A Study on Hybrid Power Generation (HPG) Systems In India

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Abstract

Hybrid Power Generation (HPG) systems are electric power generation and utilisation systems that do not rely on a large, centralised power grid. They are made up of various power generators. components with a single major control system that allows the system to operate in a variety of sizes, from massive island networks with many megawatts to single-family homes, to provide electricity of the proper power quality. Power supplies of a few kilowatts of power. The HPG system's components can make use of Wind turbines, photovoltaic panels, and solar thermal panels are examples of renewable energy sources. Stations that use hydropower, wave power, or biomass electricity, for example. Additionally, fossil-fueled power plants, such as diesel generators, gas turbines, and fuel cells, can be constructed. with these types of apparatus

Keyword*-wind energy, solar energy, current scenario*

Introduction - Low fuel prices, a clean environment, and virtually always available renewable energy sources make renewable energy technology one of the finest ways to create power. Wind energy, solar energy, tidal energy, and geothermal energy are just a few examples of renewable energy sources. Wind and solar energy sources are the most common among the sources due to technological advancements that make power generation from these sources simple to install in any location. Wind and solar power generation equipment can easily be coupled with traditional power generation systems due to their adaptability.

Literature Review -

Prema and Rao (2014) proposed a Predictive Power Management scheme that incorporates a forecast of each generator's power generation capability, load demand, and other site-specific data to get the most out of a hybrid power generating system. Scholars from all around the world are working on a management system that makes a long-term forecast to eliminate errors in wind and solar energy behavioural patterns. The pros and downsides of various power management approaches and alternative predictive power management topologies were discussed in this study. Pirhaghshenasvali and Asaei (2014) developed a hybrid generation system for a stand-alone application in Iran. Wind turbine generators (WTG), photovoltaic (PV) systems, battery banks, and a diesel generator are included in the proposed system as power sources. The investment and fuel costs for the proposed system were kept to a minimum. The suggested generation method should be capable of producing enough electricity to meet peak demand. The principal power sources are PV and WTG, as well as battery banks, with a diesel generator providing backup power. The stand-alone system is based on data from local solar radiation and wind speeds, as well as system load operation states across a 24-hour period. The Particle Swarm Optimization (PSO) technique was used to identify the ideal sizes for the WTG, PV, battery banks, and diesel generator. Tlili et al. (2104) explored the use of a photovoltaic generator (GPV), a PEM fuel cell (PEMFC), an electrolyzer, and a hydrogen storage tank in conjunction for long-term power generation. The PV generator feeds a variable load through a DC-DC converter controlled by an MPPT (maximum power point tracking) control and, if possible, transmits energy to the electrolyzer side to make hydrogen that is stored in a tank for later use in the fuel cell in the proposed PV-FC hybrid system (PEMFC). When the PV system is unable to provide all of the load demands, the FC system steps in to fill the gap. in order to model the projected PV-FC hybrid For the Page 16 system, a MATLAB-Simulink simulation was created. The simulation results were given to demonstrate the suggested hybrid system's capabilities. Shuben Zhang et al. (2014) investigated dynamic diesel generator reconfiguration in a smart hybrid energy micro-grid system including wind turbines, solar photovoltaic panels, and diesel generators. They created a system that dynamically adjusts the number of active diesel generators to reduce total fuel expenditures while maintaining a certain level of quality-of-service (QoS) in terms of the risk of a shortage. They proposed a Hoeffding Theorem-

based dynamic diesel generator reconfiguration algorithm capable of calculating the minimum number of active diesel generators subject to a shortage probability below a desired threshold, and they ran a simulation study, with the simulation results indicating a fuel cost reduction. Kollimala et al. (2014) suggested a Hybrid Energy Storage System (HESS) that combines PV, battery, supercapacitor (SC), and load for far-area power distribution. Because PV generation and load demand vary over time, battery partial charge/discharge cycles might be unpredictable. Because of their low power density and low charge/discharge rates, batteries were used in the recommended technique to balance low frequency power surges. Because of their high power density and fast charge/discharge rates, SCs are utilised to balance high frequency power surges. The battery system's control is synchronised with SC to improve battery life and reduce battery stress. Using digital simulation, the proposed control approach is compared to the current technique and validated for rapid changes in PV generation and load demand. Zahboune et al. (2014) investigated a hybrid power supply system that integrates PV and wind generation, as well as battery storage, to meet electricity demand while lowering costs. A case study of a house and three water pumps was used to demonstrate the proposed algorithm findings of a novel Electricity System Cascade Analysis (ESCA). The system's daily energy consumption was 44.235 kWh. A modified approach was used to reduce the size of the installed PVP, wind turbine capacity, and inverter.

Conclusion

This study looks at a number of hybrid power generation systems, as well as a number of control strategies and optimization algorithms that are employed in the production of electrical energy from a variety of non-conventional energy sources. Many scholars supported both simulation and real-time application for hybrid power generation systems. Finally, we can conclude that combining renewable energy sources HPG systems and distributed generation systems with traditional power generation schemes provides an alternative strategy for dependable, cost-effective, and efficient power generation systems that is extremely beneficial to the power engineering society.

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