PFISTERER Customer Magazine
Issue 2 **2016**

PFISTERER

connect

www.pfisterer.com

Legal Notice

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

Reto Aeschbach, Christoph Badertscher,
Jürgen Finsinger, Natalie Fischer,
Steffen Jordan, Peter Kaiser, Peter Müller,
Dr. Frank Schmuck, 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

PFISTERER
Customer Magazine
Issue 2 **2016**

Michael Keinert

Editorial

Factoring efficiency into safety

A reliable and safe power supply is proof that high-quality, practical solutions pay off:

The contribution that custom-made busbars and high-voltage silicone composite insulators can make to sustainable operating safety is explored by the project report covering a new 220 kV open-air switchgear in Switzerland (page 4). How you can replace power transformers in just a few days is demonstrated by a pioneering new development for all (emergency) situations: the flexible and quick-to-install "transformer to go" with CONNEX connections (page 16). The fact that user-friendliness is decisive for trouble-free operation is demonstrated by KP-Test-5 voltage testers for internationally established rail applications (page 22).

I hope you enjoy reading this issue.
The level of performance provided by PFISTERER to keep your networks and systems operating reliably and safely is something you can count on!

Kindest regards,

Michael Keinert

Chairman of the Executive Board
PFISTERER Holding AG

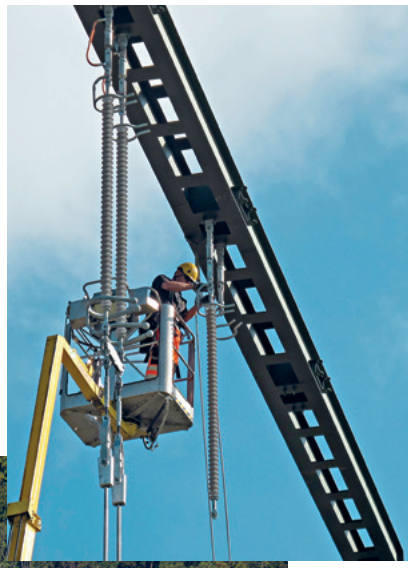
Outdoor progress

Partners for grid expansion: Martin Schättin, the head of assembly and service at Axpo (photo at bottom center), and the PFISTERER system experts Christoph Badertscher (left), and Reto Aeschbach (right) are pleased about the progress made erecting the new 220 kV Swissgrid outdoor switchgear by late summer 2016. It will form a strategically important node within the Swiss transmission network once commissioned, as is planned for 2017.

The Swiss transmission grid operator Swissgrid is installing a new 220 kV outdoor switchgear in Rüthi in the canton of St. Gallen. It has commissioned Axpo Power AG for its engineering and assembly and PFISTERER as one of several component suppliers. "The technical requirements for this project are very high," as Martin Schättin, who works for Axpo, reports. "PFISTERER has optimally satisfied these by providing economical solutions from one source." This is exemplified by the customized system of tubular busbars with composite post insulators and strain insulator strings. The contribution that the PFISTERER components can make to ensure sustainable operational reliability is described on site in Rüthi by Axpo's head of assembly and service, along with two system experts from PFISTERER.

Swissgrid understands that modernization of the transmission grid is a key factor for a sustainable energy future. In its report on the "Strategic Grid 2025," Swissgrid transparently outlines the measures required for this. The construction of the new 220 kV outdoor switchgear in Rüthi is one of Swissgrid's many grid projects. Its concrete benefit is explained by Roman Manczer, Swissgrid's client-side project manager: "By commissioning this new outdoor switchgear the connection of the Swiss transmission grid to Austria via the substation there in Meiningen is to be improved. Furthermore, the grid structure north of Rüthi will be disentangled. There two lines are yet crossing on one mast. By connecting them to the switchgear, they will be selectively switchable. These measures will increase the reliability of the power supply in eastern Switzerland."

Besides reliability of supply, personal safety and efficiency are the key principles governing the way Swissgrid operates the national transmission network. In order to implement these rigorously, Swissgrid also defines technical standards oriented by diverse technical codes. These technical standards form the basis for specifications for Swissgrid construction plans, just as for the new 220 kV outdoor switchgear in Rüthi. On the drive there, Reto Aeschbach, PFISTERER sales manager for Switzerland, spells out the first details of the project requirements: "The technical Swissgrid standards for this project follow, among others, the LeV, the Swiss Ordinance on Electric Lines. This is absolutely binding in Switzerland, and its requirements are, in part, higher than international standards. Which PFISTERER components are affected is something we will see on site."



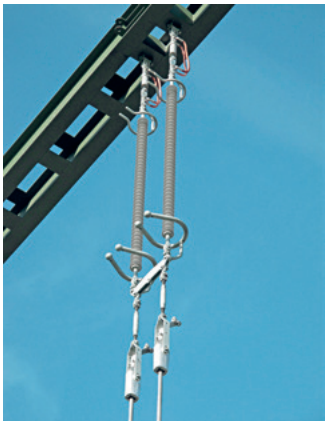
Quality for high requirements

Before a glimpse of the outdoor switchgear installation can be caught through the rows of trees that line the A13 freeway, the station's presence is heralded by a sight that is at once impressive and unobtrusive: the terminal tower for the line connection from the south rises 30 meters into the air. Kept dark-green, it naturally blends into the Rhine Valley in St. Gallen, just as the 17.5 m towers for the other connections do. The idyllic landscape is dominated by the Hohe Kasten, a mountain rising to 1794 m in elevation. The community of Rüthi is located at its foot, barely a 15-minute drive from Liechtenstein and situated directly on the banks of the Rhine, which forms the border with Austria here.

Reto Aeschbach steers the car to the entrance of the outdoor switchgear. It encompasses six line bays with one coupler bay over the 20,000 sqm area. "Let's start our site inspection at the switchovers between the line sections and the switchgear," Martin Schättin says while getting out of the car. He sees the plant installation through on the part of Axpo as technical project manager. With a keen eye for its construction, he points to a terminal tower on the left. "220 kV strain insulator strings made by PFISTERER are used on towers right next to the station. With these strings the incoming and outgoing transmission lines will be secured vertically for being connected to the switchgear. When it comes to the operational safety of the strings, the quality of their individual components and an optimal interplay between them are decisive. Both can be expected from PFISTERER products."

Well-prepared for overvoltages

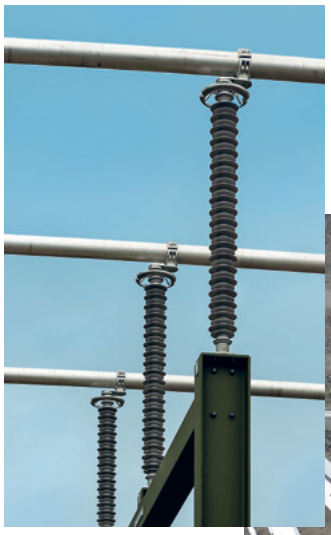
Aeschbach has specific quality values on tap. "Our strings have been tested as complete systems, and can withstand a short-circuit current of 50 kA for more than a second. Their centerpiece is formed by our composite long rod insulator. Their insulation properties against flashovers caused by an impurity layer are outstanding. Flashovers can be provoked by overvoltages, for example. There are two decisive test values for this."



A win for assembly and operation: 220 kV complete insulator strings made by PFISTERER are used to secure the incoming and outgoing lines at the switchgear (above: installation of the strings; installed strings shown in photos below). The compact string design is enabled by using slender composite insulators with combined protection from corona discharge and flashovers. HTV silicone rubber shields make the insulators much lighter, and more resistant to breakage, than conventional insulators.

He opens up a loose-leaf binder, and points out technical project data.

"The power-frequency withstand voltage stands for an operating voltage up to which no flashover can occur on the insulator. In this regard, for the string type used here an effective value of 460 kV is specified in accordance with the LeV. The lightning impulse voltage, in turn, reproduces overvoltages resulting from lightning strikes. Swissgrid requires a peak value of 1,050 kV for this, as specified in the LeV. Our insulators provide both, with flying colors." Aeschbach looks up. "To give an example, these values exceed the requirements laid out in the IEC 61466-2 standard that applies in this case." Axpo's head of assembly nods and adds: "PFISTERER has satisfied the high project requirements within the framework of an economical service package. This is valued by Swissgrid as the plant operator that stands for operational safety according to modern standards, and Axpo as the executing engineering and assembly company."



Powerful lightweights: 245 kV-post insulators with anti-corona rings made by PFISTERER were installed as supports for the tubular busbar conductors and the cable connectors for diverse switchgear instruments. A fiberglass-reinforced epoxy resin rod in a HTV silicone rubber shield means each insulator weighs just under 70 kg and can withstand cantilever forces of up to 10 kN.

« Dimensioning busbar systems requires an exact application of expertise and empirical values to the individual requirements. PFISTERER has demonstrated exactly this.»

Martin Schättin
Head of Assembly and Service, Axpo Power AG

Compact. Lightweight. Unbreakable.
Baden-based Axpo Power AG plans, builds, operates, and maintains distribution grids and electrical systems for energy providers, as well as industrial and railroad customers. "Our services are based on years of experience. We bring this to the Swissgrid project in full," Schättin states. "Experience shows, for example, that component features such as ease of installation and resistance are likewise very important. PFISTERER composite insulators satisfy these requirements, and not only in strain insulator strings."

Schättin heads into the installation, looking in different directions and to different heights. "Over there, those are all PFISTERER electrical station post insulators. We have installed 99 in total." They blend inconspicuously into the multiple-component station structure. "The composite design makes extremely compact insulators possible," Axpo's head of assembly explains, "and the composite insulators weigh far less than comparable standard insulators. And they are resistant to breakage. Not only does this make assembly easier, but their robustness also has advantages for operational safety." Aeschbach explains why: "HTV silicone rubber makes insulators resistant to sudden loads, whether due to arcs, deliberate attacks, or – as has actually happened – wayward golf balls." Schättin smiles and adds: "Speaking of which, these PFISTERER-insulated supports have other properties that could possibly also be relevant for sustainable operating efficiency."

Clever dynamics: The tubular busbar conductors were supplied as pre-bent components in accordance with PFISTERER designs, and are installed with the bend facing the sky. This partially compensates for any tendency of the tubes to bend toward the ground under their own weight, and the weight of ice. Cables were integrated when installing the conductor tube. As an unrestrained additional mass inside the tube, they absorb tube vibrations caused by wind, in order to prevent fatigue breakage on the conductor and damage to post insulators and other devices.

Reto Aeschbach offers new examples to illustrate this: "The operational reliability of insulators also depends on their response to impurities. Protection level III with 25 mm/kV of specific creepage distance is specified for these insulated supports under the "old" IEC 815 standard. According to the new versions of the standard, IEC 60815-1 and 60815-3, which have been in force since 2008, the creepage distance now refers to the highest conductor-ground voltage rather than to the line-to-line voltage. This results in a specific value of 43.3 mm/kV for this level of impurity. The creepage distance of our insulated supports totals 6,960 mm. Even at a maximum operating voltage of 253 kV, the requirements of both standards are fulfilled very well. Added to this are the already above-average insulation properties exhibited by HTV silicone rubber when impurity layers are present. Not to forget that high-quality silicone insulators can, among other things, also be produced economically because their shells are injection-molded. This process makes efficient, high-volume production possible."

Customized busbars

The majority of the station insulators are installed on the busbar. Designed as a double busbar for 4,000 A/220 kV in a tubular design, it is comprised of six busbar sections, each 160 m long and running parallel at a height of 10.5 m. All energy passing through the switchgear will flow through them. "Dimensioning busbar systems requires an exact application of expertise and empirical values to the individual requirements," as Schättin says, "and PFISTERER has demonstrated exactly this with the technical report for this project." The report was written by Christoph Badertscher. The PFISTERER expert explains details while walking along the line sections.

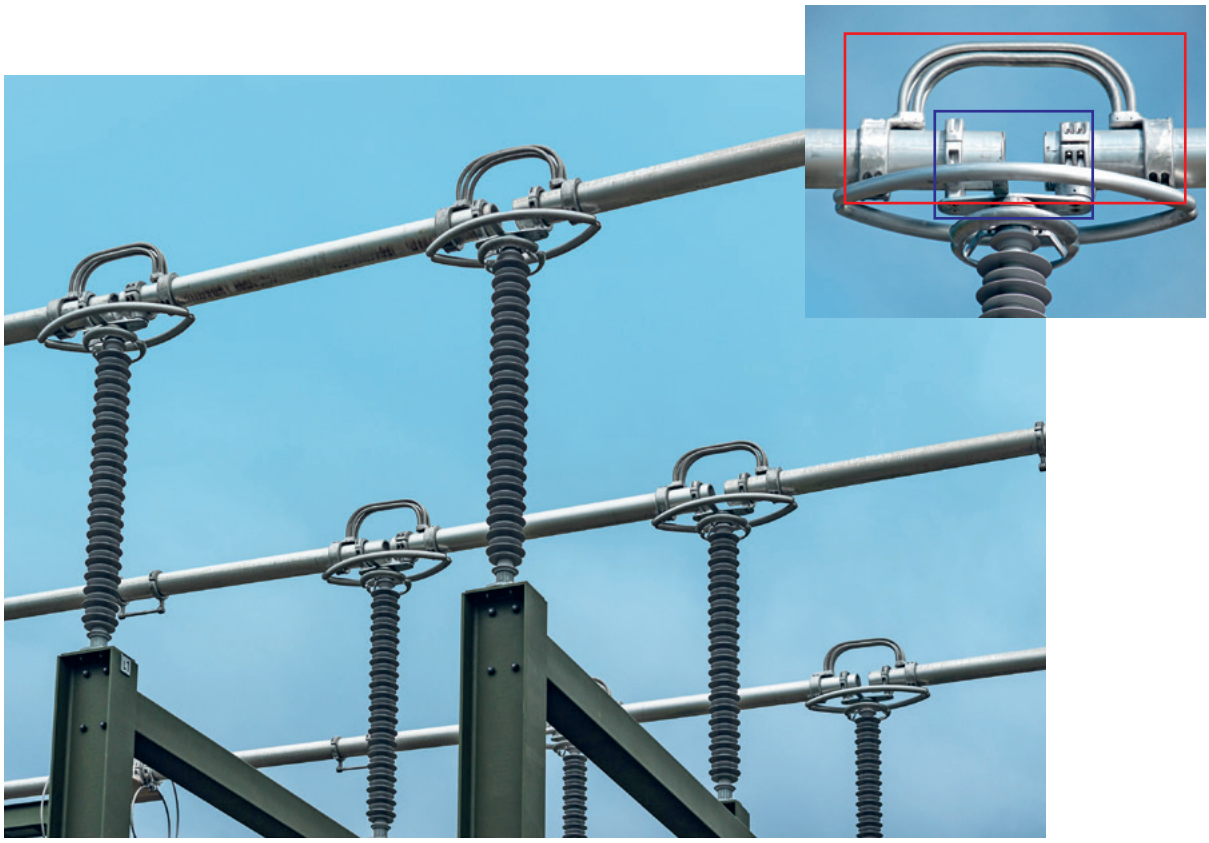
« The sum of our services for this switchgear shows the capability of PFISTERER. »

Reto Aeschbach
PFISTERER Sales Manager for Switzerland

"What might seem like a straightforward layout of conductor tubes and terminal clamps is actually the result of complex calculations," Badertscher explains, "which start with a multitude of electrical, mechanical, and thermal requirements resulting from operating modes and the system environment. These all need to be factored into the dimensioning while ensuring that all busbar components are so well harmonized that they can perform in perfect interplay. To achieve this, we have the tubes specially prepared and we combine different types of the terminal clamps we make."

Installed with leeway

Fixed and floating line racks form a clever team of terminal clamps on every tube segment. They guide and support the conductor tubes on the post insulators. Badertscher describes how their interplay prevents excess mechanical loads on the insulated supports: "The fixed line rack features a tumbler element to fix the tube on all axes while providing an elastic bearing. This allows the terminal clamp to yield both parallel and perpendicular to the tube axis, providing leeway for the unavoidable tube bending that occurs." And Badertscher's



Clever trio of clips: PFISTERER expansion connectors join the busbar tubes together. By pairing fixed and floating line racks (outlined in blue in the small inset above), they hold the tubes on the insulator posts while also giving them room to bend and for thermal expansion. The current bridge (outlined in red) forms the conductive junction between the tubes. The tube clamps on both sides have grooves on the inside to ensure optimal contacting, allowing defined contact points to form once they have tightened.

calculations show that this really is indispensable: the tube is subject to a force of just under 240 N/m by its own weight and a 2-cm layer of ice. This causes it to bend by 338 mm in mid-span.

"The floating rack also gives the tube section it holds in place additional leeway for changes to length caused by temperature," Badertscher continues. "Assuming the extreme temperatures of –40 °C to +200 °C projected in this case, the maximum possible change in length totals 109 mm. The expansion connectors need to permit this as well." The busbar expert shows a specimen that connects two tube sections of adjacent switch bays. "A fixed and a floating line rack are combined with a current bridge in each of these expansion connectors. It forms the conductive element out of two tube clamp rings with aluminum cables welded in. Good, lasting contacting is provided by grooves on the insides of the clamp rings. Clearly defined contact points form on them."

Tried-and-tested products with new dimensions: Fork-type T-shape clamps made by PFISTERER provide the best connection for busbar lines by using cables with busbar ground isolators.

User-friendly grounding and short-circuiting: The multi-component design with a lowered connection part for the phase terminal clamp (aluminum ring outlined in red) allow PFISTERER grounding and short-circuiting devices to be installed ergonomically even at challenging working heights.

The fork-type, T-shape clamps also exhibit these contact grooves. Twelve of these combination clamps for tube and cable conductors are installed on the ends of the line sections to connect them to the busbar ground isolators. PFISTERER adapted this type of clamp to the required dimensions to ensure that it can be installed with an exact fit. "No two switchgears are alike. Individual solutions for this are therefore standard," Badertscher says. "We supply them as customized busbars based on tried-and-tested components and more than 70 years of experience with design."

Shared milestone

The PFISTERER package for Rüthi includes even more components: for example, grounding and short-circuiting kits. "Their multiple-component design with a lowered fixed phase point ensures ergonomically safe work when working at challenging heights," Aeschbach notes. "The sum of our services for this outdoor switchgear shows that you can rely on the capability of PFISTERER." "Absolutely," Schättin adds, "and good partners are important for completing demanding projects according to schedule." The next stage will soon be complete, and assembly work should be finalized by the end of the year. Commissioning of the new switchgear by Swissgrid is planned for mid-2017. It is plain to see that the head of assembly and service at Axpo is looking forward to this milestone.

Scan this QR code
for more information.

Fine-Tuning for Railway Giants

Positioning bulky heavy loads safely and precisely – Kirow railroad cranes are proven all-rounders in this field. For more than 130 years, the world market leader has been building agile heavy goods equipment for demanding applications on rail networks. And offering fine-tuning to customer requirements. As is the case with the PFISTERER distance voltage sensor – this assistance system was specifically developed for crane operators carrying out sensitive work near overhead contact lines.

It is important to keep a safe distance away from overhead lines. For railroad crane operators, this is an everyday challenge. They balance, change, and position tracks and points. They rerail railway vehicles, and clear debris in an emergency. With the greatest precision, usually under time pressure, always looking out for construction workers, emergency responders, incident commanders. And frequently surrounded by obstacles such as platforms, masts, signalling equipment and indeed overhead contact lines. PFISTERER distance voltage sensors offer more safety for delicate maneuvering. The assistance system detects the voltage state of overhead lines. If they are energized, the crane must not get too close to them under any circumstances. Otherwise, high-voltage electricity will take an uncontrolled path.

No contact. But still deadly.
Even critical proximity to an overhead contact line can cause a flashover, accompanied by an arc. Their

destructive power can damage hearing, give a fatal electric shock, ignite combustible material, or cause an explosion. If direct contact is made, high currents will flow straight through the crane into the ground. The crane operator should be all right, as the metal cab shields the operator like a Faraday cage. But everyone and everything in the vicinity of the crane is in immense danger: bodily injury or death, property damage or destruction.

To prevent this, there are regulations for working in or on electrical systems. Nevertheless, electrical accidents involving overhead lines do still happen. While the Five Safety Rules are considered to be an international standard, they are not universally applied. Human error can undermine any safety precautions. Kirow takes these facts into account.

Unclear circumstances. Clear boundaries.

"Crane manufacturers know the potential application-specific hazards. What they cannot know are the specific operating conditions. Cranes move around, and every site is different. Take overhead lines, for example. You don't find them everywhere. Where they are present, the question is whether they are live. Or rather, are they de-energized when they are supposed to be," says Arnfried Wagner, control technology specialist at Kirow in Leipzig. "It follows that a practical railroad crane is one that can be used flexibly and safely. Our multi-tasker cranes meet these criteria in multiple respects. They are fundamentally suitable for working below overhead contact lines, whether those are switched off or live."

For efficient working: Kirow multi-tasker railroad cranes automatically keep a safe distance from overhead contact lines, thanks to a factory-set working height limiter on the crane arm. It can be switched off at any time if more room for maneuver is required.

One way this is achieved is through a control mechanism for the crane arm, which is essentially the tool that the crane operator works with. On multi-tasker cranes, its working height is preset at the factory. It provides enough room for maneuver for common tasks such as track work. At the same time, the crane arm cannot be extended beyond a defined maximum height. As long as the crane operates with this basic setting, the crane arm automatically keeps a safe distance from overhead contact lines.

Working height changes to suit the application

"For many common applications, this makes the job easier for crane operators," Wagner notes. "Rail networks need to be modernized or modified. Overhead contact line systems power most electrified railways. So there's a high likelihood that a railroad crane will be operating below overhead contact lines. In our experience, it's really the rule for track works." Multi-tasker cranes are practically flexible for other types of applications, including deviations from normal operation.

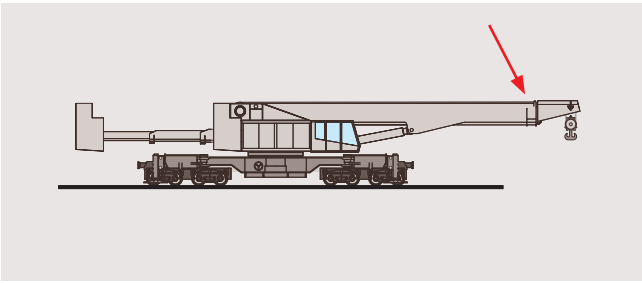
"Railroad cranes place locomotives and carriages onto tracks, and recover them if they derail. Just to get a rail car under the crane hook, you sometimes need to be able to extend the crane arm higher than usual. And it's the same with other applications," explains the control technology expert. "That's why the crane operator can switch off the working height limiter if needed."

Voltage sensor

Adaptability is a requirement that stems not only from the wide variety of applications, but also from rail operators' safety standards. These vary from country to country. And they change based on experience. So custom adaptations are part of the routine for Kirow. Sometimes they break new technological ground, as was the case in 2011.

"A customer in China wanted an additional feature. They wanted the crane operator to be able to check for themselves whether an overhead wire was live or not," Wagner relates. "Detecting high voltage is not a core competence for crane manufacturers, but at Kirow we are used to exploring new possibilities. So we sought the help of an experienced specialist. And that's what we got from PFISTERER."

Their contribution to the custom solution was a distance voltage sensor for use below 25 kV/50 Hz overhead contact lines. Fitted to the top of the crane arm, it detects the voltage state of the overhead line from a defined distance, and sends signals accordingly. These signals are clearly displayed for the crane operator on a monitor. Green indicates "no voltage present," red warns that "voltage is present."



For safety below overhead contact lines: The PFISTERER distance voltage sensor is fitted to the top of the crane arm so it can detect whether voltage is present in overhead contact lines. This means that crane operators can always verify the voltage state of lines for themselves.

« Voltage sensors can offer added safety in many other applications, for example, work near overhead power lines. PFISTERER is already experienced in developing individual custom solutions. »

Jürgen Finsinger
Product Manager for Safety Equipment at PFISTERER

Result from the Far East

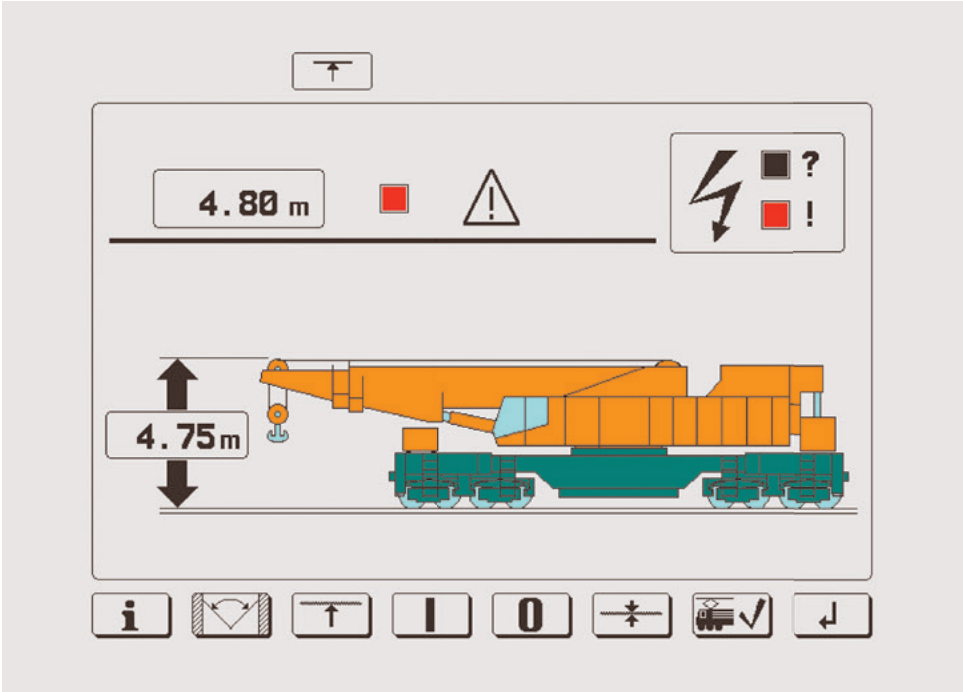
"Our solution has been in use in China for four years with no problems," Wagner reports. The voltage sensor has a built-in self-test for reliability. As soon as the crane operator activates the sensor, its operational readiness is tested automatically in a matter of seconds.

The PFISTERER assistance system is making a valuable contribution to workplace safety in many applications. Wagner explains why: "Whatever safety measures are put in place for work on or near overhead lines, there are many factors that influence their effectiveness. Even with established processes and trained, experienced personnel, misunderstandings are still possible – increasingly so as more people are involved. This is where our solution is beneficial. It means that crane operators can always clearly verify the voltage state of an overhead line for themselves."

Sensor with signal effect: Kirow cranes fitted with PFISTERER voltage sensors demonstrate that assistance systems for voltage detection can provide added safety wherever heavy mobile equipment encounters electrical conductors, including overhead power lines.

Launch in Switzerland. Potential for more.
It's an advantage that recently attracted the attention of a Swiss track construction company. For the imminent market launch in this forward-looking railway country, the distance voltage sensor is being modified to meet various operator requirements, including use below 15 kV/16.7 Hz overhead contact lines. "We took this development step with PFISTERER too," says Wagner. "Our collaboration so far and its results have been highly successful." Jürgen Finsinger, Product manager for safety equipment at PFISTERER, sees further application potential: "Cranes and excavators of all kinds are constantly running into dangerous sources of electricity. Voltage sensors can therefore offer added safety in many other applications, for example, work near overhead power lines. PFISTERER is already experienced in developing individual custom solutions."

Tried-and-tested in China, ready to launch in Switzerland: PFISTERER voltage sensors (circled in red) fitted to crane arms on Kirow multi-tasker cranes. On the right you can see the sensor model for use below 25 kV/50 Hz overhead contact lines. Below is the sensor version for 15 kV/16.7 Hz railway power supply systems.



Working by eye: Kirow helps crane operators during maneuvering with a user-friendly display on a monitor. This screen shows that the crane arm is currently at a working height of 4.75 m, and that its automatic height limiter is set to 4.80 m. Switching off the height limiter is out of the question in this case. The red square to the right tells the crane operator what the PFISTERER distance voltage sensor (also active) has detected: the overhead contact line above is live.

News

Plug-in HV cast resin joints rated for up to 170 kV

Solid-insulated, easy to use, involving no gas and oil work, and with a particularly compact design as well: the new HV-CONNEX size 6 cast resin joint is particularly suitable for assembly tasks performed in confined spaces and that need to be completed quickly. The new connection joint from PFISTERER is currently being used in offshore projects in the North Sea, as well as in newly developed emergency transformers in the USA.

Because space is so much more limited in offshore converter stations than in equivalent land-based substations, cast resin joints in a compact design are a significant factor. This allows cable systems to be installed that save considerable space compared to SF_6 joints. Furthermore, the new CONNEX joints are resistant to salt water and UV radiation, are submersible, maintenance-free, and have been certified for offshore applications by the certification authority DNV GL. This makes them ideal for use on open-sea platforms. The CONNEX size 6 cast resin joint connects cables with different diameters and made of different conductor materials, such as aluminum and copper. Both rigid and flexible cables can be connected to each other in this manner. A voltage tap has been integrated as an additional component, allowing an "at a glance" check of voltage levels in combination with permanently installed voltage testers.

Applications

- Temporary use at testing points, or as an interim solution for line construction
- Consistently safe, compact cable connection
- Suitable for Cu or Al cables
- Voltage range up to 170 kV

Properties & benefits

- Fast assembly without any complicated gas or oil work
- Straightforward plug-in connection
- More compact than conventional connection joints
- Safe to touch, submersible, and maintenance-free
- Certified for offshore use
- Type-tested in accordance with IEC 60840

Scan this QR code for more information.

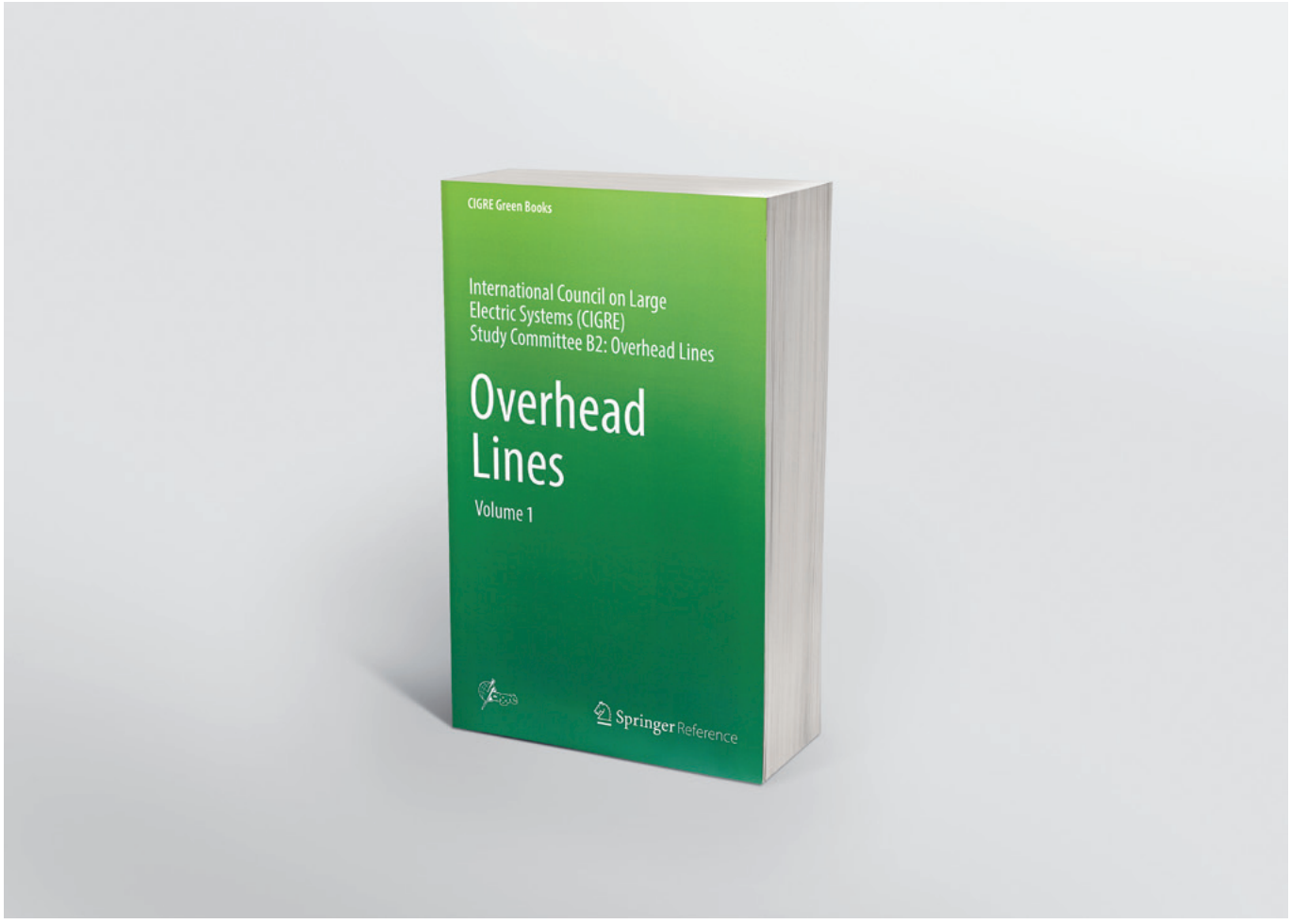
CIGRE recommended reading: “Overhead Lines”

Published in cooperation with Springer International Publishing, the new edition of the reference book “Overhead Lines” promises in-depth expertise.

As part of the “CIGRE Green Books” series, it conveys the latest expertise from over 50 internationally recognized experts acting as contributing authors, including Dr. Frank Schmuck, head of the Insulators Technology division at PFISTERER and coauthor of “Silicone Composite Insulators”, a reference book published in 2012. His contribution addresses questions concerning design, standard requirements, test philosophies, practical examples, and the various fault mechanisms of conventional insulators and silicone insulators.

Overhead lines are the backbone of energy grids worldwide. With 1,300 pages and more than 800 illustrations, the standard reference work “Overhead Lines” addresses planning and management concepts, electrical and mechanical requirements, as well as environmental influences, and discusses all individual components in detail. The academic contributions were reviewed by the CIGRE Overhead Lines Study Committee and reflect the objective international state of knowledge.

The book is available in print and as an e-book.
ISBN: 978-3-319-31746-5



The “transformer to go”: mobile units for any emergenc

The lights go off, computer screens go black, elevators and subways screech to a halt – in the USA, the risk of a blackout caused by transformer failures grows from year to year. If the worst comes to pass, restoring power as quickly as possible is what matters most. However, replacing a transformer can take up to 12 months. Forward-thinking utilities therefore place their trust in innovative emergency transformers that are easy to transport, can be used for many applications, and are quick to install. PFISTERER develops components for an overall concept that, along with transformers, provides easy transport, straightforward connection technology, and on-site training for technicians. The first mobile units have been ordered by Westar Energy in Kansas and Con Edison in New York.

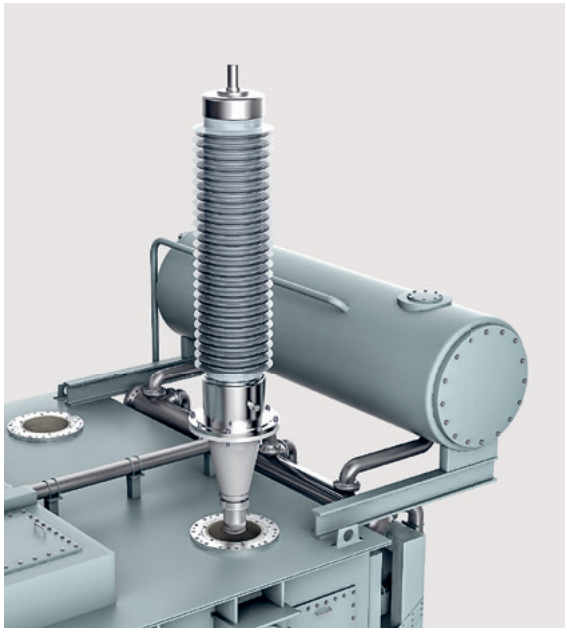
Power transformers are the most complicated and sensitive elements in a power network. Their service life is around forty years, and with increasing age, they become more and more prone to failure. Because most transformers in the USA were installed between 1950 and 1970, many systems have long since reached, or outlasted, their expected service life. This might be profitable for power utilities, but it is also a big risk. Because the danger of a blackout looms large every day.

A defective transformer is not exactly easy to replace, as nearly every one is unique, specifically designed for factors such as voltage, capacity, and its function within the network. Building a new one, transporting it to the site of use, and installing it can take up to twelve months. However, a blackout lasting just a few days, should it occur in Manhattan, would be enough to cause huge economic losses. Con Edison, the power utility in New York City and environs, recognized the need to take action back in

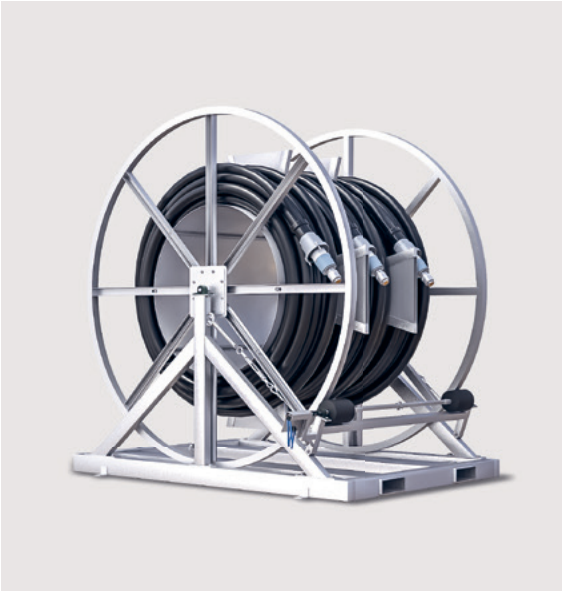
cy.

New Yorkers experienced some dramatic times during Hurricane Sandy 2012: for days, millions of people in Manhattan, Queens, and Brooklyn had no power. The failure of one transformer station alone paralyzed 250,000 connections. Acting quickly afterwards, power utility Con Edison sought an emergency solution – as it wasn't just storms threatening the infrastructure.

Aging power transformers represent a growing threat to energy supply in the USA. Insurer HSB expects continuously rising failures in structures dating from 1964 to 1992 until the year 2020. At the peak, a loss of power of over 40,000 MVA is expected. This amount is enough to supply four million households with power (HSB, 2011).



For a compact transformer design, PFISTERER developed the first pluggable bushing up to 362 kV. It requires only a third of the length and allows the CONNEX equipment connectors to be integrated into the cover of the transformer. When transported, the bushings can be easily removed.



Well-conceived down to the last detail: The drums of the MV- and HV connection cables fit in standard containers, have transport rails for forklifts and a truck air pressure drive that is current-independent.

2014. They were looking for a strategy to safeguard the power supply in the event of an emergency, and the technology giant Siemens joined forces with PFISTERER to develop a concept that impressed Con Edison. "The new mobile emergency transformers are a pioneering solution. The successful development of these transformers and the all-round solution providing straightforward installation and quick and safe connection is a groundbreaking innovation that will benefit the entire industry. Plug-in and insulated connections from PFISTERER have allowed the "plug-and-operate" principle to be implemented in the technology used for power transformers," as Peter Müller, project manager at PFISTERER, explains.

Innovative mobility – by train or truck

Mobile emergency transformers are by no means conventional, redundant transformers. This is illustrated by the Westar project, which introduces a new transformer concept from Siemens. "In order to connect a transformer to the grid in a matter of a few days, transformers with standard functionalities are not enough. The Pretact® Resilience concept from Siemens provides for a new type of mobility based on a specific design and cabling concept. We took an innovative approach to this task right from the start. A plug-in CONNEX connection system made by PFISTERER, which allows production of compact and quick-to-install transformers, is crucial. These are the features so urgently needed for a prompt reaction in an emergency," explains Christian Ettl, project head at Siemens.

Conventional power transformer units can weigh tons. Moving them from one place to another on short notice in an emergency is almost inconceivable. This, however, is exactly what the concept allows for: transport by truck or train, right across the USA, and without special permits. Weight and dimensions are the key factors for transport. To produce the compact, lightweight design required for this, a transformer bank with three single-phase transformers is used instead of a regular three-phase transformer. These are connected to one another and to the power grid by means of HV and MV cables. To achieve the particularly compact transformer dimensions, PFISTERER, together with HSP, the leading manufacturer of transformer bushings, also produced the first, dry-pluggable bushings for voltages up to 362 kV. It requires only one-third of the length of a conventional bushing to discharge the field control inside the transformer. This allows the CONNEX connector, plugged in using the bushing, to be integrated into the transformer cover to save space, and allowing it to be made in the shape of a small cube. "Two different field control methods meet up at the tip of the bushing. Simulating this range correctly and dimensioning it accordingly was a huge challenge. PFISTERER, as the only provider of

In a power failure, it's not just the lights that go out. Hospitals, water utilities, and telecommunications – quite simply, the entire social infrastructure – all rely on fast repair.

Plug and operate.
Deliver. Plug in. Ready.

After a blackout, it's all about re-establishing the power supply as quickly as possible. This can be achieved with mobile emergency transformers and the equipment specially developed for this by PFISTERER. The pluggable CONNEX connection system makes the units easy to transport and quickly ready to use. All components – from the combinable HV and MV connection cables to the cable drum – are completely ready for transport. The plug-and-operate concept reduces replacement time from months to just a few days.

Mobile

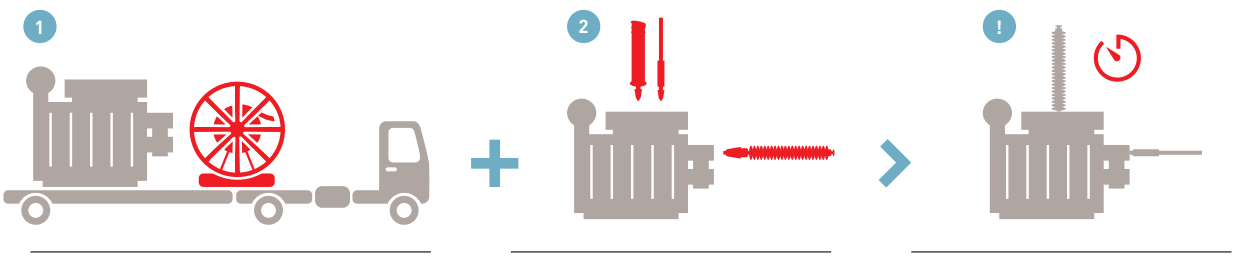
All components can be transported in standard containers – by truck or rail.

Flexible

The pluggable CONNEX system offers numerous combination options.

Fast

Within 96 hours, the mobile transformers are ready to operate at the usage location.



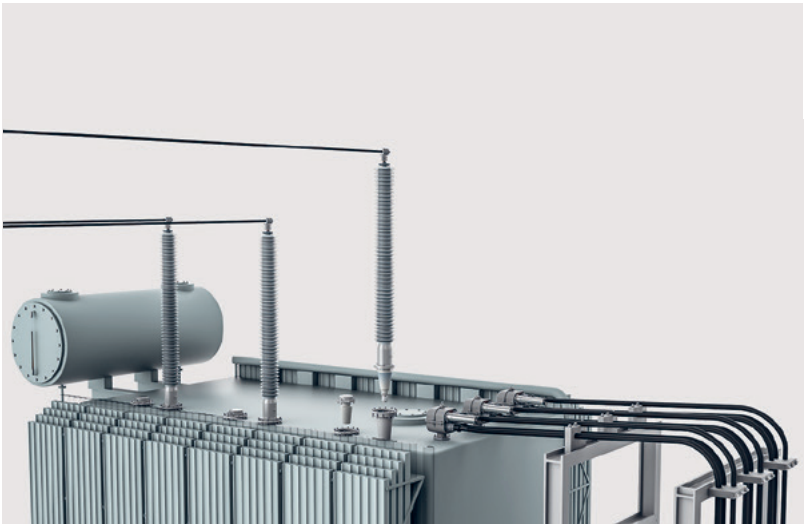
plug-in HV bushings, poured all its expertise into this project," Peter Müller underscores. In addition, the bushings can be easily removed and transported separately. This makes it easy to maneuver the emergency transformer through the narrow streets of New York and even deliver it by water using pontoons, should this be necessary.

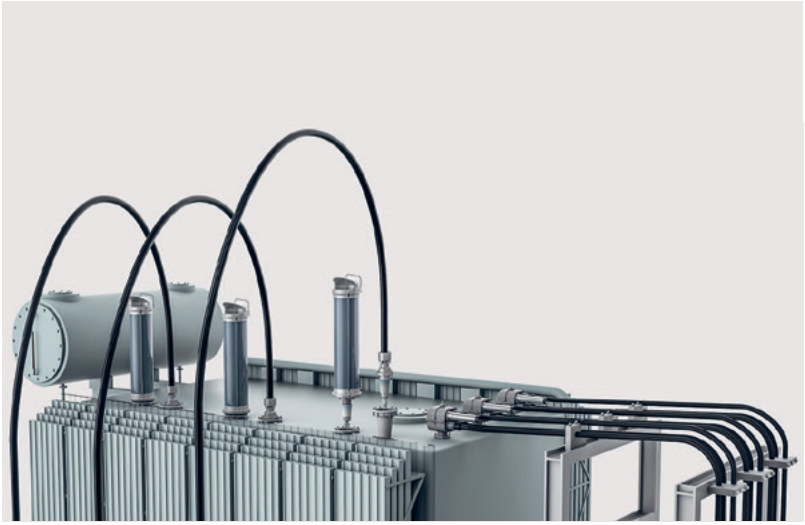
Ready for use quickly

Due to the USA's decentralized, regional grid structure, it is not easy to switch over to a different transformer station in the event of transformer failure. But in an emergency, time is of the essence. This is why the demands made on emergency transformers are high: they should be ready for use no later than 96 hours after a blackout. The plug-in CONNEX connection system makes this possible. A transformer equipped with this system, along with its bushings, is fully tested at the factory, ensuring it does not need to be opened up at the installation site. This means that – in contrast to standard systems – no oil or gas work is required, and up to 75 percent less time is needed for initial installation. Changing a bushing in the event of maintenance is equally effortless.

Installation in confined spaces

To replace transformers with different capacities, an emergency transformer needs to be flexible. This is why it has been designed for operation at several voltage levels right from the outset. For power utilities, this has the advantage of not requiring a mobile transformer to be kept in reserve for each individual grid voltage. This lowers the cost of investment along with the outlay for storage and logistics. The importance of the role played by the cables as well is revealed by installation in a transformer substation. Busbars and technical equipment impose limits on the space available, and there is often no room to install the mobile unit next to the regular transformers. However, this is not necessary either, as plug-in





Flexibility and safety with CONNEX

CONNEX is a pluggable connection system for all voltage levels from 6 to 550 kV. The system makes power transformers and gas-insulated switchgears (GIS) flexible in design and use in an unparalleled way. Cable or distribution line connections, test adapters, and surge arresters can be easily installed and replaced via standardized connecting parts.

Systems equipped with CONNEX are delivered factory-tested and do not need to be opened on site – gas and oil work, as well as field-testing, are eliminated. Assembly is reduced to a simple plug-in process.

« In an emergency, the clock is ticking: after 96 hours at the latest, the emergency transformer is ready for use. »

Peter Müller
PFISTERER Project Manager for Cable Systems

Feltoflex cables allow the distance between the three compact individual transformers to be easily bridged, making it possible to install them in different places according to the space available. The HV and MV cables, which are available in different lengths, can be extended by means of CONNEX high-voltage cable couplers. They are used to connect the individual single-phase transformers to each other and to the overhead line – regardless of the respective location. "We already had the pre-qualification for Feltoflex cables and all type tests, because we have been using the highly flexible connection cables with low bending radii for offshore wind parks for some time now. We were able to incorporate our experience from these projects into the concept for the emergency transformers," Müller notes.

Perfectly fitted out – from cables to gloves

The first units delivered to Con Edison and WESTAR show just how sophisticated the overall concept for the mobile transformers is. This includes, for example, specially developed trailers and cable drums for the connection cables, which are up to 60 m long and can weight more than one ton. They feature transport rails for forklift trucks, along with a pneumatic motor for the drum drive – which can be operated using compressed air from a truck in the event of a power failure – and the height and width of the drums allows three of them to fit alongside each other in one shipping container. The cables are also assembled, tested, and delivered ready-made by PFISTERER. And ease of transport is not the only aspect to have been thought right through. To connect the CONNEX cable couplers, lint-free cleaning cloths and gloves are required. These are supplied in sufficient quantities, along with pre-portioned grease for lubricating the plugs. "We had a challenging task to master. A mobile transformer and everything needed for fast, problem-free installation should fit into just two standard shipping containers. We developed many new products for this, and we succeeded in making a real 'transformer to go,'" as Peter Müller reports.

The first emergency transformer systems have been delivered to Westar Energy and Con Edison.

In Europe as well, energy providers use mobile and flexibly usable transformers with the pluggable connection system by PFISTERER. Since 2011, E-ON and Svenska Kraftnät have been using a CONNEX-equipped mobile transformer station near the city of Landskrona in southern Sweden. The unit is transportable and can be set up simply and quickly at any location needed.

Tracking voltage

With a construction precisely tailored to rail applications used all over the world, and designed for flexible adaptation to country-specific and individual requirements, the KP-Test 5 voltage tester product line can master both challenges with ease. And much more as well. Voltage tests need to deliver reliable results even under demanding usage conditions – ensuring proper protection for human life and for property assets.

"No voltage" or "live voltage" – the findings that a voltage tester delivers are indispensable for averting any risks that could pose a serious danger when performing work on electric railroad installations: an electrical accident harmful to health and a risk to life and limb, one that puts the integrity of the system at risk and brings both urgently required work and normal operations to a standstill.

"To ensure that prevention works, voltage testers need to be able to do far more than evaluate voltage conditions exactly," Jürgen Finsinger says. The PFISTERER product manager for safety technology also knows why: "Voltage testers are often used when maximum efficiency is required, as is the case during work on rail networks or in emergencies. Decisive for the efficiency of voltage testers

For railroads worldwide: The KP-Test-5 R used here features a hook electrode to make applying a contact to AC overhead lines easier. The model is one of many PFISTERER voltage testers for rail applications. They can be modified to suit requirements and make efficient work out of safe voltage tests not only of overhead lines, but also of conductor rails, switchgears, and power lines.

is, in particular, their user-friendliness." Steffen Jordan, a development engineer at PFISTERER, names key factors that influence this: "Practical experience has shown what presents a regular challenge for users: environmental factors and the design of the infrastructure. This is why we make allowances for these factors when designing voltage testers."

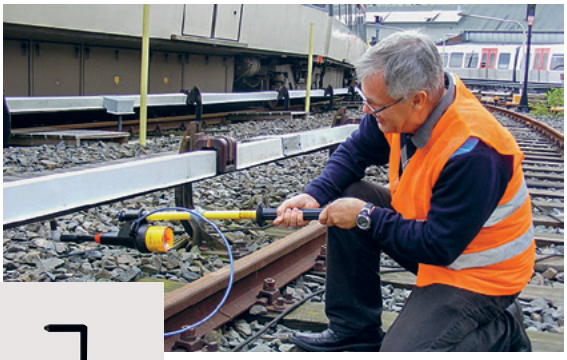
Getting a grip on environment and installation

As one of the first manufacturers worldwide to do so, PFISTERER has combined visual and acoustic indicator signals as well as optimizing their effectiveness and interplay. The result provides invaluable certainty: the voltage status detected by all KP-Test-5 models is clearly identifiable for the person performing the test – even when working in deafening noise, in blinding sunlight, or in fog.

PFISTERER also makes allowances for installation-specific features and test methods: KP-Test-5 models with a robust hook electrode simplify applying a contact to overhead lines from the ground. In a streamlined form, they also make applying a contact to railroad power lines when working from the mast or a lifting platform much more straightforward. DC models ensure that simultaneous connection to the contact wire and track are easy to implement by using a positive pole in the shape of a hook, and a negative pole with a magnet. PFISTERER also delivers models suitable for practical use with third conductor rails, rail networks, and railroad switchgear.

Diversity for global benefits

The KP-Test-5 family demonstrates its flexibility with its suitability for international use: it covers the most commonly used AC and DC traction supply systems worldwide; other systems can be added at any time. Five signal modes for indicator signal output are available. PFISTERER develops clever, individual solutions for specific requirements. A good example is the customized DC version with AC detection for combined railroad power infrastructures. As varied as the models are, along with the combined LED and acoustic indicator signals, they also share another feature: a self-test that automatically checks operational readiness of the device before each voltage test. PFISTERER voltage testers ensure that you stay on the safe side, and do so efficiently.



KP-Test 5 DC for 3rd rails: A contact electrode that has been extended at a right angle makes applying a contact to covered power rails for DC railways easy using this version of the device, once the negative pole has been applied to the rail by a magnet to ensure it does not slip out of place.

KP-Test 5 for railroad power lines: Its slim design, including a finer hook electrode, is optimal for voltage tests on railroad power lines performed from the mast or a lifting platform.

KP-Test 5R DC for overhead DC contact lines: An additional feature on this model, apart from the hook electrode, is the mechanism for affixing the ground-end pole to a magnet. This makes correct connection of both poles possible without unnecessary complications. PFISTERER can provide an insulating rod as well upon request (not shown here).

Scan this QR code for more in-depth information about rail voltage testers in the special issue of CONNECT.

PFISTERER

Easy. Safe.

Voltage detectors plus grounding and short-circuiting kits from experts.

M2016-053 EN 11/2016 Art Direction: VISCHER&BERNET, Stuttgart Für Druckfehler übernehmen wir keine Haftung/Technische Änderungen vorbehalten