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"SOLAR PV-WIND HYBRID POWER SYSTEM"

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"Solar PV-Wind Hybrid Power System"

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Abstract – Energy generated from power system like solar, wind, biomass, hydro power, geothermal and ocean resources are considered as a technological option for generating clean energy. But the energy generated from solar and wind is much less than the production by fossil fuels, however, electricity generation by utilizing PV cells and wind turbine increased rapidly in recent years. This paper presents the Solar-Wind hybrid Power system that harnesses the renewable energies in Sun and Wind to generate electricity. System control relies mainly on micro controller.

Keywords: Power System, Hybrid Power System, electricity, solar power.

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INTRODUCTION

Hybrid Power Systems incorporate several electricity generating components with usually one major control system which enables the system to supply electricity in the required quality.

Components for electricity generation can utilize renewable energy sources like wind turbines, photovoltaic, solar thermal, hydro power, wave power or biomass power stations, etc. Furthermore, fossil power plant like diesel generators, gas turbines or fuel cells etc. can be added.

The term Hybrid Power System does not give any information about the size of the energy system. Generally, Hybrid Power Systems are considered to supply loads in the size of several watts up to several megawatts. They usually supply island networks that are not connected to an integrated grid covering countries or even continents – but represent small grids with a limited number of consumers. Due to the resulting fluctuating consumption pattern several specific features are required concerning the electricity supplying Hybrid Power System.

In integrated electricity grids the load equalizes due to the large number of consumers and its statistical application. This is how base, medium and peak load are defined which are covered by dedicated base, medium and peak load power plant to minimize the electricity cost price. Base load is needed continuously 24 hours per day, medium load is required in consecutive 3 to 6 hours and peak load is required in shorter sequences. Unfortunately, this cost effective procedure cannot be transferred to Hybrid Power Systems in most of the cases. On the contrary, Hybrid Power Systems have to cope with much more severe short term variations in power demand. Thus, different energy management structures have to be applied. These energy management structures vary with the size of the Hybrid Power System depending on the financially optimal system design.

In island networks it is essential to integrate one component that is responsible for frequency and voltage stabilization. In small systems up to 50 kW inverters and battery systems are applied for frequency and voltage stabilization; in lager systems continuously running synchronous generators with controllable engines are more cost effective. The further the technical progress of power electronics the more systems in the higher power class are controlled by inverter technology, too. Depending on the magnitude of the Hybrid Power System, different storages for equalization of load variations are applied. For Megawatt class systems pumped storage plants are most appropriate, for medium sizes of several hundred kilowatts the application of compressed air storage plant and for small scale systems the application of battery storages is advisable considering the economic point of view.

In larger systems, often geographical constraints prevent the application of appropriate storages. Thus, in these cases the storage component is replaced by a dynamically controlled generator driven by a fuel engine. The necessity for this operation results from the requirement to match demand and supply in electrical grids for each moment in time for stable grid operation. In order to avoid short term voltage drops and flickers power storages are applied. These storages provide high power for short periods. In contrast, the stored energy in such storages is rather small. Fly wheel storages, capacitors and special kinds of batteries belong to this group of storages.

A hybrid power system has an ability to provide 24-hour grid quality electricity to the load. This system offers a better efficiency, flexibility of planning and environmental benefits compared to the diesel generator stand-alone system. The operational and maintenance costs of the diesel generator can be decreased as a consequence of improving the efficiency of operation and reducing the operational time which also means less fuel usage. The system also gives the opportunity for expanding its capacity in order to cope with the increasing demand in the future. This can be done by increasing either the rated power of diesel generator, renewable generator or both of them [1].

SYSTEM COMPONENTS

In order to design a mini-grid hybrid power system, we have to provide some information from a particular remote location such as the load profile that should be met by the system, solar radiation for PV generation, wind speed for wind power generation, initial cost for each component (diesel, renewable energy generators, battery, converter), cost of diesel fuel, annual interest rate, project lifetime, etc [2, 3]. After that, we perform the simulation to obtain the best hybrid power system configuration, which in this project is done by utilizing HOMER software from NREL [4, 5].

IMPLEMENTATION OF HYBRID ENERGY SYSTEM

Intermittent energy resources and energy resources unbalance are the most important reason to install a hybrid energy supply system. The Solar PV wind hybrid system suits to conditions where sunlight and wind has seasonal shifts. [8] As the wind does not blow throughout the day and the sun does not shine for the entire day, using a single source will not be a suitable choice. 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. The load can still be powered using the stored energy in the batteries even when there is no sun or wind. Hybrid systems are usually built for design of systems with lowest possible cost and also with maximum reliability. The high cost of solar PV cells makes it less competent for larger capacity designs. This is where the wind turbine comes into the picture, the main feature being its cheap cost as compared to the PV cells. Battery system is needed to store solar and wind energy produced during the day time. During night time, the presence of wind is an added advantage, which increases the reliability of the system. In the monsoon seasons, the effect of sun is less at the site and thus it is apt to use a hybrid wind solar system. The system components are as follows.

1. Photovoltaic solar power

Solar panels are the medium to convert solar energy into the electrical energy. Solar panels can convert the energy directly or heat the water with the induced energy. PV (Photo-voltaic) cells are made up from semiconductor structures as in the computer technologies. Sun rays are absorbed with this material and electrons are emitted from the atoms .This release activates a current. Photovoltaic is known as the process between radiation absorbed and the electricity induced. Solar power is converted into the electric power by a common principle called photo electric effect. The solar cell array or panel consists of an appropriate number of solar cell modules connected in series or parallel based on the required current and voltage.

2. Wind Power

The wind energy is a renewable source of energy. Wind turbines are used to convert the wind power into electric power. Electric generator inside the turbine converts the mechanical power into the electric power. Wind turbine systems are available ranging from 50W to 3-4 MW.

3. Batteries

Energy stored in the battery is drawn by electrical loads through the inverter, which converts DC power into AC power. The inverter has in-built protection for Short-Circuit; Reverse Polarity, Low Battery Voltage and Over Load. The batteries in the system provide to store the electricity that is generated from the wind or the solar power. Any required capacity can be obtained by serial or parallel connections of the batteries.

4. Inverter

Energy stored in the battery is drawn by electrical loads through the inverter, which converts DC power into AC power. The inverter has in-built protection for Short-Circuit; Reverse Polarity, Low Battery Voltage and Over Load.

5. Microcontroller

The microcontroller compares the input of both Power system and gives the signal to the particular relay and charges the DC Battery. The DC voltage is converted into AC Supply by Inverter Circuit. The MOSFET (IRF 540) is connected to the Secondary of the centre tapped transformer. By triggering of MOSFET alternatively, the current flow in the Primary winding is also alternative in nature and we get the AC supply in the primary winding of the transformer.

CONCLUSIONS

Hybrid Power Systems all areas without electricity supply from integrated networks but demand for electrification can be identified as potential markets. Large potential for rural electrification especially with renewable energy sources can be found in developing countries. Unfortunately, the market for such systems has not materialized to a substantial scale yet due to a lack of structures in financial and political aspects. Furthermore, in many countries the required infrastructure for assembly, operation and maintenance of complex technical systems is not available locally.

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