Power Generation From Solar Photovoltaic and Wind Energy

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Abstract-*With increasing demand for energy and with fast depleting conventional sources of energy such as coal, petroleum, natural gas, etc. the non-conventional sources of energy such as energy from sun, wind, biomass, tidal energy, geo-thermal energy and even energy from waste material are gaining importance. Wind and solar energy are complementary to each other, which makes the system to generate electricity almost throughout the year. The main components of the Wind Solar Hybrid System are wind aero generator and tower, solar photovoltaic panels, batteries, cables, charge controller and inverter. The Wind - Solar Hybrid System generates electricity that can be used for charging batteries and with the use of inverter we can run AC appliances.*

I. INTRODUCTION

Solar Energy can be converted into electrical energy with the help of PhotoVoltaic(PV) Cell . Electric Power generation from Solar cell is based on principle of photovoltaic effect. When light energy hits the cell the electron hole diffusion occurs that creates electric field. Electric field produces the current to flow in one direction and hence electric power is extracted from the circuit. To maintain generation system reliability Hybrid Power Generation system is proposed. Which consists of Wind power generation system with Solar system. Wind energy is not a constant source of energy. It varies continuously and gives energy in sudden bursts. Standalone wind with solar PV is known as best hybrid combination of renewable energy systems.

II. PROBLEMFORMULATION

Electric power generation from solar Energy is based on Photoelectric effect .Where light energy is converted into electric energy. Its completely environment friendly. Though the solar energy is available in large quantity there are many problems associated when it is used as a power generation source with the help of photovoltaic cells.

The insolation level which makes it impractical to directly connect them to the load without any storage devices or utility grid interface. Even in the hottest regions of the earth, the solar radiation flux available rarely exceeds 1kW/m2 and the total radiation over a day is at best about 7 kWh/m2. These are low values from point of view of technological utilization.

Standalone Solar Energy generation has several Efficiency Issues Solar panels are currently not highly efficient although efficiency continues to improve with technological advances. The efficiency can be dramatically affected by many factors, including regular, everyday issues like the amount of shade (from trees, structures...), wind, dust, snow, angle of the panels, amount of daylight, access to direct sunlight, solar intensity resulting in Non Uniform Solar radiation.

Hence In order to meet continuous load demand additional power generating resource is adopted

The main objective of this thesis is the development of a Hybrid Energy System combination of

- Photovoltaic (PV) system and
- Wind turbine generator system

III. PROPOSED SYSTEM

Intermittent energy resources and energy resources unbalance are the most important reason to install a hybrid energy supply system. Electric Power generation from solar energy is based on the Photovoltaic Effect.Where photo stands for light and voltaic implies producing voltage.Photovoltaic (PV) systems convert light directly into electricity (using semi-conductor technology). Power generation from wind can be done by convrteting Kinetic Energy of Wind to Mechanical power . The system components are as follows

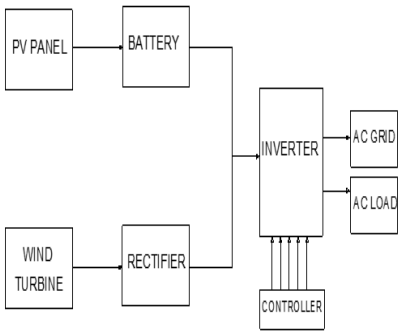

Fig.1 Proposed System Block diagram

A hybrid arrangement of combining the power harnessed from both the wind and the sun and stored in a battery can be a much more reliable and realistic power source.Proposed system contains

- Solar photovoltaic system
- Wind turbine generator
- DC-AC conversion assembly

System control & present technologies are been studied. Overall system is simulated using MATLAB environment. Since system is use for both Grid & individual AC loads output parameters are verified using Simulink with either grid connected or disconnected using breaker switch. In order to analyze the operation of microgrid system both the modeling and controlling of the system are important issues. Hence the control and modeling are also the part of this thesis work.

3.1 Solar power generation

The basic ingredients of PV cells are semiconductor materials, such as silicon. Polycrystalline Thin-Film Photovoltaic Technologies are widely used nowadays.A simple solar cell is a pn junction diode The n region is heavily doped and thin so that the light can penetrate through it easily. The p region is lightly doped so that most of the depletion region lies in the p side. The penetration depends on the wavelength and the absorption coefficient increases as the wavelength decreases. Electron hole pairs (EHPs) are mainly created in the depletion region and due to the built-in potential and electric field, electrons move to the n region and the holes to the p region shown in fig.2. When an external load is applied, the excess electrons travel through the load to recombine with the excess holes. Electrons and holes are also generated with the p and n region some of the EHPs generated in these regions can also contribute to the current. Typically, these are EHPs that are generated within the minority. Radiation is absorbed in the depletion region and produces electrons and holes. These are separated by the built-in potential. Depending on the wavelength and the thickness different parts of the device can absorb different regions of the solar spectrum.

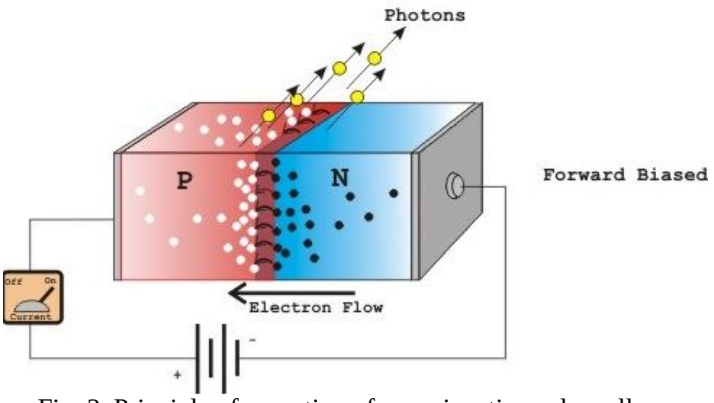

Fig. 2. Principle of operation of a p-n junction solar cell.

3.1.1 Photovoltaic Module

Because of the low voltage generation in a PV cell (around 0.5V), several PV cells are connected in series (for high voltage) and in parallel (for high current) to form a PV module for desired output. In case of partial or total shading and at night there may be requirement of separate diodes to avoid reverse currents. The p-n junctions of mono-crystalline silicon cells may have adequate reverse current characteristics and these are not necessary. There is wastage of power because of reverse currents which directs to overheating of shaded cells. At higher temperatures solar cells provide less efficiency and installers aim to offer good ventilation behind solar panel. umber of Solar cells together form PV module individual solar cell voltage is typically 0.5V.

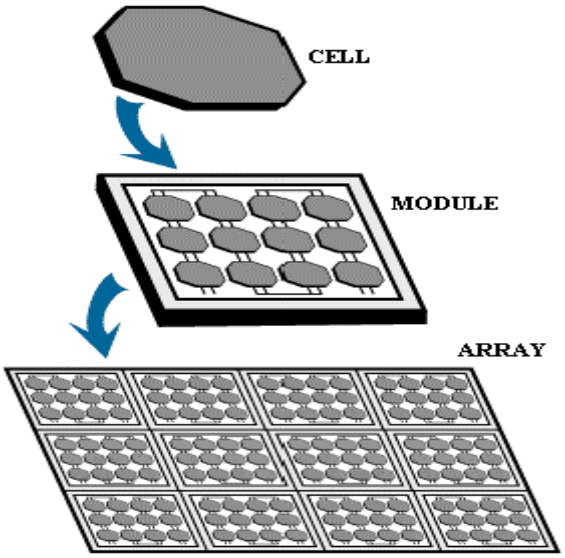

Fig 3. Photovoltaic system

3.2 Wind Energy Conversion System

Wind energy is the kinetic energy associated with the movement of atmospheric air. It has been used for hundreds of years for sailing, grinding grain and for irrigation. Wind energy systems convert this kinetic energy to more useful forms of power. Wind energy systems for irrigation and milling have been in use since ancient times and at the beginning of the 20th century it is being used to generate electric power. Wind turbines transform the energy in the wind into mechanical power, which can then be used directly for grinding etc. or further converting to electric power to generate electricity.

3.2.1 Wind Turbine System

In wind energy generation, kinetic energy of wind is converted into mechanical energy and subsequently into electrical energy. Wind has considerable amount of kinetic energy when blowing at high speeds. This kinetic energy when passes through the blades of the wind turbines, it is converted into mechanical energy and rotates the wind blades. When the wind blades rotate, the connected rotor also rotate, thereby producing electricity with the help of a generator connected to the rotor.

DFIG System

A three-phase wound-rotor induction machine can be setup as a doubly-fed induction motor. In this case, the machine operates like asynchronous motor whose synchronous speed (i.e., the speed at which the motor shaft rotates) can be varied by adjusting the frequency (f-rotor) of the ac currents fed into the rotor windings. The same wound-rotor induction machine setup canals serve as a doubly-fed induction generator. In this case, mechanical power at the machine shaft is converted into electrical power supplied to the ac power network via both the stator and rotor windings. Furthermore, the machine operates like a synchronous generator whose synchronous speed (i.e., the speed at which the generator shaft must rotate to generate power at the empower network frequency (f-network) can be varied by adjusting the frequency of the ac currents fed into the rotor windings. The remainder of this exercise discussion deals with the operation of three-phase wound-rotor induction machines used as doubly-fed induction generators.

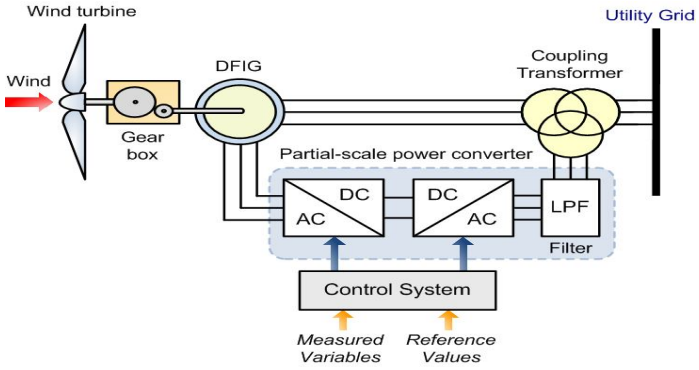

Fig.4 DFIG System

IV. CONCLUSION

The modeling of hybrid power system configuration will be done in Matlab/Simulink environment. The present work will be based on Collating two renewable power resources meeting load demand of AC grid as well as individual AC loads. Hybrid system output is tested in simulation.It is Possible to improve over all PV system efficiency with addition of several energy efficient components into the system. Enabling the designer to design a system with smaller (and less costly) PV arrays and batteries while still allowing the PV system to provide adequate coverage to the base.

REFERENCES

[1] V. Khadkikar, Member, IEEE, Rajiv K. Varma, Member, IEEE and Ravi Seethapathy, Senior Member, IEEE," Grid Voltage Regulation Utilizing Storage Batteries in PV Solar – Wind Plant based Distributed Generation System "

[2] Venkatesan M , Vineeth Vijayaraghavan Director - Research & Outreach "Hybrid Battery Charging System Using Solar PV and Utility Grid"

[3] Bong -Yeon Choi, Yong-Su Noh, Young-Hyok Ji, Byoung-Kuk Lee, Chung-Yuen Won Sungkyunkwan University "Battery-Integrated Power Optimizer for PV-Battery Hybrid Power Generation System Bong"

[4] M.H. Nehrir, C. Wang, K. Strunz, H. Aki, R. Ramakumar, J. Bing, Z. Miao,and Z. Salameh "A Review of Hybrid Renewable/Alternative Energy Systems for Electric Power Generation: Configurations,Control, and Applications" Special Task Force of the IEEE PES Renewable Energy Technologies Subcommittee, Energy Development and Power Generation Committee

[5] W.D.Kellogg, M.H.Nehrir,G.Venkataramanan,andV.Gerez,"Generation unitsizing and cost analysis for stand-alonewind,photovoltaic, and hybrid wind/PV

systems,"IEEE Trans.Energy Convers., vol. 13, no. 1, pp. 70–75, Mar. 1998.

[6] "A study on photovoltaic parameters of mono-crystalline silicon solarcell with cell temperature" Subhash Chander , A. Purohit , Anshu Sharma , Arvind , S.P. Nehra , M.S. Dhaka