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EDITORIAL

Energy systems special issue on "Smart Microgrids"

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Microgrids are associated with significant benefits and have been receiving increasing attention in the world, given the falling prices of renewables and storage. They can be defined as a local distribution network, which can operate autonomously and islanded from the main distribution system. Thus, intelligent systems are required to integrate distributed generation, loads, and storage systems. Several motivations to promote microgrids can be highlighted: customers are increasingly interested in reducing energy costs and improving reliability, the industry of electricity is interested in maintaining or improving power quality, meeting growing demand and clean energy commitments, and governments are interested in mitigating climate change.

Functionality and operability conditions are needed to implement a microgrid. First, power generation must meet customer demand, and this requires a power management system to maintain minimum operating requirements. In addition, systemic flexibility is important, allowing the microgrid to operate connected or islanded from the main grid. Finally, a microgrid must continue operating even with the loss of any equipment. In order to make these conditions available, microgrids require several interfaces, including supervision, control, and

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protection devices, ensuring a reliable operation without causing disturbances to the microgrid and its customers.

Microgrids can be seen as the building block of modern electric energy networks, with high potential to deal with the decarbonization of the grid, providing technical and economic flexibility. Although the development of microgrids is growing, there are still several challenges to optimize their operation and efficiently control them. In addition, microgrids are now powered by renewable energy resources, and they are coordinating in real-time demand and supply to optimize the operation of the system. This special issue promoted the research related to Smart Microgrids, focusing on microgrids powered by renewable resources and controlled by smart algorithms.

The guest editors thank the contributing authors and the many referees for their constructive reviews. The papers received demonstrate the importance of this research field and the many challenges to overcome. The resulting contributions are as follows.

1. In "The Requirements and Constraints of Storage Technology in Isolated Microgrids: A Comparative Analysis of Lithium-ion vs. Lead-Acid Batteries", Santos-Pereira et al., present an analysis of two different battery technologies, examining the operational requirements for islanded microgrids.
2. In "A novel application of multifunctional inverters to enhance power quality of smart microgrids: An analysis on a low voltage and four-wire grid", Silveira et al., present a multifunctional inverter model to improve power quality in a microgrid operating both connected and islanded from the main grid.
3. In "Performance Investigation of Grid Connected PV Interleaved Inverter with Power Quality Enhancement", Gali et al., propose an interleaved inverter topology associated to a control technique to perform multifunctional operation and enhance the system efficiency.
4. In "A Power Electronic Converter-Based Microgrid Model for Simulation Studies Fundamental controls, DER modeling and applications ", Ioris et al., propose a power electronic converter-based microgrid benchmark with the fundamental theory about microgrid control, operation and modeling, besides functional examples of microgrid operation, providing a reference to implement a microgrid model.
5. In "Mixed Integer Conic Model with Dynamic Sets for Real-time Energy Management in Islanded Microgrids", Barbosa, et al., present a new approach for modeling and executing models for optimization problems, applying non-uniform periods to the forecasted data, related to demand and generation, for a realtime EMS in Microgrid operation running in islanded mode. In this work, the term used for this kind of intervals organization in the mathematical model is denominated dynamic interval.
6. In "A Critical Review of Energy Storage Technologies for Microgrids", Denisson Oliveira et al., provide a critical review of the existing energy storage technologies, focusing mainly on mature technologies. Their feasibility for microgrids is investigated in terms of cost, technical benefits, cycle life, ease of deployment,

energy and power density, cycle life, and operational constraints. Authors suggest that different storage technologies are commercially and technically viable only for specific applications.