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AN APPROACH TOWARDS MODELING OF HYBRID POWER SYSTEM

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ABSTRACT:

The solar energy, hydraulic power, wind power and tide energy are natural assets of the concern to produce electrical sources. Subsequent to numerous technological progressions, technology of proton exchange membrane fuel cell has now attained the assessment and the phase of demonstration. A dynamic representation and simulation of a system of solar cell /fuel cell/ wind turbine hybrid power is developed by means of a new topology to set off each other and to improve the effects of environmental differences. The model of renewable energy based hybrid power system in Simulink contains a solar cell, a proton exchange membrane fuel cell, an ultra-capacitors, a wind turbine, electrolyzer in addition to a power conditioner. A module of solar cell is the basic element of each system of photovoltaic consists of numerous jointly associated solar cells. The power output of wind turbine relates to the speed of wind with a cubic ratio. The fuel cell of PEM is for the most part capable and undoubtedly the best identified of the types of fuel cell and is often measured as a potential alternative for the engine of internal combustion in applications of transportation. An ultra-capacitor is a device of energy storage with a construction comparable to that of a battery and are used in applications of power necessitates short extent peak power. The hybrid power system can endure the rapid modifications in load and environmental situation, and restrain the consequences of these fluctuations on the voltage of equipment side.

Keywords: Solar energy, Wind turbine, Ultra-capacitors, Proton exchange membrane fuel cell.

1. INTRODUCTION:

The wind and solar energy are welcome replacement for numerous other energy resources since it is natural, unlimited resource of sunlight to produce electricity. When compared with the energy of nuclear and thermal power, the renewable energy is unlimited and has characteristics of non-pollution. The solar cell relies on the weather aspects, mostly the irradiation and the temperature of cell. The weather factors for instance the irradiation and the temperature is exploited for the assessment of the utmost power [4]. The main difficulty of wind turbines is that obviously changeable wind speed causes fluctuation problems of voltage and power at the load side and it can be solved by using suitable power converters and strategies of control. To accumulate the energy generated by wind turbines intended for future usage when no wind is obtainable excluding the user demand exists is another important problem. Subsequent to numerous technological progressions, technology of proton exchange membrane fuel cell has now attained the assessment and the phase of demonstration [8]. The modern commercial accessibility of small units of proton exchange membrane fuel cell has formed numerous novel opportunities to plan systems of hybrid energy for remote applications by means of energy storage in form of hydrogen. By an electrolyzer, conversion of hydrogen allows mutually storage and transportation of huge amounts of power at much superior densities of energy. Coupling a wind turbine, fuel cells a solar cell and electrolyzers is effective to get better environment pollution by means of using natural energy [1]. A dynamic representation and simulation of a system of solar cell /fuel cell/ wind turbine hybrid power is developed by means of a new topology to set off each other and to improve the effects of environmental differences. Modelling and simulations are conducted by means of software packages of MATLAB/Simulink confirms the efficiency. The system of hybrid power system can endure the fast changes in natural situations and restrain the effects of these fluctuations on the voltage within the suitable range [11].

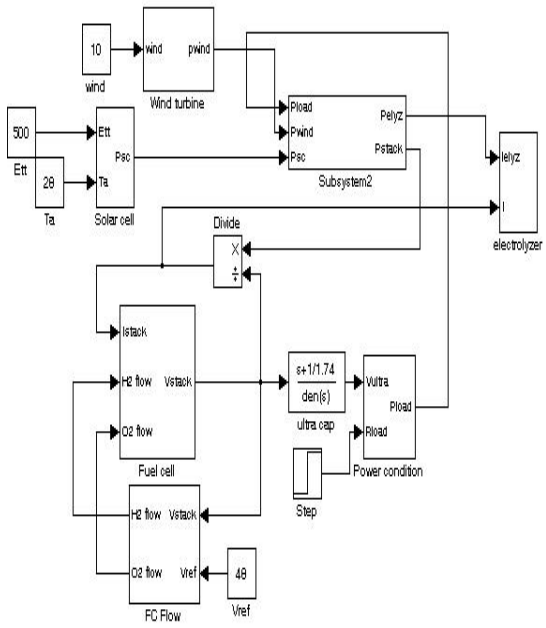

Fig1: An overview of hybrid power system

2. METHODOLOGY:

The model of renewable energy based hybrid power system in Simulink is revealed in Fig. 1. The system contains a solar cell, a proton exchange membrane fuel cell, an ultra-capacitors, a wind turbine, electrolyzer in addition to a power conditioner [3]. The power conditioner comprises a boost circuit in addition to an inverter of SPWM. Wind turbine as well as solar cell is the major sources to provide load demand. Model of Fuel cell includes a module of fuel cell and a fuel controller. The fuel controller comprises of two controllers of PID to bind the flows of hydrogen and oxygen. The cell of fuel is an accessory generator and supplies inadequate power [14]. When the supply is higher than the load requirement, the model of electrolyzer electrolyzes water to generate hydrogen and accumulate it for additional usage as a result, the system can possibly circulate demand of supply load and energy will not be exhausted [9]. A module of solar cell is the basic element of each system of photovoltaic consists of numerous jointly associated solar cells. Number of models of solar cell has been introduced; however the electrical equivalent circuit of one diode is usually used for analysis of cell based or else module based [7]. It comprises of a diode, a series resistance, a parallel resistance as well as current source. The diode corresponds to the junction of p-n of a solar cell. The temperature reliance of the current diode saturation and steady factor of diode ideality are integrated in the modeling. At actual solar cells, a loss of voltage on the means to the exterior contacts is practical. The power output of wind turbine relates to the speed of wind with a cubic ratio [2]. Both the initial order moment of inertia and a dynamic model of friction based intended for the wind turbine rotor, and a model of first order intended for the undeviating magnet generator are assumed. The dynamics of the wind turbine appropriate to its rotor inertia in addition to generator are

additional by means of considering the response of wind turbine as a second order to some extent under-damped system [15]. The fuel cell of PEM is for the most part capable and undoubtedly the best identified of the types of fuel cell fulfilling the requirements. It is often measured as a potential alternative for the engine of internal combustion in applications of transportation. The fuel cell of PEM comprises porous carbon electrodes connected to an extremely thin membrane of sulphonated polymer [12]. Water can possibly be decomposed into its elementary components by means of passing electric current connecting two electrodes detached by an aqueous electrolyte. The ratio connecting the authentic and the theoretical maximum quantity of hydrogen created in the electrolyzer is identified as Faraday efficiency. Ultra-capacitors are used in applications of power necessitates short extent peak power. An ultra-capacitor is a device of energy storage with a construction comparable to that of a battery [5] [10]. The model of the ultra-capacitor bank to carry out load sharing with the system of fuel cell was introduced when they concurrently function with the wind turbine and solar cell. Even though systems of fuel cell display good power supply ability throughout operation of steady state, the response of fuel cells throughout instant and periods of short-term peak power demand is comparatively poor [6]. The ultra-capacitor bank can assist the system of fuel cells to attain good quality performance while reducing the outlay and dimension of the system of fuel cell [13]. Such a module of ultra-capacitor was associated in parallel with the fuel cell to decrease its voltage difference appropriate to unexpected load changes.

3. RESULTS:

The results of simulation by means of step alterations in load demand, wind speed, and ambient temperature are examined. The performance of power tracking of the hybrid topology regarding to load demand alters. Several connected parameters in solar cell, fuel cell, wind turbine, ultra capacitor in addition to the performance of system are analyzed. The fuel cell makes available power intended for load necessity for the reason that of the output powers of the wind turbine and solar cell are not enough to provide load demand. As the wind speed augments, the captured power increases and the involvement of the fuel cell reduce.

Usually, a lower level of current involves voltage of higher stack and vice versa.

4. CONCLUSION:

When compared with the energy of nuclear and thermal power, the renewable energy is unlimited and has characteristics of non-pollution. Subsequent to numerous technological progressions, technology of proton exchange membrane fuel cell has now attained the assessment and the phase of demonstration. A dynamic representation and simulation of a system of solar cell /fuel cell/ wind turbine hybrid power is developed by means of a new topology to set off each other and to improve the effects of environmental differences. The hybrid power system can endure the rapid modifications in load and environmental situation, and restrain the consequences of these fluctuations on the voltage of equipment side. The fuel cell makes available power intended for load necessity for the reason that of the output powers of the wind turbine and solar cell are not enough to provide load demand.

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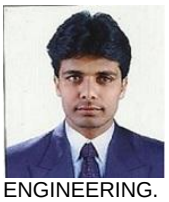

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