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Research Article EAI.EU

Investigating Safe and Economic Adjustment of Power Balance in Smart Grids Based on Integration of Renewable Energy

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Abstract

The present pace of integration of renewable sources into the electrical grid is insufficient, failing to fulfill the expectations of producers or coincide with sustainable national objectives. Furthermore, sustainable national policies are not being executed. Despite the growth of the solar and wind energy industry and the installation of decentralized energy production systems, this scenario has emerged. Several factors contribute to this scenario, including advancements in administration, forecasting, and oversight, along with enhancements in infrastructure. These issues may arise notwithstanding the decentralized nature of renewable energy sources. The integration rate of renewable energy sources into networks, along with the efficiency of these networks, is clearly hindered as a result of this. Furthermore, we will examine the problems associated with the implementation of this network. We will focus on the low injection rate and the balance between supply and demand. Subsequently, we will examine the impact they have on the operation of the interconnected system. We will provide management solutions tailored to each detected issue, along with the suggested cures for any recognized concerns. The aim is to discover the structures, procedures, and tools that will enhance the network's reliability and energy efficiency while simultaneously reducing installation costs and fortifying the network. The findings indicate that the interruptions in voltage, frequency, and power have been mitigated due to the dynamic simulations using the proposed method. The calculations were predicated on an integration of solar and wind energy, with twenty percent of the energy derived from wind.

Keywords: Solar energy, Wind energy, Voltage fluctuations, Power variations, Frequency variations, Renewable energy and Smart Grid.

Received on 18 07 2024, accepted on 25 10 2024, published on 19 12 2024

doi: 10.4108/ew.6665

1. Introduction

Incorporating renewable energy sources into transmission networks, such as solar and wind power, is becoming an increasingly frequent practice. The output of renewable energy sources is prone to fluctuate depending on the weather and the time of day. Renewable energy sources have a propensity to be intermittent, and their production is subject to fluctuation. As a consequence of this, the inclusion of renewable energy sources into power networks may result in substantial issues to the system's capacity to retain its stability [1-3]. As a direct consequence of these problems, which ultimately resulted in the development of intelligent power networks, they have only lately been placed into business. Smart grids (SG) are able to complete the functions of monitoring, managing, and optimizing the functioning of the electrical network [4,5]. This is made possible by the use of

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