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Editorial: Power Management for AC/DC Hybrid Microgrid

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Editorial on the Research Topic

Power Management for AC/DC Hybrid Microgrid

Renewable energy sources (RESs) such as photovoltaic (PV) and wind power, energy storage, and modern DC loads are increasingly present in microgrids. Hybrid AC/DC microgrids contain AC/DC power sources and loads and have the advantages of both AC and DC power systems. AC and DC components are segregated and connected to reduce the number of power conversion stages, thus increasing the overall efficiency. Recent studies show that hybrid AC/DC microgrids provide a promising solution to integrate both AC and DC microgrids into existing power grids.

Control, optimization, and power management of hybrid AC/DC microgrids is becoming a significant challenge with the high penetration of renewable energy and energy storage systems (ESS). Meanwhile, centralized transparency into all devices, from power generation to loads, enables proactive management of the power system. Control of microgrids can be divided into two categories: long-term energy management and short-term power management. The global objective of long-term energy management is to optimally match the total power production to the demand. Short-term power management is used to regulate the instantaneous operating conditions such as voltage, current, power, and frequency.

Control of microgrid typically includes local control and coordinated control. Droop control is used for coordinated control among parallel converters for load sharing. In a multi-terminal DC (MTDC), the AC terminals and the ESS need to cooperate to maintain the stability of the DC bus voltage. Each ESS has different dynamic and static power capabilities. To distribute dynamic and static power accordingly, Xie et al. proposed an adaptive droop control strategy based on dynamic and static power decoupling. Through adaptive virtual resistance control, static power was distributed according to the charge-discharge status and battery capacity, while dynamic power distribution was determined by virtual capacitance.

Zhou et al. proposed an autonomous cooperative control for hybrid ac/dc microgrids with ice storage systems (ISS) and ESS. ISS is a kind of thermal energy storage that can alleviate power shortages during peak periods. The proposed control method has ISS and ESS absorb energy according to their rated capacity in the energy storage period. In the energy-releasing period, ISSs were used first, and then the rest of the loads were shared among the ESS based on their rated capacity ratio.

The issues of potential congestion caused by uncoordinated operation flexible demands such as heat pumps and high penetration of RES were addressed by Chen and Liu. A network reconfiguration integrated dynamic tariff-subsidy (DTS) congestion management method was proposed to alleviate congestion in microgrids. The microgrid system operator-controlled sectionalization switches while customers or aggregators scheduled ESS in response to DTS. The aggregators shifted power consumption from congestion hours to off-peak hours to minimize energy costs, consequently resolving congestion.

Finally, the power transmission network in Oman was analyzed by Omairi et al. Structure, demand, standards, and penetration of smart grids were studied to gain a clear understanding of the network to provide a practical tool for future extension and increase in renewable energy penetration.

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In summary, this research topic discussed different emerging techniques in the power and energy management of microgrids and provided an overview of the national power grid of Oman. Research on advanced control and power management methods, demonstration, and overview studies on AC/DC microgrids are expected to be conducted extensively in the near future.

AUTHOR CONTRIBUTIONS

LG drafted the editorial. XF and JZ revised the editorial and approved it for publication.

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