Advertorial

Driving resilience for modern grids

Securing a reliable energy future: The integral role of resilience transformers

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Rapid deployment and versatile design are essential for quickly restoring power during outages or emergencies

Resilience transformers are designed to withstand extreme weather conditions, reduce noise, and improve safety, making them indispensable in modern power systems

Resilience in power systems is crucial, especially in the face of increasing demand and environmental challenges. Power transformers play a vital role in ensuring the stability and reliability of the electric grid. They are essential for adapting to the dynamic energy landscape, which includes integrating renewable energy sources and meeting the growing power demands stemming from urbanization, digitalization, and changes in weather patterns. Resilient transformers are designed to withstand extreme weather conditions, reduce noise, and improve safety, making them indispensable in modern power systems. The use of advanced materials, such as aramid-based insulation and K-class liquids, enhances their performance by allowing higher temperature operations and reducing the risk of failures. These innovations not only improve the operational flexibility of transformers but also contribute to a more sustainable and reliable energy future.

Enhancing electric grid stability: The role of resilience transformers

The robustness of power transformers plays a key role in securing the stability and dependability of the electric grid, a factor becoming increasingly important amid growing challenges such as the impacts of climate change, the frequency of extreme weather phenomena, and the intensifying demands for energy. Power transformers play a vital role in the transmission and distribution of electricity, acting as the backbone of the grid by stepping up and stepping down voltage levels to facilitate efficient power flow. The development of resilience transformers involves innovative designs and advanced materials that enhance their ability to withstand and quickly recover from disruptions. This includes the use of high-temperature insulation systems, such as aramid paper and ester liquids, which improve thermal performance and reduce the risk of failures. Additionally, resilient transformers are designed for rapid deployment and flexibility, allowing utilities to quickly restore power in the event of outages or emergencies. By incorporating these advanced technologies, resilient transformers contribute to a more robust and adaptable power grid, ensuring a continuous and reliable supply of electricity to meet the needs of modern society.

Minimizing downtime impact: The PRETACT® resilience concept

The PRETACT® Resilience Concept is designed to enhance grid resilience by providing innovative solutions for power transformers and substations. It focuses on rapid deployment, flexibility, and advanced materials to ensure reliable performance under extreme conditions. The concept includes mobile and plug-and-play transformers, high-temperature insulation systems including ester liquids, which improve thermal performance and improve the overall efficiency and reliability of the transformers. By integrating these technologies, the PRETACT® Resilience Concept aims to ensure a continuous and reliable supply of electricity, even during emergencies and outages. It uses a modular architecture to

- **Protect** against natural disasters and forced outages,
- **Prevent** operational issues,
- **React** to emergencies and temporary outages.

Ensuring continuous power: The pillars of transformer resilience

Transformers are essential for improving grid resilience because they play a critical role in the transmission and distribution of electricity. They help maintain the stability and reliability of the electric grid by stepping up and stepping down voltage levels, which ensures efficient power flow and minimizes energy losses. In the face

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of increasing challenges such as climate change, extreme weather events, and growing energy demands, resilient transformers are crucial for maintaining a continuous and reliable supply of electricity.

To enhance grid resilience, transformers need to meet several key features:

Transformers are essential for improving grid resilience because they play a critical role in the transmission and distribution of electricity

- **Advanced Insulation Systems:** Using high-temperature insulation materials, such as aramid paper and ester liquids, improves thermal performance and reduces the risk of failures
- **Flexibility and Versatility:** Transformers should be capable of operating at multiple voltage levels and adapting to various configurations. This flexibility allows for an optimized number of spare transformers and at the same time allow rapid deployment and integration into existing infrastructure, minimizing downtime, and improving grid stability
- **Rapid Deployment:** Transformers designed for quick installation and easy integration can help restore power swiftly during outages or emergencies. Mobile and plug-and-play transformers are examples of such designs
- **Enhanced Safety:** Using ester insulation as an alternative to mineral oil provides additional safety by lowering fire and explosion risks. This allows transformers to be placed in protected environments and urban areas with reduced safety distances
- **Sustainability**: Incorporating environmentally friendly materials and

Designing transformers for fast deployment and easy installation is crucial for enhancing grid resilience. Early customer engagement allows for a clear understanding of their needs and expectations, facilitating the development of tailored solutions

technologies, such as ester liquids or no SF6, helps reduce the environmental impact of transformers and contributes to a more sustainable energy infrastructure

By incorporating these features, transformers can significantly enhance the resilience of the electric grid, ensuring a reliable and continuous supply of electricity even under extreme conditions.

Crafting solutions together: The value of customer engagement from day one

Involving the customer at the beginning of a project and throughout the drafting of specifications and design is crucial for ensuring the project's success. Early customer engagement allows for a clear understanding of their needs, preferences, and expectations, which helps in creating a tailored solution that meets their requirements. By collaborating with the customer from the outset, project teams can gather valuable insights and feedback, which can be used to refine and optimize the design and specifications. This collaborative approach not only fosters a sense of ownership and commitment from the customer but also helps in identifying potential issues and challenges early on, reducing the risk of costly changes and delays later in the project. Moreover, team up with the customer on every decision-making process ensures that the final product aligns with their vision and delivers maximum value, ultimately leading to higher customer satisfaction and long-term success.

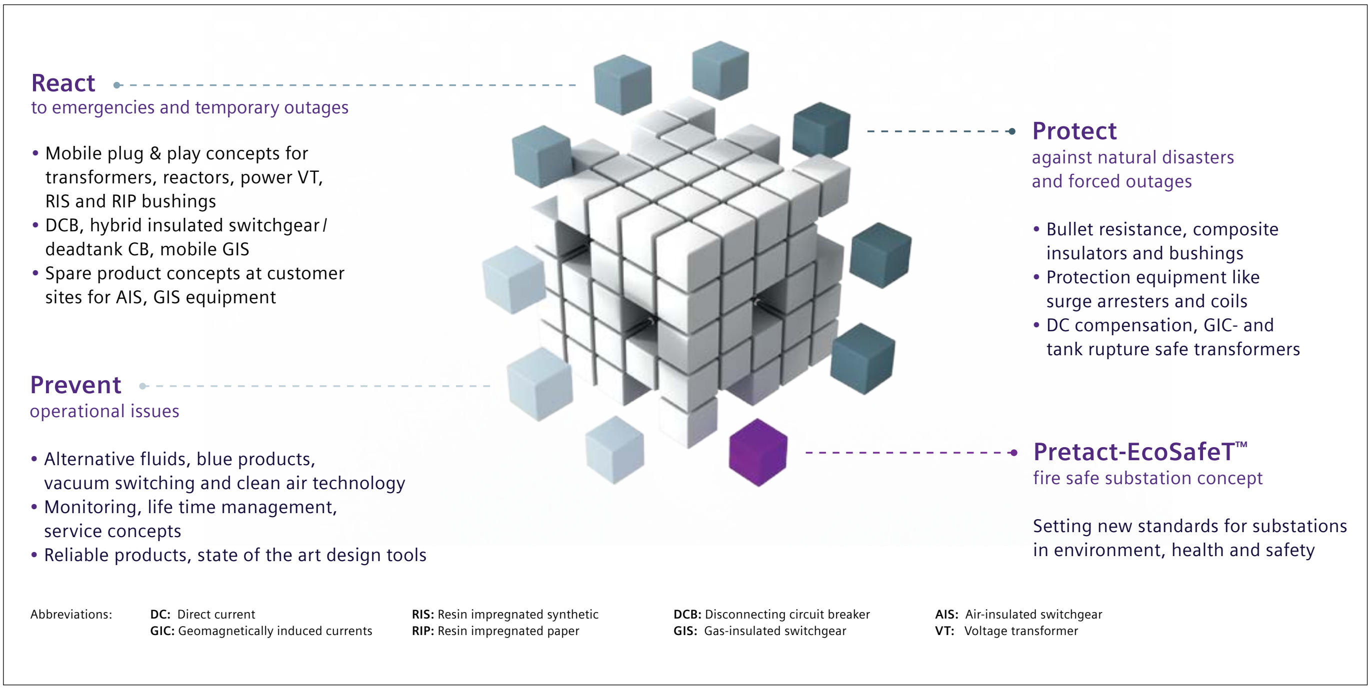
Area station transformers: A new era of performance and sustainability

The development of area station transformers (AST) at an U.S.-based utility has focused on enhancing their resilience, flexibility, and environmental sustainability. These transformers are designed to meet the diverse needs of utilities, ensuring reliable performance under various conditions.

One key development is the use of high-temperature insulation systems and ester liquids, such as Midel® 7131, which improve thermal performance and reduce the risk of fire and environmental harm.

This innovation allows for the design of transformers that can operate at higher temperatures and with greater efficiency.

Pretact® ensures uninterrupted power, elevating grid resilience at all times through a modular feature architecture designed for proactive protection, prevention, and responsive action



There are different types of area station transformers, each tailored to specific requirements:

AST Type 1: This type is designed to replace transformers with multiple MVA ratings (10-90MVA) and different impedances and low noise. It uses high-temperature winding insulation incl Midel 7131 and sophisticated winding arrangements to meet diverse utility needs

AST Type 2: Focuses on a 10% higher power rating without compromising size and noise constraints in substations. It is designed to reduce the complexity and use of high temperature insulation materials.

AST Type 3: This type combines the features of AST Type 1 and AST Type 2, using high-temperature insulation parts and Midel® 7131 to achieve both high performance and environmental sustainability. Four operation modes and multiple impedance bands cover a broad range of operating conditions and incorporate various transformer types and impedance bands.

This resilience transformer can operate at ratings of 58 MVA, 65 MVA, or 93 MVA, with primary voltages of either 132 kV or 65 kV, and secondary voltages of 13.8 kV, 28 kV, or 35 kV

The innovative winding setup concept, featuring tap-changers, enables seamless switching between different winding connections. This design incorporates insulation materials like aramid and fiberglass, which support high-temperature requirements for safe operation.

This resilient transformer can operate at ratings of 58 MVA, 65 MVA, or 93 MVA, with primary voltages of either 132 kV or 65 kV, and secondary voltages of 13.8 kV, 28 kV, or 35 kV. The regulation of the secondary voltage is achieved through an on-load tap changer (OLTC), with impedance ranging from 9.91% to 22% to match the existing installed fleet. These operating options necessitate a winding setup with eleven individual windings per phase, managed by four de-energized tap-changers (DETC) and one OLTC. The OLTC regulates ±16 steps for the low voltage windings, while the DETCs switch between the selected nominal voltage and impedance levels.

Adaptable power: Enhancing grid robustness through multi-ratio transformer technology

The development and implementation of multi-ratio and versatile power transformers are essential for enhancing grid resilience. These transformers, with their ability to operate at multiple volt-

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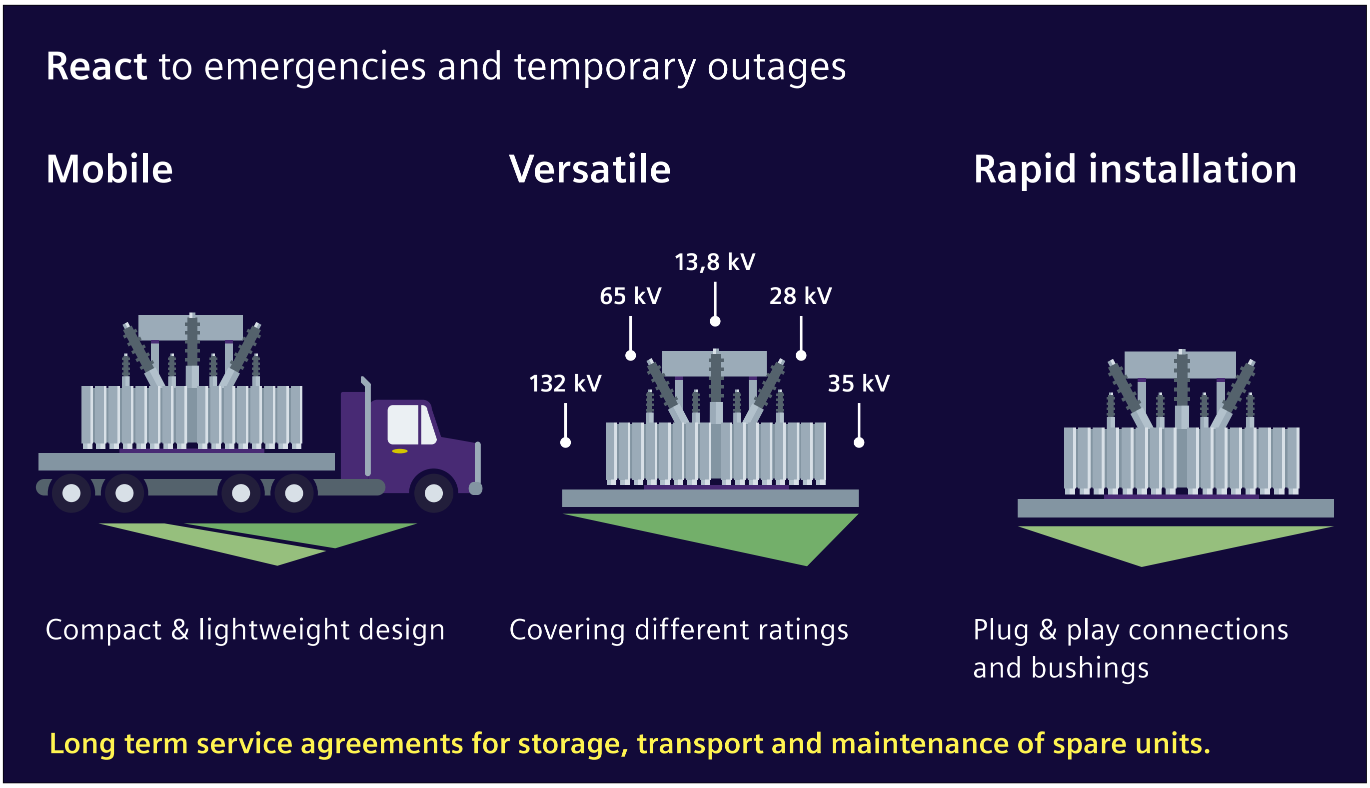

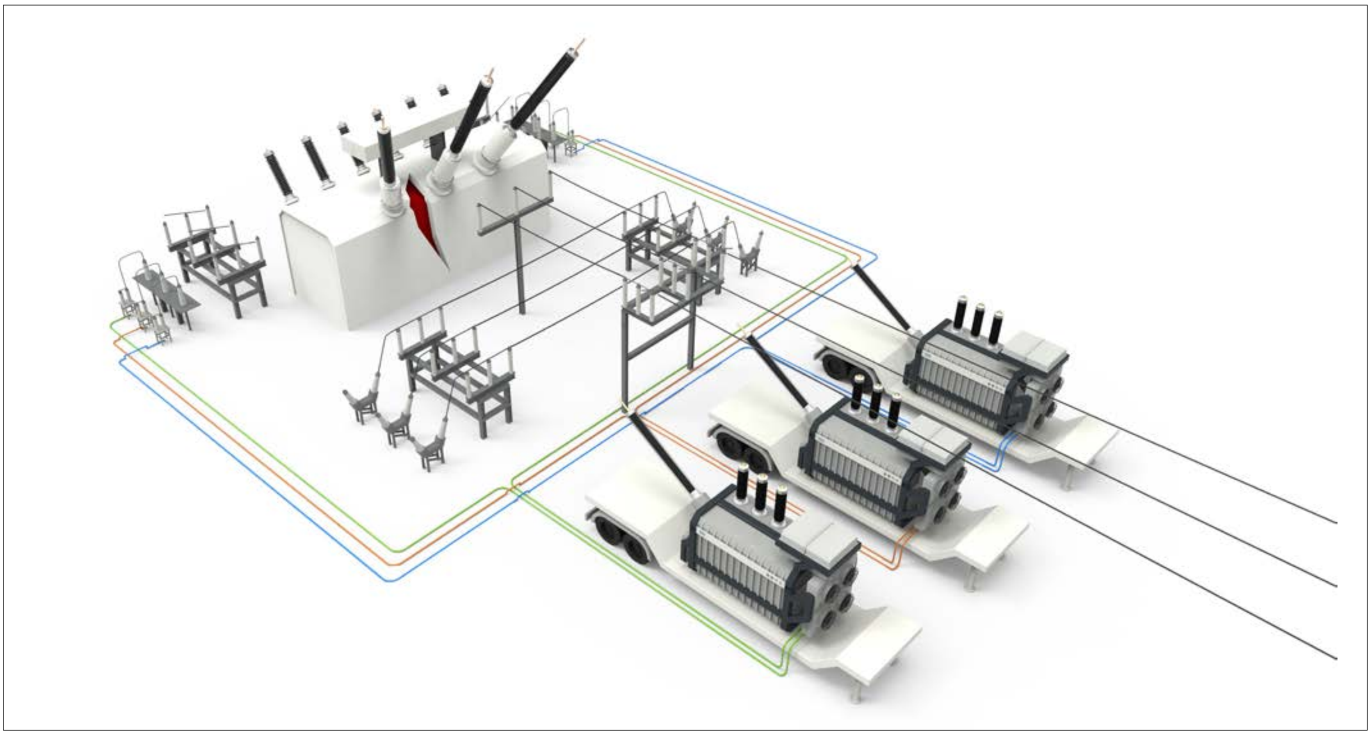

Mobile resilience transformers can operate in various configurations and voltage levels, enhancing grid resilience

age levels and adapt to various configurations, provide the flexibility needed to respond to the dynamic demands of modern power systems and at the same time optimizes the number of spare transformers needed. By incorporating advanced insulation materials and innovative design features, these transformers can withstand higher operating temperatures and overload conditions, ensuring reliable performance even under extreme conditions. The versatility of these transformers allows for rapid deployment and integration into existing infrastructure, minimizing downtime, and improving the overall stability and reliability of the electric grid. As the energy landscape continues to evolve with the integration of renewable energy sources and increasing electrification, the need for resilient and adaptable power transformers becomes even more critical to ensure a continuous and reliable supply of electricity.

Authors

Robert Mayer is head of Offer Management at the Siemens Energy Austria, Transformers in Linz responsible for worldwide projects.
With more than 30 years of experience in the field of transformers he performed the typical underdog career. Starting with an age of 15 as an apprentice in the transformer workshop. He gained a lot of hands-on experience during almost 9 years as a technical filed assistance / supervisor responsible for assemblies around the globe. Robert then joined the test bay at the transformer factory and served as a test engineer and specialist for protection and monitoring of transformers and reactors for more than 6 years. After this his path took him into project execution where he uses the abilities that he learned for working with the customers to find the perfect solution for their needs. In 2023 he took over the team lead for the offer management team.

Ewald Schweiger is head of PRETACT® Global Grid Resilience Concept within Siemens Energy Transmission Products. Mr. Schweiger started in the transformer business more than 25 years ago and held several positions and was responsible for the acquisition and execution of transformer and shunt reactor contracts and key account manager for several of the largest utilities in the US. He was responsible for the business development and sales strategy for all three large power transformer factories within the VA TECH group and the representation in the US market. His abroad experience includes the business development and project management for shell form power transformers and as head of the offer and project coordination for the US in Raleigh, NC.
He is an active member of IEEE/PES Transformers Committee including several working groups and sub committees and chairs several IEEE working groups incl. dual logo documents of IEEE and IEC on Phase Shifting Transformers. Mr. Schweiger received a Dipl.-Ing. Degree (equivalent to M.Sc.) for power engineering from the Graz University of Technology, Austria.