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Revolution in Electric Power System: Hybrid Power System

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ABSTRACT
This paper proposes is a complete electrical power supply system by hybrid power plant that can be easily configured to meet a broad range of remote power needs. Hybrid power system is a combination of more than one conventional and non conventional power generating plants. There are three basic elements to the system the power source, the battery, and the power management centre. The power sources are a wind turbine, diesel engine generator, and solar arrays. The battery allows autonomous operation by compensating for the difference between power production and use. The power management centre regulates power production from each of the sources, controls power use by classifying loads, and protects the battery from service extremes. Hybrid power systems combine two or more energy conversion devices, or two or more fuels for the same device, that when integrated, overcome limitations inherent in either. Hybrid systems can address limitations in terms of Fuel flexibility, efficiency, reliability, emissions and economics. A hybrid system is most often used for larger applications such as village power, residential systems where generators already exist, and in applications like telecommunication. Where availability requirements are near 100 percent. Hybrid energy system usually consists of two or more energy sources used together to provide increased system efficiency as well as greater balance in energy supply.
Keywords -*Hybrid power system, conventional, nonconventional, power management, efficiency, power source.*
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INTRODUCTION

INDIA the country second largest in population, but quite far in power rank . This causes trouble for Population to use the Power; we have quite less energy per capita per head. The main problem is base power plant's efficiency. Energy is a requirement that is endlessly and exhaustingly utilized the world over. With the increase in the rate of various developmental activities around the world the energy being consumed is also increasing with the result that conventional energy resources are fast getting depleted and even hidal reserves are proving less than sufficient to satisfy the growing energy demand. When thinking about nonconventional source of energy what usually comes to our mind are the existing and extensively used nonconventional sources of energy like solar, tidal, wind, geo thermal heat, biomass .But in countries where we have so fluctuant weather and temperature, to depend on these resources are highly unreliable .That made think out of the box and find a new method of generating energy which should be highly reliable and cost effective, which is a hybrid power system. Hybrid energy system usually consists of two or more energy sources used together to provide increased system efficiency as well as greater balance in energy supply. Example of a hybrid energy system can be a solar electric (PV) array that could be coupled with a wind turbine, which would create output from the wind turbine during the winter, whereas during the summer the solar panels would produce their output with a better efficiency.

NEED OF HYBRID POWER PLANT

There are some disadvantages which leads to use Hybrid Power;
1. It is costlier in running cost as compared to Hydro electric plants.
2. It pollutes the atmosphere due to production of large amount of smoke and fumes.
3. Over all capital investment is very high on account of turbines, condensers, boilers reheaters etc. maintenance cost is also high on lubrication, fuel handling, fuel processing.

4. It requires comparatively more space and more skilled operating staff as the operations are complex and required precise execution
5. A large number of circuits makes the design complex.
Starting of a thermal power plant takes fairly long time as the boiler operation and steam generation process are not rapid and instantaneous

HYBRID POWER SYSTEM

The solution of above problem is "HYBRID POWER SYSTEM". As we know Hybrid is a mixing of two or more methods, which puts a efficient result. A hybrid power system is nothing but a system that uses more than one source to produces electrical energy. Apart of the existing system in which tying up of outputs of different generating stations, here the different sources of energy are tied up at the point of production that is using two or more fuels for the same device, that when integrated, overcome limitations inherent in either.
The different types of hybrid power systems that are commonly used are:
1. Solar-wind hybrid power plant.
2. A solid oxide fuel cell combined with a gas turbine or micro turbine.
3. A wind-fuel cell hybrid system.
4. Wave wind hybrid system.
5. Wind turbine with battery storage and diesel backup generator.
6. DC hybrid system and micro grid.
Here we are considering mainly on SOLAR-WIND HYBRID POWER, because it is the time to look towards the non conventional sources of Energy.

REMOTE AREA POWER SYSTEMS (RAPS)

When considering a remote stand alone electrical power generating system it makes economic sense to specify a hybrid system with both solar and wind power systems together rather than a single energy source.

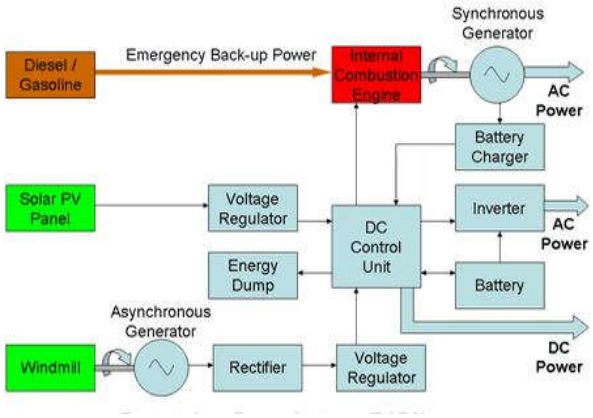

Fig 1: Remote Area Power System (RAPS)

SOLAR-WIND HYBRID POWER

Hybrid system is a combined system of wind and solar power generation system. Aero turbines convert wind energy into rotary mechanical energy. A mechanical interface, consisting of a step-up gear and a suitable coupling transmits the energy to an electrical generator. The output of this generator is connected to the Battery or system grid. The battery is connected to the inverter. The inverter is used to convert DC voltages to AC voltages. The load is drawn current from the inverter.
Main parts of the wind mill section are:
1. Generator
2. Main shaft with Leafs
3. Gear Wheel Arrangement
Solar energy means all the energy that reaches the earth from the sun. It provides daylight makes the earth hot and is the source of energy for plants to grow. Solar energy is also put to two types of use to help our lives directly solar heating and solar electricity. Solar electricity is the technology of converting sunlight directly in to electricity. It is based on photo-voltaic or solar modules, which are very reliable

and do not require any fuel or servicing. Solar electric systems are suitable for plenty of sun and are ideal when there is no main electricity.

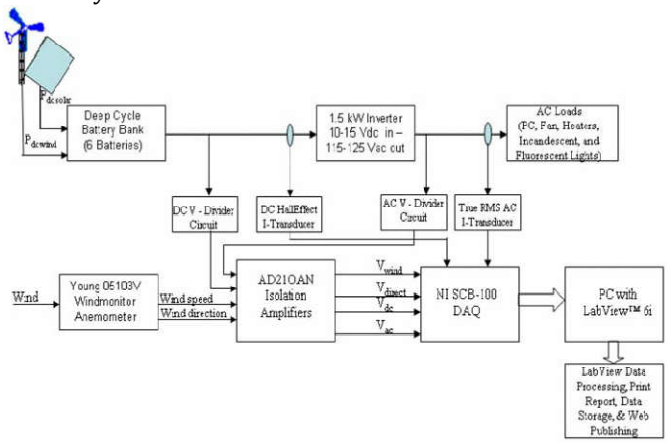

Fig 2: Solar-Wind Hybrid Power Station

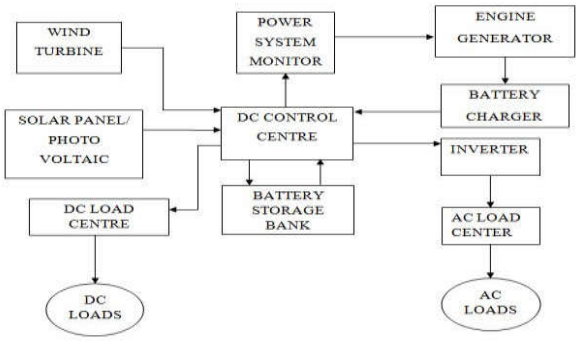

Fig 3: Block Diagram of Solar-Wind Hybrid Power

COMBINING WIND TURBINE AND SOLAR PANELS

If the amount of energy consumption increases, it makes sense to combine Photo Voltaic 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. Combining Wind Turbine and Solar Panels into a hybrid system offers several advantages. In many places, wind speeds are low in the summer when the sun is plentiful. The wind is strong in the winter when less sunlight is available. Because the peak operating times for wind and solar systems occur at different times of the day and year, hybrid systems are better balanced and more likely to produce power when you need it.

Wind Solar Hybrid power System includes:

1. *SOLAR ARRAY*: A number of PV panels connected in series and/or in parallel giving the required DC output from the available irradiance. Orientation and tilt of these panels are important design parameters, as well as avoiding as much shading as possible from surrounding obstructions.

2. WIND TURBINE: This is installed on top of a tall tower, collects kinetic energy from the wind and converts it to electricity that is compatible with a home's electrical system.

3. HYBRID CONTROLLER: This controls the battery bank charge and discharge keeping it within optimum safety limits.

4. BATTERY BANK: This can be a single battery or multiple batteries connected together to create essentially one large battery of the required voltage and amp- hour capacity. The battery configuration

and capacity are the most important electrical power decisions that have to be made, and a wise choice in this regard can help guarantee a steady supply of electrical power as well as a system that is simple to operate and maintain.

5. INVERTER: A converter that changes the DC power from the batteries into AC power suitable for the require loads. Loads being the network connected appliances in the building that are fed from the inverter (A loads), or from the battery bank (DC loads).Wind solar hybrid power system is an integrated system of solar energy and wind energy. The rational allocation of every part's capacity of generating system is very important to guarantee the reliability of generating system. To satisfy the requirement of users' electricity consumption, our company will analyze the electricity consumption and local solar and wind resources conditions to allocate the most suitable system for different users. Many hybrid systems are stand-alone systems, which operate "off-grid"—not connected to an electricity distribution system. For the times when neither the wind nor the solar system are producing, most hybrid systems provide power through batteries and/or an engine generator powered by conventional fuels, such as diesel. If the batteries run low, the engine generator can provide power and recharge the batteries. Adding an engine generator makes the system more complex, but modern electronic controllers can operate these systems automatically. An engine generator can also reduce the size of the other components needed for the system. Keep in mind that the storage capacity must be large enough to supply electrical needs during non-charging periods. Battery banks are typically sized to supply the electric load for one to three days .Hybrid generator systems can be created either as grid-assisted or grid-inter-tied and off-grid. Grid assisted systems can use both electrical grid and various energy sources. The electrical energy provided from these multiple sources can then be stored in battery systems. There's a bonus to grid-assisted different energy sources. When the wind does not blow, or the sun will not shine, the electrical system will still be storing power in the battery system. In these systems, hybrid generators operate as a method to reduce utility costs. Off-grid systems on the opposite hand are designed to supply alternative energy sources that are fully become independent from grid power. Hybrid generators in this case are the sole technique of electrical input to the battery storage system. Initial, they minimize the environmental footprint of someone's electrical consumption. Second, they eliminate an individual's reliance upon utility firms and utility costs. Lastly, hybrid generator systems can be created nearly anywhere replacing the requirement for expensive utility connections to remote areas. With any natural disaster electricity may be out for an unknown period of time. When a large disaster strikes (hurricane, terrorist attack, earthquake, tornado, etc.) many of the necessities of life are suddenly gone, poof! - Instantly gone. Electricity is always the first to go. After a massive disaster, emergency lighting may need to be used for a long time - days, weeks, even months. If you are trying to mitigate or plan for the above "massive disaster" scenario, on a small personal scale, it would make much more sense to have a reliable means of using natural energy than storing gasoline or batteries which go bad and age over time. What if you had to move around a stricken area or totally "Bug out" and evacuate an area? There an off grid solar wind hybrid generator will help you.

METHODS OF SIZING PV-WIND HYBRID SYSTEM

THE YEARLY MONTHLY OVERAGE SIZING METHOD: In this method, photovoltaic and wind generators size are measured from the average annual monthly values of energies statement E PV, EW and the load EL. This calculates is basing on the average annual monthly data of sunning and the wind.

THE MOST UNFAVOURABLE MONTH METHOD: For this method the size of the PV and Wind generators is being calculated in the most unfavourable month. Generally the month most unfavourable in wind is favourable in irradiation. So we are obliged to dimension the system in two most unfavourable months (unfavourable irradiation month and unfavourable wind month). When the system functioned in this month it's automatically functioned in the other month.

LOSS OF POWER SUPPLY PROBABILITY (LPSP) METHOD: This sizing method consists in determining the optimal number of the batteries and the photovoltaic modules according to the optimization principle knowing: the reliability, which is based on the concept of the probability of loss of energy (Loss of Power Supply Probability _ `LPSP') [2], and on the cost of the system. LPSP' is defined as being the fraction of the deficiency energy and that required by the load. It explains the rate of not satisfaction of the load, in term of state of batteries charging.

FACTORS CONSIDERED FOR SIZING A HYBRID SYSTEM

The key factors to be determined while selecting the size of a solar generator are:

1. The load mix between PV and generator,
2. The size and type of generator, and
3. The battery size.

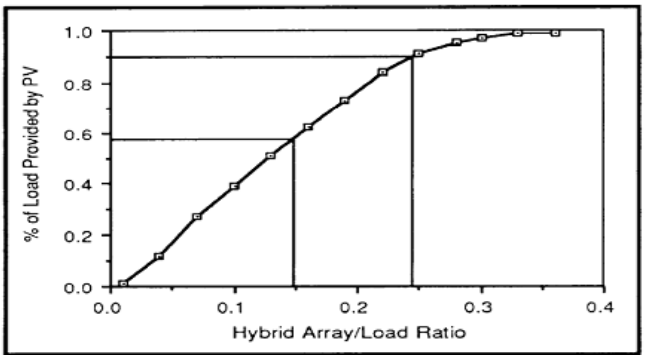

Fig: 4: Source: Stand – alone Photovoltaic System

The designer selects a hybrid array to load ratio for the system realizing that the higher up the curve, the higher the percentage of load supplied by the PV array. The load mix will be a key determinant in the type and size of the generator and the battery. The most cost-effective system is obtained by selecting a point on or slightly below the knee of the curve. For example, a hybrid array/load ratio of 0.25 should give a hybrid system design where the PV array supplied 90 percent of the annual load demand. An array/load ratio of 0.15 would give a system with lower initial cost because the amount of load provided by the PV array would be about 57 percent.

The generator would operate more in this latter design with corresponding increases in fuel cost and maintenance. If the generator is in a remote location the cost of this maintenance may be exorbitant. These are the design tradeoffs that must be made. If high reliability is required, the system should be designed for 90 to 95 percent PV contribution. The generator is used only for back-up during worst-case conditions, typically in the winter months when it is most difficult to get a generator started. Therefore, having two power sources at an unattended site does not, in itself, guarantee 100 percent reliability.

Similarly the sizes of the wind mills are also selected scientifically and in the most economical way. The control system must be properly designed for fail-safe operation and regular maintenance performed, particularly on the generator. Also, the control system for a hybrid system is more complex because the regulation of the batteries and load must be maintained under all operating conditions.

All generators require periodic routine maintenance (i.e., oil change, engine tune up, and eventually engine rebuilding). With a generator available for back-up power, the battery size in the hybrid system may be decreased without lowering system availability. However, the battery must be carefully matched to the loads and power sources. Integration of a generator into a PV system requires a more sophisticated control strategy. Most controllers are custom designed by an experienced electronic engineer / technician. Controls for PV - generator systems perform two main functions--battery regulation and subsystem management.

ADVANTAGES AND DISADVANTAGES OF HYBRID POWER PLANT

1. Fuel saving (up to 50%).
2. Lower atmospheric contamination.
3. 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.
4. 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.
5. Diversity and security of supply.
6. Rapid deployment - modular and quick to install.
7. Fuel is abundant, free and inexhaustible.
8. 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.

APPLICATION

1. In electricity generation it can be used to produce high electricity with more reliability. India is developing country and power is first need of developing country.So nonconventional energy sources are more helpful in development.
2. It helps to improve the tourism sector. People have an interest to visit village or rural areas. But the lack of good facilities withdraws a large percentage of people from it. So by providing electricity to such places, the tourism sector will be benefitted.
3.Nonconventional energy sources are environment friendly and available in huge amount. It is hybrid of wave and wind energy so it produces more power than individual wind and wave**.** Distributed Generation Applications.
4. Constant Speed and Variable Speed.
5. Wind Energy Conversion Systems, Photovoltaic Energy System.

CONCLUSION

As to fulfil the current need, we have to adopt such method which can increase our Generation capacity. Hybrid power system is an evolution in this area. It combines the advantages of both Wind and solar power Generation and it has decreased our reliability on conventional sources. They make an evolution which can make us to be dependent on Natural Resources. A hybrid power system is nothing but a system that uses more than one source to produces electrical energy. Apart of the existing system in which tying up of outputs of different generating stations, here the different sources of energy are tied up at the point of production that is using two or more fuels for the same device, that when integrated, overcome limitations inherent in either. So it revolutionizes the Power Generation capacity.

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