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Tutorial on Keeping Grids Resilient: Maximizing Network Stability with Rapid Transformer Exchange by Using Advanced Insulation Systems and State-of-the-Art Connectivity

— Technical Presentation —
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1. Abstract

This presentation reviews the newest developments and trends in large power transformers for improving grid resiliency by using advanced insulation systems that allow smaller size and lower weight designs. Versatility covering different locations and transformer configurations is achieved by applying state-of-the-art design tools in combination with hybrid insulation systems, both of which have evolved for use with larger units in order to make transformers lighter and allow rapid movement in emergency situations.

More compact units will be possible with new insulation systems currently in development that use insulation components made of alternate liquids and high temperature materials governed by high temperature IEEE standards. New bushings and terminations have also advanced state-of-the-art connectivity using a plug-and-play concept that further improves large transformer mobility and speed of replacement. Details around development of high voltage plug-in bushings and connectors that eliminate the need for on-site tank penetration and active part dry-out will be presented.

This presentation will also provide an overview of specific requirements for rapid replacement in applications involving highly constrained installations where a larger capacity and flexible rating is needed but must fit an existing space. The presenters will detail how grid resilience can be improved by applying the newest technologies in combination with innovative solutions for the assembly of these critical components into a power transformer that meets the special needs of a specific installation and application, such as fast deployable large power emergency replacement units.

2. Learning Objectives

This tutorial plans to

- Demonstrate how grid resilience can be improved by detailing examples of rapid power transformer replacement, including installation and commissioning
- Demonstrate how the capacity of a large power transformer can be increased without changing the footprint of a constrained substation installation
- Show multiple examples of fast deployable and portable power transformers
- Illustrate the design and application of high voltage plug-in bushings and connectors

3. Learning Outcomes

By attending this tutorial, attendees will gain an understanding of the following:

- Alternate insulation systems that can reduce the size and weight of a power transformer
- Temperature limits defined by IEEE standards that exceed those of conventional transformers
- Application of plug-in high voltage bushings and connectors
- Many options now available in power transformers to meet specific application needs due to new insulation components

4. Presenters' Biographies

Richard Marek is the global transformer application specialist for DuPont Energy Solutions, with whom he has been employed since 1998. His previous work experience includes 28 years as an engineer in design, test and development for specialty magnetics, dry-type, epoxy cast and liquid immersed transformer products. For 20 of those years, he served as a design or engineering manager. He holds three patents, and his papers have been published by IEEE, CIGRE, MatPost and INSUCON. Richard is a senior life member of IEEE, where he has been active in the Transformers Committee, various subcommittees and numerous working groups since 1982. He served as past and current Chairman of the high temperature liquid immersed transformer standard C57.154. Richard is also an IEC TC14 delegate for the U.S. Technical Advisory Group, recipient of the IEC 1906 award, convenor of the high temperature liquid immersed transformer standard IEC 60076-14 and the reciprocal liaison between IEC TC112 and TC14. He received his BSEE from Purdue University in 1970.

Dr.-Ing. Peter Müller graduated from the University of Stuttgart in 2007, holding a diploma in electrical engineering. In 2014, he earned the Dr.-Ing. title at the Institute of High Voltage and Power Distribution, also from the University of Stuttgart. Peter worked in the field of arc fault protection for air-insulated switchgear as a research scientist and as a research engineer in the field of high current relays. He was Pfisterer's project manager for the first resiliency transformer projects in the USA. His current position at PFISTERER Kontaktsysteme is Regional Sales Manager for Central and Eastern Europe.

Anastasia O'Malley has been employed at the Consolidated Edison Company of New York since 1990 and currently works as a project manager in the Substation Equipment Section of Central Engineering, providing guidance on the purchase, installation, maintenance and replacement of Con Edison's power transformer fleet. Anastasia previously served as an officer of the Doble Engineering Transformer Committee and is an active member of the IEEE PES Transformers Committee. She also collaborates with the Electric Power Research Institute (EPRI) to support projects impacting transformer condition assessment and life extension. She received an MSEE from Manhattan College, a BSME from Rutgers University and an MBA from Fordham University.

Ewald Schweiger is head of the grid resilience concept with worldwide responsibility within Siemens Transmission Products. During his more than 20 years in the transformer industry, he has held several positions that included responsibility for the acquisition and execution of transformer and shunt reactor contracts. He was also a key account manager for several of the largest utilities in the U.S. Ewald was responsible for business development and sales strategy for all three large power transformer factories within the VA TECH group and the U.S. market representative. His broad experience includes business development and project management for shell form power transformers.