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Editorial: Stability and Primary Control, Dynamic Analysis, and Simulation of Microgrids With New Forms and Features

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Editorial on the Research Topic

Stability and Primary Control, Dynamic Analysis, and Simulation of Microgrids With New Forms and Features

The Research Topic focuses on the stability/primary control, dynamic analysis, and simulation of microgrids and welcomes discussions on new forms and features of microgrids. The topic includes six papers in total, among which four are review papers and two are general research papers.

Review papers give potential readers an overview of modeling, planning and scheduling, optimal operation, and dynamic control of microgrids. They are also helpful in guiding readers into the research areas related to analysis, simulation, operation, and control of microgrids.

One research paper discusses the electrical-thermal multi-energy flow simulation and loss analysis methodology. Another one probes into hybrid energy storage system sizing for inertial and primary frequency control.

The collected papers also give us a glimpse into some exciting forms and features of newly developed and constructed microgrids, including multi-energy systems integrating the chemical, electrical, and thermal energy forms, cyber-physical hybrid microgrid, DC nano power grids, hybrid energy storage systems, etc.

The contents of the six papers are briefly summarized below.

1) Fan et al. Review of Control Strategies for DC Nano-Grid. The review paper summarizes the structure and components of DC nano grids. Then, it emphasizes the crucial control and investigates local and coordinated control, including voltage/current control, power-sharing control, cooperative control, etc. The last part of the paper compares and discusses the performance and features of various control strategies.

2) Fan et al. Review on Coordinated Planning of Source-Network-Load-Storage for Integrated Energy Systems.

The review paper focuses on the coordinated planning technical approaches for source-network-load-storage systems integrating electricity, gas, and heat. Four parts comprise the article: the structure and characteristics of the integrated energy system (IES), key findings for the IES planning, modeling methods for complex planning problems, and optimization methods for IES planning.

3) Fan et al. Review of Modeling and Simulation Methods for Cyber-Physical Power System.

The review paper takes the modeling and simulation of the cyber-physical power system (CPPS) as the theme, aiming to provide readers with different perspectives on the dynamic models and simulation methods. It presents an overview of the CPPS framework and the interaction between the

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communication and physical power systems. Then, it summarizes the mainstream work and methods of modeling and simulation of CPPS, with comments on their technical features. Future research directions are also suggested.

4) Fan et al. Review of Uncertainty Modeling for Optimal Operation of Integrated Energy System.

In this paper, the models and modeling methods are summarized and evaluated for the optimal operation of integrated energy systems (IES), considering operation uncertainties. First, the basic models for IES optimal operation are collected, and the uncertain factors in operation are analyzed. The contents are organized according to the IES's major parts: source, load, grid, storage sides, and the trading market. Then, the authors explore how to model IES uncertainties and solve the models. Research challenges and future directions are also initially discussed.

5) Lei et al. A Novel Methodology for Electric-Thermal Mixed Power Flow Simulation and Transmission Loss Analysis in Multi-Energy Micro-Grids.

Authors develop a new mathematical expression for working medium temperature drop features by modifying the Sukhov cooling operator, intuitively revealing how factors impact transmission loss in hot water pipes. Then the authors derive a multi-energy flow model and a hybrid energy flow calculation algorithm based on the expression. We can efficiently analyze the power flow characteristics of multi-energy systems.

6) Alves et al. Sizing of Hybrid Energy Storage Systems for Inertial and Primary Frequency Control.

This paper first clarifies the different time-scale features and control actions of AC system frequency responses and significant factors. Next, it derives algebraic equations to rate energy storage systems providing inertial and primary control. The equations are robust to system nonlinearities and rely on accessible parameters. Going one step further, the paper gives a step-by-step procedure to size the main components of the energy storage system connected through a converter. The proposed method is practical and makes it easy to set specific requirements for each storage device according to the provided frequency control.

AUTHOR CONTRIBUTIONS

All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

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