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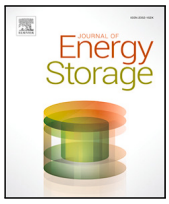

Research papers

LFC based OPF with renewable energy, BESS and FOPID controller using QODTBO algorithm

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ABSTRACT

As a means of tackling the problems of depleting fossil fuels, rising energy consumption, and man-made global warming, renewable energy sources like photovoltaic and wind turbines are becoming widespread. Because of its intermittent nature, integrating renewable energy resources (RERs) into the electrical grid is an extremely difficult task. With benefits like rapid response times and continuous power delivery, battery energy storage systems are often regarded as one of the possible ways to address these variability. Now a days, energy storage devices are crucial for interconnected power systems. They may be applied for peak shaving in addition to Blackuction variations brought on by dispersed power sources. In this paper, the impact of renewable energy with battery energy storage system (BESS) on the power system is examined, using the optimal power flow (OPF) model. The suggested model aims to reduce the overall generation cost, emission, and the frequency deviation. This study resolves an optimal scheduling issue with the hybrid generation system taken into account. Conventional thermal generator, wind, and solar photovoltaic (PV) modules with batteries are the main elements of this hybrid system. The suggested model establishes the ideal output power for every interval and the timing of battery charging and discharging. The usefulness and validity of the suggested model are demonstrated by the numerical example based on the IEEE-57 system. This study examines three different situations: optimal power flow in the absence of RES (wind, solar) & BESS, optimal power flow in the presence of RES (wind, solar) & BESS, and the combination of RES (wind, solar) & BESS with fractional order proportional integral derivative (FOPID) controller. Outcome of the test reveals the better result in resolving the OPF problem, by incorporating RES & BES with FOPID controller. In power systems, fractional order controllers are used to regulate frequency and voltage. Controlled wind turbine dynamics in particular helps to improve grid operations' resilience to uncertainties and disruptions. After integrating RES & BESS with FOPID controller, the total fuel cost & emission are reduced by 11.43%, 11.32% during 24 h and frequency deviation reduces OS-88.34%, US-25.88%, ST-38.59% for area 1 and OS-19.79%, US-54.07%, ST-35.76% for area 2 and OS-65.43%, US-73.46% and ST-21.03% for area 3. Quasi opposition driving training based optimization (QODTBO) with FOPID controller has been employed to obtain optimal solution. The statistical methods, such as one-way ANOVA (analysis of variance), has been used to validate the superior outcomes of the proposed algorithm.

1. Introduction

The increasing integration of renewable energy resources, deregulation of electricity markets, and higher peak-to-value ratio of daily load are some of the factors contributing to the growing complexity of power systems with the advancement of economy and technology. in light of these issues, it is necessary to make improvements in the conventional power generation scheduling systems. The goal of this work is to optimize generation scheduling over a long time horizon by utilizing the possible integration of large-scale energy storage devices. Numerous researchers have endeavoBlack to advance the extensive global uses of energy storage technologies. Peak-shaving effect is one of the most significant uses of energy storage systems. This feature of energy storage devices has been extensively studied from a variety of angles, including system dependability and economic impact. Managing the

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