A Hybrid Soft Regulating (Wind-FC-Diesel-Battery) Renewable Energy for Island/Village Utilisation Scheme

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ABSTRACT

The paper presents a hybrid (Wind–Diesel-Fuel Cell-Battery) renewable energy scheme for island/village electricity utilisation. The proposed hybrid renewable energy scheme with Flexible AC Transmission System (FACTS) stabilisation devices ensures efficient energy utilisation and robusts low impact interface of hybrid wind, diesel and the fuel cell. The stand-by diesel generator set is mainly used to balance the steady state load demand according to dynamic power changes to minimise the diesel fuel consumption. The stochastic nature of the wind energy system requires new FACTS stabilisation devices to maximise the wind energy utilisation. The paper also presents a application of soft computing self regulating Multi Objective Genetic Algorithm (MOGA) and Particle Swarm Optimisation (MOPSO) techniques to dynamically select optimal control gains for the 6-pulse rectifier interface converter, additional FACTS Dynamic Filter/Capacitor Compensation (DFC) on the AC side and Green Power Filter Compensator (GPFC) on the DC side schemes using dynamic self regulating objective functions based on minimal error tracking. A tri-loop error driven dynamic time-de-scaled controller is used to adjust the switching PWM sequence of the DFC on the AC side filter compensator and the GPFC for stabilisation and energy efficiency. Power factor correction and power quality are improved under different excursions and operating conditions, including load changes disturbances, faults and FC/wind velocity excursions. The multi-objective search and optimisation technique are used to find the optimal dynamic control gain settings that minimise the selective number of objective functions based on control system absolute errors.

Keywords: Diesel-Hybrid, Fuel Cell, Backup Battery, Flexible AC Transmission System (FACTS), Multi-Objective Particle Swarm Optimisation (MOPSO), Multi-Objective Genetic Algorithm (MOGA)