

# Guest Editorial

## Special Section on Protection and Real-Time Monitoring of Transmission and Distribution Systems with High Penetration of Distributed Generation and Microgrids

**E**CONOMIC, political, environmental, societal and technical factors have encouraged the proliferation of Distributed Energy Resources (DER), particularly Distributed Generation (DG), in transmission and distribution (T&D) systems. DG proliferation is already a reality in numerous markets around the world and can impact several aspects of T&D planning, operations, engineering, analysis, policy and regulation. The industry is actively engaged in evaluating the severity of those impacts on existing T&D grids and developing solutions to ensure seamless integration. The growing interest and increasing penetration levels of DG, particularly of renewable generation technologies such as photovoltaics, and the emergence of energy storage, have also spurred attention to revisiting the microgrid concept as a solution to effectively manage, integrate, and benefit from variable DG. This involves additional monitoring, protection, automation, and control challenges. Finally, it is expected that penetration levels of DG will continue growing, given the favorable business, regulatory and policy landscape, decreasing technology prices, and evolving end-user expectations (including the emergence of the prosumer). Widespread adoption of DG will increase the complexity of the T&D grid, accentuating the need for reliable real-time operations and control, and triggering additional engineering issues. In this context, one of the key topics that the industry needs to address is the development of new solutions for protection and real-time monitoring of T&D systems with high penetration of DG and microgrids.

This Special Section focuses on exploring methodologies and applications that address the challenges and needs associated with this new paradigm. We received numerous high quality submissions, conducted a careful review process and finally accepted 25 papers. The selected articles include authors from the Americas, Europe, and Asia, and provide readers with a variety of perspectives and approaches to address the challenges

posed by DG proliferation and microgrids. The technical areas covered by the selected papers encompass different aspects of protection and real-time monitoring of T&D grids, including design, coordination, reliability, and testing of protection methods, fault detection and modeling, signal processing, dynamic line rating, state estimation, and applications of synchrophasors. These proposals cover a heterogeneous set of problems, from analyses of high-voltage transmission systems to specific studies of low-voltage microgrids. It is our expectation that they help generate further discussions and contributions from subject matter experts, and motivate new generations of researchers to actively participate in this rapidly growing and increasingly complex field.

I would like to thank Prof. Wilsun Xu, Editor-in-Chief of the IEEE TRANSACTIONS ON POWER DELIVERY, for the opportunity to lead this initiative and for his instrumental support throughout this process. I would also like to thank Ms. Cheryl Koster, Administrator of the IEEE Power & Energy Society Publications, for her diligent and outstanding administrative support. I would like to express my gratitude to the Guest Editorial Board: Prof. Walmir Freitas, Mrs. Solveig Ward, Dr. Babak Enayati, Prof. Amin Khodaei, Mr. Fred Friend, Mr. Robert Uluski, and Dr. Bartosz Wojszczyk for their valuable assistance. On behalf of the Guest Editorial Board our recognition goes to the reviewers for their priceless time and hard work evaluating the submitted papers and providing insightful recommendations to the authors. Our objective is that this Special Section serves as a reference for the development of solutions for protection and real-time monitoring of modern and future T&D systems.

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Dr. Romero Agüero is the Chair of the IEEE Distribution Subcommittee and the IEEE Working Group Distributed Resources Integration, an Editor of the IEEE TRANSACTIONS ON POWER DELIVERY and the IEEE TRANSACTIONS ON SMART GRID, and member of the Advisory Committee of DistribuTECH. He is an associate member of the Graduate Faculty, University of North Carolina, Charlotte, NC, USA.