Hybrid Power Generation System Using Wind Energy and Solar Energy

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ABSTRACT

Renewable energy is the energy produced from sources that do not deplete or can be replenished within human life such as solar, wind, tidal, geothermal etc. Renewable energy accounts for 2% of world's electricity. Nowadays electricity is most needed facility for the human being. All conventional resources are depleting day by day, so we have to shift from conventional to non-conventional resource. We can give uninterrupted power by using hybrid energy system. In this paper hybrid combination of two energy source i.e. wind and solar. Basically this system involves integration of two energy system. Solar panels are used for converting solar energy & wind turbines for converting wind energy into electricity. This paper deals with generation of electricity by combining two non-conventional sources which leads to generate electricity which affordable cost without disturbing nature balance.

Keywords: Electricity, Hybrid, Solar, Power, Wind

I. INTRODUCTION

Electricity is most needed for our day to day life. There are two ways of electricity generation either by conventional or non-conventional energy resources like coal, diesel, nuclear, etc. the main drawback of these sources is that they produce waste like ash, nuclear which also damages the nature.

The non-conventional energy source should be good alternative for the same. These. There are many non-conventional energy source such as geothermal, wind, solar, etc.

Solar and wind energy are available in all condition. They have been deemed clean, inexhaustible, unlimited and environment friendly. Such characteristics has attracted the energy sector to use renewable energy source on larger scale. However, all renewable energy sources have drawbacks too.

Wind and solar source is dependent on unpredictable factors such as weather and climatic condition. To overcome this drawback we can use two energy resources. This brings us to the hybrid solar. Solar, wind, power plant concept. Hybrid energy system have proven to be advantageous for decreasing the environment.

II. SOLAR ENERGY

Solar energy is the energy which gets by the radiation of the sun. it is renewable, inexhaustible & environment pollution free and affordable in cost. Solar charged battery system provide power supply for complete 24 hrs a day irrespective of bad weather. It has greater efficiency and only need initial investment.

III. WIND ENERGY

Wind is natural phenomenon related to the movement of air masses caused primarily by differential solar heating of earth's surface. The wind

turbines captures the winds kinetic energy in a rotor consisting of two or more blades mechanically coupled to an electrical generator the wind energy needs less cost for generation of electricity. It needs high initial cost, except it is reliable, has less emission and maintenance cost is also less.

IV. HYBRID ENERGY SYSTEM

Hybrid energy system is the combination of two energy sources for giving power to load in other word, it is defined as "Energy system which is fabricated or designed to extract power by using two energy sources. It has good reliability, efficiency, less emission & lower cost. The various hybrid are wind-solar, solar-diesel, wind-hydro. In this proposed system, solar & wind is used for generating power. Hybrid energy generation is more important because wind do nit flow continuously & sun radiation is only present approx 8 to 10 hrs a day. So for continuous power, it is important to hybridise the solar & wind power with storage batteries.
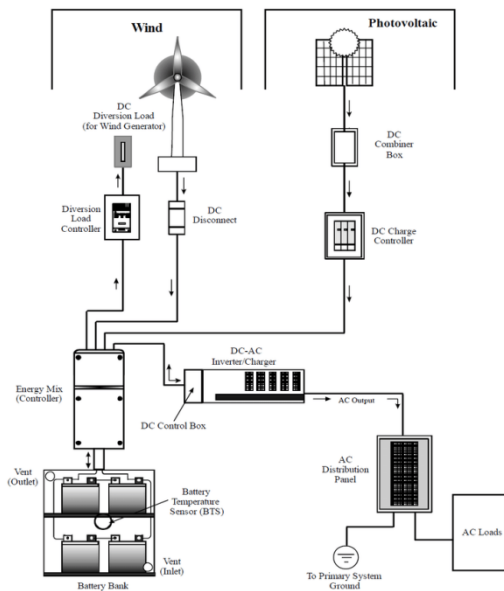

Figure 1: Schematic diagram of Hybrid (Renewable) Solar – Wind Power Source

❖ DESIGN OF HYBRID ENERGY SYSTEM

For designing of hybrid energy, we need to find data as follows

a. Data requirement for solar system

1. Annual mean daily duration of sunshine hours.
2. Daily solar radiation horizontal (kwh/m²/day)

b. Data requirement for wind system

1. Mean annual hourly wind speed (m/sec)
2. Wind power that can be generated from wind turbine.

The above fig. shows block diagram of hybrid power generation system using wind & solar power. It consist of following components.

1. Solar panel
2. Wind turbine
3. Charge Controller
4. Batteries
5. Inverter

1. Solar panel:- solar/pv panel are used to connect the renewable power coming from sun into electrical energy. The principle working solar panel is with semiconductor i.e. PN junction diode. When junction absorbs light, energy absorbed photon is transferred to electron-proton system of material creating charge carriers which get separated at junction. These charge carries field is circulate potential electrically connected in series parallel combination to generate required current & voltage.

2. Wind Turbine:- It is a mechanical system which generates electrical energy from renewable energy source. It extracts energy from wind by rotation of blades. Basically wind turbine has two types, one is vertical & another is horizontal. The wind speed does not remains same. The power generated from wind is not continuous, its fluctuating to obtain non-fluctuating power, we have to store in battery & then provide it to the load.

3. Charge controller:- Charge controller has basic function that it control the source which is to be active or inactive. It simultaneously charge battery and also gives power to the load. The controller has

over-charge protection. Short-circuit protection, pole confusion protection and automatic dump-load function. It also the function is that it should vary the power as per the load demand can fulfill. And when power is not generating it should extract power from battery and give it to the load.

4. Batteries:- Batteries are used in order to store electricity that is produced from wind energy. The capacity of battery may vary depending on the size of wind turbine or solar power plant. Battery should be having low maintenance & charge leakage should also be low. Multiple batteries can be connected in series & parallel to increase or decrease the capacity of battery, depending upon capacity of battery, depending upon o/p from hybrid system.

5. Inverter:- As we know most of the electrical appliances require Ac voltage, so first Dc output of batteries will be converted into AC voltage with the help of an Inverter. We have to choose greater rating inverter than desired rating, it must be having over voltage protection, reverse polarity & short circuit protection, the input voltage output voltage & frequency and overall power handling depends on the design of the specific device or the chemistry.

V. FORMULAS

The total power generated by this system may be given as the addition of the power generated by the solar PV panel and power generated by the wind turbine.

Mathematically it can be represented as,

$$P_T = N_w * P_w + N_s * P_s$$

Where,

P_T is the total power generated

P_w is the power generated by wind turbines

P_s is the power generated by solar panels

N_w is the no of wind turbine

N_s is the no of solar panels used

A. Calculations for wind energy

The power generated by wind energy is given by,

Power=(density of air*swept area*velocity cubed)/2

$$P_w = \frac{1}{2} \cdot \rho (A_w)(V)^3$$

Where,

P is power in watts (W)

ρ is the air density in kilograms per cubic meter(kg/m^3)

A_w is the swept area by air in square meters (m^2)

V is the wind speed in meters per second(m/s)

B. Calculations for solar energy

To determine the size of PV modules, the required energy consumptions must be estimated. Therefore, the power is calculated as

$$P_s = \text{Ins}(t) * A_s * \text{Eff}(pv)$$

Where,

Ins(t)= isolation at time t (kg/m^2)

A_s= area of single PV panel (m^3)

Effpv= overall efficiency of the PV panels and dc/dc converters.

Overall efficiency is given by,

$$\text{Eff(pv)= H*PR}$$

Where,

H= Annual average solar radiation on tilted panels.

PR= Performance ratio, coefficient for losses

C=cost

The total cost of the solar-wind hybrid energy system is depend upon the total no of wind turbine used and total no of solar panels used. Therefore the total cost is given as follows

Total cost=(No. of wind turbine*cost of single wind turbine)+(No. of solar panels*cost of single solar panel)+(No. of batteries used in battery bank* cost of single battery)

$$C_T = (N_w * C_{WT}) + (N_s * C_{SP}) + (N_B * C_B)$$

Where,

C_T is the total cost in Rs

C_{WT} is the cost of single wind turbine in Rs

C_{SP} is the cost of single Battery in Rs

C_B is the cost of single Battery in Rs

N_w is the number of wind turbine used

N_s is the number of solar panels used

N_B is the number of Batteries used in Battery Bank.

Applications:-

- Islanded System (Remote Areas)
- Hybrid vehicle (Fuel less)
- Distributed power generations
- Transmission & communication tower

Advantages:-

- Best for Remote area System(RAPS)
- Can be used for 24 hrs power generation
- Operational in all weather
- Green, Environment Friendly
- Higher output power
- Efficiency improvement

VI. CONCLUSION

Hybrid power generation system is good and effective solution for power generation than conventional energy resources. It has greater efficiency. It can provide to remote places where government is unable to reach. So that the power can be utilize where it is generated so that it will reduce the transmission losses and cost. Cost reduction can be done by increasing the production of equipment. People should be motivated to use the non conventional energy resources. It is highly safe for the environment as it doesn't produce any emission and harmful waste product like conventional energy resources. It is cost effective solution for generation. It only need initial investment and affordable solution for electricity generation.

VII. REFERENCES

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