Message from Editors

STRUCTURED microgrids (SμGs) and flexible electronic large power transformers (FeLPTs) are emerging as two essential technologies for renewable energy integration and flexible power transmission. FeLPTs provide the processing and control required and its configurability provides the capability for flexible transmission. SμGs provides the integration of renewable energy and storage to balance the energy demand and supply as required for a given design. Challenges in FeLPTs include efficiency, reliability, size and cost parity. Challenges in SμGs include accurate forecast for renewable availability, cost-effective integration and efficient control. As the technologies progress, successful integration and solar and battery has proven to be technically effective ad economically beneficial. Australia Hardsdale Solar Farm has reduced the operator cost by tens of millions and Solar and storage based peakers can cost less than diesel based ones. This special issue intends to provide a forum for most recent progress in SμGs, FeLPTs, and related systems issues.

It is in this recognition that we organized this special issue on structured microgrids and flexible electronic large power transformers. This special issue intends to provide an international forum for people from industry and academia to exchange their ideas, progress in technology development, and most recent research results. Topics of interest include, but are not limited to:

FeLPTs cost and size reduction, reliability enhancement, FACTs applications, related devices and components, packaging and system integration, and insertion into substations. SμGs energy balance techniques and algorithms, AI for renewable forecasting methods and techniques, system integration and operation, control techniques for transactive energy, and FeLPTs and SμGs integration and simulation.

We have organized the accepted 10 papers in three groups: 1) Flexible electronics large power transformers (FeLPTs), 2) Control techniques for FeLPTs, and 3) Industry applications for FeLPTs.

In the first group, the first paper, "Structured microgrids and flexible electronics large power transformers," by D. Tan, provides an overview and key definitions of structured microgrids (SμGs) and flexible electronic large power transformers (FeLPTs). It also discusses its basic functions and their potential for serving as a basic fundamental building block for the emerging electronic power grids. The second paper, "Smart Transformer and Large Flexible Transformer," by R. Zhu, et al, goes into the details of grid support characteristics for the FeLPTs with key performance characteristics. It also summarizes ancillary services it can provide for grid support. The third paper, "A Discrete State Event Driven Simulation based Losses Analysis for Multi-terminal Megawatt Power Electronic Transformer" by J. Zhen et al, explores an event-driven simulation technique for megawatt systems. Its powerfulness of this breakthrough technology is demonstrated through a detailed loss analysis.

In the second group, the first paper, "Smart Transformer-based Medium Voltage Grid Support by Means of Active Power Control" by S. Giacomuzzi, et al, presents an active control technique to replace the traditional tap-changer based control method with a medium voltage active injection. The second paper, "A New Voltage Control Strategy to Improve Performance of DSTATCOM in Electric Grid" by C. Kumar, et al, proposes a new distribution static compensator application for the FeLPTs technologies. It features two dimensions of control, outperforming traditional approaches. The third paper, "Arm Voltage Balancing Control of Modular Multilevel Resonant Converter" by J. Zhang, et al, discusses a control technique for arm voltage balance for resonant converter cells. Simulation and experimental results are presented. The forth paper, "Modeling and Control of the Modular Multilevel Converter (MMC) based Solid State Transformer (SST) with Magnetic Integration" by G. Zhen, et al, explores a new approach in modeling the coupling of medium frequencies into magnetic with effective attenuation. The fifth paper, "A Distributed Feedforward Control Method for Power Electronic Transformers" by S. Lu, et al, presents a distributed control technique for the cascade H-bridge-based FeLPTs. Simulation result demonstrated improved computational and communication throughput, together with improved step-load response.

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In the third group, the first paper, "A Novel Single-Phase Five-Level Transformer-less Photovoltaic (PV) Inverter" by X. Zhu, et al, extends the concept to transformerless for a given conversion ratio. It presents a transformerless inverter for solar systems. It promises to significantly reduce the potential leakage current in the system. And the second paper, "Parameter Deviation Effect Study of the Power Generation Unit on a Doubly-Fed Induction Machine-based Shipboard Propulsion System" by K. Ni, et al, explores the shipboard applications for the FeLPTs as motor drives.

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