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Editorial

Special Issue on Microgrids/Nanogrids Implementation, Planning, and Operation

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1. Introduction

Today's power system faces the challenges of environmental protection, increasing global demand for electricity, high-reliability requirements, clean energy, and planning restrictions. To move towards a green and smart electric power system, centralized generation facilities are being transformed into smaller and more distributed generations. As a result, the microgrid concept is emerging, where a microgrid can operate as a single controllable system and can be viewed as a group of distributed energy loads and resources, which can include many renewable energy sources and energy storage systems. Energy management of a large number of distributed energy resources is required for the reliable operation of the microgrid.

Microgrids can allow better integration of distributed energy storage capacity and renewable energy sources into the power grid, therefore, increasing its efficiency and resilience to natural and man-caused disruptive events. In addition, microgrids and nanogrids are potential solutions for providing a better electrical service for both insufficiently supplied and remote areas. Microgrids networking with optimal energy management will lead to a sort of smart grid with numerous benefits such as reduced cost and enhanced reliability and resiliency [1]. As microgrids, nanogrids are an effective solution to promote renewable energy consumption and build a low-carbon and environmentally friendly power grid. They include small-scale renewable energy harvesters and fixed energy storage units typically installed in commercial and residential buildings.

In this challenging context, the objective of this special session is to address and disseminate state-of-the-art research and development results on the implementation, planning, and operation of microgrids/nanogrids, where energy management is one of the core issues.

2. Special Issue Contributions

This section briefly presents the special issue published papers' main contributions.

Liu et al. in [2] addressed the issues of operation cost and energy waste caused by wind and light abandonment. Indeed, energy management systems efficiency is a major concern for wind-PV and storage electric vehicle systems, where optimized operation and flexible scheduling are coordinated with the power grid. In this context, a time-sharing scheduling strategy has been proposed based on the storage system's state of charge and flexible equipment. A quantum mayfly algorithm has also been designed to implement the strategy. The scheduling results have shown that the proposed time-sharing scheduling strategy can reduce the system cost by 60%, and the method decreases energy waste compared with ordinary scheduling methods when using the quantum mayfly algorithm.

Ahmed et al. in [3], consider power quality problems such as voltage sag, swell, and harmonics can significantly affect the systems performance. To address these issues, the

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dynamic voltage restorer became very popular while to become effective fast responsive-operating, fast and accurate detection of sag and swell is essential. However, calculating the voltage magnitude, for comparison purposes, can be tricky in the presence of nonlinearities such as harmonics. In this context, a single-phase quasi-type-1 phase-locked loop, including a pre-loop filter composed of a frequency-fixed delayed signal cancellation method, and a two-stage all-pass filter has been proposed. This pre-loop filter is easy to implement and can provide rejection of any measurement offset thanks to the frequency-fixed nature. The carried out experiments have shown that the proposed method is fast in detecting and compensating any grid voltage anomalies to maintain constant load voltage despite voltage sag, swell, and harmonic distortions.

Roldán-Blay et al. in [4], analyzed the benefits of sharing two stand-alone facilities from a reliability standpoint. In this context, a random sequential Monte Carlo simulation was applied to a cooperative microgrid to evaluate the impact of a simple cooperative strategy on cluster reliability. It was found that the reliability of the system increases when cooperation is allowed. Furthermore, at the design stage, this allows for more cost-effective solutions than individual sizing with a similar level of reliability. The proposed study should be beneficial in optimizing energy consumption, generation, and storage in neighboring communities with distributed energy resources.

Nematollahi et al. in [5], addressed the problem of microgrids distributed generations optimal sizing and sitting with the objectives to minimize the resources generation cost and mitigate power losses. In this context, it has been proposed to use the lightning attachment procedure optimization It has been shown that this procedure outperforms the artificial bee colony approach in terms of convergence speed and the accuracy of solution-finding. In addition, to handle PV generation and load forecasting uncertainties, the lognormal distribution model and the Gaussian process quantile regression (GPQR) approaches have been adopted.

Bouzid et al. in [6], addressed the issues of microgrids stability and performance optimization for different types of loads, including the problem of harmonic cancellation and output voltage disturbance mitigation of distributed generation resource systems caused by nonlinear loads. In this context, robust proportional-resonant controllers with a harmonics compensator based on the internal model principle have been proposed. These controllers ensure robust tracking of sinusoidal reference signals in distributed energy resource systems subject to load variation with respect to sinusoidal disturbances.

Kharrich et al. in [7], proposed to address microgrids challenge of optimal design of the hybrid system while considering both economic cost and location installation feasibility. In this context, a smart algorithm has been developed; namely the quasi-oppositional Bonobo optimizer for the optimal economic design of a stand-alone microgrid in Aswan, Egypt. The proposed study achieved results that highlighted the efficiency of the adopted optimization algorithm for different hybrid system scenarios. Furthermore, a sensitivity analysis has shown that the PV system sizing is critical as it significantly impacts the microgrid's overall performance.

Vink et al. in [8], carried out a study to evaluate the potential of long-term forecasting of energy production and demand in microgrids. In this context, in terms of the scale of a research building, both energy demand and production on a long-term scale have been proposed to be predicted using R software in combination with microgrid data records. The proposed study identified supporting evidence supporting the potential to model both solar power generation and the microgrid (building in this study) energy consumption simultaneously, based on the parameter of solar irradiance and in combination with known time parameters affecting building occupancy.

Jackson et al. in [9], proposed a comprehensive overview of state-of-the-art trends in hierarchical microgrid control. This review-based study has shown the variability of coordinated control schemes in terms of objectives and applications. This review highlighted decentralization and centralization technique characteristics, along with non-communication versus communication approaches. Primary and secondary levels were described by showing different modes of operation as a hierarchical control strategy. Furthermore, a comparative study highlighted the pro and cons of controllers, including the inner loop, power sharing, voltage and frequency restoration, and grid synchronization schemes.

3. Conclusions

Although submissions for this special issue have been completed, more in-depth re-search in the field is being collected in a new special issue: "Microgrids/Nanogrids Implementation, Planning, and Operation, 2nd Volume" (https://www.mdpi.com/journal/applsci/special_issues/2Z946DAPHE, accessed on 23 September 2022).

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