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Editorial: Innovative methods and techniques in new electric power systems

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Editorial on the Research Topic
Innovative methods and techniques in new electric power systems

The digital evolution of the energy industry is increasing in intensity worldwide, among which reform of the electric power system plays a central role. In order to achieve the goals of carbon peaking and carbon neutrality, the construction of a new electric power system (NEPS) with renewable energy as its core is the only viable path (Aslam et al., 2021). In the process of digital transformation of the NEPS, intelligent power equipment, sensor technology and energy storage technology are of strategic significance for enhancing the operational level of the power system, preserving the national energy security, and facilitating the achievement of carbon peaking and carbon neutrality. Wind and solar energy occupy a dominant position in the NEPS (Cameron and Van Der Zwaan, 2015). Renewable generation is projected to account for 25% of total electricity production in 2030% and 60% in 2060. The volatility, intermittency, randomness, and anti-peak shaving characteristics of wind and solar energy will pose new challenges to the capability of NEPS to provide a dependable power supply and maintain a safe and stable operation.

Therefore, innovative methods and techniques including energy storage materials, energy storage management, wind and solar power predictions, decentralized and distributed control, and fault tolerance are researched to manage the low-carbon transformation of power delivery and supply to maximize the cost-effectiveness of generation resources in the NEPS (Zhang et al., 2022; Zhao et al., 2022), which guarantees that the carbon emission targets in the power industry can be achieved.

The Research Topic consists of sixteen highly diverse contributions, which we briefly summarize below.

Firstly, Mao et al. proposes a new integrated energy system based on reversible solid oxide cell (RSOC) for photovoltaic consumption. The integrated electricity-gas system (IEGS) considers the two modes of electrolysis and power generation of RSOC in the model. The model takes the minimum running cost as the objective function to linearize part of the model to generate a mixed integer linearization problem and solve it in general algebraic modeling system. The case study shows that wind power is maximized, and the gas mixture can be transported in natural gas pipelines, improving the economics and stability of IEGS.

Chen et al. deduces the theoretical calculation equation of the quantitative evaluation index of the participation factor. She establishes the small-signal model of the MMC-HVDC transmission system for a wind farm and calculates the dominant oscillation mode of the system and participation factors of 11 oscillation modes of the system. The correlation between the participation factors of each oscillation mode, wind farm, and the MMC system is investigated, which laid a foundation for the formulation of broadband oscillation suppression strategies.

Wind power prediction accuracy is beneficial to the effective utilization of wind energy. Xiong et al. proposes an improved XGBoost algorithm optimized by Bayesian hyperparameter optimization (BH-XGBoost method), and the method is employed to forecast the short-term wind power of wind farms. The proposed BH-XGBoost method can outperforms other commonly used methods including XGBoost, SVM, KELM, and LSTM in all the cases, especially in the cases of wind ramp events caused by extreme weather conditions and low wind speed range.

Wu et al. proposes an adaptive under-frequency load shedding (UFLS) control strategy of power systems with wind turbines and ultra high-voltage DC (UHVDC) participating in frequency regulation. He establishes the simplified frequency response model of the power system considering the participation of wind turbines and UHVDC in frequency regulation, and analyzes the impact of the active power response characteristics of wind turbines and UHVDC participating in frequency regulation on the magnitude of the active power deficiency.

Cai et al. develops a distributed control framework for cost-effective storage coordination in the distribution networks, in which the energy storage units are coordinated to contribute to a given power reference at the aggregated level while regulating the local network voltages in the presence of renewable generations. The salient features of the proposed virtual storage plant (VSP) control roots from the successful employment of an inexact alternating direction method of multiplier (ADMM) algorithm, in which the primal updates have analytical solutions in closed form using proximal operators, which significantly reduces the computation efforts of individual storage agents and renders fast storage dispatch.

Finally, energy storage is very important to the new power system, which has the function of peak cutting and valley filling. Chen et al. proposes a hybrid model for the battery life prediction. The capacity signal is decomposed by the improved complete ensemble empirical mode decomposition with an adaptive noise algorithm to solve the backward problem. Then, the least squares support vector regression algorithm is used to predict each decomposition component separately. A good point set principle and inertia weights are introduced to optimize a sparrow search algorithm. Experimental results confirm that the proposed hybrid prediction model has high accuracy, good stability, and strong robustness.

Overall, recent years have seen great progress in the NEPS. However, this Research Topic could not be finished without the authors' and reviewers' contributions. We hope that this issue sheds light on various frontiers related to the NEPS and adds the credits to the effort in solving the current challenges in the fields.

Author contributions

CZ has written the text, XW has checked the whole paper and all authors listed have made a substantial, direct and intellectual contribution to the work, and approved it for submission.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

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