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Design and Development of Hybrid Power Generation Using Solar Energy & Wind Energy

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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 most important type of renewable energy is wind and solar energy which are most efficient. The green power generation resources are used power generators in Distributed Generation (DGs) sources that are in direct relation with use of micro capacity power generating unit of power system that are installed in distribution level of power system or all segments that loads and energy consumers are located. Hybrid systems are varying in models. The best hybrid models available today is combination of grid connected wind turbines and solar PV cells that compensate each other in grid connected state. In addition, solar cell provides electricity required in day time while wind turbines compensate the power generated in the night period. Solar cells are consisted of a series of assembly of different cells together to form a flat photovoltaic systems to absorbs the photons and generate electricity by electrons energized in the circuit. On the other hand, systems for conservation 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- Photovoltaic solar cell, wind energy, renewable energy, integrating power generation system, wind power generation system, solar PV tracking systems, solar power generation system.

I -INTRODUCTION

Hybrid renewable energy systems (HRES) are becoming popular for remote area power generation application due to advances in renewable energy technologist and subsequent rise in prices of petroleum product. Hybrid energy systems usually consist of two or more renewable energy sources use together to provide increased system efficiency as well as greater balance in energy supply. The rapid depletion of fossil fuel sources on worth wide basis has necessitated an urgent search for alternative energy sources to cater to present demands. Alternative energy sources such as solar and wind have attracted energy sector to generate power on large scale. A drawback of common to wind and solar options is their unpredictable nature and dependence on weather and climate changes, variation of solar and wind energy may not match with the time distribution of demand. The hybrid systems that combine solar and wind generating units with battery backup can attenuate their individual fluctuation and reduce energy storage requirements significantly. This complexity brought about by use of two different resources combine makes an analysis of hybrid systems more difficult.

Advantages of hybrid systems:-

The main advantages of hybrid systems are:-

1) The rapid deployment-modular and quick to install.

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2) Fuel is abundant, free and inexhaustible.
3) Diversity and security of supply.
4) Environmental protection especially in terms of CO2 emission reduction.
5) Low cost-wind energy and solar energy can be competitive within nuclear, cola and gas specially considering possible future cost trends to fossil and nuclear energy.
6) The possibility to combine two or more renewable energy sources based on natural local potential of the user.

Small hybrid system requirements

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

1) The electric input parameter should be compatible with electric output parameters, especially taking into account.
2) 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.
3) The reduced range of variations of the accumulator battery's load and unload electric parameter, this mode having to be controlled by means of charge controller.

II -METHOLOGY

Basic components of small hybrid system:

1. Solar PV generator
2. Wind generator
3. Storage unit
4. Unit for power conditioning

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

Solar PV generator:-

It contains number of series as well as parallel interconnected solar modules including connections and protection element. This element delivers parts of electrical energy supply through solar energy conversion.

Wind generation

Providing part of necessary electric energy by converting the mechanical energy from the wind.

Storage unit (Accumulator battery setup):-

Usually Pb batteries are used, but also Ni-Cd or Ni-Fe, dedicated to application in the area of renewable energy sources.

Unit of power conditioning

This can be AC/DC convertor (for DC loads) and invertor for (AC loads).

The solution based on Hybrid system:

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

The hybrid systems studied is one combining solar & wind energy conversion system, with diesel generator(S) & a bank of batteries include for back up purposes. Power conditioning unit such as convertors are also ma part of system. The operational concept of the hybrid system is that renewable sources 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. The electronic controller circuitry is used to manage the energy supply &load demand. A schematic diagram of the standalone hybrid power supply system is as shown in fig.

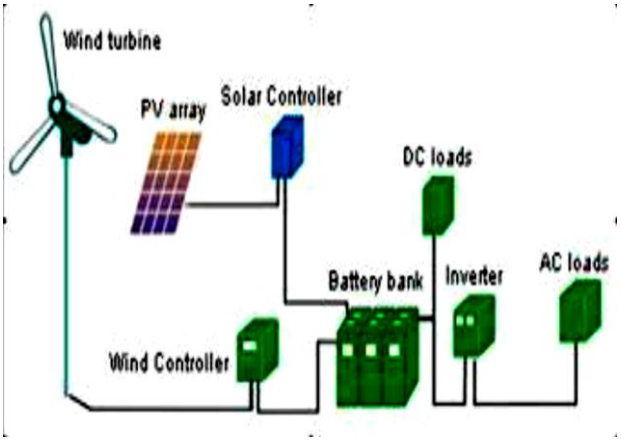

Fig 1- Block diagram of integrated electricity generating systems.

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Fig.2 - Integrating Electricity Generating System

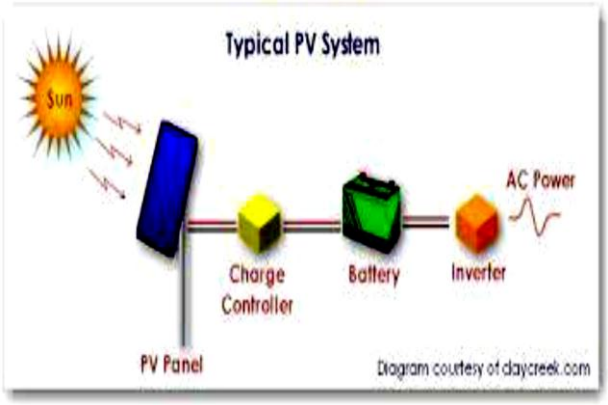

Fig.3- Solar PV Cell.

Photovoltaic system is classified into two major types: the off-grid (standalone) systems and inter- tied systems. The off-grid (standalone) 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 and then installing power lines and step- down transfers especially to remote areas.

Solar modules produce electricity devoid of pollution, without odour, 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 part or special repair that require such expertise.

Basic components of solar power

The major components include PV modules, battery and invertor. The most efficient 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.

When designing the solar power systems, 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 PV 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 discharge as much as 80% of their capacity and so they are a good choice for power system.

Fig.4- Wind Energy Conservation Mechanism

A wind turbine is a machine for converting 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. Wind turbine can also be classified by the location in which they are used as Onshore, Offshore and aerial wind turbines.

III –CONCLUSION

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

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