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Saving Space Underground: The New Substation in Oerlikon

The new Oerlikon substation is a great example of space-saving design engineering. Located in the heart of Zurich, the system spreads across three underground levels below the ewz grid base, which was also recently installed. Together, the facilities require just 30 percent of the space required by the previous outdoor installation. The all-new straightline Connex transformer connections rated to 52 kV safely link the transformers and switchgear between the levels. The latest addition to the Connex line can also accommodate vertically installed medium-voltage cables as a unique feature.

North Zurich, Eduard-Imhof-Straße. The Oerlikon substation would have been all but invisible had ewz not erected a grid base directly above its three underground installation levels. The above-ground constructions, which include a warehouse, repair shop and social facilities, are used by up to 45 ewz employees involved in grid expansion and maintenance activities. ewz is one of the ten largest utility companies in Switzerland and has been providing Zurich and parts of Canton of Grisons with power since 1892.

Future Technology

Oerlikon is a forward-looking substation built using space-saving connection systems that free up additional space in the city center. The installation is also sustainable as SF_6 gas is not used for the gas-insulated high and medium-voltage switchgear, but instead an environmentally-friendly gaseous mixture. ewz likewise places a very demanding set of requirements on the technology and systems used as Pascal Müller, who headed the construction project for the substation and grid base, explains: "When and if a component malfunction occurs, it will almost definitely have to do with the interface point. To minimize this inherent design risk, we view the quality of the connection systems integrated as playing an equally important role." This is why Connex connections from Pfisterer are used. The engineer has done his homework when it comes to the total costs of higher and lower quality componentry as in 2003 he was part of a team of authors who presented a new computational model for determining the cost efficiency of investments made in electric and electrical operating equipment. To this end, the article focuses on failure scenarios that can be directly attributed to the quality of the components used. The model not only takes foreseeable outlay into account, but also the costs associated with specific events. "This includes managing and troubleshooting faults as well as follow-up costs such as lower revenue and the effects of a tarnished image", explains Müller. "In calculating these costs for a 170 kV power circuit breaker and a substation, it was determined that they can increase dramatically and account for a considerable portion of the overall lifecycle costs of the unit as the quality, or reliability of the products used goes down. When on the other hand high-quality, reliable components are used, these ancillary costs barely show up on the radar screen".

The new Oerlikon substation, operated by ewz, is located in downtown Zurich below the also new ewz grid base (image center), whereby both facilities together require considerably less space than the previous outdoor installation.
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The Oerlikon substation is located on three levels beneath the state-of-the-art above-ground grid base operated by ewz.
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Ultra-Compact System Connection

Connex products have already proven their worth in various power systems along the ewz grid. "We have been using Connex connection systems and components for over ten years and are quite pleased with them. The new Oerlikon substation therefore incorporates Connex products for all high and medium-voltage connections between the two switchgear assemblies and three transformers", states Müller as he makes his way through the underground installation rooms to open a sliding panel painted in bright signal red. "Here you can see it all at work, including the latest addition to the product line." A 50 MVA power transformer from ABB measuring 6.6 meters in height, 5.5 meters in length and 4.1 meters in width dominates the first impression. Rising above its cover plate is the new size 3 MV Connex transformer terminal (TAT) rated to 2,200 A/3,150 A (depending on the connection type) and 52 kV. Inside, three cables with MV Connex cable terminals are connected in close arrangement and extend toward the ceiling. For Müller, this highly compact vertical cable installation represents just one of the many benefits of the new connection. "As you can see, the fourth connecting point is unassigned and could be used to connect a Connex earthing kit without having to physically access the internal componentry, thereby preserving the encapsulation of the system. The voltage range can also be conveniently set via the integrated voltage tap, which connects directly to a Pfisterer continuous voltage indicator, and the encapsulation surrounding all Connex cable connections improves reliability while making all system interfaces safe to the touch. Our maintenance personnel can therefore move around freely down here without having to walk around areas that would otherwise be cordoned off – a key aspect of space-saving design".

Leveraging Cost Efficiency for More Space

The transformer cell is fully utilized. With an internal volume of 280 m^3 and a footprint measuring 35 m^2, it not only accommodates the 80-ton transformer, but also a heat exchanger on each transverse side. The two heat exchangers cool the transformer oil while using the waste heat generated to warm up the air and water – one of several measures that ewz has implemented to keep the energy required to heat the building to a minimum. The amount of space the compact substation frees up can perhaps be best explained by taking in the expansive view on one of the balconies of the neighboring building. Located behind the new grid base is an outdoor high-voltage switchgear facility that extends across the ewz company grounds. It forms part of the old Oerlikon substation that has provided the Zurich city districts of Oerlikon, Seebach and Neu-Affoltern with power since 1949 and has reached the end of its service life. The installation is replaced by the new substation, which was commissioned in August and will have been fully integrated in the ewz power grid by 2018, at which time the outdoor installation that is currently on standby will be decommissioned and taken down. The older unit appears much larger than entire new construction. Müller adds to the impression with a fact: "The new substation and its more advanced technical equipment only take up 30 percent of the space originally needed." When the old substation is removed, a valuable building plot will become available again.

A 50 MVA power transformer outfitted with compact Connex connections in an underground transformer cell of the new Oerlikon substation.

Ultra compact: Several vertically routed medium-voltage cables can be connected to the new Connex transformer terminals rated to 52 kV.

Safe to the touch, even when high voltage is applied: Three cable connections to the 50 MVA transformer realized with the encapsulated HV Connex system for 170 kV applications.

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Specifically, ewz plans to sell back approximately 5,200 m² to Zurich, which will cover the added outlay for the underground construction.

Vertical Integration for Up to Four Cables

The straightline MV Connex transformer terminal (TAT) rated at up to 52 kV is Pfisterer's latest addition to the Connex system and can connect up to four cables in an ultra-compact vertical installation. This setup also makes it possible to connect transformers and GIS equipment installed at different levels underground in a safe and compliant manner. "The last five decades have seen substations installed in increasingly small environments. With the advent and ongoing development of the Connex system, we cater to this sustainable trend by offering targeted-oriented solutions", affirms Reto Aeschbach, Sales Director at Pfisterer Sefag AG.

About Connex

The dry-installed Connex connection system, which was originally developed in 1975 for low and medium-voltage applications, currently covers the entire range of voltage supplies from 12 kV to 550 kV. Connex also represents the largest single product line on the market for voltage ranges up to 220 kV thanks to its wide array of cable fittings, solid-insulated surge arresters, plug-in bushings, sliding sleeves and voltage testing systems. Connex is compatible with all types of cable and can be used with indoor and outdoor transformers as well as with gas-insulated switchgear (GIS). Due to the plug-in design of Connex components, this power equipment is quickly installed, maintained and replaced as no gas or oil operations are required, and the standardized connection interface makes it possible to conveniently reassign transformers and GIS equipment to different applications to remain in operation for the long term, even when network infrastructures change. Last but not least, the Connex connection system is the only one of its kind to have been certified for offshore applications by the DNV GL classification society and can therefore also be incorporated on deep-sea platforms and in wind power stations.

About PFISTERER

PFISTERER Holding AG, headquartered in Winterbach near Stuttgart, with around 1,400 employees and an annual turnover of around 250 million euros, is one the world's leading technology companies for system solutions and components in energy transmission. Established in 1921, this family-owned German-Swiss company is one of very few in the world to offer solutions for the complete transmission chain of low, medium, and high-voltage for outputs of between 110 V and 850 kV. The Group operates technology, distribution, and training centers at a number of locations in Germany and Switzerland; it has several manufacturing facilities in Europe, Argentina, and China, and is represented with sales offices in 18 countries throughout Europe, Asia, South America, and the USA. As an innovating force and supplier of key technologies with a complete range of products, as well as consulting, installation, and training services, PFISTERER AG is in demand globally as a partner for energy supply utilities, network operators, technology companies, rail transport operators, and other infrastructure companies.