Guest Editorial: Special Section on Active Distribution Networks: Markets, Operations, Planning, and Regulation

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THE power system is in change, and the most fundamental changes are happening in the distribution grid. Formerly passive consumers get active and smart, storage and distributed generation appears, and the "grid edge" is upgraded with Intenet of Things (IoT). Gone are the days where distribution infrastructure consisted of passive assets, dimensioned for the worst case of load. We are now entering a new phase where active distribution grids are operated with the help of local markets, machine learning techniques, and distribution automation. Integrating renewable energy or electric vehicles and electrifying the last remaining fossil applications require a flexible and powerful active distribution grid.

This Special Section includes 17 research articles to present state-of-the-art in markets, operation, planning, and regulation within such active distribution networks.

1) The paper entitled "A Review on Active Customers Participation in Smart Grids" investigates the capabilities of active customers in performing local ancillary services to contribute to the distribution network operation.

2) The paper entitled "A Multi-objective Chance-constrained Information-gap Decision Model for Active Management to Accommodate Multiple Uncertainties in Distribution Networks" proposes a scheduling method based on a multi-objective chance-constrained information-gap decision model to obtain the active management schemes for distribution system operators.

3) The paper entitled "Fault Location and Classification for Distribution Systems Based on Deep Graph Learning Methods" proposes a fault diagnostic framework for distribution networks based on deep graph learning.

4) The paper entitled "Two-stage Optimal Dispatching of AC/DC Hybrid Active Distribution Systems Considering Network Flexibility" proposes the optimal dispatch of an AC/DC hybrid active distribution system considering the dynamic thermal rating, soft open point, and distribution network reconfiguration.

5) The paper entitled "Two-stage Optimization for Active Distribution Systems Based on Operating Ranges of Soft Open Points and Energy Storage System" proposes a two-stage optimization strategy for active distribution networks interconnected by soft open points.

6) The paper entitled "Multi-stage Co-planning Model for Power Distribution System and Hydrogen Energy System Under Uncertainties" describes a multi-stage co-planning model for the power distribution system and hydrogen energy system.

7) The paper entitled "A Two-stage Stochastic Mixed-integer Programming Model for Resilience Enhancement of Active Distribution Networks" proposes a stochastic programming model to minimize the upgrading and operating cost of network by considering random scenarios that refer to different operating states of network caused by disastrous weather events.

8) The paper entitled "Sequential Reconfiguration of Unbalanced Distribution Network with Soft Open Points Based on Deep Reinforcement Learning" develops a deep reinforcement learning method for the sequential reconfiguration with soft open points based on real-time data.

9) The paper entitled "Two-stage Stochastic Programming for Coordinated Operation of Distributed Energy Resources in Unbalanced Active Distribution Networks with Diverse Correlated Uncertainties" proposes a stochastic programming method for the coordinated operation of distributed energy resources in the unbalanced active distribution network considering diverse correlated uncertainties.

10) The paper entitled "Intelligent Voltage Control Method in Active Distribution Networks Based on Averaged Weighted Double Deep Q-network Algorithm" proposes an voltage control method based on average weighted deep double Q-network algorithm to overcome the shortcomings of overestimation of action reward values in deep Q-network algorithm and underestimation of action reward values in double deep Q-network algorithm.

11) The paper entitled "Calculation Model and Allocation Strategy of Network Usage Charge for Peer-to-peer and Community-based Energy Transaction Market" proposes an network usage charge calculation method for peer-to-peer and community-based transactions to address holistically economic and technical issues in transactive energy markets and

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distribution system operations, respectively.

12) The paper entitled "Localization of Oscillation Source in DC Distribution Network Based on Power Spectral Density" establishes a DC distribution network model combined with the component connection method and divides the network into multiple power modules.

13) The paper entitled "Optimal Day-ahead Dynamic Pricing of Grid-connected Residential Renewable Energy Sources Under Different Metering Mechanisms" uses a decomposition method for day-ahead dynamic pricing of renewable energy resources under different metering mechanisms: feed-in-tariffs, net metering, and net purchase and sale in conjunction with carbon emission taxes.

14) The paper entitled "Decentralized Bilateral Risk-based Self-healing Strategy for Power Distribution Network with Potentials from Central Energy Stations" proposes a decentralized self-healing method of power distribution network, considering thermal storage and building thermal inertia, as well as the flexible topology of power distribution network.

15) The paper entitled "A Mixed-integer Linear Programming Model for Defining Customer Export Limit in PV-rich Low-voltage Distribution Networks" presents a mixed-integer nonlinear programming model to define such optimal customer export.

16) The paper entitled "Learning Reactive Power Control Polices in Distribution Networks Using Conditional Value-at-Risk and Artificial Neural Networks" develops a data-driven control methodology using artificial neural networks to compute the reactive power setpoints utilizing conservative convex approximations of chance constraints.

17) The paper entitled "Reconfiguration of Active Distribution Networks Equipped with Soft Open Points Considering Protection Constraints" proposes a comprehensive framework using soft open points to enable the most efficient system configuration for improved active distribution networks utilization.

We would like to thank all participating authors for submitting their works to this Special Section. We are truly thankful to the Guest Editors that have shepherded the reviews of all the articles considered for this Special Section in a most efficient and efficacious manner: Kaikai Pan, Pedro Vergara Barrios, Yi Wang, Juan S. Giraldo, Anamika Dubey, Xiaonan Lu, Zhi Wu, and Juan M. Mauricio. Thank you!

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Guest Editors-in-Chief

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