



Hybrid Power Generation System Using Wind Energy and Solar Energy

MISS. RITUPARNA GUCHHAYAT

(M.TECH 2ND YEAR POWER SYSTEM FROM RKDF UNIVERSITY)

Abstract- Today as we all know that electricity is most necessity facility for the human being. The conventional energy resources are depleting day by day and demand for more energy makes us seek for new energy sources. This journal addresses for choosing optimal scheme of standalone power supply to consumers of mineral resource industry located far from a centralized power supply system using a hybrid wind-solar unit. Substantiation has been made for the Wind and solar energy have being popular in abundant, due to the ease of availability also for convertibility to the electric energy. By using hybrid system we can get continual power. Basically this system has the integration of two types of energy system that can give continuous power. Solar panels are used for converting solar energy and wind turbines are used for converting wind energy into electricity. These electrical power can be utilize for various purpose and can be fed to the grid system.. This paper will deals with the generation of electricity by using two types of sources when combine produce electricity at affordable cost without damaging the nature balance.

Keyword- electricity, hybrid, solar, power, wind, conventional and non- conventional Energy

I. INTRODUCTION

One of the driving forces for social and economic development and a basic demand of nations is energy. Most of the energy production methods are one-way, which requires change of form for the energy. Electricity is necessity for our day to day life for this there can be two ways of electricity generation it can be either by conventional energy resources or by non-conventional energy resources. As the appetite of electrical energy increases in world, so to fulfill this demand electrical energy have to be develop. In present scenario Electrical energy is generated by the conventional energy resources i.e coal, diesel, and nuclear etc. One of the main drawback of these sources is to produces waste like ashes in coal power plant, nuclear waste in nuclear power plant and taking care of these wastage become very costly. The nuclear power waste is also very harmful for human being. Also the conventional energy resources are getting depleted day by day, soon it will be completely get vanishes from the earth for that we have to find another way to generate electricity. Hence the new source should be reliable, pollution free & economical.

The non-conventional energy resources are the good alternative energy resources for the conventional energy resources. There are many non-conventional energy resources like, tidal, wind, geothermal, solar etc. the tidal energy has drawbacks like it can only implemented at sea shores. And geothermal energy are more complicated to available in all condition. The non-conventional energy extract heat from earth. Solar and wind are easily available in all the condition. These are non-conventional energy resources like solar, wind can be good alternative source. Solar energy have a drawback that is, it can not produce electrical energy in rainy and cloudy season. So we need to overcome these drawback we can use two energy resources, so one of source fails other source will keep generating the electricity. Where as in good weather condition we can use both sources combine. The Efficiency of solar power conversion systems is ca.18%, where as that of wind power is ca. 55%. These efficiencies could be increased by 50% with beam tracking, beam focusing and wind direction adaptive motion methods.

II. HYBRID ENERGY SYSTEM

Hybrid energy system are those system in which power of two system is combine to give energy to load. In other word it can defined as "Energy system which is fabricated or designed to extract power by using two energy sources is called

as the hybrid energy system.” These energy system has good reliability, efficiency, lower cost and less emission. In this proposed system solar and wind power is used for generating power. Solar and wind has good advantages than other than any other non-conventional energy sources. Both the energy sources are abundant in environment. It needs lower cost. There is no need to find special location to install this system.

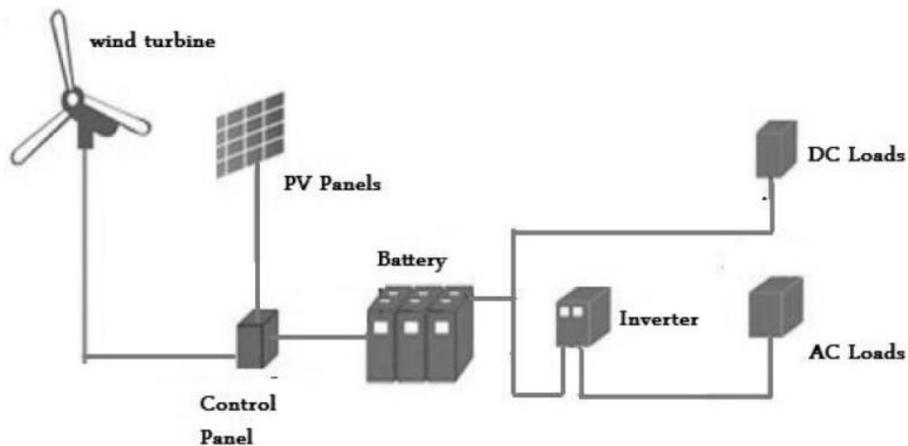


Figure 1. Hybrid System of solar and wind power

II.A. Solar Energy

Solar energy is that energy which we obtain by the radiation of the sun. Solar energy is reaches on the earth continuously and that in abundant manner. Solar energy is freely available by environment. It doesn't produce any gases and pollution free. It is affordable in cost. It also has low maintenance cost. The Only problem is withthe solar power system is that, it cannot produce energy in bad weather condition. Although it has greater efficiency compare to other energy sources. Its only need is that it requireinitial investment. It has long life span and has very lower emission.

II.B. Wind Energy

It is the energy which is extracted from the wind energy. For producing these energy we use wind mills. Wind energy isalso a renewable energy sources which needs less cost for generation of electricity. Overall maintenance cost is also less for wind energy system where as its installation cost is expensive. Wind energy is present almost 24 hours of the day. It doesntheve any emission of gas. Initial cost compare to other power generation system is less. Generation of electricity from wind is depend upon the speed of wind flowing.

One of 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. Hence any one source of power fails the other source will take care of the generation. In this proposed system we can use both sources combine. Another way is that we can use any one source and keep another source as a stand by unit. Hence it will leads to the continuity of generation. This will make the power transmission system more reliable. The main disadvantages of this system are that it needs high initial cost. Except that it is reliable, it has less emission. Maintanance cost is less. Life expectance of this system is more compare to other systems. Efficiency is more and The main advantage of this system is that it gives continuous power supply.

III. DESIGN OF HYBRID ENERGY SYSTEM

for the design of the hybrid energy system, the following data have to find:

III.A. Data required for Solar System:

1. Annual mean daily duration of radiation receive on earth (Sunshine) hours
2. Daily Solar Radiation at horizontal (KWH/m²/day)

III.B. Data required for Wind System:

1. Mean Annual Hourly Wind Speed (m/sec)
2. Wind Power that can be generated from the wind turbine

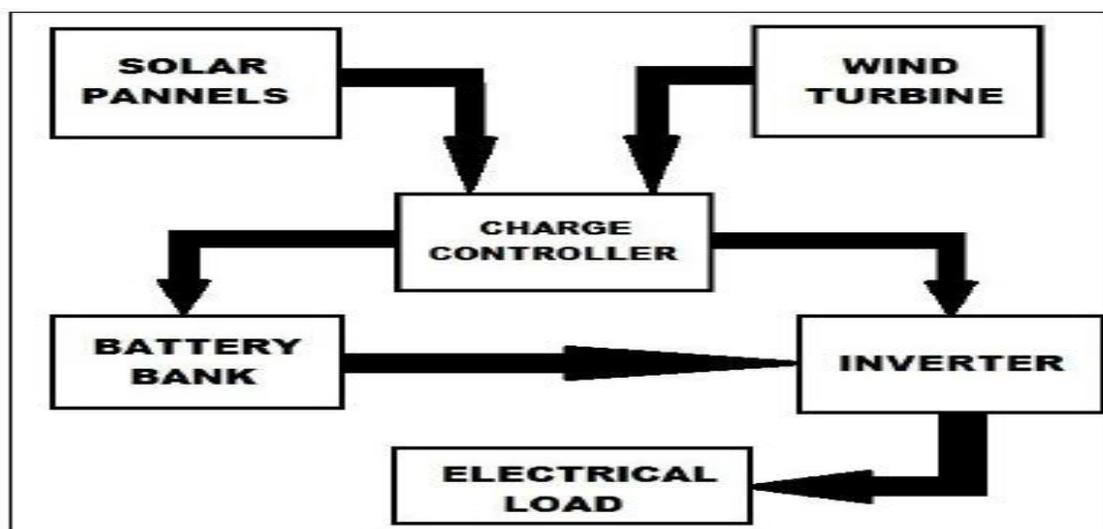


Fig2. Block diagram of Hybrid energy generation system

As we can see from the above figure2 block diagram of the hybrid power generation system which is using wind and solar power system.

This block diagram includes following blocks.

- i. Solar panels:
- ii. Wind turbine
- iii. Charge controller
- iv. Battery bank
- v. Inverter

i) Solar panel :

Solar panel convert the solar radiation into the electrical energy. The construction of PV cell is very similar to that of classical diodes in which a PN junction is formed by semiconductor material. When the diodejunction absorbs light, the energy of radiation absorbed by photon and is transferred to the electron-proton system of the material, this create charge carriers that are separated at the junction. The charge carriers in the junction region create a potential gradient, which get accelerated due to the electric field, and it circulate as current by an external circuit. Solar array or panel is a group of several modules, they are electrically connected in seriesand parallel combination to generate the required current and voltage. Solar panels are the mode to convert solar power into the electrical power.

ii) Wind turbine:

Wind turbine is the system which generate energy from wind by the rotation of the blades of the wind turbine. Basically wind turbine are of two types:

Horizontal Axis Wind Turbines (HAWT): Horizontal axis wind turbines, also shortened to HAWT, are the common style that most of us think of when we think of a wind turbine. A HAWT has a similar design to a windmill, it has blades that look like a propeller that spin on the horizontal axis.

Vertical axis Wind Turbines(VAWT): Vertical axis wind turbines, as shortened to VAWTs, have the main rotor shaft arranged vertically. The main advantage of this arrangement is that the wind turbine does not need to be pointed into the wind. This is an advantage on sites where the wind direction is highly variable or has turbulent winds. 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.

iii). Charge controller:

Charge controller has basic function it control the source which is to be active or inactive. It simultaneously charge battery and also gives power to the load. Charge controller is a device preventing batteries from overcharging and over discharging. One of the most common problems of batteries is that they cannot be discharged excessively or recharged too often. A charge controller controls the charge by managing properly the battery voltage and current. 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 add the both the power so that the load demand can fulfill. And when power is not generating it should extract power from battery and give it to the load.

iv) Battery Bank :

Solar batteries can be represented with an equivalent circuit of a current source, a resistor and in parallel, and an external load-resistor , as seen in Figure 3.

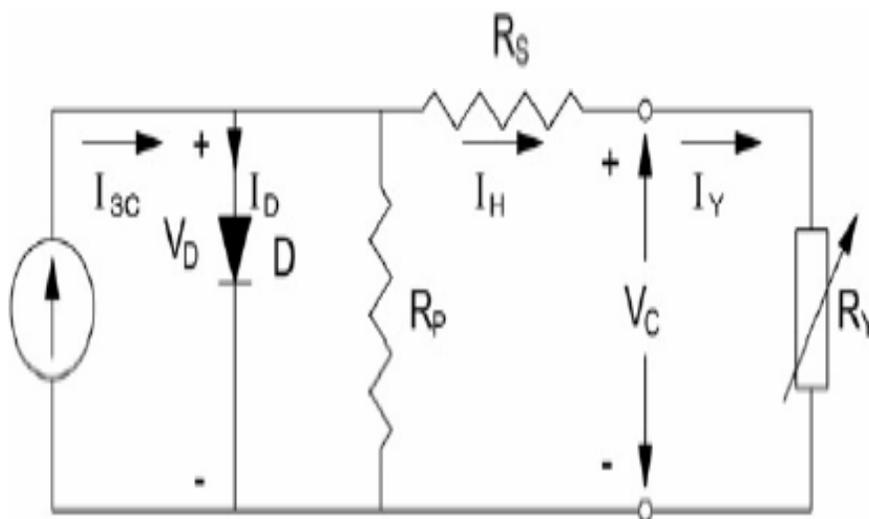


Figure 3. Equivalent circuit of solar battery

It is possible to insert AC-DC converter, charger, accumulator, extra power source, and controller depending on the design differences in operational and functional specifications. Solar system could be categorized into two types:

Line-independent systems: These are established in absence of line electricity to provide electricity. Since the current in these systems are DC and it must be also available overnight, energy is stored in accumulators, DC-Batteries. In case of AC-Supply requirements for the appliances, it is possible to use DC-AC invertors .

Line-dependent systems: These systems do not need DC Batteries, since the energy is served to the demand with the help of an invertors. Line electricity is being switched in use in case of insufficient sun beam .

We have to choose battery bank size per the load requirements so that it should fulfill the requirement of load for calculating the battery bank size. following data we need to find :

1. Find total daily use in watt-hour (Wh).
2. Find total back up time of the battery

To increase battery bank size , battery should be connect in series and parallel for that we can get the larger battery bank size.

v. Inverter

We have to choose the higher rating of inverter than the desired rating. For this system pure sine wave inverter is recommended in order to prolong lifespan of the inverter. Inverter is required 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.

IV. 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,

$$PT = NW * Pw + Ns * PS$$

Where,

- PT is the total power generated
- PW is the power generated by wind turbines
- PS is the power generated by solar panels
- NW is the no of wind turbine
- Ns is the no of solar panels used

IV.A. Calculations for wind energy

The power generated by wind energy is given by,

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

$$PW = \frac{1}{2} \cdot \rho (AW) (V)^3$$

Where,

- P is power in watts (W)
- ρ is the air density in kilograms per cubic meter (kg/m^3)
- AW is the swept area by air in square meters (m^2)
- V is the wind speed in meters per second (m/s).

IV.B. 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)

Effpv = 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.

IV.C. 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)

$$CT = (NW * CWT) + (NS * CSP) + (NB * CB)$$

Where,

CT is the total cost in Rs

CWT is the cost of single wind turbine in Rs

CSP is the cost of single solar panel in Rs

CB is the Cost of single Battery in Rs

NW is the number of wind turbine used

NS is the number of solar panels used

NB is the number of Batteries used in Battery Bank.

Solar-wind hybrid energy systems needs only initial investment its maintenance cost is very less as compare to other power system. It will compete well with other conventional energy sources. The cost of the system depends on the system that have chosen, it also depend on the wind resource on the site, the transmission cost also matter, electric costs(tariff) in the area and the battery bank required. For minimize the cost of the system we need to increase the use of non conventional energy sources. So that production of solar and wind power generator will be increase. That will reduce cost of the whole system.

V. 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 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 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. It has also long life span. Overall it good, reliable and affordable solution for electricity generation. S

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