Grid Integration of Hybrid Generation for an Alternative Energy Power System with Improved Power Quality

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Abstract— As the requirement for energy rises and with the extinction of non-renewable energy resources, consumption of renewable energy resources have been trending. Various sources of renewable energy giving to current energy requirement consist of water, wind, solar energy. As a result, the quick advances of power electronic systems the formation of electricity from wind and photovoltaic energy sources has improved considerably. The act of the wind/PV hybrid system is considered under distinct grid perturbation conditions in this study. In this paper, the act of the wind/PV hybrid system is considered under different grid perturbation conditions. Based on the level solid oxide fuel cell (SOFC) dynamic model for optimization method was used to establish the maximum electrical efficiency of the grid-connected SOFC to the constraints of fuel consumption factor, stack temperature and output active power. Power quality is one of a major constraint in power system transmission and distribution. This project gives an idea on effective control of PV/Wind hybrid power generation scheme for standalone applications. This system consists of PV/wind hybrid energy system, boost dc-dc converter, a three phase DC to AC converter, PWM controller and nonlinear load. The boost converter can supply power to the load depending on the source of availability. A synthesized AC output voltage is produced by appropriately controlling the switches using PWM technique using average power control to control active and reactive power fed to the load the operating setting of the grid-connected SOFC was obtained by predicting the difficulty considering the power consumed by the air compressor. With the average operating conditions of the maximum efficiency operation obtained at unusual active power output levels, a hierarchical load tracking control scheme for the grid-connected SOFC was proposed to appreciate the maximum electrical efficiency utility with the load high temperature bounded. Generation and utilization of electricity will be takes place at reasonable cost. This proposed concept deals with the generation of electricity by using two sources which combines which leads to create electricity with reasonable cost and lacking damages in the proposed system.

Keywords: Power Quality, PWM, DC-to-DC Converters, Electricity, Hybrid, Solar, Power, Wind, Grid Integration, SOFC

I. INTRODUCTION

Electrical energy is the most essential energy for everyday life. There are two ways of energy creation in addition they are conventional energy resources and by non-conventional energy resources. Electrical supply need increases when the discharge demand to generate electrical energy. Now a day's, electrical power is generated by the conventional energy resources like coal, diesel, and nuclear etc. The deregulation of electric power utilities, environmental concerns, promote insecurity and growing matter about availability and the value of electrical supply have led to the improvement of circulated generation system. One of the well-identified DG sources is a fuel cell, which can be operated in value consistent mode or set up in a remote area to supply part power. Lately, much work has been focused on interfacing DG with the network, and its process and control.

A supple DG can be used to pick up the power factor and voltage fluctuations of the utility. SOFC based DG System is usually interfaced with the service network through a set of power electronics devices. The boundary is very important as it affects the process of the fuel cell coordination and the power grid. The major problem of these sources is that it produces waste like ash in coal power plant, nuclear misuse in nuclear power plant Captivating care of this consumption is very costly. The conventional energy resources are depleting day by day. Soon it will be entirely vanishes from the earth so we have to uncover a new way to generate electricity. The new source should be dependable and economical. The non-conventional energy property should be good alternative energy resources for the conventional energy resources. There are lots of non-conventional energy resources available in nature. They are geothermal, tidal, wind, solar. Power quality, the electrical networks are the grid's capacity to supply a cleaned stable power supply. High power quality preferably creates a faultless power supply that is presented, as a pure noiseless, sinusoidal wave shape, and is always within voltage and frequency tolerances. It can also be considered as the term which is used to outline the power of electricity and it used to drive the electrical load and ability to drive task used in electric power.

Wind energy is generally nonpolluting in nature provides greater efficiency and has a comparatively low operating cost. By means of hybrid energy systems, these demerits can be overcome to a certain extent. In this paper, we have developed a solar-wind hybrid system.

II. HYBRID ENERGY SYSTEM

Hybrid energy system is the collection of two energy sources for producing flexible electrical power to the output side. In additional, it can defined as "Energy system which is designed to extract power by with two energy sources is called as the hybrid energy system." Hybrid energy system have good security, efficiency, flexible power and lower cost.

In this proposed system solar and wind power used for producing power. Solar and wind power has planned to gain than any other non-conventional energy sources. Both the energy sources have larger accessibility in all areas. It necessities minor cost. Here there is no alternatives to set up this system.

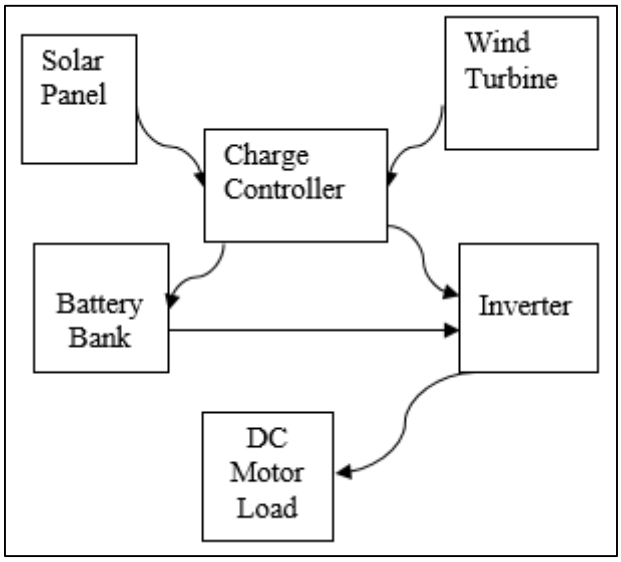

Fig. 1: Generation of Hybrid Energy System

A. Solar Energy

Solar energy is the renewable source of energy which observes the energy from the sun. Solar energy is freely available. It is difficult to produce energy in poor weather condition. But it has more efficiency than other practical energy sources. It requires only initial savings. It has high life span and has less emission.

B. Wind Energy

Wind energy is the non-polluted renewable source of energy which is obtained from wind. For extraction we use wind mill. The wind energy needs minimum cost for creation of electricity. Major part of maintenance cost is with a reduction of wind energy system. We can get approximately 24 hours of the day. It has less discharge. Initial cost is also less for the system. Generation and production of electrical output from wind connects upon the speed of wind from end to end in a day.

The major difficulties of using unrestricted renewable energy resources are that lack of control throughout the day is to overcome this we can use solar and wind energy commonly. So that one source of power fails can be taken care by the source of energy. In this proposed concept we can use both the renewable sources combined. In secondary stage we can use any one of the source remains as a stand by unit. This will leads to link the production. This will make construction reliable. The main process of this structure is high initial cost. Except that it is reliable and less discharge. Maintenance cost is also very less. Life cycle of this system is highly raised. Efficiency is high.

A solar tracker is a device that adds a charge near the sun. Tracking apparatus can be classified into two types namely as single axis and dual axis tracking.

The axis of rotation of single axis trackers is typically aligned along with a true value. It is possible to hold them in any fundamental direction with superior tracking algorithms. Dual axis trackers have two degrees of choice that operates as axes of rotary motion. The axis that is set with value to the ground can be measured by a primary axis. The axis that is assign to the primary axis can be uniformly by a secondary axis.

The selection of chaser type depends on the factors such as system size, electric charge, government incentives, land constraints, liberty, and local conditions.

Initial condition, Single axis trackers are worn for great distributed invention schemes and value scale methods. Horizontal single axis trackers also add a large amount of efficiency during the system and summer side, when the sun is raised in the sky. The natural strength of their last construction and the ease of the instrument results in high accuracy which keeps maintenance costs low.

perpendicular axis tracker with permanent or variable angles are fit for high latitudes, where the visible solar trail is not high, but which lies along days in summer, with the sun travelling by an extensive curve.

Dual axis trackers are normally used in smaller housing installations and locations with very high running feed in tariffs.

The driver used for tracking instrument is classify as active trackers and reactive trackers.

III. PROPOSED GRID INTEGRATION OF HYBRID SYSTEM

The planned system combines solar PV and wind energy. Power generated by this property is mutual and used for a mixture of purposes.

Auto-beam tracking is implemented to find maximum power from light. Tracking is through locate the direct beam of rays which possess more electrical energy. For this purpose, LDRs are used as potentiometers. Ordinary input voltage, say +5V are given as input to every three possible partition circuits.

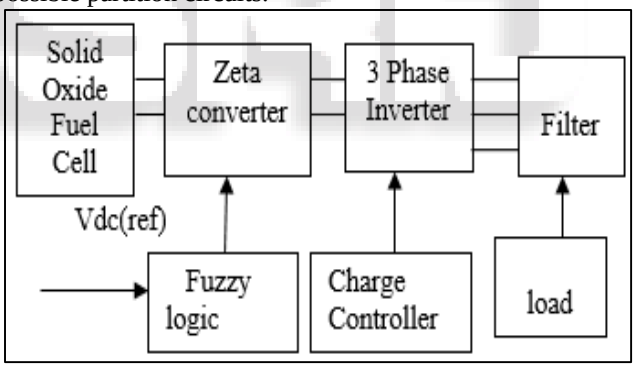

Fig. 2: Schematic of Grid integrated Power system

The combination of collective solar and wind power systems into the grid can assist in dropping the overall cost and improving reliability of renewable power production to supply its load. The grid takes overload renewable power location and stores power to the site loads as necessary. General DC and frequent AC bus grid-connected to solar PV and wind mix system. The total system is measured in two buses i.e., DC and AC bus. PV, Wind and battery. Make the architecture of DC bus, and the power exchange and shifting occurs connecting these mechanism through a CEMCA. Family load and national grid are the section of AC bus.

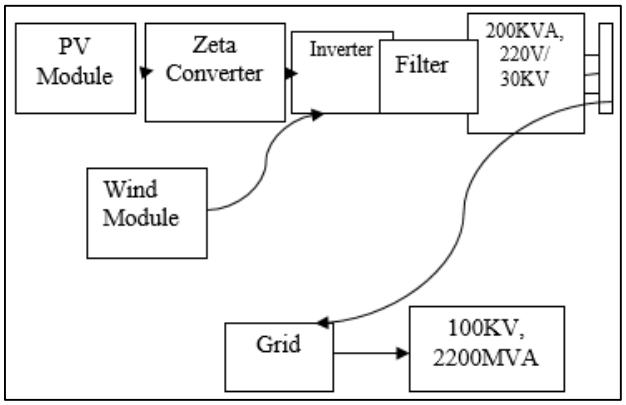

Fig. 3: Grid Connected hybrid energy systems

The output powers of PV and SOFC are controlled and adjusted over two non-isolated DC–DC boost converters. The boost converter is controlled through Proportional Integral Differentiator (PID) controller. The proposed model of bidirectional power flow of location with the stoppage of the system occurs during a buck boost converter. The step up and step down converter is controlled throughout Proportional Integral (PI) controller. The output of DC bus provides the necessary power to the grid and grid-connected load through three phase inverter even if only one source is on hand. The inverter is controlled via hysteresis current control strategy. It is main concept to describe that the planned HPS is flexible and, therefore, easily upgradable providing a new PV, SOFC and battery are additional to the offered ones deficient increasing the circuit difficulty.

Sinusoidal pulse width modulation is used here, numerous pulses per half cycle are recycled as in the case of different pulses per width of modulation. In its place of maintaining the width of all pulses the equal as in the case of multiple pulse width modulation, the width of each pulse is varied related to the amplitude of a sine-wave to determine the set of value at the center of the same pulse.

IV. EXPERIMENTAL RESULTS

By the help of MATLAB Simulink software the following results are verified according to the nature of hybrid generation.

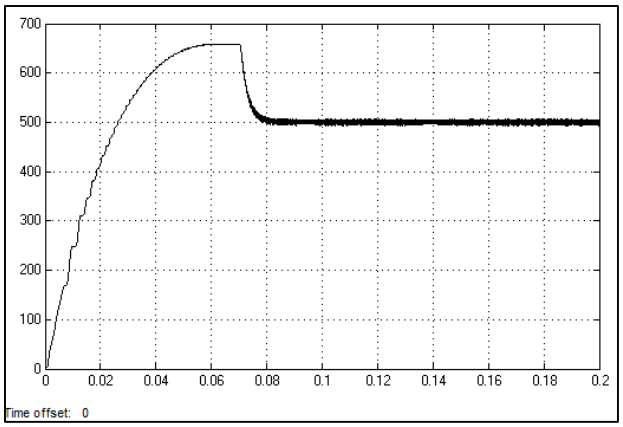

Fig. 4: Solar PV Output voltage

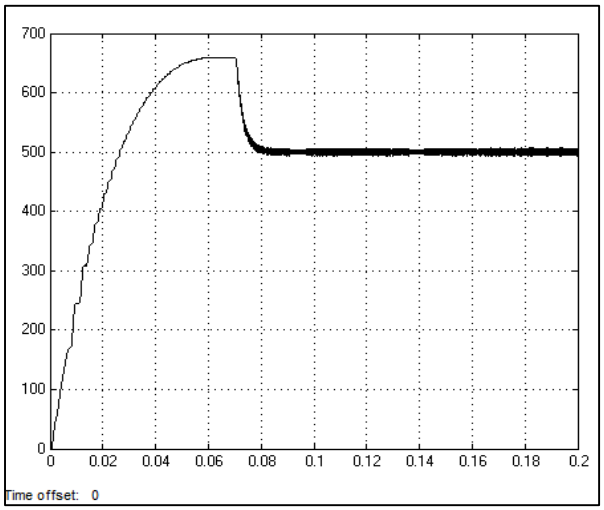

Fig. 5: Wind model output

The developed wind DC output is 500V.

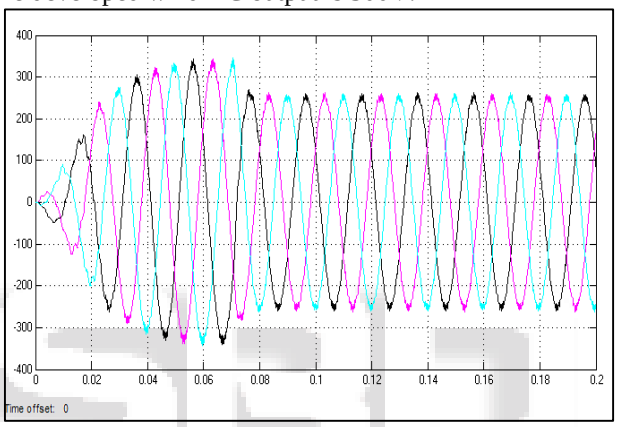

Fig. 6: Three phase 420V AC Inverter output voltage developed from single phase inverter output.

V. CONCLUSION

The performance of SOFC based DG scheme associated to grid has been accepted out. In grid-linked mode, the voltage and incidence are controlled by the grid. Thus, the DG units are controlled to supply particular quantity of real power calculate on the rating of the units. A control plan has been industrial using decouple process to organize the active and reactive powers separately from the solid oxide fuel cell. This paper has provided an evaluation of challenges and convenience on integrating solar PV and wind energy sources for electricity creation.

Hybrid power generation system is worthy and direct answer for power generation than predictable energy resources. It has higher efficiency. It can offer to isolated places where government is unable to reach. So as to control can be operate where it produced so that it will decrease the conduction losses and cost. Cost saving can be finished by raising the invention of the apparatus.

Tracking instrument increases power creation nearly by 40%. Voltage reading of solar panel, wind turbine and battery were communicated to the system operator using wireless module helps in monitoring systems installed in remote areas.

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