Feasibility, Design, and Performance Analysis of Hybrid Microgrid System

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Hybrid microgrid (HMG) technologies are playing an essential role in reliable and sustainable energy solutions which grabbed new research attention globally. The integration of an HMG-powered grid can effectively reduce transmission losses and costs within the existing grid infrastructure. This research represents a study on the feasibility, design, and performance analysis of a hybrid microgrid system in a selected location [1]. The system comprises solar PV panels, wind turbines (WT), a diesel generator (DG), and a battery energy storage system (BESS) which remarkably minimizes carbon emission (CO_2). To design an optimal sizing of a hybrid microgrid, a one-year PVGIS meteorological dataset has been considered which includes irradiance, temperature, and wind speed [2].

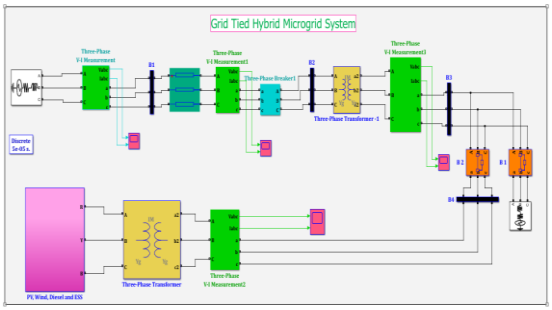

Fig.1 Hybrid Microgrid System

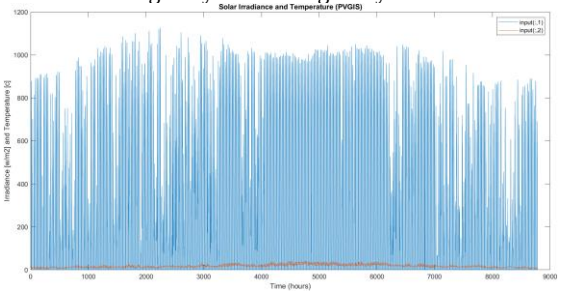

Fig.2 Meteorological Data (PVGIS)

This comprehensive dataset enables accurate environmental analysis, ensuring efficient and maximized energy production and system reliability. The proposed design meets the sustainable energy demand of the location. Advanced modeling and simulation tools are utilized such as HOMER Pro and MATLAB/Simulink to optimize HMG design, evaluate system performance, and reduce the levelized cost of electricity (LCOE). Additionally, this study provides insight into operational challenges to meet the energy demands over the years. The research demonstrates that the optimized HMG design would be more financially viable when solar PV panels and wind turbines are the principal energy sources [3]. The analysis indicates hybrid microgrid system could be a suitable model for delivering reliable energy and cost-effective solutions for the specific location.

Keywords: Hybrid Microgrid (HMG), Renewable Energy, System Reliability, LCOE

Acknowledgment

The authors express gratitude to the University of Évora's ICT research centre (reference number UIDB/04683) and Universapulsar LDA, as well as NeuralSolar - Start-up funding from Portugal Ventures for supporting this work. The third author acknowledges the Foundation of Science and Technology (FCT) Portugal, MCTES of ESF of the European Union, for their doctoral research grant 2020.06312.BD that made this work possible.

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