A Review on Hybrid Wind and Fuel Cell System

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Abstract: In this paper, development and simulation of an efficient small-scale centralized dc-bus grid connected hybrid wind/photovoltaic/fuel cell for supplying power to a low voltage distribution system are presented. The hybrid system consists of wind and photovoltaic as a primary power system. A fuel cell is added as a secondary system to ensure continuous power supply and to take care of the intermittent nature of wind and photovoltaic. The objective of this study is to design and control a hybrid system that guarantees the energy continuity. A simple control method is applied to the proposed configuration to simultaneously achieve three desired goals: to extract maximum power from each hybrid power system component; to guarantee dc bus voltage regulation at the input of the inverter; and to transfer the total produced power to the grid at unity power factor, while fulfilling all necessary interconnection requirements. This paper gives the review of hybrid fuel and wind cell.

Key words: Hybrid system, photovoltaic, wind, fuel cell

Literature Survey:

Mohamed A. H. El-Sayed et al. (2010) A hybrid wind/fuel cell renewable energy utilization scheme for electrical energy generation from renewable resources is digitally simulated and presented in this paper. The proposed hybrid renewable green energy scheme has four key subsystems or components to supply the required DC and AC electric loads. The first subsystem includes the renewable generation sources from Wind turbine and Fuel Cell. The second is the interface converters used to connect the renewable energy generators to the common DC collection bus, where the generated energy is collected. The third device represents the added inverter between the common collection DC bus and the added AC bus interface to feed all AC loads before integration with the public grid. The fourth subsystem comprises all controllers including the modulated power filter. The controller main function is to ensure efficient energy utilization and dynamic matching between loads and green energy generation as well as voltage stabilization. The proposed controllers are coordinated dynamic error driven PI regulators to control the interfaced converters. The integrated hybrid green energy system with key subsystems are digitally simulated using the Matlab/Simulink/Sim-Power software environment and fully validated for efficient energy utilizations and enhanced interface power quality under different operating conditions and load excursions.

Sandeep kumar et al. (2013) This paper deals with the detailed of a hybrid model of a solar / wind and fuel cell in Simulink, a high efficient hybrid model is developed and is compared with the hybrid model which is using battery as its storage system instead of fuel cells. The simulation includes all realistic components of the system, in this thesis power delivered by the combine system component is compared with each other and various conclusions are drawn. A comparative study of hybrid model of solar /wind and fuel cells system has been made. This paper describe of solar-wind hybrid system for supplying electricity to power grid. Work principle and specific working condition are presented in this paper.

Hussein Ibrahim et al. (2012) A comparative analysis of different storage technologies currently in use was effectuated according to several criteria such as cost, energy density, specific power, contributing to reducing fuel consumption and GHG emissions, the lifetime and efficiency of each technology. This analysis was served to determine the performance index of each storage technology based on the nature of the project application. The determination of the performance index of each technology represents, despite its subjectivity resulting from the use of the decision matrix, a solution where we have some difficulty to choose a technology and where the constraint of time does not achieve a detailed modeling of the studied systems. This method showed that the CAES answers to the choice criteria with a performance index approximately 82 %. Other systems are also more or less effective but at the cost, simplicity, adaptability to the WDHS, the contribution to reducing fuel consumption and GHG emissions and duration of life that there is some difference. For these reasons, CAES technology was adopted to associate with the wind-diesel hybrid system.

Akbar Maleki et al. (2014) Because of their low impact on environment, PV/wind hybrid systems which use fuel cells (FCs) as the energy storage device are one of the most promising renewable energy sources. In such systems, optimum configuration (sizing) plays an important role for decreasing the system cost. In this paper, PV/wind/FC system is modeled and a hybrid metaheuristic technique based on chaotic search (CS), harmony search (HS) and simulated annealing (SA) is employed to find the optimum configuration. Optimum configuration is found for PV/FC, wind/FC, and PV/wind/FC systems and the results are compared.

Abhishek Moyal et al. (2014) In today's world the rising rate of consumption and the price of fossil fuels and the environmental problems caused by the conventional power generation draw worldwide attention to renewable energy technologies. In fact, renewable energy systems are pollution free, takes low cost and less gestation period, user and social friendly. However, renewable power unit based on single source (wind or solar source) may not be effective in terms of cost, efficiency and reliability. A viable alternative solution is by combining these different renewable energy sources to form a hybrid energy system. This paper deals with the detailed of a hybrid model of a solar / wind and fuel cell in Simulink. An efficient hybrid model is developed and compared with hybrid model which is using battery as its storage system instead of fuel cells. In this paper, power output from the combination of solar and wind power is compared and results are shown.

D. L. Manoj Kumar et al. (2015) The renewable energy sources are gaining popularity day by day as the fossil fuels required for conventional electrical energy production are getting depleted. Hence a new hybrid topology formed by the integration of wind turbine, photo-voltaic cell and a fuel cell unit is proposed. This hybrid system consisting of these three sources is operated in parallel and any one of these sources can meet load demand depending on the availability from each source. Here the battery is provided as a regulating mechanism for ensuring continuous power supply to the load. This regulatory mechanism is done with the help of a battery controller. The battery controller action and the control action for the wind and the photovoltaic is discussed in this paper and the load sharing between these sources is explained with the help of simulated graphs. Here a load is taken that varies with time and the control topology mechanism is explained. This type of energy generation can be utilised for distributed.

Muhammad Saad et al. (2015) the basic aim of this paper is to understand possibilities to generate the green electrical as well as on cheap price. The prices of fossil fuels are in swift and the conversion cause a fatal amount of pollution. Solar, wind and water are three main resources green energy in the universe. By combining the system together and make a hybrid system which convert the different form of energies into the electrical energy. This project is proposed in South Australia but it is not feasible with hydropower plan because there is not any source of water like dams in SA except seashore. We could refer to the tidal energy but for this point we replace the hydropower generator with a diesel generator which only operate when there is failure of solar and wind energy. This is a simulation project and all simulation are conducted on MATLAB Simulink toolbox.

Nabil A. Ahmed et al. (2016) This paper is aimed at combining WEC, PV and FC generating systems to maximize the output energy and reduce the output power fluctuations for standalone applications. The proposed hybrid WEC-PV-FC system is connected to the grid through a PWM inverter as a distributed generation system to relieve the demand tension of electricity on the grid and act as an uninterruptible power source when the grid is disconnected.

Muhammad Shahazad Aziz et al. (2017) The depleting conventional energy sources and world population growth at a rapid rate predict the severe global energy crisis in near future. As an alternative, the world has started considering renewable energy sources as they are ubiquitous, environmentally affable and freely available. One of the fastest expanding renewable energy sources is wind energy. The stand-alone wind energy systems may not be practical for fulfilling the electric load demands at the places having unsteady wind speeds with high unpredictability. At those places wind-hybrid energy systems, comprising of the wind energy system combined with one or more other renewable energy systems, can be of great significance in overcoming the weaknesses of stand-alone wind energy systems. This paper mainly focuses on wind energy and wind-hybrid power generation systems used to electrify various locations. This paper also describes the details of renewable energy sources and wind energy softwares, worldwide wind energy potential and use, demonstrations of wind hybrid power generation systems and some examples of their feasibility studies and implementations at different sites all over the world.

Raja Manickam.P et al. (2017) This paper depicts model and simulation of a renewable energy based hybrid power system for improving power quality because optimal utilization of primary energy sources will increase the level of supply reliability. In order to meet sustained load demands during varying natural conditions, different renewable energy sources and converters are need to be integrated with each other. The combination of Photo Voltaic (PV) array System, Wind

turbine system, Fuel cell (FC) and Diesel generator systems are used for power generation. Due to variation in output power of solar panel, wind turbine and fuel cell, Diesel engine is also coupled to ensure reliable supply under all conditions. Regenerative cycle of fuel cell helps to dump excess energy from DC bus. The results show that the proposed hybrid power system can effectively manage the optimal utilization of primary energy sources and improves the power quality in an islanding as well as grid connected mode.

Conclusion: The paper presents a utility interactive hybrid WEC/PV/FC power system with MPPT and dc bus voltage regulation. The proposed hybrid system is able to provide almost continuous electric power with better reliability than a single power source. The controller of wind and PV has the function of MPPT control while the controller of FC has the function of load power fluctuation compensator. A simple control method tracks the MPP of the wind and PV is proposed without measuring the wind speed or solar irradiance, which is very useful for actual small size wind turbines and PV systems. The FC is thus controlled to provide the deficit power when the primary combined PV and wind energy sources cannot meet the net grid or load power demand.

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