ABSTRACT

Hybrid power systems are combinations of energy conversion devices, that when incorporated, overcome limitations that may be inherent in either. Due to their high levels of efficiency, reliability and long term performance, these systems can also be used as an effective backup solution to the public grid in case of blackouts or weak grids. Power quality surveys indicate the seriousness of the power quality problems and their economical impact on the consumers and utilities. Although investigations are in progress in the field of power quality, no steps were taken to predict the power quality problems of power systems. This research is proposed to investigate the performance of Hybrid Renewable Energy Systems (HRES) comprising of Wind Energy Conversion Systems (WECS) and Photo Voltaic (PV) systems. Each system individually has been successfully deployed with its own limitations. The unpredictable nature of the renewable sources makes them unsuitable for providing sustained predictable energy required for grid systems. This research proposes to overcome some of the limitations of renewable systems by proposing hybrid energy systems with a common controller. The proposed solution overcomes some of the limitations of the individual renewable system by integrating more than one renewable sources.

Extensive modeling is required to study the effects of transients and stability of the wind energy system before implementation. In this research MATLAB/Simulink is used to create the simulation setup that consists of two pairs of wind turbine each of 3 MW capacities connected to a 25 kV distribution system. The distribution system is connected to a 120 kV grid located at 10 km from the wind farm. The wind turbine uses Squirrel Cage Induction Generator with the stator winding connected directly to the grid and the rotor driven by a variable pitch wind turbine. The dynamic behaviour of the 6 MW wind generation system using induction generator is investigated under different fault conditions. An additional active voltage support produced by a Static Synchronous Compensator (STATCOM) can significantly
improve the recovery of wind turbines from the fault due to faster restoration of the voltage, improving the stability of the induction generator.

Due to the high cost of STATCOM, a Hybrid Renewable Energy System comprising of a PV System with capacity of 100 kW and a Wind Energy Conversion System with a capacity of 6 MW is modelled using MATLAB. A VLSI based Fuzzy Logic Controller is developed to effectively control the power flow to the load from the two sources and recover faster in the case of faults.

The harmonic contents of the output of the proposed distributed PV system are analysed using LabVIEW in this research work. The actual tested waveforms in a distributed PV system are modelled using LabVIEW for low irradiance and high irradiance conditions. The algorithm used for processing the voltage signals is ChirpZ Transform with 7 term B Harris window. The results obtained are promising and has the potential as an alternative processing method for harmonic analysis in Photo Voltaic system.