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Renewable Energy Resource of Power Generation Using Solar Photovoltaic And Wind Energy

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Abstarct: *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.*

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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 insudden bursts.Standalone wind with solar PV is known as best hybrid combination of renewable energy systems.

II. Problem Formulation

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 IssuesSolar 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.
HenceIn 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

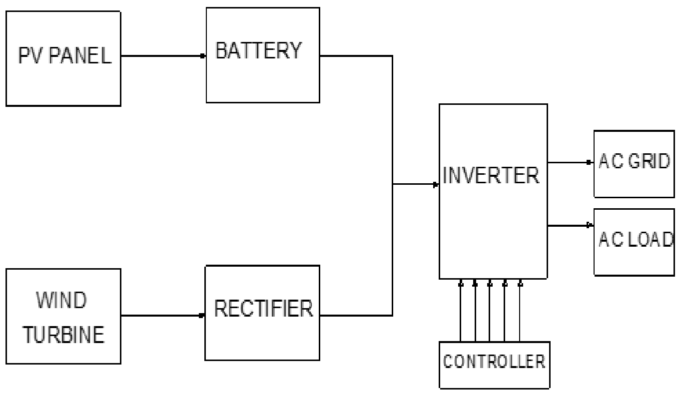

Fig.1 Proposed System Block diagr

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 diodeThe n region is heavily doped and thin so that the lightcan penetrate through it easily. The p region is lightly doped so that most ofthe depletion region lies in the p side. The penetration depends on the wavelengthand the absorption coefficient increases as the wavelength decreases.Electron hole pairs (EHPs) are mainly created in the depletion region and dueto the built-in potential and electric field, electrons move to the n region andthe holes to the p region shown in fig.2. When an external load is applied, the excess electronstravel through the load to recombine with the excess holes. Electronsand holes are also generated with the p and n region some of the EHPs generated in these regions can also contribute to thecurrent. Typically, these are EHPs that are generated within the minority.Radiation isabsorbed in the depletion region and produces electrons and holes. Theseare separated by the built-in potential. Depending on the wavelength and thethickness different parts of the device can absorb different regions of the solarspectrum.

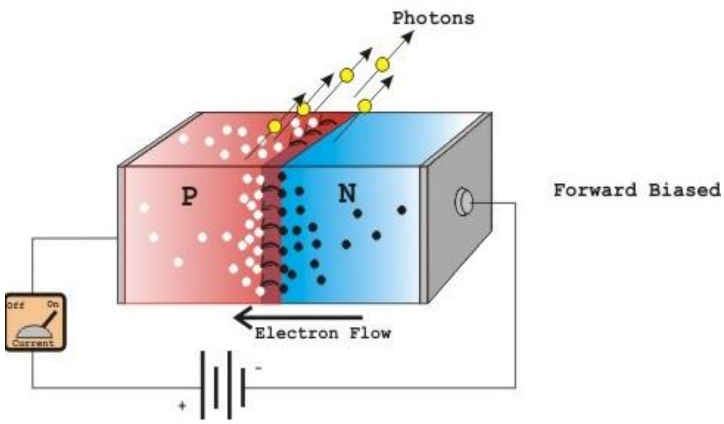

Fig. 2. Principle of operation of a p-n junction solar cell.

3.1.1 PhotovoltaicModule

Because of the low voltage generation in a PV cell (around 0.5V), several PV cells areconnected 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 goodventilation behind solar panel.umber of Solar cells together form PV module individual solar cell voltage is typically 0.5V.

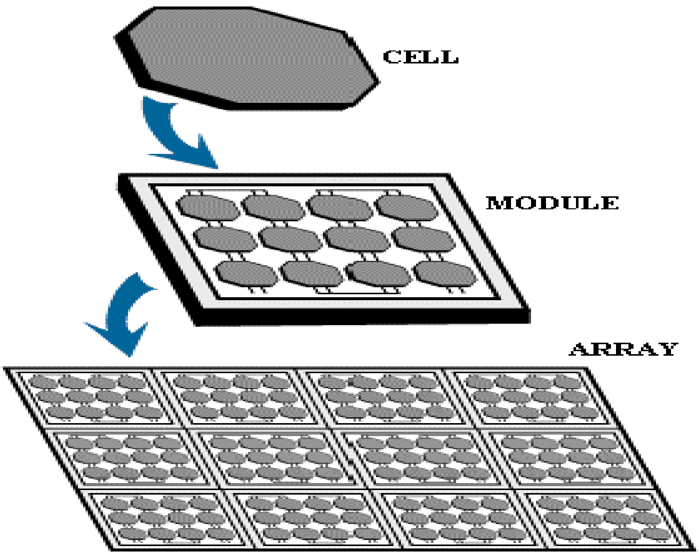

Fig 3. Photovoltaic system

3.2 WindEnergy 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 subsequentlyinto electrical energy. Wind has considerable amount of kinetic energy when blowing at high speeds. Thiskinetic energy when passes through the blades of the wind turbines, it is converted into mechanicalenergy 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.

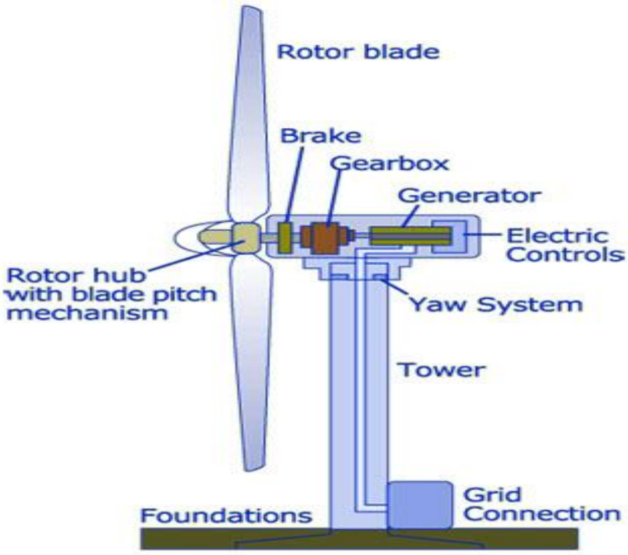

Fig.4Wind turbine system

The wind turbine is a three bladed, upwind, horizontal-axis wind turbine with a rotor diameter of 82.5m.The turbine rotor and nacelle are mounted on top of a tubular tower giving a rotor hub height of 80m.The machine employs active yaw control (designed to steer the machine with respect to the winddirection), active blade pitch control (designed to regulate turbine rotor speed), and a generator/powerelectronic converter system.The wind turbine features a distributed drive train design wherein the major drive train componentsincluding main shaft bearings, gearbox, generator, yaw drives, and control panel are attached to abedplate.Wind turbine parts are shown in fig.4

- **Rotor**

Wind turbine has rotor which rotates as wind in given as iput to it.Rotor speed is regulated by a combination of blade pitch angleadjustment and generator/converter torque control. The rotor spins in a clock-wise direction undernormal operating conditions when viewed from an upwind location.

- **Blades**

There are three rotor blades used on each wind turbine. The airfoils transition along the blade span withthe thicker airfoils being located in-board towards the blade root (hub) and gradually tapering to thinnercross sections out towards the blade tip.

- **Blade Pitch Control System**

The rotor utilizes three (one for each blade) independent electric pitch motors and controllers to provideadjustment of the blade pitch angle during operation. Blade pitch angle is adjusted by an electric drivethat is mounted inside the rotor hub and is coupled to a ring gear mounted to the inner race of the bladepitch bearingActive-pitch controller enables the wind turbine rotor to regulate speed, when above rated wind speed,

by allowing the blade to "spill" excess aerodynamic lift. Energy from wind gusts below rated wind speedis captured by allowing the rotor to speed up, transforming this gust energy into kinetic which may thenbe extracted from the rotor.Three independent back-up units are provided to power each individual blade pitch system to feather theblades and shut down the machine in the event of a grid line outage or other fault. By having all threeblades outfitted with independent pitch systems, redundancy of individual blade aerodynamic brakingcapability is provided.

- **Hub**

The hub is used to connect the three rotor blades to the turbine main shaft. The hub also houses the threeelectric blade pitch systems and is mounted directly to the main shaft. Access to the inside of the hub isprovided through a hatch.

- **Gearbox**

The gearbox in the wind turbine is designed to transmit power between the low-rpm turbine rotor and high-rpm electric generator. The gearbox is a multi-stage planetary/helical gear design. The gearbox is mounted to the machine bedplate. The gearing is designed to transfer torsional power from the wind turbine rotor to the electric generator. A parking brake is mounted on the high-speed shaft of the gearbox.

- **Bearings**

The blade pitch bearing is designed to allow the blade to pitch about a span-wise pitch axis. The inner race of the blade pitch bearing is outfitted with a blade drive gear that enables the blade to be driven in pitch by an electric gear-driven motor/controller. The main shaft bearing is a roller bearing mounted in a pillow-block housing arrangement. The bearings used inside the gearbox are of the cylindrical, spherical and tapered roller type. These bearings are designed to provide bearing and alignment of the internal gearing shafts and accommodate radial and axial loads.

- **Brake System**

The electrically actuated individual blade pitch systems act as the main braking system for the wind turbine. Braking under normal operating conditions is accomplished by feathering the blades out of the wind. Any single feathered rotor blade is designed to slow the rotor, and each rotor blade has its own back-up to provide power to the electric drive in the event of a grid line loss. The turbine is also equipped with a mechanical brake located at the output (high-speed) shaft of the gearbox. This brake is only applied as an auxiliary brake to the main aerodynamic brake and to prevent rotation of the machinery as required by certain service activities.

- **Generator**

The generator is a doubly-fed induction type. The generator meets protection class requirements of the International Standard IP 54 (totally enclosed). The generator is mounted to the bedplate and the mounting is designed so as to reduce vibration and noise transfer to the bedplate.

- **Flexible Coupling**

Designed to protect the drive train from excessive torque loads, a flexible coupling is provided between the generator and gearbox output shaft this is equipped with a torque-limiting device sized to keep the maximum allowable torque below the maximum design limit of the drive train.

- **Yaw System**

A roller bearing attached between the nacelle and tower facilitates yaw motion. Planetary yaw drives (with brakes that engage when the drive is disabled) mesh with the outside gear of the yaw bearing and steer the machine to track the wind in yaw. The automatic yaw brakes engage in order to prevent the yaw drives from seeing peak loads from any turbulent wind. The controller activates the yaw drives to align the nacelle to the average wind direction based on the wind vane sensor mounted on top of the nacelle. A cable twist sensor provides a record of nacelle yaw position and cable twisting. After the sensor detects excessive rotation in one direction, the controller automatically brings the rotor to a complete stop, untwists the cable by counter yawing of the nacelle, and restarts the wind turbine.

- **Tower**

The wind turbine is mounted on top of a tubular tower. The tubular tower is manufactured in sections from steel plate. Access to the turbine is through a lockable steel door at the base of the tower. Service platforms are provided. Access to the nacelle is provided by a ladder and a fall arresting safety system is included. Interior lights are installed at critical points from the base of the tower to the tower top.

- **Nacelle**

The nacelle houses the main components of the wind turbine generator. Access from the tower into the nacelle is through the bottom of the nacelle. The nacelle is ventilated. It is illuminated with electric light. A hatch at the front end of the nacelle provides access to the blades and hub. The rotor can be secured in place with a rotor lock.

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 overall 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.

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