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ABSTRACT

Energy has become center piece of all human activities today and it faces two enormous challenges globally viz. energy security and climate change. Renewable energy has been staged as a solution to this problem due to its abundance and cleanliness, but renewable energy also faces many challenges due to its distributed and stochastic nature.

This research work is comprised of four problems on and around the theme of the thesis. In first problem, performance of the wind diesel hybrid system has been undertaken. Power and frequency controllers have been developed to control power sharing of hybrid system and maintain stable frequency respectively. The power controller reduces the fuel consumption and running costs of hybrid system substantiated by respective load graphs. Power controller starts or stops the diesel generator when wind power is less or more than load on the hybrid system. The frequency controller exploits dump load to dissipate surplus power generated from wind to maintain the system frequency stable. The performance of the system has been evaluated using Matlab/Simulink.

In second problem, performance of a variable speed PMSG fuel cell hybrid system with storage is evaluated. Direct drive based PMSG wind energy conversion system has been explored here. The DC link voltage is maintained constant and therefore AC output is also maintained constant with the help of PWM inverter. A

proper power control algorithm has been developed by providing a switching scheme between the wind, fuel cell and battery. The simulation has been carried on Matlab/Simulink platform and its performance is validated to be satisfactory.

In third problem, standalone SPV based distributed power generation model has been proposed that does not convert power from DC to AC rather it uses DC in its original form i.e. as received from SPV array. This approach to the distributed generation saves 36% of cost as compared to the conventional AC based. It is concluded that load requirement in SPV based DC load is reduced to 63.63% of SPV based AC load. A term 'per capita generation' has also been coined to measure the feasibility of an individual to generate electricity by Micro Distributed Solar Photo Voltaic (MDSPV). Here generation of electrical energy is made attemptable to every individual that is currently under reach either by states or generation companies. A case study involving 'SPV unique applicability in hostile territory' is also studied in this work.

In one of the research work, a relation between power outage and GDP of India is also attempted to be established. As 'per capita income' has caught up the same curve as 'per capita consumption' of electricity for any country [9], it is established that any alleviation in per capita consumption will affect the per capita income of the individual and GDP of the nation [9]. Data of most power consuming areas of 10 states are taken as a reference and extrapolation method is used to calculate its effect on national level. It is concluded that power outage is directly affecting the GDP of India to approximately 5% and minimizing the profit from Indian industries due to backup arrangements.