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Study of Hybrid Wind-Solar Green Energy System

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Abstract

In the world worldwide energy demand is uninterruptedly rising owing to fast improvement in modern civilization and it is a heavy burden on non-conventional energy sources. The compactness of Solar- wind-battery is the green source of energy to utilize for a standalone wind energy conversion with PV cells. However, wind-solar are intermittent by nature so to maintain continuity of electrical power it is required an appropriate storage technology used as a backup. The generation of electrical power by wind and photovoltaic should exceed its optimistic capacity for the maximum energy generation. Wind and solar are to be considered very clean energy sources for sustainable future growth. As the days passing, the study of photovoltaic cells and wind energy with its modern control technology is to be adopted. Now in India it is the time to generate electricity decentralized manner and forming small micro grids. The distributed hybrid generation needs to be installed with an interconnection for automated distribution.

Keywords – *Wind energy, maximum power point, solar energy, hybrid energy.*

I. INTRODUCTION

In present, the electric power generation by Wind Energy Conversion System (WECS) along with the PV cell is a more dominant experience. As the hybrid energy systems have eminence considerably above average potential to provide higher quality and more consistently good in quality or performance power, reduce CO2 gas emissions and produce something better than power system reliability. To produce clean and unceasing electric power, growth power system generation capacity, it should have the Interconnection of WECSs along PV cells to power systems network can increase [1-2]. Continuous and persistently investigation has been approved for the most appropriate alternator for single-handedly wind energy conversion system.

Wind hybrid power systems and Solar systems are building using small wind turbine alternators and solar panels for generating electrical energy. As regards the greater part, these solar-wind hybrid systems are achieving a specified thing of small power generation of electricity. In general, the range from 1 kW to 10 kW small power generation capacities of solar- wind hybrid systems is available [5]. It must be necessary to know in a brief discussion about the solar panel and wind hybrid power plant, we all should be aware of through observation about solar power generation plant and wind-power generation systems too.

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II. Implementation of Hybrid Solar Wind Energy System

To study better perceive the intended meaning of the working operation of solar wind hybrid system plants, we all must be aware of through observation the working nature of solar energy power station systems and wind power systems. In simple word the system which uses solar radiation for the generation of electrical power that system is termed as a solar power panel. The make the movement figure of lunar power airstream power mixture scheme is given in figure1 in that all parts similar PV boards and airstream turbines are used to power generate precisely. The supreme important thing to commence a hybrid energy scheme means solar power and wind power is that repeatedly getting the solar source and wind source [3]. The output energy of wind power and solar PV panels are seasonable means according to season sources are available. It's already known to us that the airstream has not misfortune throughout the day and the sun does not sheen for the complete day, so a single source of energy will not be an appropriate very good quality of choice. To get much more realistic power from the battery, it should have a combination of hybrid energy solar power and wind power plant. Even when there is no availability of wind and sun, energy can be extracted from batteries. Usually, hybrid systems are building up with optimum cost along with the maximum possible reliability of energy. The cost of PV cells for larger panels increases so wind can minimize it. Owing to that matter the wind turbine comes into the picture, the main a distinctive attribute being its cheap cost as compared to the PV panels. In a day energy can be stored easily in DC batteries. The use of wind is an additional benefit, which improves the reliability and availability of the system at night time also [7]. During monsoon seasons, the effect of sun rays is less at the site and hence it is good to use a hybrid wind-solar system.

III. Pitch Behavior System

The power developed by the wind turbine is directly relative to the cube of airstream rapidity available. Usually, the reference s of wind for modern wind turbine plants is much larger equated to that of the rated speed of wind turbines (WT). The wind turbine should not operate the entire range of wind speed otherwise blades may get damaged because it does not have any control mechanism and the angular shaft speed is higher than its rated value. So there must be a rotor angle control skill to regulate the speed, turbine power with the safety of blades [9]. Therefore, it is an essential need to regulate the speed and output above the wind power and below the graded wind speediness. It has been accomplished with varying the rotor blade angle regulates the turbine. This technique of behavior was termed as the rotor blade control technique of wind. The (Cp) is the power coefficient against characteristics TSR (λ) of the wind turbine deliberated in it, diverse pitch angles are given in Fig.4. According to inspected since the features, when a rotor angles of 0 degrees the reference of the Cp power coefficient is having the greatest value. But it is clear that the optimal value of power coefficient condenses with an escalation in the Pitch control scheme for a stand-alone WECS pitch angle shown in Fig.3. This materializes because with the rise in blade pitch the lift coefficient decreases which consequences in declining the value of Cp. So, the pitch control behavior tool regulates the turbine output power with decreasing the power coefficient on greater airstream speediness [10-11].

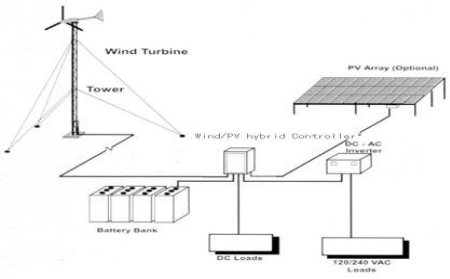

Fig. 1. Solar Wind Hybrid Power System Block Diagram

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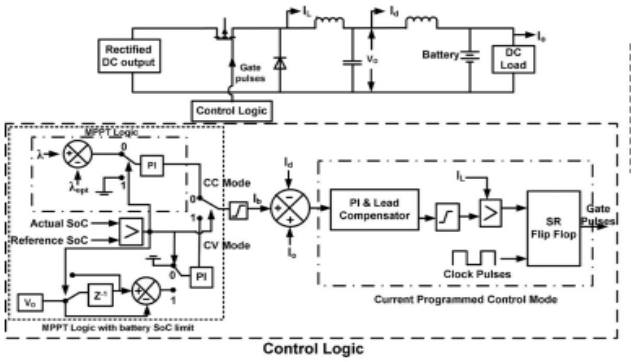

Fig2. Regulator circuit for battery with schematic block & flowchart

Underneath the esteemed rapidity of the wind, the rotor blade is retained at 0 degrees to get hold of maximum power output. When the wind turbine parameters go beyond the rated values then pitch controller raises pitch blade. The decline in the value of power coefficient Cp by plunging recompenses for the growth in turbine power output underneath the effect of greater airstream speediness. In addition to amendable parameters of WT, it is likewise a need to regulate the ac to dc output voltage rectifier because the overvoltage problem should not arise in the WECS [11].

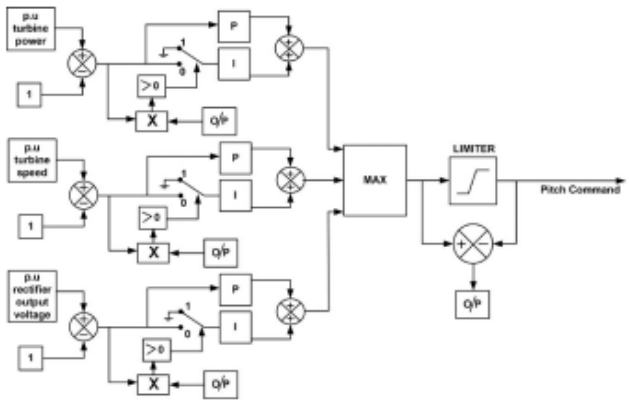

Fig. 3. Blade angle regulator technique for a hybrid WECS

Henceforth, the rotor blade regulator confirms that with required rotor angle knack, the turbine constraints and the dc output that is dc potential are controlled inside their particular extreme permissible restrictions to safeguard harmless process of the hybrid wind system. The rotor angle control mechanism system is displayed in Fig.3. As perceived the per unit. The numerical of every response is matched with one to estimate the miscalculation error. These wrong values are adjusted by the proportional integral regulator technique. The "MAX" block selects the extreme result from each proportional integral regulator which is formerly delivered to a restraint to produce the rotor angle for the wind turbine. The actual rotor blade angle force is equaled per partial value. The minimum value bound of the rotor angle is fixed 0. There stand up wrong values when the actual rotor angle energies upstairs or downstairs the quantified edge. It is directly grown with the mistake attained from each of the given comparators [13]. The parameter was equaled with 0 towards govern the transferring sense for the integrate. This procedure is supported to evade permeation. The pitch angle command is controlled by the controller due to variation in the rotation of the turbine, output power and rectified output voltage which safeguards the safe operation of the Wind Energy Conversion System.

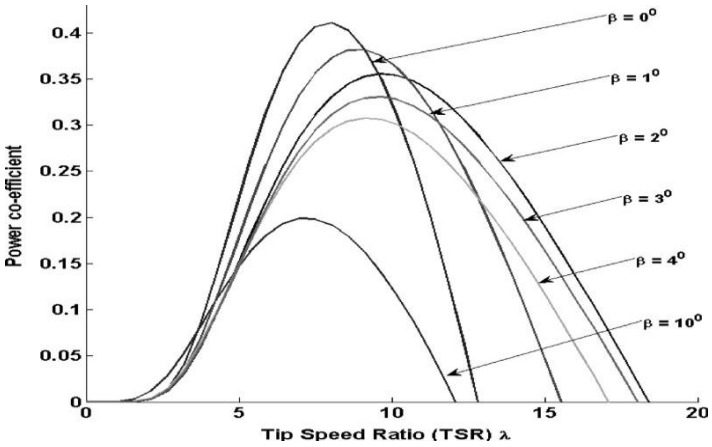

Fig. 4. Wind Characteristics

The electricity generates from that part of the energy necessary for a farmhouse, Private Guesthouse, a private home, a tiny scale industry, learning foundation, an building contingent for the necessity of site where applied has been abounding through the electrical energy produced from the solar power and wind.

It obviously increases the reliability and simultaneously reduces dependability on a single source of energy. Thus we have to improve the

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efficiency of this proposed system compared to the conventional source [14]. For the purpose of numerical computation, there is interactive software is available MATLAB which can be used for graphics also. All the matrix computation can be designed by using MATLAB software

1) Calculating Eigenvectors and Eigenvalues 2) Linear equations of a system 3) Factoring matrix etc Through MATLAB programming or our own programming, the ability of graphics can be extended easily. MATLAB's competences to nonlinear problems can be extended, such as differential solution into the no of variable values.

All the arithmetic operations with finite-precision can be easily done using MATLAB. Thus it yields estimated rather than precise solutions, and it should not have any confusion for symbolic representations. One should be clear that assumed this does not make MATLAB improved or inferior to an SCS, It is a perfect tool premeditated for different working tasks and it is consequently not straight comparable [16]. The MATLAB software is a package for modeling, Simulink, examining dynamical systems and simulating. It provisions modeled in continuous time, linear and non-linear systems, a hybrid of the two or testing time. Systems of software can also have a multi-level speed, i.e. all the different parts are sampled at different rates. These block public libraries of sinks, linear, nonlinear components and connectors included in Simulink. We can make our own blocks for design purposes. Models are designed with increased levels of model details i.e. is hierarchical. How models are organized and interacted can be shown here. The display block and scopes can be seen in the simulation [16]. Linearization and trimming tools that can be accessed from the command line are analyzed using MATLAB tools, in addition to that many tools in MATLAB and its solicitation toolboxes. WECS requirements to be proficient to ensure unremitting power generation with the flow to the load end. With suitable control logic, the effectiveness can be achieved in a hybrid system of WECS with PV [14]. Pitch control technique and charge controlling both are integrated at this level. The regulation of the battery bank can be done using charge controllers while hybrid turbine action was well-ordered by moving rotor blade angle control during the high and low speed of the wind. To validate the system efficiency both the system should be integrated on their side. The load profile of 0 to 4KW can be used for this system. To guarantee continuous power transfer, load requirement was assumed more importance above storing battery charging [17]. For the following wind storing battery constraints are perceived. 1) Fall and rise of gradual wind speed. 2) With a variation of speed step. 3) Arbitrary change in wind speed.

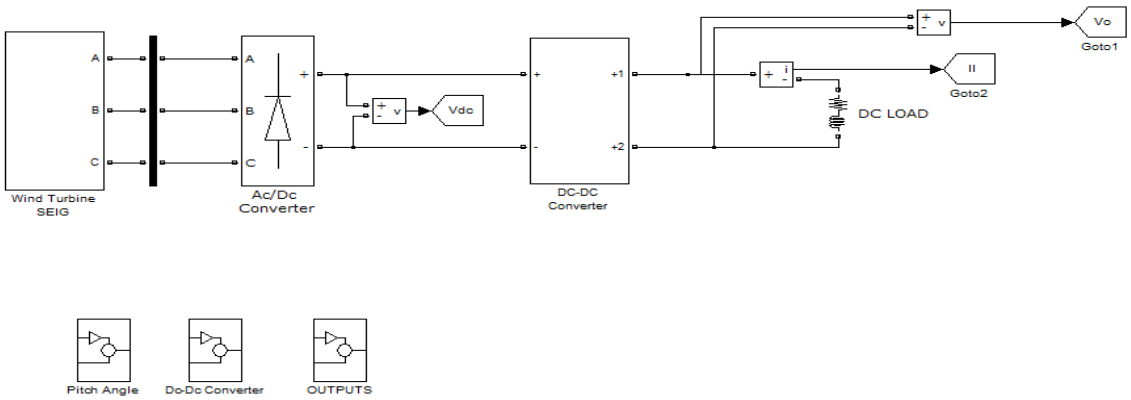

Fig. 5.1 Wind system circuit

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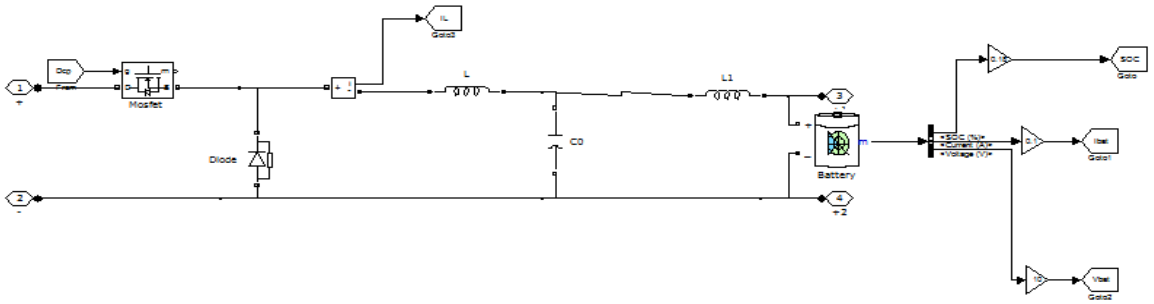

Fig. 5.2 DC-DC Converter

A steady increase and drop in airstream rapidity exposed in Fig. 6(a) was realistic to the hybrid wind. From 8.0 to 12.0 m/s in 15.0 seconds, the wind turbine speed steadily rises and then drops to 8 m/s in the succeeding 15 seconds. The load, battery, converters were practical in Fig. 5(a) and 5(b). Additional the effectiveness of the complete control system is authorized with a step deviation in airstream outline and random unpredictable airstream rapidity.

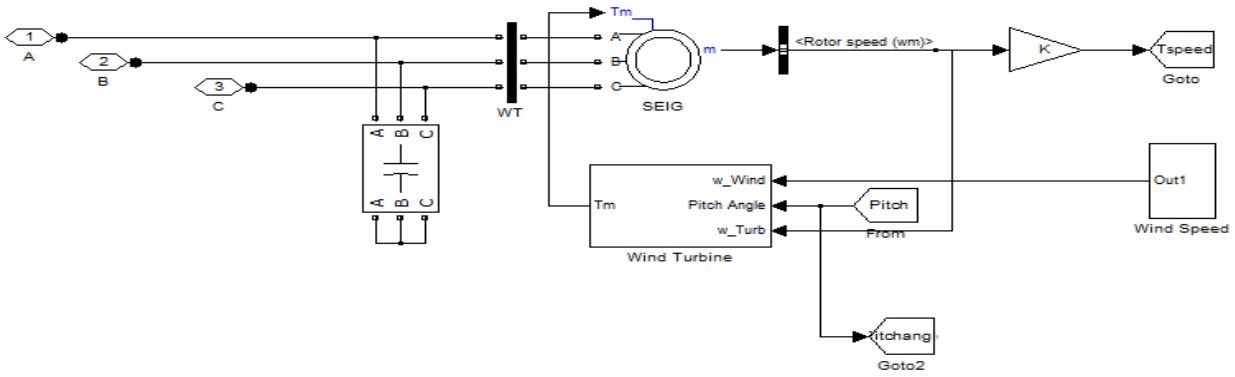

Fig. 5.3 Wind energy system

The deviation of the airstream speed at the stage from 8.0 to 12.0 m/s is given Fig. 6(a) though the random deviation in airstream speediness since 6.0 to 14.0 m/s is underlined in Fig 6(b). Reaction of wind parameters, the actual data wrt stage deviations with random deviations were given in Figs. 5.1 or 5.9, correspondingly. The consequences likewise reveal the alteration in battery SoC aimed at completely conceivable wind data profiles. From Fig 5 and Fig6, it is experimental, that after the airstream rapidity is touched set reference value (10.0 m/s) the MPPT system controls the TSR of turbine on its finest number regardless of the deviation in wind outline constraints. Consequently, supreme power is extracted from hybrid system at different wind speeds to come across the load prerequisite and safekeeping charging the battery bank. Nevertheless, the wind power generation is not continuously enough to encounter the load requirement and charge in the mode battery in CC. in this condition, the system first encounters the load necessity and charges the battery bank with a concentrated amount slowly [17]. Furthermore, if the power from wind output was not tolerable as per the load requirement, the discharge of the energy storing device. The State of charge upsurges while charge and vice versa although pay off. Nevertheless, the charge regulator safeguards that the current should not exceed 40A during charging. The below 10m/s the pitch angle is maintained at zero degrees.

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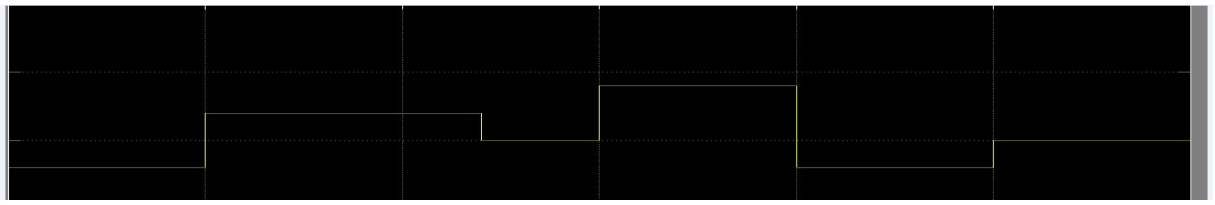

Fig. 5.4 wind speed

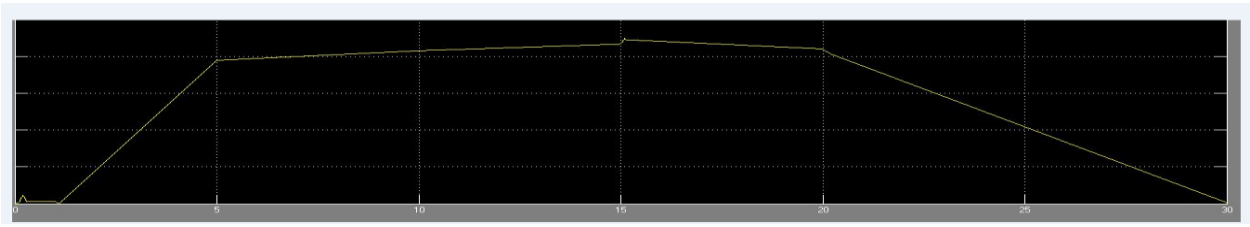

Fig. 5.5 Turbine power

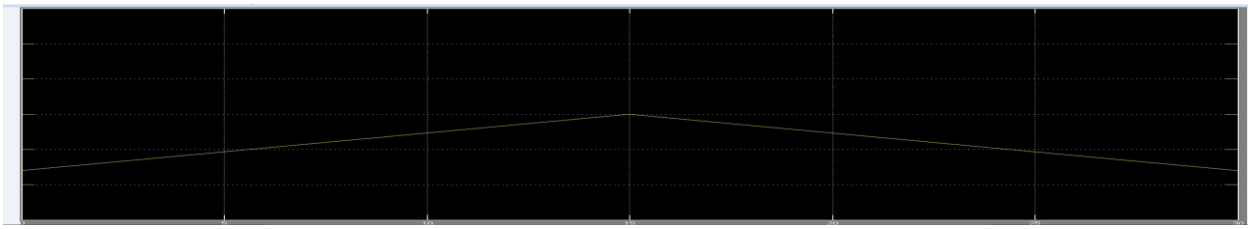

Fig. 5.6 Speed

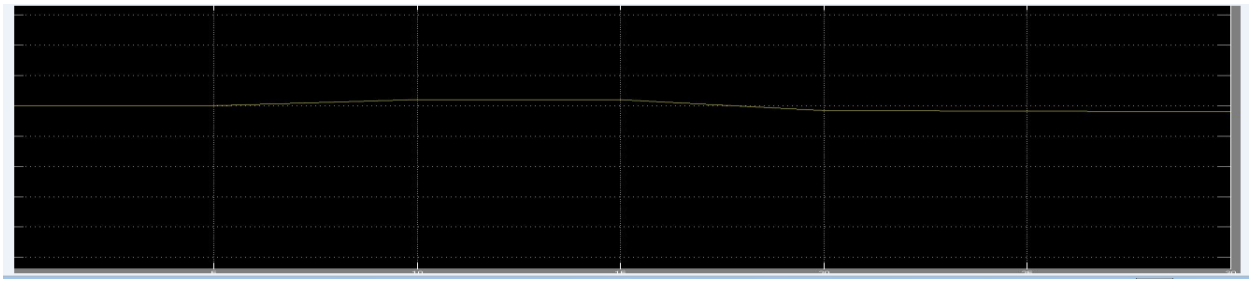

Fig. 5.7 SOC

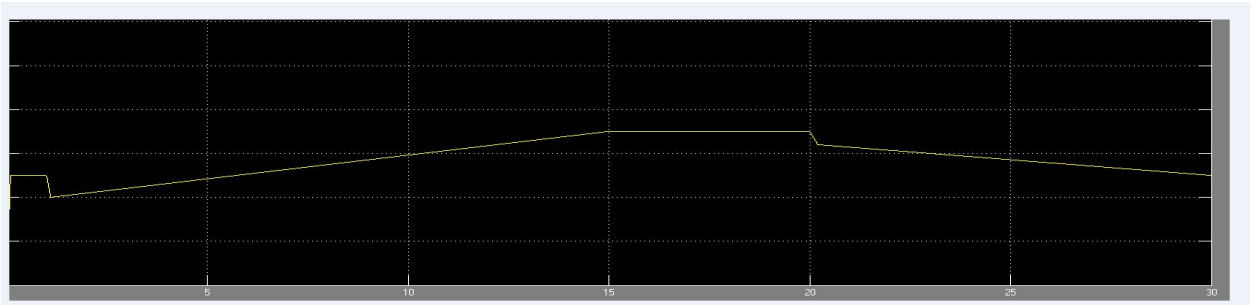

Fig. 5.8 Shaft speed

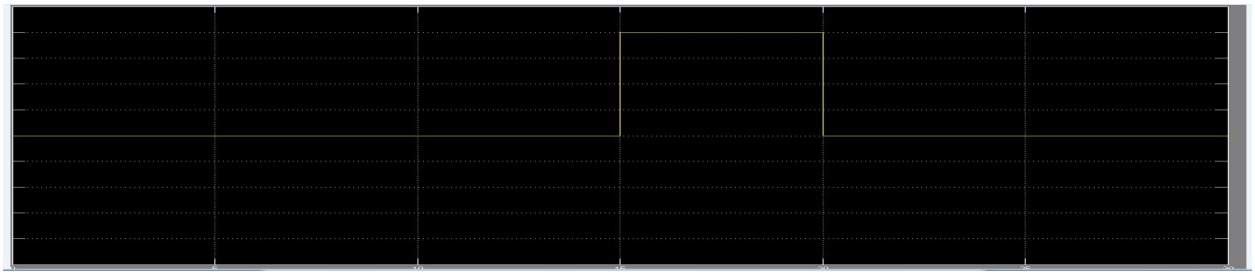

Fig. 5.9 Pitch angle

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Nonetheless, the tone supervisor is to be triggered when the speed of wind air surpasses its graded edge. There should be limit in power generation and speed of the wind when there is increase in pitch angle. The hybrid WECS can response to all variation of current with changing parameters.

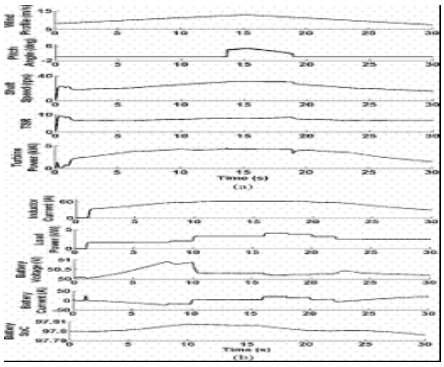

Fig. 6 (a) Wind Turbine output with speed variation

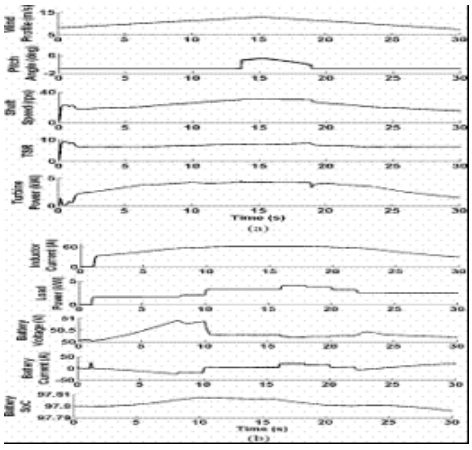

Fig. 6 (b) Battery parameters with speed variation

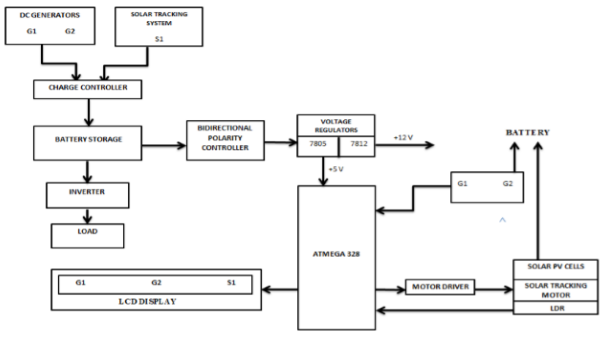

Fig.7a Slab Diagram of Hybrid Energy

IV. SOLAR ENERGY SYSTEM WITH PHOTOVOLTAIC

The combination of series-parallel cells constitutes solar PV panels and the capacity of building voltage and flowing current through it. The PV panels are nothing but PN junction layers formed which can be shown in

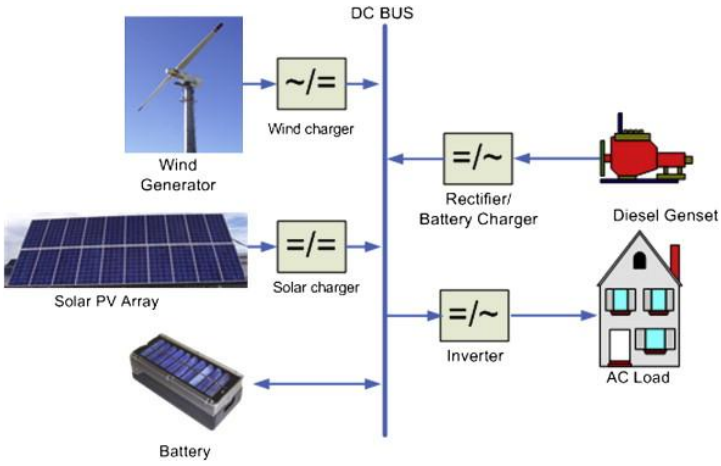

Fig. 7b Solar-Wind Battery Hybrid System

The direct current potential output of Hybrid scheme is supplying a constant load through rectifier. A study on a hybrid scheme consist of a photovoltaic lunar source and a wind alternator was prepared with MATLAB/SIMULINK has been accomplished.

V. CONCLUSION

As the only power getting from wind system is undependable. Consequently, a wind system cannot guarantee continual power transfer to the consumer. To come across the load demand at various conditions, the hybrid system must be implemented. Hence, in my paper, a hybrid wind-solar scheme with PV can preferred to supply the anticipated output power at a consumer terminal. To diminish the arbitrary features of wind speed rate the wind system is integrated for output power along with controllers [6-8]. In a hybrid set up a controller with logic, support is integrated. The pitch control action comes in the picture during power mismatch and regulates the output power.

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Besides that logic control avoids any overvoltage situation. The hybrid wind-solar battery is developed using MATLAB/SIMULINK; it was observed that renewable technology must be pooled to guarantee secure and more stable operation. The solar source must be more predictable than wind [9]. In a developing country like India, these systems give more reliable and secure operations and solving the energy crisis.

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