PFISTERER Customer and Staff Magazine
Issue 1 **2012**

PFISTERER

connect

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Editorial

Innovations meet the challenges

The challenges facing the energy industry are endless: Energy demand is increasing worldwide, power supply grids need to be renewed or extended, there is increasing use of renewable energy.
If everything is in a state of flux, the best approach is to use applied knowledge in new ways. And this is PFISTERER's way of doing things.
Check out our project reports from page 8 onwards to find out how we use and optimize our proven technology in one of Germany's first commercial offshore wind farms.
In conditions of continuous growth, we need to remain flexible to meet a wide range of customer needs. That's why we have put our group of companies on a new footing – see page 4.
We would like to give you a better insight into the work we do for our clients across the world, with a rede-signed CONNECT magazine that is more reader-friendly.
We hope you find it a worthwhile read, giving you a new perspective on familiar challenges. We are ready to work with you to overcome them!

Sincerely,

Hr. Klein

CEO, PFISTERER GmbH

Strong growth and the changes in the energy market have transformed the PFISTERER Group in recent years. We have now reorganized the group so that we can continue to deliver efficiency to our customers.

The PFISTERER Group started out as a consortium of independent companies. In 2005, their activities were strategically brought together in four centers of excellence, each with worldwide responsibility for the product groups assigned to them, and a global sales network was established. This partial centralization, product-oriented in its nature, achieved its goal of improving cooperation between the companies and brought about cross-border synergies. Since then, sales have more than doubled, the number of sales locations increased by over 70 percent and the number of employees worldwide by almost 40 percent. Thus in a short period of time, the group outgrew the recently established structures that had supported its tremendous growth.

The markets were changing at the same time. More and more suppliers were adopting dry pluggable cable connection systems, a technology pioneered by PFISTERER and one in which the company has a leading position today. Increasingly, cable manufacturers are selling cable accessories without the cable itself. In the overhead line sector, insulators supplied from the Far East gained increasing acceptance, even at higher voltages. The increasing competition in established business areas mean that there is a greater need for application-specific solutions and the provision of an integrated customer service. Emerging markets, such as renewable energy, require innovative, cross-product solutions.

PFISTERER: A new organization for new markets

Centralization for differentiation

"Looking at how we have developed and the changes in our markets, the reorganization was a logical step," said Dr. Thomas Klein, CEO of PFISTERER Holding AG, "We can only secure what we have achieved and promote further growth by aligning our structures with the new circumstances." In recent months, PFISTERER laid the foundations for this with the introduction of four major business segments in which the core functions are coordinated and harmonized centrally across companies and national borders.

The Sales Division brings together all the sales activities of PFISTERER companies across the world with the aim of creating a customer service that is even more application-oriented. The Technology Division includes all development departments, laboratories, prototyping and product management with priority being given to the rapid development of new products and product variants. The Operations Division is expanding the successful use of synergies across all manufacturing sites. The financing, controlling, accounting, IT, HR and other key tasks are brought together for all companies within the Finance Department.

CEO Dr. Thomas Klein also sees this reorganization as one that positions the PFISTERER Group to meet tomorrow's demands: "The focus of the new functional units also shows what we want to do for our customers, which is to bring new technologies to market more quickly and to even more finely differentiate our services according industry and application."

"Looking at how we have developed and the changes in the markets, the reorganization was a logical step."

Dr. Thomas Klein, CEO

IXOSIL joints for Siemens. Waterproof housing. Easier installation.

When equipping a new substation in Gera, Siemens decided to use PFISTERER connection technology. Six IXOSIL MSA123-DOMG joints are included in the delivery package for the 110 kV cables.

The new Gera Süd substation in Thuringia is the final part of a larger project: The 30 kV medium-voltage level in the local power distribution network is to be left out in favor of the nationwide 110 kV mains voltage. For this, extensive cable lines were laid for the 110 kV grid and two new substations have already been built and connected, in Gera-Nord (1995 to 2007) and Gera-Mitte (1996 to 2005). The entire project will be completed by mid 2013, including, alongside the construction of the three substations, the laying of a total of twelve kilometers of 110 kV cable and 90 kilometers of medium voltage cable.

The Gera Süd substation was built by Siemens as a turnkey project. For the 110 kV cabling required, the general contractor chose IXOSIL sets from PFISTERER, including the MSA123-DOMG slip-on joints. The consistently modular

Easier installation thanks to modular IXOSIL joints with bayonet locking housings

concept of the joints with the easy to install bayonet housing was particularly impressive. So during assembly two sleeve elements are simply put together and rotated against each other until they click. The metallic clamping rings that were previously attached are no longer required at all, and pipes and flanges are no longer needed either.

The solid implementation of transverse water tightness by using an additional copper housing in the interior of the joint was also popular. Unlike plastic housings, this prevents penetration by hydrogen, which can lead to corrosion and partial discharges as well. For this reason, cables wrapped with aluminum foil are used as in the telecommunications industry. The conical shape at both ends of the joint housing also ensures high resistance to mechanical shear loads, as can occur when there is soil subsidence for example.

Applications and benefits of IXOSIL MSA slip-on joints

The IXOSIL slip-on joints consist mainly of prefabricated silicone parts and are available in one-piece or three-piece versions. Both joints are available in several versions, which differ from each other as regards the screening, the water vapor barrier and the protective housing.

Applications

- For joining copper or aluminum conductors
- With cable cross-sections of up to 2,500 mm^2 and bonding sections of up to 630 mm^2
- As a one-piece design for voltages from 72.5 to 300 kV / U_m
- As a three-piece design for voltages from 72.5 to 170 kV / U_m

Features & Benefits

- Simple and secure assembly thanks to slip-on technology and bayonet locking
- Waterproof for buried joints according to IEC
- Designed for use with various fillings
- Available in various designs according to customer requirements, such as glass fiber reinforced PP
- Maximum stability thanks to 6 mm wall thickness
- Lightweight, tough material

Global Tech I is to be constructed in the North Sea shortly – one of the first commercial offshore wind farms in Germany. PFISTERER is demonstrating the breadth of their range of products in this mammoth project: As a contact technology specialist supplying technologies that are suitable for offshore, they have developed a heavy-duty HV-CONNEX special solution, laying a total of 5,800 m of cable under difficult conditions.

Until now, in Germany, wind energy has been produced almost exclusively on land. Starting this year, power will be generated on the high seas around 180 km off Bremerhaven and 138 km off Emden, in a northwesterly direction: At a water depth of 40 m, a substation and 80 wind turbines will be installed over an area of 41 km^2. Global Tech I will be completed in 2013. With 400 MW rated power the wind farm will then be mathematically capable of providing electricity for 445,000 households.

The AREVA Wind M5000 wind turbine generators (WTG) are designed specifically for offshore wind projects. Their rotor hubs rise 92 meters above sea level, each rotor and its three blades having a diameter of 116 m and sweeping an area as large as a one and a half football fields. The tips of the blades reach a top speed of 320 km/h. The rotors start to turn at a wind speed as low as 4 m/s. The turbines reach their peak power output of 5 MW at an average wind speed of 12.5 m/s. In severe storms, with wind speeds of 90 km/h, they turn off automatically for safety reasons.

Offshore wind farm: PFISTERER solutions – pioneering achievements

Image source: Areva Wind GmbH

PLUG for marine power plants

All 80 WTGs are equipped with the PFISTERER PLUG system. This provides secure cable connections for the three components that are essential for generating energy – the wind turbine generator to the inverter and the inverter to a 5 MW power transformer. PLUG has already demonstrated its reliability in the rail sector, even under harsh conditions. Here on the high seas, the connection system's strengths are played to the full: Because they are plugged, there is no need to access the internal parts of the equipment when making connections. This meant that ABB Switzerland was able to assemble the plug sockets in their inverters at the factory and supply them ready to be connected up. PFISTERER supplied the cable side plug to Areva Wind.

This is an enormous advantage, and not only for the initial installation: Offshore maintenance work is costly, and the ease of installation saves time and money. The fitters are protected in both cases, as the connection system is designed to be safe to touch. The WTG itself must be able to withstand winds, wave loading and water currents in a saline environment. No problem for the plug connections: They are vibration resistant and protected against the ingress of foreign bodies and water in accordance with IP68. Thanks to their uniquely high current carrying capacity up to 1,250 A, they form lasting high-performance interfaces between the different items of electrical equipment. From there, the electrical power follows its path to the next station in the center of the wind farm – the substation.

With suction cans on the sea floor

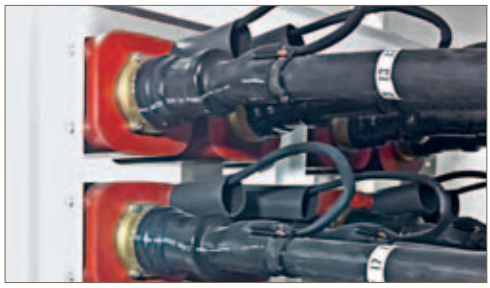
For this purpose, a new concept was developed using an alternative approach. Overdick GmbH & CO. KG, engineers specializing in offshore applications, designed a platform

Substation in transport construction and after anchoring in its final position in the sea
Image source: Overdick GmbH & Co. KG

with an enclosed cabinet that houses all of the resources for the connection of the wind farm to the grid, and protects them against the corrosive saline atmosphere. As the anchoring of the platform does not require pile driving work, the substation can be installed in a very environmentally friendly manner and with a minimal use of offshore logistics: Offshore tugs bring the floating substation to its destination, where the four tubular steel legs located on the float are lowered to the sea bed with a temporary strand jack system. There are suction cans on the feet of the tubular steel legs with which the structure is securely anchored to the seabed. Finally the platform is raised to its final position about 20 m above sea level using the temporary strand jack system and permanently fixed in place.

The substation forms the energy heart of the wind farm: Here the power generated by all 80 turbines is brought together via submarine cables. MV-CONNEX joints form the secure interface to four 33 kV switchgear units. These distribute the incoming load to four power transformers that raise the voltage to 155 kV for transmission. To prevent shutdowns, multiple redundancy is built into these components.

Behind the transformers is a gas-insulated switchgear unit. It distributes the power to two submarine cable systems. To protect against corrosion and abrasion, the submarine cables have particularly robust sheathing and are laid approximately 1.5 m in the seabed using a remotely controlled underwater vehicle. Laid in different routes, they will transmit the power in a southwesterly direction to the "BorWin Beta" converter platform. From there, the power is transmitted over a 195 km long high voltage direct current (HVDC) transmission link to the mainland to the transformer station hall in Lower Saxony, once again transformed and fed into the German grid. As one of the few offshore wind farms, Global Tech I already has an unconditional grid connection commitment.



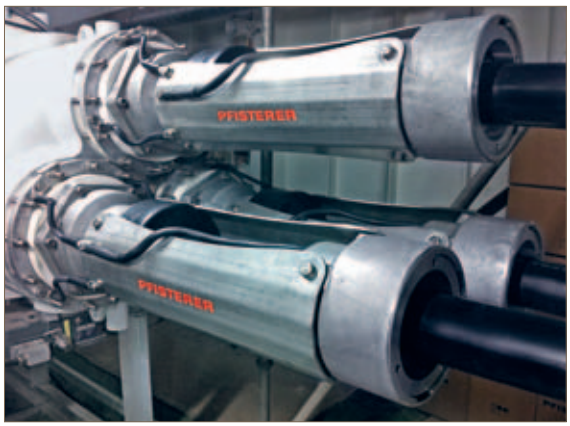
Seaworthy interface: MV-CONNEX joints can be mounted horizontally and vertically

Complex cable-laying for CONNEX connectors

PFISTERER supplied the CONNEX dry plug-connection system for cable connections between the switchgear and transformers at the substation. In 2010, CONNEX was the first complete system certified by German Lloyd for offshore use. PFISTERER developed the HV-CONNEX compensation clamp to be used for the first time in Global Tech I: It ensures the correct mechanical fixing of the cable with respect to the contacts and insulation of the HV-CONNEX system even under special installation and environmental conditions (for further details, see the report on page 12).

A total of 5,800 m cable is attached to the CONNEX connectors, laid in the Rotterdam Dry Dock belonging to offshore business Keppel Verolme by a 14-man team from PFISTERER, including experts in cable laying work on oil rigs. A highly demanding task: In conventional cabling projects, 2,000m of cables can easily be laid every day, whereas here a maximum of only 120 m per day was possible. The complicated routing of the cable around a number of corners and over several decks required an immense effort in planning and organization.

About 300 employees from various companies were working in various trades in parallel, in a confined space and to extremely high safety standards. So the PFISTERER professionals had to carry out the high voltage testing at night at weekends, as only then is the platform, which is still under construction, largely deserted. Nevertheless, the schedule was met, right down to the day: After 13 weeks of working under pressure, PFISTERER passed over the successfully tested cable system on 31 July.



PFISTERER special solutions for Global Tech I: Compact compensation clamps for HV-CONNEX cable connectors on the switchgear unit on the offshore transformer station

Global Tech I: The construction site at sea

Constructors and operators of the wind farm: Global Tech I Offshore Wind GmbH
Scope of project: 80 Areva Wind M5000 (5 MW) wind turbines, 1 transformer station (400 MW)

Participating companies (excerpt):

Wind turbine generators (WTG)

Manufacturer: AREVA Wind GmbH,
Connector technology: PFISTERER
WTG foundations:
Manufacturer: ARGE Tripod Global Tech I (consortium of WeserWind GmbH, Offshore Construction Georgsmarienhütte and Erndtebrücker Eisenwerk GmbH & Co. KG) and SIAG Nordseewerke GmbH
Installation: HOCHTIEF Solutions AG

Substation

Manufacturer: Alstom Grid GmbH and Keppel Verolme BV
Medium and high voltage cable and connection technology: PFISTERER

Wind farm – internal wiring

Manufacture, supply and install: Consortium of Norddeutsche Seekabelwerke GmbH and Global Marine Systems Ltd.

Grid connection

Network operator: TenneT TSO GmbH

PFISTERER special solutions for Global Tech I:

Wind Turbines

Delivery:
- 4160 Plug connector systems Size 3 (male + female)

Substation

Cable installation
- 650 m HV cable 800 mm²
- 1,400 m HV cable 500 mm²
- 2,900 m HV cable 400 mm²
- 850 m HV cable 150 mm²

Delivery and assembly:
- 244 MV-CONNEX plugs size 3
- 172 MV-CONNEX sockets size 3
- 36 MV-CONNEX joints size 3
- 44 HV-CONNEX plugs size 6
- 44 HV-CONNEX sockets size 6

Testing:
Acceptance tests for HV and MV cable connections on the platform

HV cable systems from one source – PFISTERER

Scope

- Projection, calculation, sizing, supply, installation and commissioning of high voltage cable systems with XLPE cables up to 245 kV

Engineering

- Quotation processing
- Load calculations
- Routing
- Project management including commissioning
- Final documentation
- After-sales customer service

Cable Laying

- Only with businesses that are known and proven in the market

Assembly

- With own staff (in each case in cooperation with qualified installation companies)
- Construction management
- Supervision
- Demo installations
- Training

Commissioning

- Acceptance testing (AC) with IPH Berlin, KEMA, EnBW

Products

- CONNEX IXOSIL accessories up to 245 kV
- XLPE cables to 400 kV, conductor cross section to 2,500 mm², jacket (copper wire, copper and Aluwell sheath; lead sheath)

HV-CONNEX: Mechanical forces safely under control

Forming a reliable interface between the plant and the high voltage cables, HV-CONNEX cable connectors fulfill important mechanical requirements in addition to their electrical functions. Mechanical forces are operating on each cable connection, and these must be compensated. PFISTERER has developed a compact clamp for particularly demanding applications such as offshore platforms.

In operation, each cable expands due to heating. CONNEX compensates for this movement, which is in the range of several millimeters, because its contact cone is designed with a special shape that acts as a sliding bearing (Graphic, Point A). Furthermore the weight of the cable and the plug position act on the connection. The larger the cable cross-section, the greater the forces that act in an amplified way in a vertical cable position.

The potential point of action of the weight is the bell flange of the CONNEX cable connector. Here there is a spring which presses the insulator of the cable connector into the CONNEX socket on the equipment side. If the weight of the cable works against this spring, the optimal contact force would not be achieved. This prevents an integrated system in the bell flange (Graphic, Point B): It centers and fixes the cable using a double cone with a bayonet lock and compression provided by an EPDM ring.

Clamps operate against lateral forces

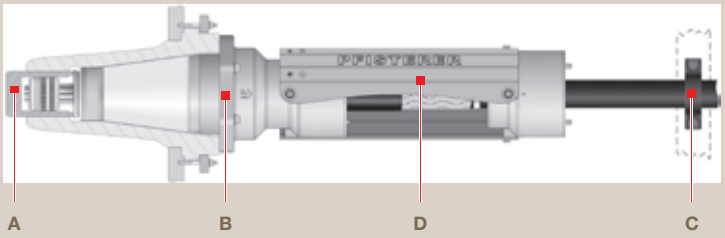
To absorb the lateral forces caused by moving cables, the clamps also fix the cable to steel frames. The first clamp next to the equipment forms the third relevant mechanical area (Graphic, Point C). It should be centrally positioned with respect to the cable runs and be fixed at a maximum distance of 800 mm from the bell flange. Not every type of installation allows this. Or the mechanical system is canceled.

On offshore platforms in particular, the transformers are often mounted on floating bearings because of their natural vibration, while the cable rack and the first clamp are removed further away to a relatively rigid base. This results in opposing cable movements that multiply the load on the connector. To deal with such situations safely, PFISTERER developed an additional compensation clamp (Graphics Point D), which was first used in the Global Tech I offshore wind farm.

Special solutions for special loads

For example, at a maximum lateral force of 1,500 N and at a distance of 800 mm from the equipment flange, the compensation clamp can limit the deflection of the cable to less than 20 mm. Without the compensating clamp this force would result in a deflection that was a factor of 10 greater. Through the use of the clamp, the cable deflection that occurs at the HV-CONNEX connector is limited to acceptable values and the concentricity of the cable to the socket is maintained. Made of saltwater-resistant material, the compensation clamp is well prepared for the offshore industry.

PFISTERER solutions for offshore applications:
Compact compensation clamps on HV-CONNEX cable plug on the power transformer



The mechanical functional units A, B and C of the HV-CONNEX cable plug ensure the correct mechanical fixing of the cable with respect to the contact and insulation of the system. D marks the additional compensation clamp for special operations such as on offshore platforms

Contacts age. But they are designed to transmit power reliably for decades, across the innumerable interfaces within the energy network. This report shows how these requirements match up with the facts, covering the basics of contact technology and with a focus on the aging mechanisms operating in contacts and effective remedies to combat them.

The initial resistance marks the beginning of aging in every contact. The higher this initial resistance is at the time a mechanical contact is manufactured, the shorter the life of the connection. Because electrical resistance grows with an increasing thermal load. Since almost all of the physical and chemical properties of materials are temperature dependent, at least to some degree, heat promotes aging in most materials.

The effect of the initial resistance was examined as long ago as 1958 by J. A. Greenwood and J. B. P. Williamson in their paper on temperature-dependent conductors, ("Electrical Conduction in Solids. II Theory of Temperature-Dependent Conductors ", Royal Society Publishing): Where the initial resistance is 10 micro-ohms (μΩ), a mechanical connection can have a service life of up to a century, whilst at 100 μΩ it will be a maximum of fifty years.

One connection. Two materials.

It does not take much to cause the resistance to rise massively: For example, when a contact is operating in a tight cable trench, soil or other particles can contaminate the contact, or crimped contacts can suffer from the wrong combination of sleeve material and conductor material. When making a connection, aside from absolute cleanliness and a professional way of working, an understanding of the various conductor and connector materials is crucial. This is another important aspect, the effect of which extends far beyond limiting the initial resistance.

The main materials used in the power supply industry are still copper and aluminum, although the recent rises in the price of copper together with the trend towards larger cable cross-sections are fueling the use of cheaper and lighter aluminum. So across the world, different conductor and connector materials are making contact with one another, for example, when a copper wire network is extended using aluminum conductors. This presents a challenge to the manufacturers of contacts, to produce a component which can be used with copper and aluminum conductors alike.

PFISTERER Al Elast Contact Disks provide well defined contact surfaces.

Why contacts age. And why they still last for decades.

The pitfalls of thermals

The following classic installation error demonstrates how two materials thermally react in different ways. If an aluminum conductor is crimped into a copper sleeve, the premature failure of the contact is inevitable, even if the sleeve size is properly selected. Once electricity passes through the connection, it heats up and the aluminum conductor expands more than the copper sleeve can yield. As the electrical load increases, the mechanical stress between the conductor and the sleeve continues to rise, until it exceeds the yield strength of the aluminum – the conductor over-expands and no longer returns to its original shape upon cooling.

After several heating and cooling cycles, the unwanted result is achieved – the minimum contact force is no longer reached and the electrical contact is degraded until there is total failure. The only remedy with crimping technology is the right combination of sleeve and conductor material, as shown in the table on page 16. The different coefficients of thermal expansion of copper and aluminum also demonstrate their effects where terminals are used. Often aluminum cables are connected to copper terminals. When heated, the conductor expands and returns to its original size on cooling. This process – called thermal breathing – can be equated with micro-movements by the conductor. The resulting aluminum abrasion debris oxidizes immediately and forms a non-conductive coating at the contact points, causing premature contact failure.

Intelligent terminal designs such as Durelast terminals with U-bolts stop this movement by creating a suitably high contact force on the conductor – a technical trick used in the rail industry: As a result of heating, rails expand in a longitudinal direction. The resulting forces are directed into the ground, and thus compensated for, by the strong clamping forces generated by the ties mounted at short intervals.

Flow. Recover. Force.

The correct dosage of contact force is determined by the flow and recovery processes in the materials, which result in a natural reduction in the clamping force. The contact force in any pair of mechanically connected materials reduces over time – or more precisely, by twenty to thirty percent just a few minutes after the initial installation. Nevertheless, it is possible to produce contacts that have a life span of ten to fifty years.

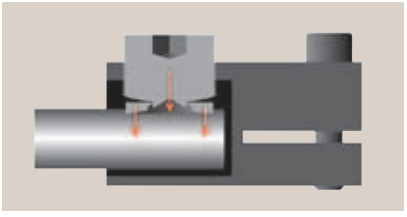
Understanding contact hysteresis provides an approach to solving the problem. It takes more force to make a contact than to maintain it. This means that the functioning of a contact is only at risk if the remaining contact force falls below a minimum value of, for example, thirty percent of the initial force.

For this not to occur during its entire service life, despite flow, recovery and thermal breathing, elasticity has to be structurally designed into the body of the clamp, for example in the form of springy, permanently elastic contact elements. Another remedy is to introduce additional elasticity by using springy washers. In the case of a screw connection for example, these are positioned between the screw head and the washer, which in turn rests on the rail to be connected.

Water. Electricity. Corrosion.

Electrolytic corrosion is another effect that drives contact aging where copper and aluminum are used in combination. Because of their molecular structure, the two metals have different potentials in relation to the neutral state: At –1.66 volts (V) aluminum is significantly more electronegative, while on the other hand copper is slightly electropositive at +0.34 V.

If the metals touch, and a conductive medium such as water is presentat the point of contact, they act as a cathode and an anode: The potential difference of the two metals is 2 V, and depending on the conductivity of the electrolyte, this drives a weak flow of current that corrodes the more electronegative metal. The aluminum becomes pitted, contact points disappear and the



2DIREKT screw with a spring action thanks to the dished washer in use on a transformer

remaining contact area is undermined. To prevent this, the design should separate different metals from one another in situations where they could come into contact with an electrolyte.

Here, a brush stroke of insulating resin just few millimeters wide at the junction of the two materials is sufficient, as the – 2 V voltage cannot generate a current even over this short strip of insulation. Another insulation method is to inject small plastic parts. For connecting planar surfaces of aluminum with ones made of aluminum, copper or bronze, PFISTERER has developed the Al Elast Contact Disks.

Three aging effects. One solution.

These are positioned between the connection surfaces on the contact screw. During assembly, their concentric annular cutting edges penetrate through the the oxide layers on the connecting faces and create clean metallic contact surfaces. At the same time, the outer polyurethane elastomer sealing ring closes under compression, hermetically sealing the contact point o that electrolytes can no longer penetrate.

Each thermal expansion may accelerate the flow and recovery processes. These processes, together with vibration, trigger mechanical movements which promote the wear of material just as oxidation and corrosion do. And that is only part of the spectrum of negative synergies that contribute to even more aging mechanisms. Their interaction may be complex, but their negative effects are clear to see: high temperatures, increasing electrical resistance, decreasing contact force – all harbingers of contact failure.

Protection against corrosion: PFISTERER Al Elast Contact Disks hermetically seal contact points

Reliable under full load

If nothing else, each terminal must be designed and used according to the expected loads. The higher the constant power load, the faster the component ages. More and more situations occur where connections have been in operation for 30 years, and are therefore already in an aged condition, but are now being placed under greater load due to the higher utilization of the grid as it transmits increasing power. This is especially true in areas where here is a high proportion of energy fed into the grid is from renewable sources, where often the networks are already at full capacity.

Martin Schuster, an expert on contact technology and Senior Adviser at PFISTERER concludes: “Anyone who aims to create reliable connections over the long-term must consider the aging mechanisms that apply in their situation and, ideally, incorporate the lessons learned in their specifications.” Or put more simply: Order contact technology from manufacturers for whom aging is not a new problem, but have developed practical solutions to combat it – such as, for example PFISTERER.

Crimping technology: The right combination. Permanently contacts.

With crimped connections, the right combination of materials also decides whether the contact will have a long or short life span. The correct choice of sleeves and conductor material is indicated by the plus sign. The minus sign indicates a classic assembly error.

	Aluminum sleeve	Copper sleeve
Aluminum conductor	+	–
Copper conductor	+	+

PRACTICAL TIP: Tightening screws only reinforces your beliefs

Some errors persist. Such as the widespread assumption that the tightening screws promotes the longevity of contacts. Terminals with shear bolts prove otherwise: They are designed to eliminate the perceived need for tightening, and are used more and more. What actually matters when assembling a screw connection is that the contact functions reliably throughout its entire life, as shown by this practical tip.

1. Besides choosing the right terminal and the right material for the conductor (for details, see Contact Technical Report on page 14 and 16), the cleanliness of the contact area is crucial. This is best cleaned with a wire brush.

2. To protect the surface from re-oxidizing, treat with a contact protection paste – particularly with easily oxidized aluminum connectors. For a permanently reliable contact, the screw also has to be clean.

3. It should also be greased so that the applied torque results in the right contact force. Since this important step is often overlooked, PFISTERER supplies screws already greased or with a special coating that provides the necessary lubrication in place of grease.

Lastly, when tightening the screws, the specified torque must be applied – this can be found in the installation manual or is printed on the terminal.

Innovation for users. Award for EST.

PFISTERER has been awarded a "Golden Amper 2012" in recognition of the level of innovation demonstrated by the new EST termination at Amper, the International Trade Fair for Electrical Engineering, Electronics, Automation and Communication Technology. PFISTERER had another winner with the development of a project-specific insulated crossarm.

Insulating oils reliably fulfill their purpose. At the same time, their use is associated with high labor costs and they pose a threat to the environment. Unlike the unique EST and ESF terminations from PFISTERER: Made of modular silicone parts that are simply inserted and glued together, they do not need any oil.

The EST is designed for continuous operation at voltage levels from 72.5 to 170 kV and consists of a flexible ESF and an additional support element. It can be installed on an overhead line tower without a working platform: The EST is connected to the high voltage cable whilst still on the ground and is then pulled up onto the mast with the cable. Compared to conventional connectors, they quickly save a significant amount in installation costs, with the downtime on the overhead line reduced from weeks to days.

One price. Two successes.

The user benefits convinced the ten experts on the Amper jury of the level of innovation demonstrated by the EST. Accepting one of five "Golden Amper 2012" awards in the "Energetics" category at the official awards ceremony in Brno, Czech Republic, Peter Feldhofer, CEO of PFISTERER Vienna Ges.mbH, and Arash Advini, Country Manager for the Czech Republic and Slovakia at PFISTERER Vienna.

"Of course every new development requires a commitment to innovation," said Feldhofer, "However, what is decisive is the view taken by neutral experts. That's why we are so pleased about this recognition." Slovak company ELV from Senec was also delighted with a "Golden Amper": It was awarded for a new tower design for a 400 kV compact line, which is impressive for its environmentally friendly aesthetics and reduced electromagnetic fields. PFISTERER contributed to this success with an insulated crossarm specifically developed and tested for this project. For the reasons mentioned, compact overhead line masts will be increasingly used in the future.

Distinguished: Arash Advini (2nd from left) and Peter Feldhofer (3rd from left) at the presentation of the Golden Amper 2012

Winners: The EST 123 on the PFISTERER booth at Amper in Brno, Czech Republic (left)

Innovative EST terminal n use on an overhead line (bottom)

TRANSFORM Campus: Accumulated knowledge about transformers

The first "TRANSFORM campus" attracted young professionals and transformer experts to Berlin on 26 and 27 June: International experts and manufacturers in the supply and measurement industry spoke about the technology and the key components involved in power transformers, together with their importance for the implementation of alternative energy sources.

"In a few years, European high-voltage grids will be totally different from today"

Prof. Dr.-Ing. Stefan Tenbohlen, University of Stuttgart

In a few years, European high-voltage grids will be totally different from today," explained keynote speaker Prof. Dr.-Ing. Stefan Tenbohlen, Head of the Department of Power Transmission and High Voltage Technology at the University of Stuttgart, at the opening of the compact two-day seminar "TRANSFORM campus: All about Transformers". The move to alternative energy sources places immense demands on the electricity highways of the future. It is not only the high-voltage lines that are of great importance, but also the power transformers that act as interfaces between distribution grids and voltage levels.

Both new transformers and those already in use will have to make the transition into an uncertain future under conditions that are to some extent still unclear. What remains is the investment risk associated with this: The purchase cost of large power transformers comes to several million euros, and they will only produce the desired return on investment if decades of trouble-free operation can be guaranteed.

Ergo: a solid understanding of the capabilities and limitations of these transformers and the interplay between their key components is absolutely essential for operators. It does not matter which manufacturer a transformer comes from, because it always consists of the same basic elements – the core, the windings, the insulation, the step switch or the bushings. The quality of these components and how they interact determines the quality of a power transformer, something to which the TRANSFORM network is committed.

From practical experience for practical use

Quality cannot be achieved without a depth of knowledge. That is why holding the compact seminar, led by Prof. Dr.-Ing. Rethmeier Kai, Head of the Institute of Electrical Power Engineering at the University of Applied Sciences in Kiel, and Martin Schuster, Senior Advisor at PFISTERER, was a logical step for the partners of the TRANSFORM network. Young engineers, young professionals and everyone in the transformer sector should be able to expand or refresh their practical knowledge at a single event. The expertise was provided by experts from the supply industry and manufacturers of transformer metrology. In addition to Herr Tenbohlen, other experts such as Prof. Dr.-Ing. Claus Neumann (Amprion / formerly RWE), Dr.-Ing. Michael Schäfer (TransNetBW) and Dipl.-Ing. Karl-Heinz Haeger (Alstom Grid) took on a complete presentation of the numerous practical contributions.

The conclusions of 70 participants from all over Europe: The transformer has never before been so explained so effectively and in an easy to understand way in any other seminar. This was feedback that was particularly pleasing for the TRANSFORM partners, because it is not just in transformer technologies that they aim for high efficiency.

TRANSFORM: Europe's premium manufacturer of high-quality transformers

The TRANSFORM name represents a network of partners who are European manufacturers of materials and components for the transformer industry. Since 1998, the network has been organizing TRANSFORM, a bi-annual international conference, which has become a respected industry platform for the transfer of knowledge relating to power transformers and the opportunity for specialists to exchange ideas. The following companies are involed in the TRANSFORM network: GEA Renzmann & Grünewald GmbH, HSP Hochspannungsgeräte GmbH & Trench Bushing Group, KREMPEL-Group, LS Cable & Essex, Maschinenfabrik Reinhausen GmbH, HIGHVOLT Prüftechnik Dresden GmbH, Nynas AB, OMICRON electronics GmbH, PFISTERER, Röchling Engineering Plastics KG and ThyssenKrupp Electrical Steel.

More information about the TRANSFORM network and its events can be found on the Internet at www.transform.net.

Realistic computer simulations confirmed. Composite insulator strings offer safety advantages. This was demonstrated by the latest practical and simulated load distribution tests for TIWAG-Netz AG – with positive results on two fronts: The PFISTERER composite insulator strings proved their resilience in operation, while the in-house simulation program proved its external validity.

Alongside the operational mechanical loading and exceptional loads, insulator strings must also take up the static and dynamic stresses that emerge when a string fails. With multiple strings, in such situations the load redistribution sometimes results in high dynamic tensile and transverse forces. When using long rod insulators, consideration must be given to additional bending stresses. Furthermore, there have been cases in which the broken porcelain long rod flew into the second porcelain long rod that was still providing support, and as a result of the impact the complete porcelain string broke. Unlike composite insulators: Due to the elastic composite material, in such incidents a damping effect occurs and the additional stresses on the overall chain are reduced accordingly.

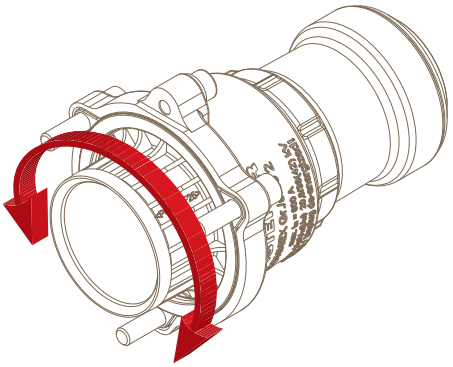
In early 2012, in connection with a new 220-kV project, TIWAG-Netz AG of Austria arranged for checks to be carried out by SAG, the German technical inspection agency, to check how a composite insulator string actually behaves in use when there is a load redistribution and what the actual loads are. To do this, dynamic load redistribution tests were conducted on double suspension and double tension sets supplied by PFISTERER, which gave positive results with regard to their load carrying capacity. In addition, the load redistribution in the double tension set was simulated in advance, using an FEM based program developed by PFISTERER SEFAG AG for such investigations.

The simulated maximum occurring forces were very close to the experimental values measured by SAG, with deviations of only 5 to 10 percent. Ergo: Although it will remain a challenge in the future to create a simulation that is identical to reality, It is already possible to simulate a load redistribution with relatively high accuracy. The main advantage of computer simulation, in addition to the calculation values it gives, is the huge reduction in costs in terms of material, time and money. Furthermore, not only can the FEM model determine the forces and strains but also other detailed mechanical values. Good reasons for PFISTERER to recommend this simulation facility to its customers.

Load transfer test set for a double hanging string at the SAG technical inspection agency

Best in test: Insulators

News



Easier reinsertion: CONNEX size 2 with rotating flange

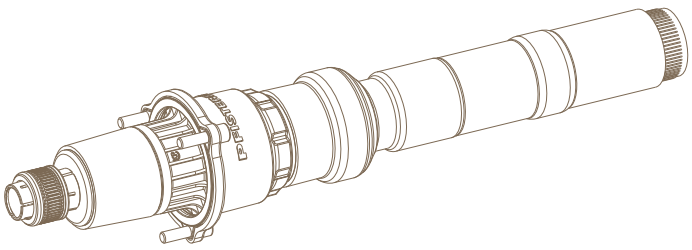
For easier reinsertion of the CONNEX cable connector parts, PFISTERER now offers size 2 with a rotating bell flange. The only exception: The bell flange on the oceangoing offshore version is still made of bronze to give higher corrosion resistance, which precludes offering a rotating version. The greater user-friendliness of all other new standard versions of the CONNEX cable connector Size 2 parts is impressive:

The fixing screws can be easily rotated to the fit the position of the threaded bushings. This also makes it easier to reinsert after the initial installation, even for large cable cross sections, such as when inspecting transformers, using portable transformers or emergency generators that feed power into the medium voltage side. An additional earthing screw on the fixing flange allows for separate earthing, for example when it is not possible to make a potential connection using the threaded sockets or the equipment housing.

Thick insulation? Compact connection! New CONNEX variant in size 2

With the introduction of a new variant of the CONNEX cable connection system, size 2, PFISTERER is making arrangements for the trend towards thicker cable insulations, and the requirements for compact design in electrical equipment. The new version is designed for cable diameters over insulation up to 44 mm^2, which can now be connected with cross-sections of 400 mm^2 (36 kV). An important advantage when connecting cables from Asian and North American manufacturers:

These often have thicker insulation and therefore a greater overall cross section. The result is that larger, often oversized cable connection components are used that take up more space in the equipment. Unlike with newcomer PFISTERER: It permits high performance connections to be made to heavily insulated cables with the usual compact design of the CONNEX system size 2 – the ideal solution for the underground installation of substations in urban areas and wherever space is tight and the safety requirements high.



PFISTERER

Compact. Pluggable.
HV-CONNEX surge arrester.

- Solid insulation
- Compact design
- Can be changed without gas or oil work in the GIS or transformer
- Interchangeable with all pluggable components from HV-CONNEX system size 4
- Voltages up to U_m = 72.5 kV