Hybrid Power Generation System Using Wind Energy and Solar Energy

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Abstract

Now a day's electricity is the most needed facility for the human being. All the conventional energy resources are depleting day by day. So we have to shift from conventional to non-conventional energy resources. On this, the combination of two energy resources is taking place i.e. wind and solar energy. This process reviles the sustainable energy resources without damaging the nature. We can give uninterrupted power by using hybrid energy system. Basically, this system involves the integration of two energy system that will give continuous power. Solar panels are used for converting solar energy and wind turbines are used for converting wind energy into electricity. This electrical power can utilize for various purpose. Generation of electricity will take place at an affordable cost. This paper deals with the generation of electricity by using two sources combine which leads to generating electricity with affordable cost without damaging the natural balance.

Keywords

Electricity, Hybrid, Solar, Power, Wind.

Introduction

Electricity is most needed for our day to day life. There are two ways of electricity generation either by conventional energy resources or by non-conventional energy resources. Electrical energy demand increases in word so to fulfill demand we have to generate electrical energy. Now a day's electrical energy is generated by the conventional energy resources like coal, diesel, and nuclear etc. The main drawback of these sources is that it produces waste like ash in coal power plant, nuclear waste in nuclear power plant and taking care of this wastage is very costly. And it also damages the nature. The nuclear waste is very harmful to human being also. The conventional energy resources are depleting day by day. Soon it will completely vanish from the earth so we have to find another way to generate electricity. The new source should be reliable, pollution free and economical. The non-conventional energy resources should be good alternative energy resources for the conventional energy resources. There are many non-conventional energy resources like geothermal, tidal, wind, solar etc. the tidal energy has drawbacks like it can only implement on seashores. While geothermal energy needs very lager step to extract heat from the earth. Solar and wind are easily available in all condition. The non-conventional energy resources like solar, wind can be a good alternative source. Solar energy has a drawback that it could not produce electrical energy in the rainy and cloudy season so we need to overcome this drawback we can use two energy resources so that any one of source fails another source will keep generating the electricity. And in good weather condition, we can use both sources combined.

Hybrid Energy System

The hybrid energy system is the combination of two energy sources for giving power to the load. In another word, it can define as "Energy system which is fabricated or designed to extract power by using two energy sources is called as the hybrid energy system." Hybrid energy system has good reliability, efficiency, less emission, and lower cost. In this proposed system, solar and wind power is used for generating power. Solar and wind have good advantages than other than any other non-conventional energy sources. Both the energy sources have greater availability in all areas. It needs lower cost. There is no need to find a special location to install this system.

Solarenergy

Solar energy is that energy which it gets by the radiation of the sun. Solar energy is present on the earth continuously and in an abundant manner. Solar energy is freely available. It doesn't produce any gases that mean it is pollution free. It is affordable in cost. It has low maintenance cost. The only problem with the solar system it cannot produce energy in bad weather condition. But it has greater efficiency than other energy sources. It only needs initial investment. It has long life span and has the lower emission.

Windenergy

Wind energy is the energy which is extracted from the wind. For extraction, we use wind mill. Ii is renewable energy sources. The wind energy needs less cost for generation of electricity. Maintenance cost is also less for wind energy system. Wind energy is present almost 24 hours of the day. It has less emission. Initial cost is also less of the system. Generation of electricity from wind depends upon the speed of wind flowing.

The major disadvantages of using independent renewable energy resources are that unavailability of power for all time. For overcoming this we use solar and wind energy together. So that any one source of power fails other will take care of the generation. In this proposed system we can use both sources combined. Another way is that we can use any one source and keep another source as a standby unit. This will leads to continuity of generation. This will make the system reliable. The main disadvantages of this system are that it needs high initial cost. Except that it is reliable, it has less emission. Maintenance cost is less. The lifespan of this system is more. Efficiency is more. The main advantage of this system is that it gives continuous power supply.

Design Of Hybrid Energysystem

For design of the hybrid energy system, we need to findthe data asfollows

Data required for SolarSystem

[1]. Annual mean daily duration of Sunshinehours

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[2]. Daily Solar Radiation horizontal(KWH/m2/day)

Data required for WindSystem
[3]. Mean Annual Hourly Wind Speed(m/sec)
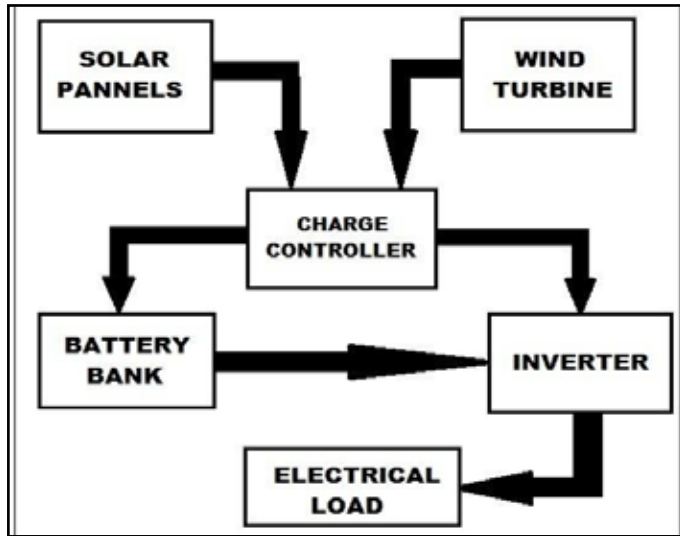[4]. Wind Power that can be generated from the windturbine

Fig. 1 : Block diagram of Hybrid energy generation system

Above figure shows the block diagram of the hybrid power generation system using wind and solar power. This block diagram includes solarpanel, windturbine, chargecontroller, battery bank, and inverter

Solarpanel
The solar panel is used to convert solar radiation to the electrical energy. The physical of PV cell is very similar to that of the classical diode with a PN junction formed by the semiconductor material. When the junction absorbs light, the energy of an absorbed photon is transferred to the electron-proton system of the material, creating charge carriers that are separated at the junction. The charge carriers in the junction region create a potential gradient, get accelerated under the electric field, and circulate as the current through an external circuit. Solar array or panel is a group of several modules electrically connected in series-parallel combination to generate the required current and voltage. Solar panels are the medium to convert solar power into the electrical power.

Windturbine
The wind turbine is that system which extracts energy from wind by rotation of the blades of the wind turbine. Basically, the wind turbine has two types one is vertical and another is horizontal. As the wind speed increases power generation is also increases. The power generated from wind is not continuous its fluctuating. For obtain the non-fluctuating power we have to store in battery and then provide it to the load.

Chargecontroller
Charge controller has basic function is that it control the source which is to be active or inactive. It simultaneously charges 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. It adds the both the power so that the load demand can fulfill. And when power

is not generating it should extract power from the battery and give it to the load.

Batterybank
We have to choose battery bank size per the load requirement so that it should fulfill the requirement of load for calculating the battery bank size we need to find following data
•   Find total daily use in watt-hour(Wh).
•   Find total back up time of thebattery
For an increase in battery bank size, we need to connect cell in series so that we can get the larger battery bank size.

Inverter
We have to choose greater rating inverter than the desired rating. The pure sign wave inverter is recommended in other to prolong the lifespan of the inverter. The inverter is needed to convert DC power into AC power. As our load working on the AC supply so we need to convert DC power. The input voltage Output voltage and frequency, and overall power handling depends on the design of the specific device or the circuitry. The inverter does not produce any power. The power is provided by the DC source.

Proposed Calculation
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 = total power generated
P_W = power generated by wind turbines
P_S = power generated by solar panels
N_W = no of wind turbine
Ns = no of solar panels used

Calculations For Wind Energy
The power generated by wind energy is given by,

$$Power = \frac{density\ of\ air * swept\ area * velocity\ cubed}{2}$$

$$Where,\ Pw = \frac{1}{2} \rho\ A_w\ V^3$$

P = power in watts (W)
ρ= air density in kilograms per cubic meter (kg/m³)
A_w= swept area by air in square meters (m²)
V = wind speed in meters per second (m/s).

Calculations For Solar Energy
To determine the size of PV modules, the required energy consumption must be estimated. Therefore, the power is calculated as

$$Ps = Ins(t) * As * Eff(pv)$$

Where,
Ins (t) = isolation at time t (kw/ m2)
AS = area of single PV panel (m2)
Eff(pv) = overall efficiency of the PV panels and dc/dc converters.
Overall efficiency is given by,
Eff(pv)= H * PR

Where,

H = Annual average solar radiation on tilted panels. PR = Performance ratio, coefficient for losses.

Cost

The total cost of the solar-wind hybrid energy system is depend upon the total no of wind turbines 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= total cost in Rs

C_{WT}= cost of single wind turbine in Rs

C_{SP}= cost of single solar panel in Rs

C_B= Cost of single Battery in Rs

N_W= number of wind turbine used

N_S= number of solar panels used

N_B= number of Batteries used in Battery Bank.

Solar-wind hybrid energy systems need only initial investment. It will compete well in the generation with the conventional energy sources. When accounted for a lifetime of reduced or avoided utility costs. The cost of the system depends on the system chosen, wind resource on the site, electric costs in the area, and the battery bank required. Cost of the Wind-Solar Hybrid system is to be minimized. For minimizing the cost of the system we need to increase the use of nonconventional energy sources. So that production of solar and wind power generator will be increased. That will reduce the cost of the whole system.

Conclusion

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

investment. It has also long lifespan. Overall it good, reliable and affordable solution for electricity generation.

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