaders. Among other things, the two most distinguished authorities in the area of insulators, Dr. Frank Schmuck and Dr. Jens Martin Seifert, are now working together. The synergies for our customers can be found in different areas: a self-contained product line with plastic composite and ceramic insulators, expertise in string construction and the know-how in developing complete insulator sets from them. That means we can provide dependable, secure systems to our customers. We complement each other in further areas, for example, at the interface between overhead line and cable system technology, PFISTERER's second key business.

Bernhard Kahl: PFISTERER always represented the benchmark in string construction to LAPP Insulators. Conversely, the LAPP Insulators management solutions and development are also having a beneficial effect on PFISTERER. It may be somewhat challenging at times, but new perspectives always bring positive impulses. We already established the LIKE business – LAPP Insulators Knowledge and Engineering – in 2013 to bundle our expertise. There we consolidate our entire wealth of experience and knowledge at one central point with the aim of developing complete solutions for our customers. Among others, the gas-insulated bushing product group was created as a result. Now we can also draw on PFISTERER's expertise in this area. Furthermore, LAPP Insulators has a high voltage lab that also provides services. PFISTERER has similar capabilities at their disposal in other areas and would also like to expand on those services as well.

Michael Keinert: Of course, it's still a bit premature to say anything definitively, but there will certainly also be new developments coming out of our joint research, e.g. in the area of compact lines. Expertise is being bundled here that no other company in the world can currently match. We are also already planning new joint solutions regarding air insulated substations. LAPP Insulators has deep knowledge in this area because of the high ceramics content, whereas PFISTERER has it with plug-in sockets for transformers.

Bernhard Kahl: We also want to utilize the now increased importance of overhead line technology in the united company more for distribution purposes. LAPP Insulators is the major brand in overhead line technology, especially in the US. We have deep roots in America and are celebrating our 100th anniversary there this year. This distribution



Michael Keinert
Member of the Board of
PFISTERER Holding AG



Dr.-Ing. Bernhard Kahl
Managing Director of LAPP
Insulators Holding GmbH



PFISTERER now offers innovative chain design with either silicone or porcelain insulators

network is now also available to PFISTERER's products. On the other hand, PFISTERER has traditionally had a stronger position in other countries and is better known in the area of components, like strings and damping elements. We may currently have two distribution channel structures at our disposal, but we complement each other well and our combined sales force is not too big. On the contrary, the added manpower gives us more heft in segments which may not have been given enough attention before. Naturally, our competitors are not particularly happy about the merger.

Mr. Kahl, your enthusiasm for the merger is quite palpable just from listening to you – is that correct?

Bernhard Kahl: I have always thought that PFISTERER was the ideal partner for LAPP Insulators. The market is a constant challenge – jointly or separately – but we are definitely stronger together.



Scan this QR code for more information.



Porcelain is still the world's the most commonly used insulator material – now also featured in the product range from PFISTERER.

PFISTERER and LAPP Insulators

LAPP Insulators is the third largest vendor of medium and high voltage insulators made of porcelain, ceramic and composition materials in the world. These products are used in more than 70 countries, particularly in the area of high voltage and traction current grids, switchgear systems and transformers. The company grew out of traditions root-ed in the renowned Rosenthal and Siemens brands, and reaches back to 1889 in Germany, and to 1916 in the US. In 2001 LAPP Insulators took over the production facility of CeramTec in Wunsiedel, Germany, and acquired Argillon Group's insulator sector and its three locations in 2008.

PFISTERER has gained a prominent market position in the overhead lines (OHL) segment through the purchase of LAPP Insulators. The meshing of the existing range of insulation strings and cable and contact systems has made PFISTERER one of the few vendors worldwide that is essentially in a position to cover the entire supply chain for contacting and insulation, from power generation to its distribution, as a one-stop source.

LAPP Insulators has around 1,200 employees worldwide, and more than half of them work at production sites in the US (Le Roy, New York state), Romania (Turda) and Poland (Jedlina). More than 500 employees work at the headquarters in Wunsiedel and two nearby locations in Germany, Redwitz and Selb. PFISTERER has production facilities in Europe, South America and South Africa as well as sales subsidiaries in another 18 countries in Europe, Asia, Africa, South America and the US. The company group employs around 2,700 people in total.

Regenerative energy supply – any place in the world

A sustainable, reliable energy network for remote locations based on renewable energy sources: What once seemed impossible has become possible with CrossPower. PFISTERER has taken the first step into the world of decentralized regenerative energy supply with the development of a hybrid energy system. The intelligent management system combines different energy sources and balances generation and consumption optimally. In the process, the system permits a quick set-up of robust energy networks with fuel savings of up to 50 percent as opposed to conventional diesel generators.

Even today a stable energy supply should not be taken for granted. There are many places around the world where power is either not available at all or is only generated with the aid of diesel generators. "We generally come across this method of energy generation in emerging and developing countries, but they even exist in Europe, for example, at large construction sites or on off-shore platforms", explains Michael Keinert, member of the board of PFISTERER



CrossPower helps to help out:
smart energy supply for all types of camps

Holding AG. Large agribusiness complexes like plantations or animal husbandry operations often don't have a stable power supply. "Furthermore, there are hotel facilities and thousands of small islands which are not connected to a stable grid. They obtain their supply primarily with the use of diesel generators, as regenerative energy sources aren't yet able to provide the necessary supply security through decentralized networks. The fuel consumption required for that is extremely high. Therefore, we wanted to develop a



system that makes the use of regenerative energy possible at any location in the world where an independent, economical and reliable energy supply is needed,” according to Keinert.

What began as an ambitious idea took on concrete form with the first CrossPower system deliveries at the beginning of February. “Our energy system is able to mix any conventional energy sources, e.g. diesel generators, with renewable energy to supplement generators in a decentralized network and optimally balance out energy generation as well as consumption,” as Martin Schuster, Senior Advisor and responsible project manager at PFISTERER explains. These isolated energy grids, or so-called microgrids, reliably ensure a stable energy supply regardless of weather conditions and fluctuating energy generation. That makes them perfectly suited for use in remote regions, in mining operations, industrial facilities and research stations. Large quantities of fossil fuels can be saved in the future with the help of the CrossPower system. The stable network layout is made possible by the interaction of intelligent energy management solutions and state-of-the-art lithium-ion technology. The



In remote places, transport costs for fossil fuels play an important role. Here, a CrossPower system pays off very quickly.



The mobile version of CrossPower brings fast reliable power supply to disaster areas.



With an output of up to 1,000 kW, entire settlements can be permanently supplied with a CrossPower system.

centerpiece of the system is made up of a central control system and high-performance storage batteries to which any number of generators can be connected. In addition, the entire CrossPower system can be easily integrated into existing energy grids and used with diesel generators that are already on hand. A parallel power generation operation is also possible to compensate for supply gaps in unstable grids.

Stationary and mobile

Besides continuous stationary operation, the system is very well-suited for mobile applications, e.g. in crisis areas or refugee camps, because of its compact design. “CrossPower can be transported quickly to any place on earth. In case of catastrophes, our mobile system can be quickly set up as a scalable temporary energy grid based on renewable energy sources,” Michael Keinert emphasizes. Transporting fossil fuels to crisis areas presents major logistics challenges – and under certain circumstances even life-threatening ones – as well as involving high costs. “At the same time, a fast set-up of working energy networks is the basis for stabilizing the situation quickly and thus allows the population to stay where they are. The use of available energy sources like wind and sun provide huge advantages here.”

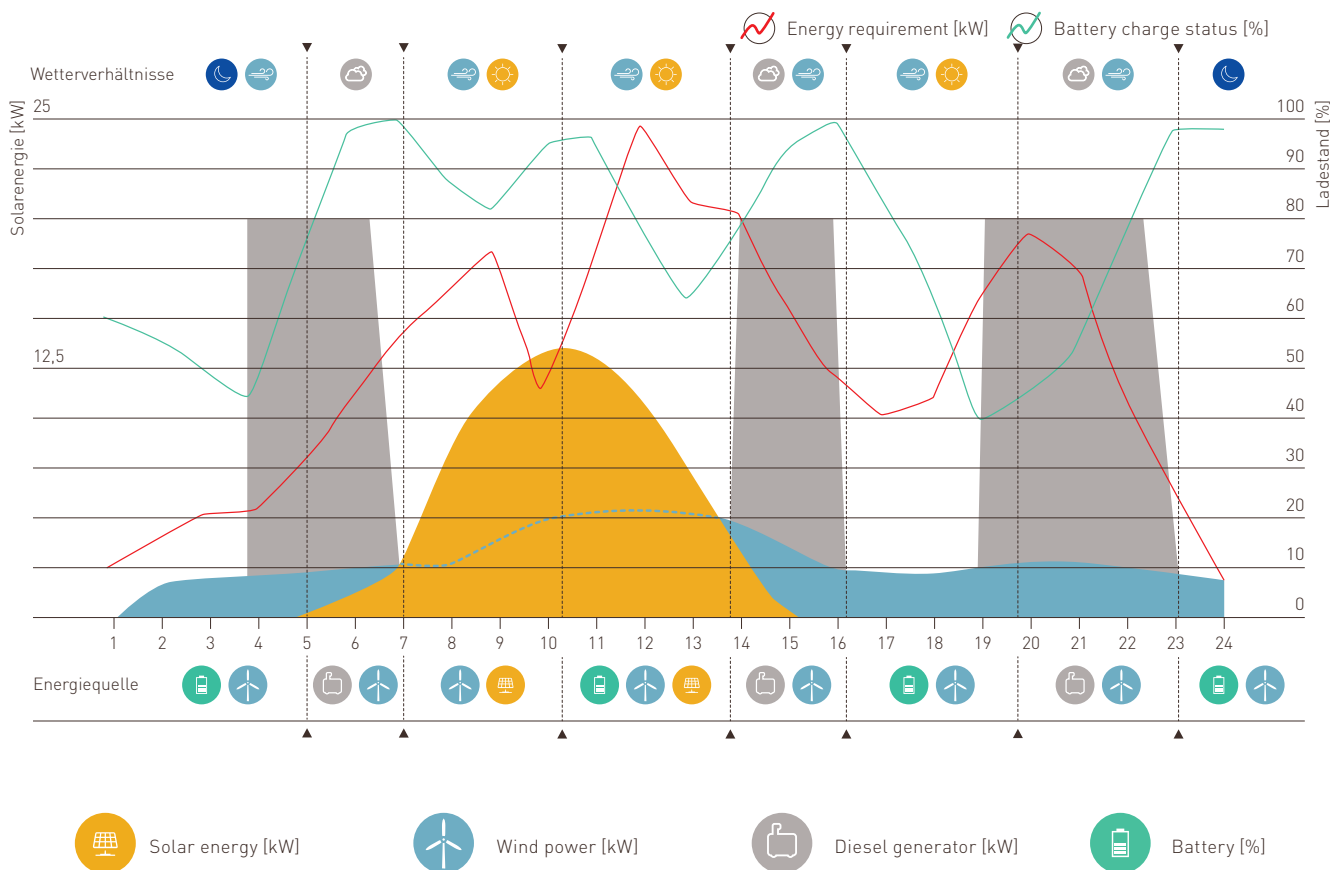
Flexible and intelligent energy management

The particular highlight of the system is the control software that independently favors renewable energy sources according to availability. The diesel generators merely serve to charge the battery only as needed and always work within their ideal output range. If both sun and wind energy are low, the management system first draws on the battery and utilizes it to the prespecified minimum. The various energy sources are so well-coordinated with each other in terms of their capacity utilization that up to 50 percent fuel savings are possible. There are also different priority levels available that can be selected individually both during energy generation as well as on the part of the consumer and monitored by the system. In cases of diesel shortages or generator breakdowns, for example, important consumers like surgery units, cold rooms or IT systems will be given priority automatically over less important ones and supplied to 100 percent with regenerative sources.

Ultimately, CrossPower provides a stable, consistent power supply, whereby output voltage and frequency can be adapted to the local requirements – everything from 230 V at 50 Hz or 110 V at 60 Hz is possible. The system is designed to be safe to touch and can be set up in close proximity to tents and working installations. Thanks to the 3G module, the



24 hours – energy requirement and power generation from various sources





Environmentally friendly energy for an entire camp.

system can be monitored and maintained remotely over all mobile phone networks using an encrypted and secure connection (VPN). In addition, the mobile networks can be set up quickly and safely without specialists due to PFISTERER's modular plug-in Plug&Operate components. The system itself can be housed in standard containers. "We were able to bring in and further expand our expertise as "network professionals" in the development and design of the system," says Michael Keinert with satisfaction.



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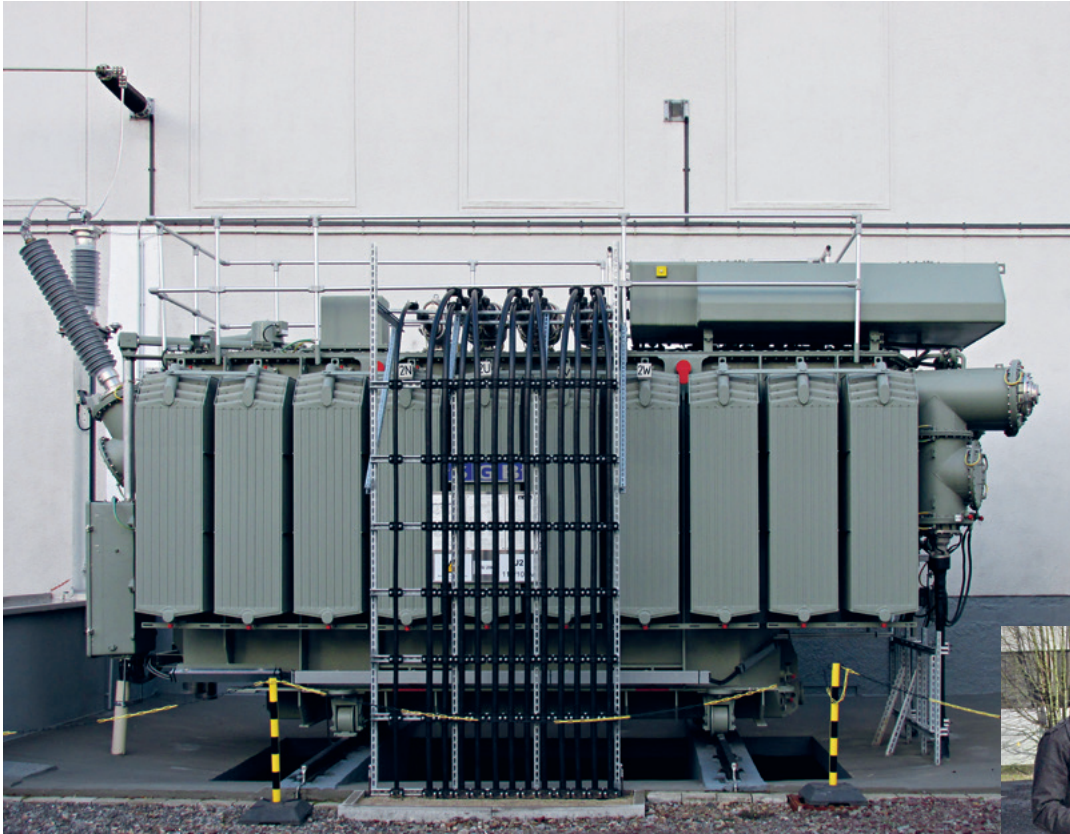


Proven in practice: the CrossPower System in Hungary.

Tried and tested in practice and already in use

The first CrossPower system was handed over to the NATO Energy Security Centre of Excellence in Lithuania at the beginning of February 2016. Sigitas Mudris, Commander of the Lithuanian Logistics Commando, expressed his satisfaction over the positive collaboration with the German industry: "PFISTERER was able to design and construct a highly-complex, very solid system in a very short time." It has an output of 150 kW (up to 2,500 kWh per day) and a storage capacity of 100 kWh. It consists of a control unit, efficient rechargeable batteries, a wind turbine and solar panels as well as two diesel generators, which can all be transported in two 20-inch ISO containers.

The mobile energy system already proved that it was practicable under realistic conditions last June during the NATO exercise "Capable Logistician 2015". A 25-kW system with a storage capacity of 60 kWh reliably provided a number of crucial facilities such as IT systems, laboratories and tent accommodation for the entire exercise. "The demands on a reliable smart energy power supply in remote regions and critical zones are high: The systems have to provide energy reliably around the clock while using locally available energy sources that are suitable for mobile applications at the same time. We were successful", says Martin Schuster, Senior Advisor at PFISTERER.



For economical transformer operations:
By making all of their connections pluggable, CONNEX makes transformers highly versatile. AVU Netz GmbH's new 110/10-kV transformers from SGB are a good example. With one design they cover all relevant connection constellations. AVU Netz specialists Nico Krächter and Volker Jost show this on a tour of their territory with PFISTERER customer service agent Volker Janzen (small picture below, from left to right).



Power transformers that can do long-term service anywhere in the network – the West German network operator AVU Netz GmbH is achieving this aim in the interest of efficient energy supply. The proven key technology it is using here is the CONNEX flexible connection system. On a brief tour of three substations, HV system experts Nico Krächter and Volker Jost explain CONNEX's advantages with an eye to changes affecting the mains supply.

«CONNEX is a modular overall system that provides an economical solution for all the relevant connection constellations in our network.»

Nico Krächter
Head of the high-voltage system team
at AVU Netz GmbH

An der Drehbank 18, Gevelsberg. The street address of AVU Netz's headquarters recalls one of the main drivers of the Industrial Revolution ("Drehbank" means "lathe"), because lathes were the precursors to engine lathes. And engine lathes

“Versatile transformers for every site”



For reliable power supply: AVU Netz's power network area in the Ennepe-Ruhr district in the heart of North Rhine Westphalia. Power transformers equipped with CONNEX play a key role in modern electricity supply for more than 45,000 households. And AVU is reliable: its average annual break in service of 3 minutes per customer is well below the Germany-wide average of around 16 minutes.

- AVU Network
- downstream network operators
- 110-kV lines
- 30-kV lines
- 110-kV substations
- 30-kV substations

were what enabled precision components for production machines and motors to be made economically on a mass scale. Efficiency in times of change is also high on the agenda of AVU Netz. In its view, efficiency should also apply to a reliable electricity supply that meets modern standards. With an average annual break in service of 3 minutes per customer, the company lies well under the Germany-wide average of around 16 minutes.

A wholly-owned subsidiary of AVU AG, AVU Netz operates its own electricity, natural gas, and water networks for the Ennepe-Ruhr district in the heart of North Rhine-Westphalia. Including links to adjacent networks, its power lines alone have a combined length of more than 3,500 kilometers, and its high-voltage network with thirteen 110-kV substations covers an area of approximately 333 square kilometers. This is the territory of Nico Krächter, Volker Jost, and their team, whose main job consists of planning and building high-voltage systems. Their work is made easier when power transformers are equipped with CONNEX technology.

Since 2014 AVU Netz has been converting its 110-kV lines on the southern ring from oil and gas-insulated to XLPE cable technology. At the same time, it is replacing a number of older systems with new ones. The network operator's planners had all of these measures in mind when they defined the specifications for the 110/10-kV transformers to be acquired. Their practical experience, both in modernizing networks and with the CONNEX connection system, also played a role.

Proven standards. New concept.

"CONNEX cable connections have been used in the AVU network for 20 years now, in both gas-insulated switchgears and transformers," reports Krächter, who heads the high-voltage system team. "There are good reasons for this. Let's take two: they can be installed without intervening in the system's interior workings, and they are completely touchproof. And then there's another crucial benefit: CONNEX is a modular



Multiple plug-in connections, all touchproof: Fully insulated MV-CONNEX size 3 cable connections on the transformer's lower voltage side: CONNEX quadruple-contact elbow bushings are used for the phase connections, and the CONNEX double-contact elbow bushing for neutral point treatment.

overall system that provides an economical solution for all the relevant connection constellations in our network.”

“The connections in every network vary depending on where and when they were installed,” explains Jost. As the project head, he frequently oversees network connection work for transformers and high-voltage cable systems. “This works best when you know the possibilities and limitations of the equipment you’re using, and if you can use it under different conditions in uncomplicated ways.”

All of these factors are reflected in the new 110/10-kV transformers of the 50-MVA power class. There are three of them with an identical design. They were made by SGB to meet the network operator’s specifications – a well-thought-out combination of proven AVU network standards with a new interface concept that consists of integrating CONNEX sockets into the transformers at all phases and star points. That allows different dry-insulated CONNEX components to be plugged into them. Jost and Krächter describe the advantages of all-round plug-in power transformers in detail where it really counts – at the sites where they are used.

Sensible exception. Safe connection.

We start at the Witten substation in the adjacent network operated by the Witten municipal utilities. The AVU network feeds 10-kV power into it as an upstream supplier. Since the autumn of 2015, the power has come from one of the three new SGB transformers. It stands outdoors on a cement platform. Everything appears to be normal. But not



Clever integration of new and existing technology: Volker Jost shows how no site conversions are needed at the Witten substation, even given its unique constellation. HV-CONNEX bushings are installed on the higher voltage side of the new SGB transformer which allow it to be connected to an indoor GIS via pre-existing gas-insulated wall bushings.



Outdoor connection with mobility options: Classical use of HV-CONNEX size 5-S bushings to connect a transformer and an outdoor switchgear at the Schwelm substation. The bushings’ horizontal configuration allows them to be transported in mounted form in compliance with Deutsche Bahn (German Rail) standards. For other modes of transport they can be removed without intervening in the system’s interior workings.

«The more transformers are equipped with CONNEX, the more flexible our system is in general.»

Volker Jost
Project head on the high-voltage system team
at AVU Netz GmbH

quite. Jost points to a flat-roofed building next to it. "There's a gas-insulated switchgear in there. The usual way of connecting it these days would be by cable to the transformer. But we're making an exception to that practice here." He turns toward the higher-voltage side of the transformer. Three HV-CONNEX bushings stick out.

Lines connect these bushings via surge arresters to SF₆ gas-insulated wall bushings mounted on the outside of the flat-roofed building. The switchgear inside the building docks through the wall via an SF₆ gas-insulated extension. "This was a special construction from the 1980s," says Jost. "It continues to work perfectly, and the new transformer can be easily integrated. So why should we do some type of complicated reconfiguration?"

Krächter nods and adds, "Regarding site-specific solutions: All three SGB transformers stand outdoors. If their MV conductor connections were uninsulated, small animals could bridge them and trigger a secondary short circuit. We've eliminated this typical operating risk with MV-CONNEX cable connections, which are fully insulated and therefore touchproof. They protect the equipment, people, and animals at the same time."

Jost and Krächter have concentrated on safety from the word go. They both completed training programs in energy electronics, studied engineering, and have more than 15 years of professional experience. We now head to the second site where they explain relevant interface-related aspects for operating network transformers.

Streamlined transmission. Variable at sites.

An air-insulated substation in Schwelm extends over an enclosed area of grass and gravel. The second SGB transformer is connected to it by three HV-CONNEX bushings. A fourth HV-CONNEX bushing serves to connect its higher-voltage star point with a ground fault deletion coil. "It's a standard configuration," says Krächter, "and CONNEX gives you valuable leeway."

Krächter moves his hands like an imaginary scale. "When you transport mobile transformers in compliance with Deutsche Bahn (German Rail) standards, you typically have horizontally mounted bushings, and these have traditionally been pre-mounted porcelain bushings. As you can see on our SGB transformer again, plug-in HV-CONNEX bushings can also be installed horizontally. That increases our flexibility for all other modes of transport too, such as flatbed trucks. Just like with the CONNEX cable connections, if you have to uninstall them you can do so without opening up the transformer. Furthermore, regardless of where you end up sending the transformer, it's easier to protect separated bushings from mechanical damage."

"And regardless of where you send the transformers, they're equipped for different situations," adds Jost. "At many of our transformer stands we run the cables on the ground to save space. So we've had SGB install a second HV-CONNEX socket facing straight down for each higher voltage phase. This lets us make a cable connection to a gas-insulated switchgear, or to an air-insulated one via additional outdoor cable terminations. In addition, we're flexible with respect to the higher-voltage star point, which we can also handle via a cable connection instead of a bushing. And for other constellations, the same CONNEX interface can be used completely differently, namely with a CONNEX plug-in surge arrester. That in turn would have two advantages: there's optimal surge protection right there at the equipment, and it's touchproof there too."



Variable star point use: CONNEX is also used on the higher-voltage star point for the new SGB transformers, like at the Schwelm substation. An HV-CONNEX socket enables a line connection to a Petersen coil. Other measures can be taken immediately for divergent system configurations. Instead of a bushing, the HV-CONNEX socket installed on the transformer side can accommodate either an HV-CONNEX separable cable connector or an HV-CONNEX surge arrester.

In short, there are many options. AVU Netz has already made use of a number of them with its new SGB transformers. Others are possible with the older transformers. The last stop on our tour shows both of these possibilities at work.

One design. Three connection variants.

The Altenvoerde substation. A simple cement structure in Wehrstraße. AVU Netz has invested around 3.4 million euros in it. The building is new, as is the equipment it houses: a gas-insulated switchgear (GIS) with digital conductor technology. It replaces a GIS from the year 1969, which was state-of-the-art back then. The new switchgear started operating at the end of 2014, and the third of the three new SGB transformers was connected in February 2015.

Krächter points to the higher voltage side. "Here you can see the type of connection that Volker was describing earlier. HV-CONNEX sockets on the ground have cable connections for the new GIS. The sockets above them for the bushing option are closed with CONNEX dummy plugs. All the other CONNEX interfaces are used like those at the Schwelm and Witten substations. With one transformer design and one connection system, we are already covering three constellations just for the higher voltage phases: two standard ones plus the special case of a bushing connection between the transformer and the GIS."

Modern conversion. Systematic approach.

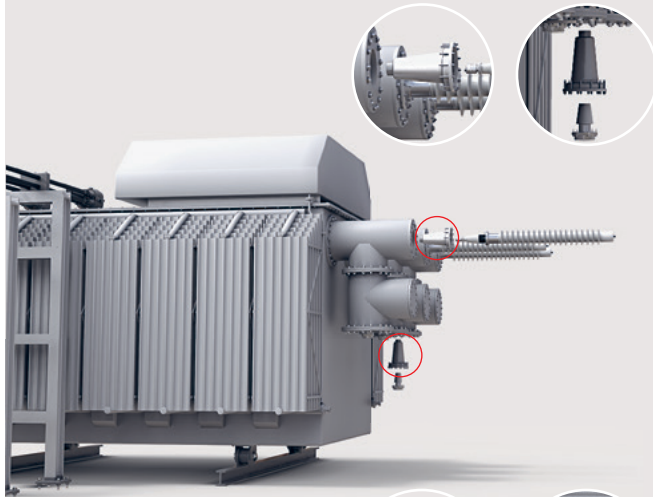
"Speaking of efficiency, when surrounding systems are updated it can also be a good idea to furnish the existing transformers with modern connections," says Jost and points to the adjacent transformer station. "Like this 110/10-kV transformer and another one here at this site. Both had wet terminations on the higher voltage side. Because of our conversion to XLPE cables, we would have had to convert the transformer connections to the new GIS anyway. That's why we're using HV-CONNEX cable connections here. They not only make sense from a technical perspective, they're also a good idea for the future: the more transformers are equipped with CONNEX, the more flexible our system is in general." And there's a lot going on. A new 110-kV XLPE cable is also being laid between the Altenvoerde and Voerde substations. The two power transformers in Voerde are scheduled to be converted in 2018. "CONNEX will make sense there too, on account of what we plan to do afterwards," says Krächter. "One transformer will stay in Voerde and be connected to the new GIS here in Altenvoerde via the new XLPE cable. That would be the 'outsourced transformer' scenario. Depending on

what the system calculations yield for this specific constellation, it could be necessary to install surge arresters directly on the transformer. And plans call for the second transformer, which is currently running as a stationary reserve, to be converted to a mobile reserve so it can be used throughout the network."

"There's another important aspect in this context," notes Jost in conclusion. "Mobile transformers in particular should be able to start up quickly and safely wherever they're needed. CONNEX supports that too. With test and transition equipment that can also be installed without complex oil work. To sum it up: CONNEX enables technically sound, versatile transformers for every site."

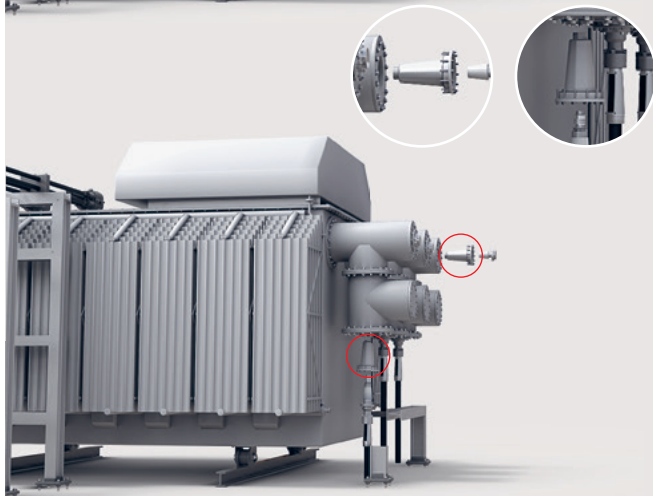


Smart double: With two HV-CONNEX sockets for each higher voltage phase, the new SGB transformers are superbly equipped for different connection constellations. Nico Krächter points to one of them at the Altenvoerde substation. The HV-CONNEX sockets installed above on the transformer for horizontal bushings are not needed at this site and so are closed with voltage-proof dummy plugs. By contrast, the ones below hold HV-CONNEX plugs for a ground cable connection to the new GIS in the adjacent building.



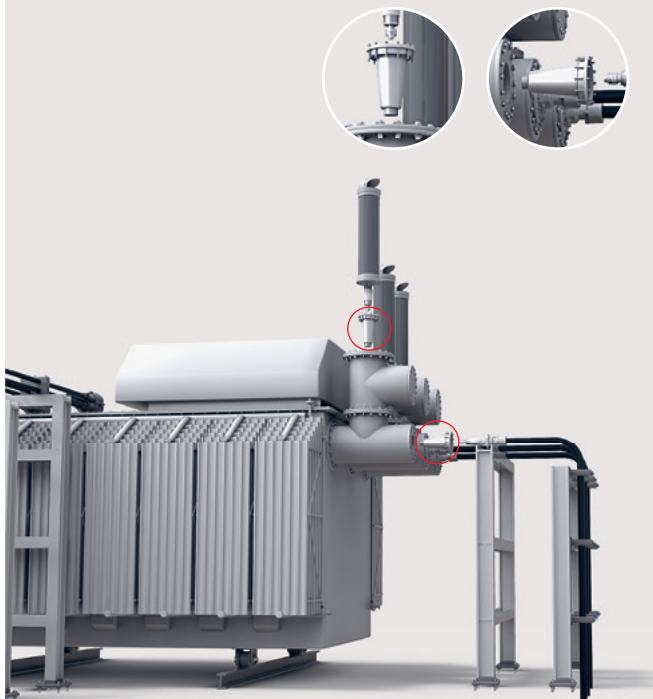
Universal plug-in options

The core of the CONNEX system consists of its sockets – circled in red here for better visibility and to show their different installation positions on the new transformers for AVU Netz GmbH. The sockets are installed in the transformer connection housings as universal interfaces for plug-in CONNEX components. For power transformers with the same design that can be used throughout the network, AVU Netz uses two HV-CONNEX sockets per higher voltage phase: the upper ones accommodate HV-CONNEX bushings for outdoor connections (above) – in a horizontal position to enable transport in compliance with German rail standards. The lower sockets facing straight down (below) accommodate HV-CONNEX cable terminations for the ground cable connections generally used in the AVU network. Whichever sockets are not used are closed with voltage-proof CONNEX blind sockets (shown hovering next to or below their respective socket, depending on which connection option is used).



Adaptable based on need

An interface concept for all-round plug-in power transformers has the potential to be conveniently adapted to future needs. This diagram of the same transformer design shows one example: if the connection housing is installed the other way around on the transformer, its integrated HV-CONNEX sockets (red circles indicate installation type) open new cable connection possibilities for each higher voltage phase, including directly installed HV-CONNEX surge arresters – a variant that could make sense if the transformer is to be connected to a switchgear at a greater distance such that it no longer has sufficient surge protection.



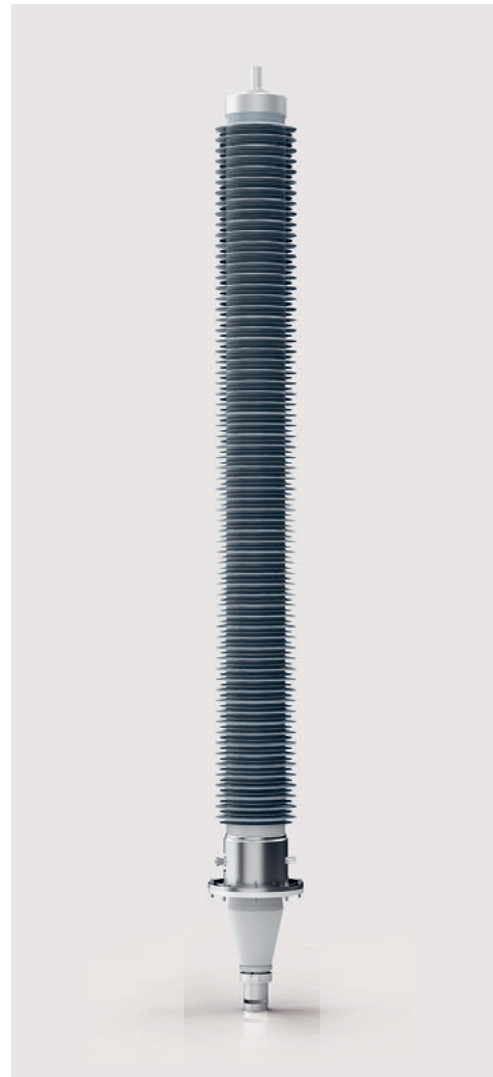
New: Pluggable CONNEX bushing for 362 kV

Mobile power transformers for emergencies – this innovative concept increases the operational reliability of power grids. The prerequisite for this are versatile transformers that are easily transported and installed quickly. It has now become possible with the pluggable HV-CONNEX bushing size 7-S, the first plug-in type bushing for high voltage levels up to 362 kV.

A secure electricity supply depends on power transformers that work properly. Yet risks like operational disruption, environmental factors or physical attacks can lead to outages. Mobile transformers are a forward-looking solution to being prepared for those kinds of emergencies. The RIP-insulated, pluggable HV-CONNEX bushing permits them to be built so compactly that they can be easily transported by truck. The on-site set-up is very secure thanks to the plug-in system, as the transformer and the bushings are already inspected at the factory and don't have to be opened again. As a result, the installation can be successfully completed in a very short time, so that only a few days go by between the outage and the start-up operation.

A special feature of the size 7-S as compared to the previous CONNEX bushings is the high ampacity, which attains a rated current of 2,000 A. In addition, a technology was developed for the high voltage level, which is protected by an FRP body at the RIP bushing.

The first bushings for mobile transformers in the US were delivered in November 2015. The HV-CONNEX bushings product range is due to be developed in the next step for voltage levels of up to 420 kV.



The advantages at a glance

- Transformers become mobile and versatile
- Easy and quick to install
- RIP-insulated and pluggable
- For extra high voltage to 362 kV

Increase the operational reliability of power grids and lower installation costs at the same time – IXOSIL EST SUB with surge arrester makes it possible. The new product solution for voltage levels from 123 kV to 170 kV combines a dry-insulated cable termination with a surge arrester in one unit for the first time.

The newcomer in the IXOSIL range combines the advantages of dry-insulated terminations with an integrated dry and gas-free surge arrester. The insulation is made exclusively with the solid material silicone. Environmental pollution or operational safety issues due to leakage are completely ruled out. The terminations don't contain any fluids, therefore they are easier to transport and faster to install than conventional terminations.

The components of the combination product are independent of each other. That means the cable termination can be fitted very accurately on the ground and subsequently mounted to the already installed surge arrester in a vertical position. It serves the cable termination as a support so additional support elements are not required. The individual elements fulfill the IEC 60840 and IEC 60099 standards. An optional surge counter is available for the surge arrester. EST SUB with an integrated surge arrester is available in two versions: the EST SUB SA for fixed earth grids and the EST SUB SAC for coiled earth grids.



The advantages at a glance

- Combined cable termination and protection from over voltage
- Quick and easy to mount
- Oil and gas-free
- Leak-proof

New: Dry IXOSIL cable termination with surge arrester

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