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Design of Hybrid Power Generation Using Solarpv Module and Wind Turbine

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ABSTRACT: *Use of Renewable Energy power sources is the best possible solution today to reduce increasingly risk of global warming and the most important type of renewable is Wind used power generators in Distributed Generation (DGs) sources that are in direct relation with the use of micro capacity power generating units of power system that are installed in distribution level of power systems or all segments that loads and energy consumers are located. Hybrid systems vary in models. The best hybrid model available today is combination of grid connected wind turbines and solar PV cells that can compensate each other in the grid connected state. In addition, solar cells provide electricity required in daytime while wind turbines compensate the power needed in the night period. Solar cells are consisted of a series of assembly of different cells together to form a flat photovoltaic system to absorb the photons and generate electricity by electrons energized in the circuit. On the other hand, Systems for conversion of energy of wind use PM Synchronous Generators. Recently, wind turbines are even enhanced to use VSD drives to provide the machine the ability of generation in cases that rotational speed varies with changes in speed of wind.*

Keywords:- *photo-voltaic, solar cell, wind energy, renewable energy, integrating power generation system, wind power generation system, solar PV tracking system, non conventional energy sources, solar power generation system.*

I. INTRODUCTION

Hybrid renewable energy systems (HRES) are becoming popular for remote area power generation applications due to advances in renewable energy technologies and subsequent rise in prices of petroleum products. A hybrid energy system usually consists of two or more renewable energy sources used together to provide increased system efficiency as well as greater balance in energy supply. The rapid depletion of fossil fuel resources on a worldwide basis has necessitated an urgent search for alternative energy sources to cater to the present day demands. Alternative energy resources such as solar and wind have attracted energy sectors to generate power on a large scale. A drawback, common to wind and solar options, is their unpredictable nature and dependence on weather and climatic changes, and the variations of solar and wind energy may not match with the time distribution of demand.

Fortunately, the problems caused by the variable nature of these resources can be partially overcome by integrating the two resources in proper combination, using the strengths of one source to overcome the weakness of the other. The hybrid systems that combine solar and wind generating units with battery backup can attenuate their individual fluctuations and reduce energy storage requirements significantly. However, some problems stem from the increased complexity of the system in comparison with single energy systems. This complexity, brought about by the use of two different resources combined, makes an analysis of hybrid systems more difficult.

A. The advantages of the hybrid system

The main advantages of a hybrid system

- The possibility to combine two or more renewable energy sources, based on the natural local potential of the users.
- Environmental protection, especially in terms of CO2 emissions reduction.
- Low cost – wind energy, and also solar energy can be competitive with nuclear, coal and gas especially considering possible future cost trends for fossil and nuclear energy.
- Diversity and security of supply.
- Rapid deployment - modular and quick to install.

- Fuel is abundant, free and inexhaustible.
- Costs are predictable and not influenced by fuel price fluctuations, although fluctuations in the price of batteries will be an influence where these are incorporated.

B. Small hybrid system requirements

The hybrid solar-wind power supply system should meet the following specific requirements:

- The electric input parameters should be compatible with the electric output parameters, especially taking into account:
  - The wide range of variation of the electric output parameters of the solar or wind generator, due to the variation of solar radiation intensity or of wind speed.
  - The reduced range of variation of the accumulator batteries load - unload electric parameters, this mode having to be controlled by means of a charge controller.
- Compatibility in various operating modes of the load by interconnecting adequate interfaces (both for the DC part and for the AC part).

C. Basic components of a small hybrid system

A typical small hybrid power system can contain the following components:

Solar PV Generator: containing a number of series/parallel interconnected solar modules (depending on the necessary voltage), including connection and protection elements (bypass diodes and/or anti-return). This element delivers part of the electric energy supply through solar energy conversion.

Wind generator: providing part of the necessary electric energy by converting the mechanical energy from the wind.

Storage unit (accumulator battery set): Usually Pb batteries are used, but also Ni-Cd or Ni-Fe, dedicated to applications in the area of renewable energy sources.

Unit for power conditioning: This can be a DC/DC converter (for DC loads) and/or inverters.

D. The Solution Based On Hybrid Systems

If the amount of energy consumption increases, it makes sense to combine PV with wind. The reason is that these other technologies can provide lower cost per Kilowatt-hour if they are scaled up to a certain level. The hybrid PV-Wind systems offer the most adequate solutions for the electrification of small rural settlements, the combination and the ratio of the two types of energy depending greatly on the resources locally available in each geographical area. These resources can be accurately evaluated only after a period of typically one year of monitoring the basic parameters (wind speed, solar radiation), necessary for sizing and implementing such systems in the respective areas.

The hybrid system studied is one combining solar and wind energy conversion system, with diesel generator(s) and a bank of batteries included for backup purposes. Power conditioning units, such as converters, are also a part of the system. The operational concept of the hybrid system is that renewable resources are the first choice for supplying load and any excess energy produced is stored in the battery. The diesel generator is a secondary source of energy. Electronic controller circuitry is used to manage energy supply and load demand. A schematic diagram of the standalone hybrid power supply system sought is shown in Fig.3.

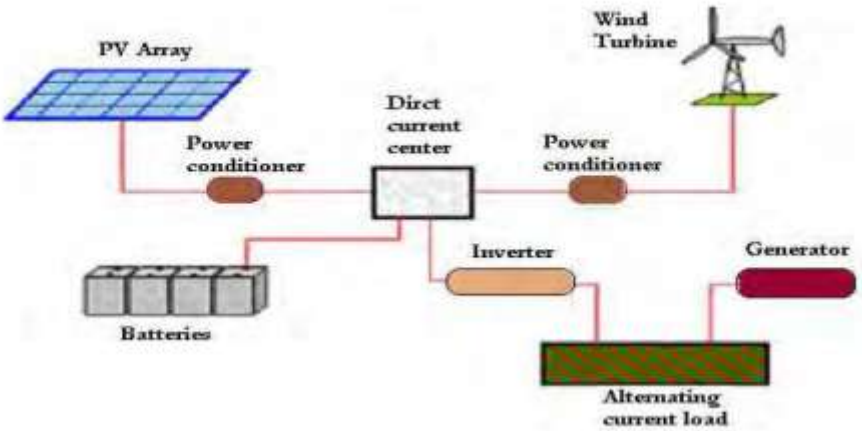


Fig.1 Block diagram of Integrated Electricity Generating system

Fig.2 Integrated Electricity Generating system

Photovoltaic system is classified into two major types: the off-grid (stand alone) systems and inter-tied system. The off-grid (stand alone) systems are mostly used where there is no utility grid service. It is very economical in providing electricity at remote locations especially rural banking, hospital and ICT in rural environments. PV systems generally can be much cheaper than installing power lines and step-down transformers especially to remote areas.

Solar modules produce electricity devoid of pollution, without odor, combustion, noise and vibration. Hence, unwanted nuisance is completely eliminated. Also, unlike the other power supply systems which require professional training for installation expertise, there are no moving parts or special repairs that require such expertise.

Basic Components of Solar Power

The major components include P.V modules, battery and inverter. The most efficient way to determine the capacities of these components is to estimate the load to be supplied. The size of the battery bank required will depend on the storage required, the maximum discharge rate, and the minimum temperature at which the batteries will be used [4]. When designing a solar power system, all of these factors are to be taken into consideration when battery size is to be chosen.

Lead-acid batteries are the most common in P.V systems because their initial cost is lower and also they are readily available nearly everywhere in the world. Deep cycle batteries are designed to be repeatedly discharged as much as 80 percent of their capacity and so they are a good choice for power systems. Figure 2 is a schematic diagram of a typical Photovoltaic System.

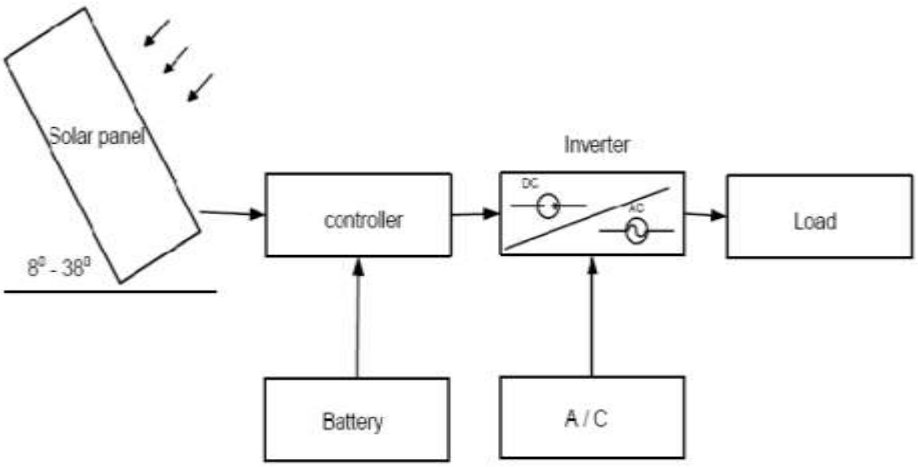


Fig.3 Solar PV cell

Wind Turbine

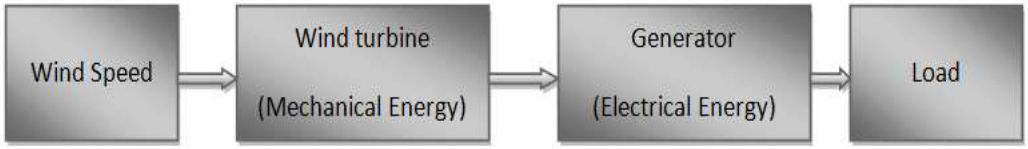
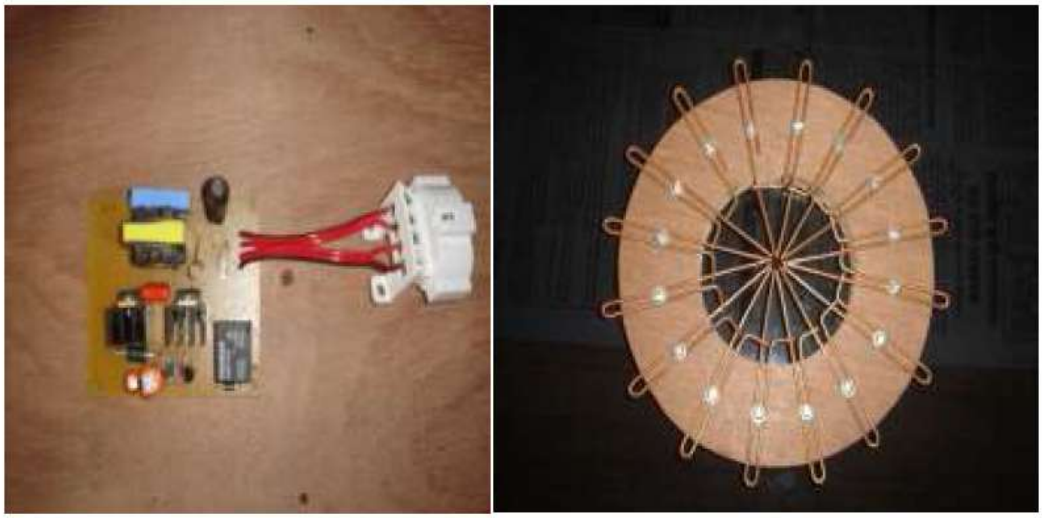


Fig.4 Wind energy conversion mechanism

A wind turbine is a machine for converting the kinetic energy in wind into mechanical energy. Wind turbines can be separated into two basic types based on the axis about which the turbine rotates. Turbines that rotate around a horizontal axis are more common. Vertical axis turbines are less frequently used [8,9].Wind turbines can also be classified by the location in which they are used as Onshore, Offshore, and aerial wind turbines [9].



II. CONCLUSION

In the present scenario standalone solar photovoltaic and wind systems have been promoted around the globe on a comparatively larger scale. These independent systems cannot provide continuous source of energy, as they are seasonal. The solar and wind energies are complement in nature. By integrating and optimizing the solar photovoltaic and wind systems, the reliability of the systems can be improved and the unit cost of power can be minimized.

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