FPGA Based Hybrid Power Supply System

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Abstract — The purpose of this project was to design a portable and low cost power system that combines both wind electric and solar electric technologies. This system will be designed for providing power to rural and research areas. And also to improve the individuals in developing countries affected by natural disasters. One of the basic needs for social & economic development in any country in the world is the provision of reliable electricity supply systems. This work is a nothing but the development of very efficient technology hybrid Solar-Wind Power system that uses the renewable energies in Sun and Wind to generate electricity.

In this, electric DC energy is produced from photovoltaic solar panel and wind systems are transported to a DC disconnect energy mix controller. The energy mix controller is bidirectional connected to a DC-AC float charging-inverter system that provides charging current to heavy loads of battery and at the same time produces inverted AC power to AC loads.

I. INTRODUCTION

Photovoltaic, and other renewable energy technologies, can significantly contribute to economic and social development of the world. To date, about 1.6 billion people in the world, many of them are living in such areas, where they still don’t have access to electricity and to clean water, primary health care, education and other basic services; the impact of which to a large extent depends on access to electricity.

As we know that, world becomes more & more concerned about its environment, pollution and energy, countries are beginning to use to renewable energies. Energy is essential to us to ensure our quality of life but the cost of energy increases day by day that is why it is necessary to look for any alternative sources of energies. We can evaluate two systems, first one is solar panel systems and second one is solar and wind hybrid system (our system).

In the hybrid power supply systems, which use solar energy and wind energy are an increasingly preferred alternatives for several reasons. In much of the United States, wind speeds are very low in the summer season. The wind speed is strong in the winter season, when less sunlight is available. Because the peak operating times for wind systems and solar systems occur at different times of the day as well as year, hybrid systems are most likely to produce power when it is necessary.

II. METHODOLOGY DESCRIPTION

Before we start the design of a Photovoltaic-wind hybrid system we should know the following main available natural resources: wind profile and solar radiation. In case we have suitable amplitudes of both renewable energy sources we can actually initiate the design of the hybrid system. First of all we have to calculate the dimension of the elements like, PV-system, wind-generator, and battery set.

Methodology

1) Calculate the PV-area and the wind-area needed for each month, covering the monthly account the month’s average-APV and AW and the correspondent standard deviations. This statistical analysis is based on the probability density associated with each natural resource.

2) The total energy supplied by the Hybrid System [KWh], Photovoltaic specific PV-energy [kWh/m2], EW: specific wind-energy [kWh/m2].

3) Resize the calculated dimensions.

4) Calculate the number of standard PV-models and Wind-generators.

5) Calculate the life-cycle costs associated with different percentages of PV-wind composition, and optimize this cost function.

Photovoltaic Energy

Solar-meter station installed on the site used to survey about solar energy. The hourly basis data were obtained in this station.
While designing the PV-unit additionally we have to consider that the PV-cell performance depending upon the following quantities 1. solar radiation 2. Temperature 3. Tension 4. Dirt located on the panel surface.

**Wind Energy**

A 30m tower equipped with an anemometer for the survey of wind energy by data acquiring through it. Note the average wind speed at a height of 30m monthly. In the year 2007 the average wind speed registered shows a value of 4.1 m/s. To evaluate the wind potential is the rate of the registered wind speed’s occurrences as well as with the final purpose of the current designations is an another way.

**Advantage of Hybrid system**

1. We can use natural renewable sources properly.
2. We can easily fulfill required load demand.
3. We can easily reduce the cost of electricity supply.

The two main types of solar power systems such are stand-alone systems and grid-connected. These systems are designed in such a way that we can operate independent of the electric utility grid, and are generally designed and sized to supply certain electrical loads. They may be powered by a solar array only, or may use wind, utility power as an auxiliary power source is called a solar-hybrid system. The simplest type of stand-alone system is a direct-coupled system. A bi-directional interface is made in between the solar system AC output circuits and the electric utility network. It allows the AC power produced by the solar power system to supply on-site electrical loads when the solar power system output is greater than the on-site load requirement. When the electrical loads are greater than the solar power system output, the balance of power required by the loads is received from the electric utility at night and during other periods.

Normally solar system operated in grid-connected mode and it can still operate critical loads when utility service is disrupted, providing that battery storage is used. This type of system is popular for homeowners and small industries where a critical backup power supply is required for critical loads such as refrigeration, water pumps, lighting, and other necessities. Under normal circumstances, the system operates in grid-connected mode, serving the on-site loads or sending excess power back onto the grid while keeping the battery fully charged. In the event the grid becomes de-energized, control circuitry in the inverter opens the connection with the utility through a bus transfer techniques, and operates that inverter from the battery to supply power to the required loads only. In such configuration, the critical loads must be supplied from a dedicated sub panel. The diagram shows that how a solar power system might be configured to operate it normally in grid-connected mode as well as power critical loads from a battery bank when the grid is de-energized.

**III. HYBRID PV SYSTEM**

A hybrid system combines photovoltaic with other forms of power generation, like a diesel generator, biogas is also used.

The other form of power generation is usually a type which is able to convert power output as a function of requirement. However, more than one form of renewable energy may be used for example wind and solar. The photovoltaic power generation serves to reduce the consumption of non renewable fuel.
IV. WIND SYSTEM

Wind energy is an indirect form of solar energy. About 1 per cent of the all solar radiation that reaches the earth is converted in the atmosphere into the energy of the wind. Winds generated from the differential heating of the earth and its atmosphere by the sun. When the sun heats the earth at different parts at different rates then the air transfer from the cold areas to the warm areas producing winds. The total quantity of this resource is extremely too large and varies with time at any given location. Wind energy is renewable and does not creating major environmental problems. Wind energy sources for different applications cannot be ignored in a country like India where considerable amount of wind power is available an estimate of the wind resource potential in India indicates a potential in excess of 22,000 MW for power generation. According to a recent valuation, India ranks very high among developing countries where wind energy potential seems more capable. Thus, the prospects of wind energy in India may be considered cost effective to conventional sources of electric power.

During the past 22 years outstanding progress has been made in the technology used to convert wind energy to electrical energy. More than 16,000 wind turbines in California and 2,800 in Denmark have been integrated into existing utility grids and routinely operated in combination with conventional sources such as hydroelectric, fossil-fuel fired, and nuclear generating stations. There is no fundamental reason why wind turbines cannot be a major part of any utility grid where there are good wind resources, provided they can participate with more familiar systems on the basis of cost, reliability and public acceptance. Although wind energy technology 20 demands careful attention to scientific and engineering detail, it is well within the capabilities of most if not all countries and is becoming economically competitive in many regions around the world.

V. CONCLUSION

From the above results we can find out that hybrid model of solar and wind energy can full fill the load demand wind energy support the solar energy to full fill load demand. So through this system we can supply the energy to rural areas. Using these technical solutions the electrical energy supply we can be resolved the problems for small farms and small problems for small industries. We will get better energy by increasing the tower height. With this it is possible to use small optimal storage capacity, because into large storage the cost is increased. Through this system we can also decrease the unit rate of energy. And reduce the pollution level also. Because of the provision of hybrid solar-wind energy system to banking and hospitals in rural and the unreached communities that are not connected to National Grid Power supply system is very important so as to maintain a continuous electricity supply.

REFERENCES