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Journal of Modern Power Systems and Clean Energy

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

In the context of the long-lasting effects introduced by the smart grid paradigm, several new trends are emerging, changing the way distribution system operators (DSOs) conceive and operate their distribution networks. In the past, distribution system infrastructure aimed to connect the upper level (high-voltage) system to customers, while self-generation was limited to large generation units at the high-voltage system. Recently, innovations at the generation and demand sides have changed dramatically the idea of distribution system operation, giving them a more active role in the operation of the whole electricity system.

An active distribution network is composed of a large number of energy-related innovations and players that actively cooperate to ensure a cost-effective and reliable operation. Active distribution networks enable the co-existence of a large number of distributed energy resources (DERs) and flexible consumers within the same electricity network. To ensure a reliable operation, all involved players (DSOs, large and small consumers, prosumers) must coordinate operation by properly managing the uncertainties typical of sources based on solar and wind power, as well as other energy-intensive resources such as electric vehicles (EVs); shifting towards a more flexible operation. These new operational conditions require the introduction of new planning models and control approaches that enable the connection of new DERs without compromising the reliable operation of the network. To achieve this, information is fundamental, not only from sources already available in the past (e.g., network measurement units) but also new sources coming from the prosumers, for instance, through the installation of smart meters and use of Internet of Things (IoT). In a later stage, all the available data can be used to understand prosumers' behavior aiming to exploit their energy flexibility potential to support the distribution network operation. Nevertheless, as a consequence of the increasing level of digitalization, the secure operation of the distribution network can also be compromised as a result of cyber-attacks. For instance, by introducing errors on the measurement units or by directly controlling assets that can produce a cascade effect, leading to an outage. In this sense, a cyber-secure operation is also paramount to ensure the reliability of supply to consumers.

The main objective of this special issue is to present state-of-the-art in markets, operation, planning, and regulation within active distribution networks. The topics of interest include, but are not limited to:

- Electricity markets design to enable flexibility from DERs to support DSOs;
- New frameworks for interaction of DSO and transmission system operator (TSO) to exploit flexibility from active distribution networks to support transmission systems;
- Energy flexibility quantification and disaggregation models for flexibility trading at distribution level;
- Active distribution network planning and assessment models with large penetration of renewable DERs;
- Stochastic and robust models for coordination of a large number of PVs, EVs, residential batteries to reduce power quality issues (undervoltage, overvoltage, congestion);
- New data-driven algorithms for active distribution networks modeling (e.g., power flow, state estimation models, etc.) and operation of a large number of DERs;

- Impact of new technologies on operation, planning, and markets at the distribution level (smart meters, PMUs, others);
- Cyber-secure operation in the context of infrastructure and DER cyber-attacks;
- Future distribution principles: self-organization and energy communities.

Important Dates

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