PFISTERER Customer Magazine
Issue 1 **2017**

PFISTERER

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Michael Keinert

Editorial

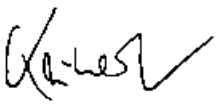
Blazing the trail for power

Efficiently opening up supply lines – PFISTERER helps businesses around the world meet this challenge. With tailor-made solutions, expertise and service.

In Switzerland, perfectly adapted components – installation-friendly, robust, and packaged for easier logistics – facilitate the construction of a 380-kV overhead power line across extreme terrain (see page 4). For ecological power generation in the middle of the Pacific, technical advice and installation accompany a shipment of environment-friendly cable terminations to the Hawaiian island of Kauai (see page 14). A unique interim solution enables redundant supply lines during grid construction work in an urban area of Germany (see page 19).

Our project news (see page 12) bring you highlights of other noteworthy projects. And if you are blazing the trail for power, PFISTERER will be pleased to actively help you reach your destination!

Sincerely



Michael Keinert

Chairman of the Executive Board
PFISTERER Holding AG

Mastering the extreme. With experience.

Superlatives define electricity infrastructure development in the Valais in Switzerland. The canton will become home to Nant de Drance, one of the largest pumped-storage power plants in Europe. For its connection to the extra high voltage network, Swissgrid is constructing a new 380-kV overhead power line – across some of the continent's most extreme terrain. It is a challenge that demands know-how and experience. Line construction firms Eduard Steiner and Lebag, together with PFISTERER, contribute both.

« What is important is the experience that all project participants contribute. »

Alexandre Rey
Project Manager Lines, Swissgrid


© Swissgrid, Sébastien Moret

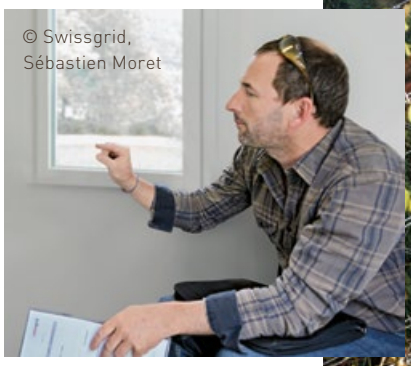
A plateau near the municipality of Salvan. From its edge there is a vertiginous drop into inscrutable depths. Lines are suspended from protruding high voltage transmission tower crossarms with insulator strings, cable vibration dampers and marker balls by PFISTERER. To construct the tower base, installation engineers abseiled 80 m down from the plateau. Farther still below winds the Trient mountain stream. So far down that they couldn't hear its roaring, crashing waters.

This is tower 124. One of 34 towers in the new overhead power line. Equipped with at least two 380-kV systems, it will replace various existing lines. With this network enhancement, Swissgrid is ensuring that energy can be transported from the Nant de Drance pumped-storage power plant. It will generate around 2.5 billion kWh of electricity annually. A substation to handle this power is situated at Châtelard close to the French border. This is where the new overhead power line begins, with tower 101. It runs for 12.5 km along the Trient Valley to the La Bâtiaz switchgear near Martigny in the Rhône Valley.

Extreme location: ravine

Alexandre Rey knows well the route of the line at the northern end of the Mont Blanc region. As Project Manager Lines at Swissgrid, he is supervising its construction

Technology rises from the deep: Taken in November 2016, a plateau near Salvan offers a closer view of the top and crossarm of pylon 124. It has since been fitted with PFISTERER insulator strings, marker balls and cable vibration dampers.



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Precise planning: Alexandre Rey, Project Manager Lines at Swissgrid, explains the design of the new 380-kV transmission line at a construction meeting.

Steep above the gorge: A section of the new Swissgrid 380-kV line in October 2016 after cable pulling – tower 124 is in the right foreground. Its location is one of the most challenging from an installation point of view: an almost sheer rock face above the Trient Gorge.

High performance at altitude: Installation engineers assemble the elements of tower 124, which is anchored into an extremely steep rock face.

Efficient deployment: (l. to r.) Lebag CEO Daniel Stutz discussing material provision for the construction of the new towers with his employees Peter Ehrentraut, installation supervisor, and João Simões, coordination and logistics manager.

and was involved in its planning. "Every line is a sophisticated compromise between numerous factors." Network strategy, the technology used, environmental standards. Interests of local communities and residents, who are consulted during the approval process. Aside from people's wishes there are natural constraints – the topography. "Every tower site represents the outcome of numerous considerations."

Tower 124 is a good example. Its site is one of the most challenging in installation terms: a rock face that drops almost vertically into the 200-m-deep Trient Gorge. This location means that the new line cannot be seen by residents of Salvan. Elsewhere too, it retreats from view. Into the impassable mountain terrain. Conventional installation methods are impossible in these situations. "What is important for every line, and especially this one, is the experience that all project participants contribute," Rey emphasises. Eduard Steiner AG and Lebag Leitungs- und Elektrobau AG together have almost 150 years of experience. The subsidiaries of Swiss group Sacac Holding AG install, maintain and dismantle lines in Switzerland and other countries, often in extreme locations. Since the summer of 2015, under the lead management of Eduard Steiner AG, they have been working in the Valais as a consortium, on behalf of Swissgrid.

They employ trusted methods and proven solutions. "We have used PFISTERER overhead power line components for years," reports Daniel Stutz, CEO of Lebag AG. "Good quality, complete, easy to use and work with. In a word: proven. Proven is an advantage in the demanding work we do." The installation engineers perform countless individual steps. For the new line, they are assembling lattice pylons with a secondary framework – comprising over 1,000 steel components and more than 6,000 bolts per pylon.

Stage by stage

On level land with vehicle access, each stage of the tower would be pre-assembled on the ground next to the tower base, before being hoisted by crane, then manoeuvred, positioned and fixed into place by installation engineers harnessed to the already-constructed part of the pylon. Not so in Valais. It is impossible for a mobile construction crane to reach any of the tower sites. Instead, an inner derrick can be used: this narrow, staged lattice structure with a winch is installed inside the pylon. Or a heavy-lift helicopter. The installation firms carefully consider which option to use where.

When installing the tower elements using a derrick, fewer pre-assembled sections are used, and more individual parts are installed directly on the tower. All of them need

Pre-assembly: Helmut Burgener (l.), PFISTERER project manager, and Michael Eichenberger (r.), CEO of Eduard Steiner, inspect a pre-assembled crossarm with pre-installed PFISTERER string fittings, from the tower suspension to the arc-rings.

« PFISTERER overhead power line components are proven. Proven is an advantage in the demanding work we do. »

Daniel Stutz
CEO, Lebag

Thousands of individual steps: For each new lattice pylon, engineers assemble over 1,000 steel components using more than 6,000 bolts, as shown here in the construction of tower 134 at Martigny and tower 110 at Finhaut in the spring and summer of 2016.

All photos on this page are © Swissgrid, Sébastien Moret

Into the heights: Some of the new pylons are constructed using an inner derrick, as shown here for tower 127 at Salvan in July 2016. The derrick functions as a slender crane substitute that the installation team raises while building the tower – with a practised instinct for securing and aligning it with cables to the tower and ground.

From the air: in October 2015, for the construction of tower 124, pre-assembled tower stages were transported by heavy-lift helicopter and lowered onto the tower before being bolted into place by installation engineers – as was also the case for five other towers in particularly exposed locations.

to be readily available. This is no option for tower 124: the rock face that its base rests in is so steep that anything unsecured set down on it will tumble into the Trient Gorge below. On top of that, derrick assembly can only progress when the engineers are working on the actual tower site. That's not possible in all weathers. And getting to the site overland can take up to 1.5 hours. The elements for a total of six pylons were brought in entirely by air – using pre-assembled pylon stages carried by heavy-lift helicopters.

At the pylon site, a groundcrew member coordinates between installation engineers and the pilot via radio. Using a helicopter requires precise timing and support sites preferably close by, with space for materials and pre-assembly as well as landing. If there's fog, the helicopters stay on the ground. But pre-assembly work can be carried out at the support sites even in bad weather. "Each installation method has its specific advantages and challenges," explains Michael Eichenberger, CEO of Eduard Steiner AG and project leader for the installation firms. "For line construction you need an optimum balance between efficiency and operational safety." Easy installation assists both, as the installation of PFISTERER insulator strings demonstrates.

Productive with PFISTERER

Installation engineers climb up a mast, strapped into a safety harness with clip-on tools. At the crossarm height, up to 70 m above the ground, they rig up a ladder and climb to the tips of the crossarms. Using a winch, they lift insulators and fittings, and bolt them to the conductor cables, standing on the ladder.

"Silicone composite insulators are ideal for this work. Firstly, they are much lighter than porcelain insulators. You really notice the weight difference in a 380-kV string," says Peter Ehrentraut, installation supervisor at Lebag. "Secondly, they're breakage resistant. If porcelain accidentally knocks into the tower or a spanner, it can crack. Composite insulators can suffer much worse than that without a trace of damage, and with no loss of functionality." Ehrentraut speaks from experience. He has been building overhead power lines for 41 years.

Over his thirty years of experience in the field, Heiri Rhyner, installation supervisor at Eduard Steiner, has worked out a few rules of thumb for easy installation. One is: "When individual components of the insulator string interact well with each other – such as the PFISTERER 380-kV strings – it makes installation that much smoother." Helmut Burgener, Senior Manager and project leader for PFISTERER, provides some insight into their design: "Customer requirements and standards set a clear framework. We exploit our design scope by optimally matching high-performance string components to each other. That increases the operational

Light and strong: a PFISTERER 380-kV insulator string is lifted by winch for installation onto the crossarm. The advantages of these insulators come into play: thanks to silicone composite technology, they weigh less than conventional insulators and, at the same time, are extremely robust.

« When individual components of the insulator string interact well with each other – such as the PFISTERER 380-kV strings – it makes installation that much smoother. »

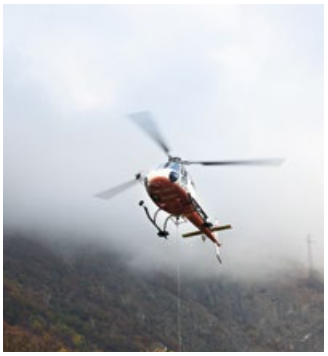
Heiri Rhyner
Installation supervisor, Eduard Steiner

reliability of the string and promotes its cost-effective deployment from installation onwards."

Precisely placed

Rhyner shows a PFISTERER string fitting for attaching the arc-ring. A double eyelet. Moulded near the central bolt hole are two nubs. "Inconspicuous, but effective during string installation. They eliminate the need to align the arc-rings." Recesses of the same shape are formed in the arc-rings. As a result, when the arc-ring is bolted onto the eyelet, the nubs ensure the arc-ring is automatically in the correct position. This is essential. Burgener explains why: "An arc-ring can only perform its protective function properly in the string if it is precisely locked in place at the transition from the fitting to the insulator." All fittings need to ensure the safe discharge of short-circuit current. PFISTERER fittings are tested to withstand 50 kA / 1 s. Not so with undersized material. It melts.

Any damage to the line costs more than simply fixing it. Millions are lost due to fatigue breaks, which can occur when wind-induced vibrations strain the components of an overhead power line over many years. Swissgrid uses vibration dampers to prevent this. "There are many types and recommendations for their selection and fitting," Rey notes. "Using vibration dampers effectively requires



Load by air: a crossarm with pre-assembled PFISTERER string fittings is transported by helicopter on cables from an installation site near La Bâtiaz. Through binoculars, Heiri Rhyner, installation supervisor at Eduard Steiner, oversees the load flight to the tower location.

« Using vibration dampers effectively requires expertise. PFISTERER is known for that. »

Alexandre Rey
Project Manager Lines, Swissgrid

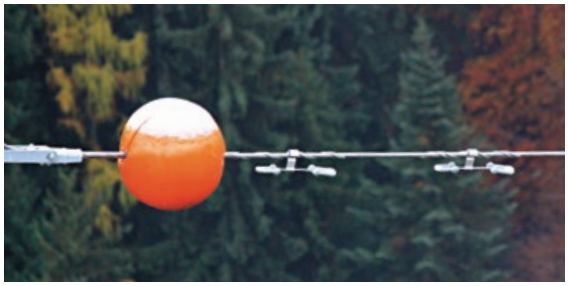
expertise. PFISTERER is known for that." It is based on decades of experience and realistic computer simulations. "For each line, we individually calculate the suitable damper type, and the installation points on the conductor cable," says Reto Aeschbach, Sales Manager Switzerland at PFISTERER. "Only the right damper in the right place can absorb vibrational energy."

PFISTERER supplies the calculations with every shipment of dampers, including for the new 380-kV line. Optimal placement is also ensured by João Simões from Lebag, who is in charge of coordination and logistics. He manages masses. The installed mast material alone weighs over 1,000 t. Plus the overhead conductors and accessories, machinery, tools and more besides. All supplied to storage and support sites in line with the principle that things needed first should be available quickly and easily. "Especially at the tower sites," Simões explains, "where the engineers don't have space or time to gather materials." Hence one of Swissgrid's requirements is that insulators and fittings are delivered ready packaged for each tower. "That isn't a standard service. PFISTERER has done it perfectly."

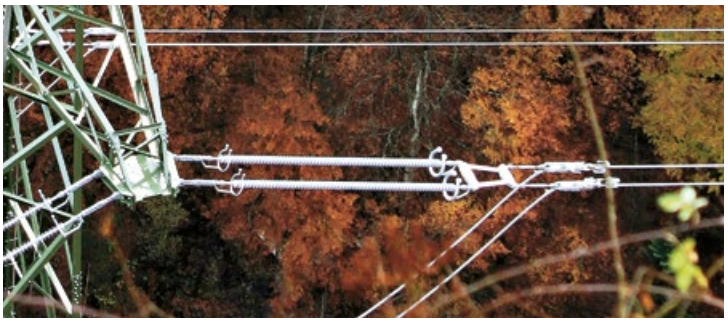
Accurate service for well-planned logistics: PFISTERER supplies the string fittings (left) and 380-kV insulators (right) ready packaged for each mast – according to Swissgrid's requirement for installation-friendly material provision.

Pre-flight test: at a pre-assembly area near Salvan, the installation firms use a crane to test the air transportability of pre-assembled tower stages, before these are flown by helicopter to the tower site.

Safety and reliability for decades with PFISTERER overhead power line components installed on the earthing cable for tower 124: the marker ball on the left serves as a visible warning signal for aircraft, while the cable vibration dampers fitted to the right of it absorb wind-induced vibrations to guard against expensive fatigue breaks in overhead power line components.



Easy installation promotes operational reliability, as demonstrated by the PFISTERER 380-kV tension string sets, installed here on tower 124. Thanks to an intelligent fitting design, the arc-rings are automatically held in the right position during string installation. As a result, their protective function is assured without manual alignment.



For power supply reliability

The overhead power line components have now all been installed, and after a good two years of construction work the installation is complete. The new power line has been on the grid since 1 June 2017. "Constructing an overhead power line is always a challenge," Eichenberger sums up. "Everyone involved is making a substantial contribution to the reliability of the power supply." As with the construction of Nant de Drance. The pumped-storage power plant forms an important part of the Swiss electricity grid and European network. Electricity from new renewable energy sources is increasingly fed into both, especially wind and solar, whose output varies with the weather. When it goes into operation at the end of 2019, Nant de Drance will play a balancing role to stabilise the grid: when energy demand is low and electricity generation is high, it will store surplus energy. Conversely, it can provide peak power within a few minutes – thanks to its 900 MW capacity, which is roughly equivalent to that of the Gösgen nuclear power station. Essential infrastructure for the reliable flow of electricity into the networks: Swissgrid's new 380-kV line.

Scan this QR code
for more information.

News

Success for modern wind farms

From 2020 onwards, more than 100 wind turbines at the East Anglia ONE wind farm 40 km off the coast of England will produce enough power for 500,000 households – a total of 714 MW. In order to transfer this high level of power, the voltage level within the wind farm must be converted from the usual 33 kV to 66 kV – and PFISTERER is providing the necessary connection technology: The size 4 CONNEX cast resin joint is the only one that has already been tested and offshore-certified for this power range. In cooperation with British cable manufacturer JDR, PFISTERER has therefore seen off the competition and been rewarded with an order for cast resin joints and CONNEX plug connectors by operator ScottishPower Renewables. At the same time, the project is opening the door to the global offshore market, since the power of wind farms is increasing on a global basis, therefore requiring the change to the 66 kV level. CONNEX provides continuous connection technology for this, from the wind turbine to the cabling of the converter platform and the mainland connection.

Plug connector for sustainable mobility

The topic of e-mobility is becoming increasingly important, also in commercial vehicles. Electrically operated buses, trucks and agricultural machinery save fuel and produce fewer CO_2 emissions. This makes them an important building block for the sustainable mobility of the future. In order for electric motors to operate reliably in vehicles weighing several tons, special components are required. In collaboration with ZF Friedrichshafen, one of the world's leading companies in the field of drive and running gear technology, PFISTERER has developed a high-performance plug connector for applications with high environmental requirements and a long service life. The HVC8 plug connector, via which the electric motor is connected, takes over an important key function in the electric drive system. PFISTERER's entire contact technology expertise has been invested in this robust and extremely long-lasting product. The technically sophisticated design is based on three patents in the areas of contact technology, shield connection and cable strain relief. The HVC8 plug connector has been exhaustively tested, checked and qualified in accordance with the ZF specifications.

155-kV connection on the high seas

With output of 900 MW, the DolWin 3 network connection project will supply about one million households with clean energy in the future. In order to provide the best possible feed, two converter platforms are being connected via a highly flexible 155-kV Feltoflex cable with 800 mm^2 cable cross-section for the first time. If necessary, the operator can switch between the DolWin 3 and DolWin 1 platforms and therefore use an alternative shore connection. This is a real challenge as far as cable laying is concerned, since the cable's cross-section is 800 mm^2 and its weight is approximately 16 kg/m. With a system length of more than 200 m, it is also the longest connection between two platforms worldwide. The onshore installations have already been successfully completed. The internal cable connections with the CONNEX connection system and the CONNEX cast resin joints have been installed and tested on the platform. The offshore installation of the HV connection at sea will take place in the next step.

Market entry in China

Xiangshan Park is one of the most popular tourist attractions in Beijing with up to 60,000 visitors every day. From September 2017 onwards, the park will also be accessible via the new "Beijing Western Suburban Line" tram system, which is currently under construction. The TENSOREX C+ spring-tensioning system from PFISTERER will be used for the first time in China on the new line. Previously, conventional wheel tensioners were used there in order to compensate for temperature-related length changes to the overhead lines. PFISTERER successfully beat off competition from China and Japan. The client, Beijing Metropol, was particularly impressed with the compact product design and the quick and easy installation. The innovative spring-tensioning system is maintenance free and ensures that the tensioned ropes and wires remain at a constant height. A total of 40 TENSOREX C+ units are being installed on the new route to Xiangshan Park.

Successfully qualified for the 420-kV voltage level

New PFISTERER cable fittings for 420 kV have successfully passed IEC 62067 qualification testing. The type test including water-tightness test for the joint and the prequalification test were carried out in partnership with Greek cable manufacturer Hellenic Cables. With the official qualification, in which all tests required under IEC 62067 were successfully passed, PFISTERER has further expanded its high-voltage range. The IXOSIL outdoor terminations and slip-on joints, the CONNEX cable connectors and sockets, and the gas-insulated CONNEX joint for the voltage level up to 420 kV are universally deployable and compatible with all XLPE cables by all providers, like all of the HV cable sets manufactured by PFISTERER. They therefore form the basis for efficient partnerships.

Peak performance of the highest order

The highest overhead power line towers in Europe can be found in the vicinity of Hamburg. The four suspension towers of Elbe Crossing 1 and 2 extend 189 m and 227 m into the air so as to provide the necessary clearance height of 75 m on the Elbe beneath the overhead power lines. The connection between Stade and Hamburg with a span of 1200 m plays a central role in Germany's north-south axis. For this reason, operator TenneT wanted to modernise the towers, which were built in the 1960s and 1970s, in order to cope with the increasing wind loads and to provide overload protection in the event of voltage peaks. Within just a few weeks, the PFISTERER team succeeded in developing new technically sophisticated fittings, manufacturing and testing the required insulator strings with an extremely high tensile strength of 300 kN, and delivering these just in time.

High voltage under Hawaiian sun.

Kauai's energy provider is pursuing an ambitious goal: by the year 2023, half the island's electricity requirement is to come from renewable resources. This will be made possible by an innovative solar power station in combination with a battery farm from Tesla. The dry, oil and gas-free IXOSIL terminations from PFISTERER will be used here for a grid connection without environmental risks.

Sun-kissed beaches, tropical rainforest and breath-taking marine fauna – Kauai, one of the eight main Hawaiian Islands, is also called the Garden Isle on account of its lush tropical vegetation and unique blossoms. Situated in the middle of the Pacific, this is where the waves first make land again after many hundreds of sea miles. An exceptional natural paradise, which has retained its charm – right up to today no house is allowed to be built on Kauai that is higher than a palm tree. For the public energy supplier however the island location poses a challenge, because no electricity can be drawn from the power stations on the American mainland some 4,000 km away. Instead, Kauai Island Utility Cooperative (KIUC) has to import fossil fuels by ship in order to operate its

Pioneering project: On the Hawaiian island of Kauai, the first solar park with Tesla power packs is being built on a 26-hectare area that caches solar power.

Ambitious goal: By the year 2023, half of all electricity required will come from renewable resources.

generating plants. This is inefficient, expensive and causes CO_2 emissions. KIUC rose to this challenge with a forward-looking project, which sets an example for environmentally friendly, cost-efficient and independent energy production in remote regions – a solar power station with a battery farm, where oil-powered generators are only connected if necessary.

Solar power by night

Around 55,000 solar panels convert sunlight into electricity here. Surplus energy is stored temporarily during the day in 'power packs'. This involves using the battery containers developed by Tesla, which contain entire rows of lithium-ion cells. The peak load on Kauai begins in the evening when the islanders return home after work and switch on their lights and electrical equipment. In future, even after dark, clean solar electricity will be available from the battery farm and minimise the use of diesel-powered generators.

Avoid environmental risks also during the connection

Conservation and safety play an important role on the green island. The oil or gas-filled connection components typically used in US-American substations present a risk of serious environmental impacts throughout the system's entire service life. Besides the risk of oil and gas escapes during the initial installation or during future replacement and repair work, there is also the hazard of

« The technology works perfectly, and we would really recommend it to others. »

John Cox
Engineering Manager, KIUC

leaks or even a component exploding. Kauai's utility companies no longer wanted to take this risk and thus opted for an insulation with the solid material silicone. With optimised total costs, this forward-looking technology ensures maximum safety, since the maintenance-free terminations do not require the handling of oil or gas at any time on-site in the substation. Being explosion-proof, the dry technology also offers extra safety against external influences, such as vandalism or extreme natural events.

PFISTERER was the only provider able to satisfy the requirements imposed by KIUC. "In opting for the dry terminations, we have deliberately chosen a new path and in doing so have taken an innovative decision for our industry, which has proven to be right in practice. The technology works perfectly and we can truly recommend it", says John Cox, Engineering Manager from KIUC. With the dry insulated IXOSIL outdoor terminations, PFISTERER not only supplied suitable components, but was included in the project planning at an early stage. KIUC had not carried out any new cable projects for around 10 years and thus required extensive support. This extended from the advice on the design of the earthing system to the procedure and calculation of the test processes through to the complete installation. "As an independent accessory manufacturer, PFISTERER offers suitable product technology for every cable and every requirement. This enables us to accompany our customers from the start through to the completion of a project and to find end-to-end solutions, like on Kauai for example, where our customer uses a highly flexible EPR cable", reports Bruno Bomatter, project manager at PFISTERER in Switzerland. To protect the cables against lightening strikes and system faults, special link boxes were required. PFISTERER carried out multiple calculations, implemented an extra compact shield surge arrester and produced the earthing link boxes to the customer's specifications. Inside the substation, three self-supporting cable terminations of the type IXOSIL EST SUB were connected via the tap-changer mechanism with the overhead power line. Outside, a further three cable terminations make contact with the transformer on the line side with a voltage level of 57.1 kV. On the secondary side, the transformer is fed with 12 kV from the solar power station.

Rapid installation in a green paradise

The installation was completed in a very short time, with the IXOSIL system showing all its advantages thanks to its light, compact design. The terminations were assembled horizontally on the ground, immune to the weather conditions under canvas, and subsequently lifted by crane. The installation was quick, precise and inexpensive, also because of the ready-assembled component groups and the fully electrically individually tested components. What is more, neither a scaffold nor special tools were required. Assembly on the ground is also beneficial for safety aspects, since hardly any hazardous work at height was performed.

On the beautiful island paradise of Kauai, the proven outdoor cable terminations will go to ensure an operationally reliable, resource-conserving electricity supply, thus helping to make the island that little bit greener. KIUC is already planning a follow-up project, for which it has reached out to PFISTERER. Worldwide, IXOSIL has been deployed reliably for decades in numerous substations and electricity pylons, and utility companies are increasingly showing interest in the advanced technology, which excels in terms of safety, time and cost savings, not forgetting environmental protection.

Oil- and gas-free solid insulation: Outside the substation, the IXOSIL terminations connect the cable with the transformer.

Reliably safe and resource-preserving power supply: Inside the substation, three self-supporting dry cable terminations are connected with the overhead power line via the tap-changer mechanism.

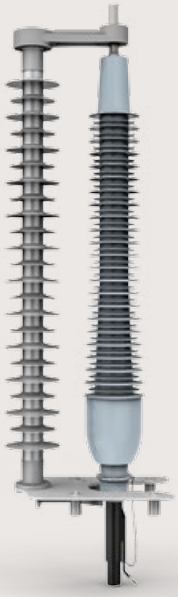
Dry Outdoor Cable Terminations

Utmost operational reliability and low total costs

- Quick and easy to install
- Oil and gas-free – leak-proof
- Maintenance-free
- 100% electrically individually tested
- Proven technology

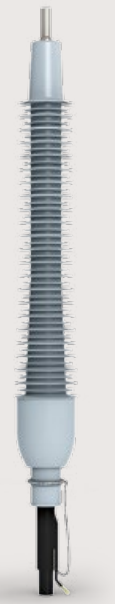
Cable termination and surge arrester in one

With the **IXOSIL EST SUB SA/SAC** (123–170 kV), the surge arrester serves as a fixing point for the cable termination at the same time. No additional supporting elements are necessary.
The cable connection and surge arrester are installed independently of each other. The individual components are compliant with IEC 60840 and IEC 60099 standards.



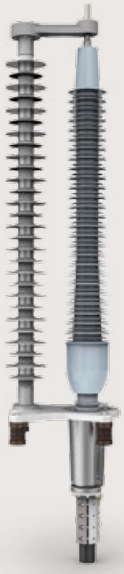
For substations

The **IXOSIL EST SUB** (52–170 kV) is the safe and cost-effective solution for substations. The cable connection and supporting element are installed independently of each other – the cable termination is installed on the cable on the ground and subsequently raised up into the supporting structure.



The flexible

The **IXOSIL ESF** (52–170 kV) is integrated into existing or new supporting structures. It is ideally suited for substations and flexible multiple-use applications in testing and temporary site cables.



For electricity pylons

The **IXOSIL EST** (72–170 kV) is fitted to the cable whilst on the ground and subsequently raised up onto the pylon. No erecting scaffold is required. The switch-off time of the overhead power line is minimised.

Provisions for supply reliability.

A resilient power grid has reserves – even during construction work. This is an important factor in supply reliability, where Dortmunder Netz GmbH (DONETZ) systematically implements the N-1 security principle. With foresighted planning. And a unique interim solution by PFISTERER, which demonstrated its strengths in a DONETZ substation.

For power in the city: The interim solution by PFISTERER for DEW21 subsidiary DONETZ was first used in the Kronenburgallee substation in Dortmund. The substation supplies electricity to around 15,000 homes.

© DONETZ


© DONETZ

Implementing reserves: To ensure constantly high supply reliability during the GIS conversion in the Kronenburgallee substation, DONETZ system specialists Jörg Sprinck (l.) and Andreas Liese (r.) plan to connect a transformer directly to the 110-kV network using an interim solution by PFISTERER.

« Minimise failure risks and guarantee the power supply with reserves. The interim solution by PFISTERER did its job reliably. »

Andreas Liese
Head of systems and cable engineering at DONETZ

Lean construction: The CONNEX elbow joint (here, three next to each other) has a compact joint body with two plug connection points arranged at right angles, thus enabling space-saving cable routings over several building levels.

May 2016, DONETZ substation, Kronenburgallee. Under a leafy tree in central Dortmund – Germany's eighth most populous city – there stands a functional building. It houses two 110/10-kV systems: a transformer and an SF_6 gas-insulated switchgear (GIS). For now, the GIS is still operating as an interface system between the transformer and the 110-kV network run by Westnetz, the largest German distribution system operator. Soon it will be dismantled for a new purpose: its components will be placed into storage as the fastest-available replacements for five other identical GIS. Until a new GIS is installed in the substation, the transformer needs to remain operational. With an interim solution from PFISTERER.

Ensuring supply reliability at DONETZ. A wholly owned subsidiary of Dortmunder Energie- und Wasserversorgung GmbH (DEW21), DONETZ is in charge of the electricity, gas and water supply networks in Dortmund as well as other neighbouring gas and water networks. Its local power distribution network comprises 110-kV facilities, the 10-kV network, and the low-voltage network including local substations. Faultless operation is partly the responsibility of DONETZ's specialist systems and cable engineering department, headed by Andreas Liese. The department's employees maintain existing systems and connect new facilities to the grid.

Resilient network in all situations

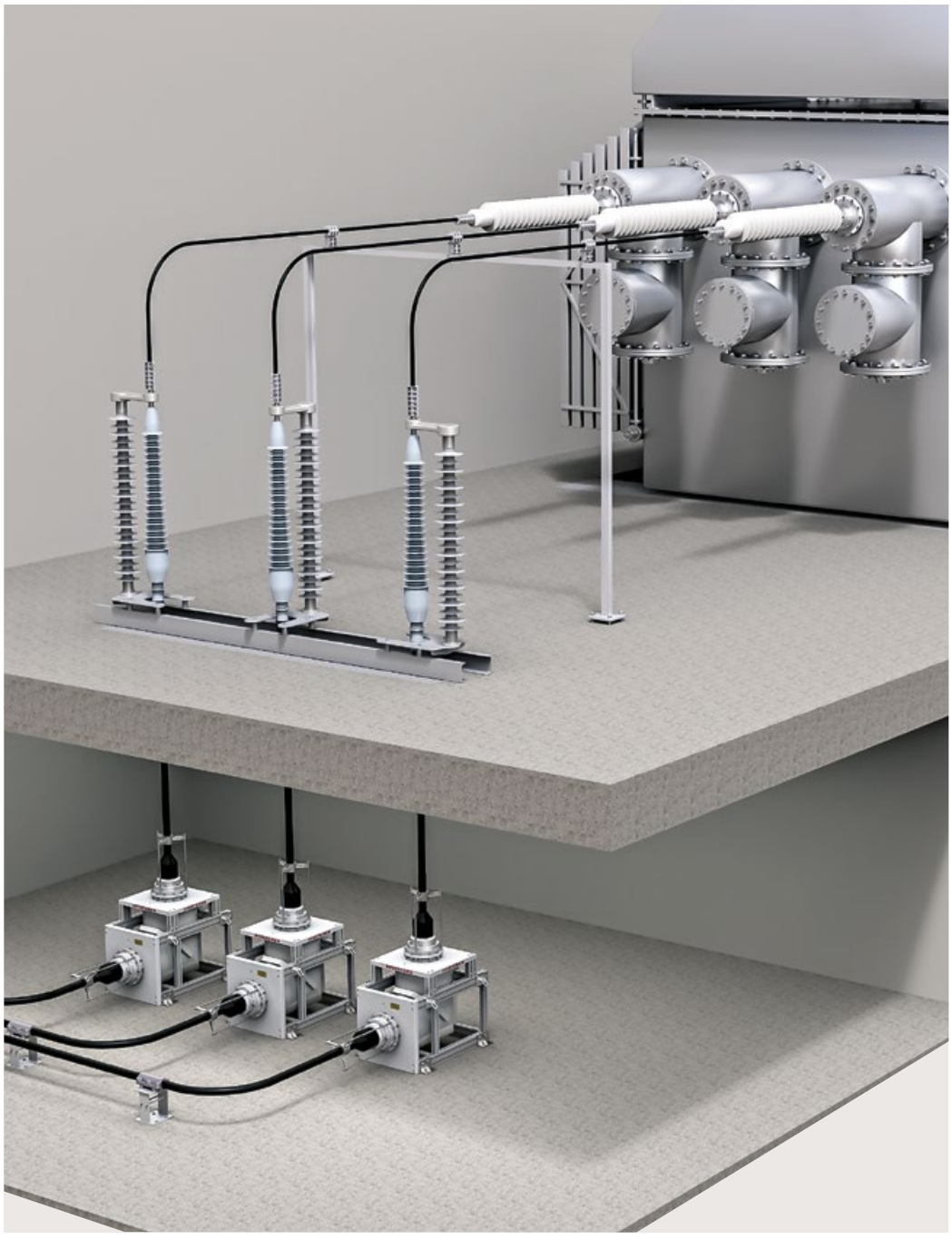
Supplying around 15,000 homes, the Kronenburgallee substation is one of three DONETZ substations in the 110-kV inner-city ring. The other two – at Lindemannstrasse and Südbad, each also have a transformer and GIS. They are linked to each other in the ring via 110-kV Westnetz cables, with a connection to the 220/110-kV outdoor switchgear at Wambel. Superposed 10-kV DONETZ cables form further connections between these and other substations. This is just one small section in a resilient grid that is N-1 secure: if one component fails, others maintain the flow of electricity.

"Dortmund's electricity network is in good shape," says Andreas Liese, "but at the same time it is dynamic, like any other network. It is upgraded, repaired. Every engineering project is a planned intervention in a balanced system. For supply reliability, you need to be aware that planned and unplanned events can coincide." Jörg Sprinck, DONETZ project manager for the work in the Kronenburgallee substation, adds: "For example, while you're replacing a system over here, a fault could develop somewhere else. So our network management sets an emphasis on continuously available reserves. We take care of the technical implementation – including the interim solution by PFISTERER."

From ring to direct connection

It's the end of June 2016, at the Kronenburgallee substation. Its 110-kV connection to the ring network begins in the cable vault with wall bushings for two 110-kV cables: one is for the connection to the Lindemannstrasse substation, the other connects to the Wambel outdoor switchgear. Both are normally connected to GIS connection points in the basement ceiling. Now only three stumps from the Lindemannstrasse network cable protrude from the wall bushing; Westnetz will replace the external-gas-pressure cable with a cross-linked polyethylene (XLPE) cable. The Wambel network cable is already an XLPE type. For the time being, its plug connectors end in the first interface of the interim solution by PFISTERER: three CONNEX elbow joints each with two connection points arranged at right-angles.

The network cable conductors plug into the front; on top are three connecting cables. These pass through the basement ceiling to the ground floor, into IXOSIL EST SUB cable terminations, the final part of the PFISTERER solution, which are connected to the transformer by lines. Following successful 24-hour protection testing, the assembly is operational on 27 June. The transformer can now be fed with power from the Wambel outdoor switchgear, instead of via GIS in the ring, by a direct connection, known in the trade as a branch line.



Installation-friendly on the ground floor: While the new GIS is being constructed, the bushings on the 110/10-kV transformer are connected by lines to easy-to-install dry-insulated IXOSIL cable terminations, from which highly flexible connecting cables descend into the cable vault.

Space-saving in the cable vault: CONNEX elbow joints form the compact interface between a 110-kV network cable (conductors plugged into the front) and the connecting cables (plugged into the top), which come down through the basement ceiling from the terminations on the ground floor. As a result, there is still enough room in the cable vault for work to proceed in parallel on the other network cable.

Until the end of October 2016, the GIS conversion and cable modification work are carried out in parallel at the Kronenburgallee substation. On weekdays, while the engineers are working, the transformer is isolated. Consumer loads in the Kronenburgallee substation are then supplied in reverse from the Südbad substation via a 10-kV connection. If a fault occurred here, work would stop immediately, then the transformer would be switched on from the Wambel outdoor switchgear. The transformer operates normally every weekend, during breaks in the engineering work. Work is completed on 18 October 2016, when the new GIS is put into service.

Smart system, many advantages.

"By operating the transformer some of the time and keeping it constantly ready for operation, we were able to minimise the typical failure risks associated with the engineering work while it was being carried out, and guarantee the power supply to the area served by Kronenburgallee with reserves," Liese explains. "The interim solution by PFISTERER did its job reliably." It is tailor-made for flexible use by DONETZ. "The CONNEX elbow joint is optimal for our indoor facilities. It is extremely compact and enables space-saving cable routing across multiple levels," Sprinck points out. "We were able to remotely monitor the pressure of its SF_6 insulating gas via the built-in manometer." The 110-kV network cable was connected using the existing plug connectors. For each joint, PFISTERER fitted a compatible socket that was then tested in its in-house lab.

« The CONNEX elbow joint is optimal for our indoor facilities. »

Jörg Sprinck
Team leader primary equipment in the systems and cable engineering department at DONETZ

After use, ready for use: The interim solution by PFISTERER is quick to assemble and dismantle. Its components can be easily stored, as shown here at DONETZ: the CONNEX elbow joints are on the shelf, and the boxes contain the dry IXOSIL terminations along with the Feltoflex connecting cables.

IXOSIL cable terminations too are appreciated on installation sites. Volker Janzen, account manager for DONETZ and head of PFISTERER's sales office for Germany North-West, lists their key advantages: "They are dry insulated. That makes everything easier. Installation, dismantling, and for storage you simply pack them in a box." Along with the Feltoflex cables that connect the terminations and joints. "They are dimensioned with length to spare, so that we can use the interim solution at other sites, too," Liese notes. "The PFISTERER installation team fitted the cables in perfectly at the Kronenburgallee substation. They can be laid very tightly." Janzen nods: "Our fittings are regularly used on these highly flexible cables in cramped offshore facilities, such as the DolWin3 converter platform. These experiences come in useful here too."

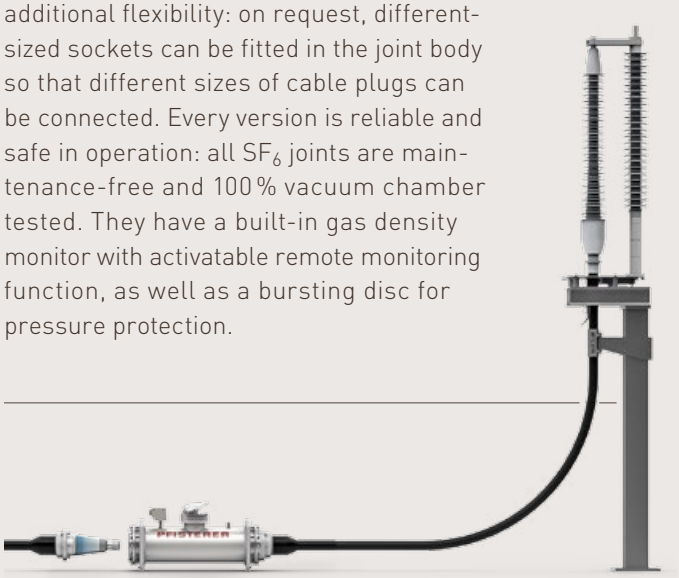
Sprinck sums up DONETZ's experience with the interim solution by PFISTERER: "Entirely positive. A worthwhile investment. The next time we need a temporary pluggable connection, we can build it in one day." All the components are stored in the city centre, ready to be used again.

Pluggable HV joints

Reliable, installation-friendly CONNEX joints for permanent and temporary HV connections are quick and easy to fit – thanks to their plug connection system and a high degree of pre-assembly. Plastic cables with various conductor materials and cross-sections can be connected to a joint; cable connections can be combined with IXOSIL outdoor cable terminations and CONNEX bushings.

Maintenance-free SF_6 joints for 72.5 to 550 kV

SF_6 gas-insulated CONNEX joints offer additional flexibility: on request, different-sized sockets can be fitted in the joint body so that different sizes of cable plugs can be connected. Every version is reliable and safe in operation: all SF_6 joints are maintenance-free and 100 % vacuum chamber tested. They have a built-in gas density monitor with activatable remote monitoring function, as well as a bursting disc for pressure protection.



Tap-off joints 72.5 – 362 kV

CONNEX tap-off joints enable versatile branching connections: from one plastic cable to two plastic cables, or from an overhead line to two plastic cables. If one connection point remains unused, it is simply sealed with a voltage-proof dummy plug.

Connection joints 72.5 – 550 kV

CONNEX connection joints are great all-rounders: they extend cable connections or create voltage resistant cable endings for cable testing. Combined with IXOSIL outdoor cable terminations, they implement connections for supplying facilities via overhead power lines by cable.

Elbow joints 72.5 – 245 kV

CONNEX elbow joints are uniquely efficient: with two connection points arranged at right-angles, they enable space-saving cable routing in cramped spaces and across multiple levels. In combination with a CONNEX bushing plugged in vertically, they are optimally suited to electrical installation testing and temporarily supplying a facility via an overhead line by cable, e.g. during revision work.

Cast resin joints for 72.5 to 170 kV

CONNEX cast resin joints are proven on land and at sea. They too can cover a range of cable cross-sections – with one compact joint. Reliable on any terrain, whether for permanent or temporary use: they extend cable connections or create voltage resistant cable endings for cable testing. In offshore facilities such as wind farms and platforms, they are used as connection components for submarine cables and internal cable sections.

PFISTERER

ALL CABLES LOVE PFISTERER. As an independent accessory specialist, we have everything that cables need. Connection systems, joints and cable terminations from PFISTERER can make any XLPE cable – regardless of the cable manufacturer or cable diameter – a voltage-proof connection up to 550 kV.
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