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SOLAR-WIND HYBRID SYSTEM

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Abstract: In India, more than 200 million people live in rural areas without access to grid-connected power. All the conventional energy resources are depleting day by day. So we have to shift from conventional to non-conventional energy resources. A convenient &cost-effective solution would be hybrid power systems which can reduce dependency on grid supply, improve reliability. 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. This paper deals with the generation of electricity by using two sources combine which leads to generate electricity with affordable cost without damaging the nature balance[1].

I. INTRODUCTION

Hybrid energy system is the combination of two energy sources for giving power to the 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." 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. The Ministry has been implementing a programme "Small Wind Energy And Hybrid Systems" (SWES) Programme to promote small wind turbines and wind solar hybrid systems since early 90s. Under the programme, financial support is provided for installation of wind–solar hybrid systems. The objective of the programme on Small Wind Energy and Hybrid Systems (SWES) is to develop technology and promote applications of water pumping windmills and aero-generators/ Wind-Solar hybrid systems including promotion by setting up of demonstration projects in North Eastern region and J&K areas. 25 SWES projects will be taken up in special areas in N-E including Sikkim and J&K including Leh and Laddakhhaving capacity in the range of 10 kW on demonstration basis. Under this category financial support @ Rs. 2.25lakh per kW can be provided[2,3].

A. Solar Energy

India is potentially one of the largest markets for solar energy in the world. The estimated potential of power generation through solar photovoltaic system is about 20 MW / Sq.km in India [5]. There is more than enough solar radiation available around the world to satisfy the demand for solar power systems. The proportion of the sun's rays that reaches the earth's surface is enough to provide for global energy consumption 10,000 times over. On average, each square meter of land is exposed to enough sunlight toproduce 1,700 kWh of power every year [1]. It is useful for providing grid uality, reliable power in ruralareas where the line voltage is low and insufficient to cater to connected load.
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.[1,4]

B. Wind Energy

Wind energy is the kinetic energy associated with the movement of atmospheric air. It has been used forhundreds of years for sailing, grinding grain, and for irrigation. Wind energy systems convert this kineticenergy to more useful forms of power. Wind energy systems for irrigation and milling have been in usesince ancient times and since the beginning of the 20th century it is being used to generate electric power. It 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. Generation of electricity from wind is depend 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 combine. This will make system reliable.[2]

II. DESIGN OF HYBRID ENERGY SYSTEM

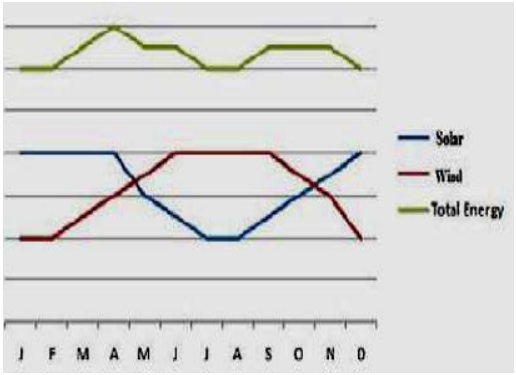

Fig.1. Sessional variation in solar and wind Energy.

The project can also be applied in urban area but the overall cost for this project would be more than the mains power supply installation. Therefore the methodology is particularly applicable in rural areas only.[3] As seen above, winter months with typical reductions in solar irradiance (shorter days) bring an increased power in potential wind energy. This relationship extends to the daily cycle as well. During

the mid-day, wind speeds are typically lower, but the solar potential is high. Conversely, at night winds are more typical, but there is no power available to the P.V. elements in the system. P.V. is operational only during daylight hours, which limits the overall production of a system. Wind has the potential to produce 24 hours a day, given the right conditions, but most importantly throughout evening hours when solar is not available.[3]

For design of the hybrid energy system we need to find the data as follows

A. Data required for Solar System:

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

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

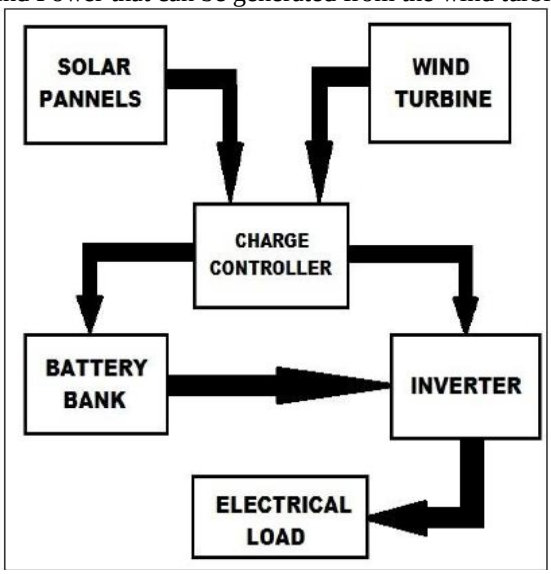

Fig. Block diagram of Hybrid energy generation system

Above figure shows the block diagram of the hybrid power generation system using wind and solar power. This block diagram includes following blocks.

i. Solar panel
ii. Wind turbine
iii. Charge controller
iv. Battery bank
v. Inverter

The solar-wind hybrid system consists of the following components:-

1. Solar Photovoltaic panels which collect the incident radiation of the sun whenever it falls on them and converts it into Direct Current output.
2. Mini Wind Turbine which is installed on top of a tall tower or placed in an open field to collect kinetic energy from the wind whenever it is available.
3. Aero-Wind Generator which converts kinetic energy of the wind turbine into electricity.
4. Battery Bank includes a group of batteries which are connected together to have one large battery bank having required voltage and ampere-hour capacity. Batteries are connected in series to increase the net voltage of the bank and in parallel to increase the amperage.

5. Maximum Power Point Tracking Controller (MPPT) is an electronic power converter which does the optimization of the power coming from the solar panels and wind generators and matches it to the capacity of the battery bank. Usually DC power is generated from both the system and this is quite high for charging of batteries. So, this higher DC voltage output is brought down to the lower voltage level required to charge the batteries.
6. PV Panel Trackers track the movement of the sun for maximum sunlight. Solar panels are mounted on these trackers.
7. Inverter is connected to the battery bank. Inverter converts the DC power received from the solar panels and the wind generator into AC power which is then utilized for residential or any other commercial purpose. Inverter supplies AC loads connected to it.[1,4]

III. SYSTEM DATA CALCULATION

The total power generated by this system may be given as Mathematically,

$PT = NW * Pw + Ns * PS$

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

A. Calculations for wind energy

The power generated by wind energy is given by,

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

$P1 = ½. \rho (AW) (V) 3$

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).

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

$P2 = I(t) * A*\eta(pv)$

Where,

I (t) = isolation at time t (kw/ m2)
A = area of single PV panel (m2)
η= overall efficiency of the PV panels and dc/dc converters.

Overall efficiency is given by,

$\eta = H * PR$

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 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. It will compete well in generation with the conventional energy sources. Indian markets have very few businesses involved in the designing and manufacturing highly efficient solar-wind hybrid systems. The companies which are currently supplying hybrid units in India are:

1. SIKCO – Society for Innovative Knowledge & Cost Optimization: It is one of the most integrated company in renewable energy sector in India. It produces products like Solar, Wind and Biogas power plants.
2. SU Solartech Systems: One of the leading manufacturer of PV Systems, solar thermal systems, SWEG, energy saving and security devices, etc. Other companies include K-lite Industries, Akshar electronics, Powermax Energies Pvt Ltd, Soyo power, Shaktee power, Shantee Power, Prolight Systems etc.[1,4]

IV. CONCLUSION:

Solar and wind energy integrated technologies have great potential to benefit our nation. They can diversify our energy supply, reduce our dependence on imported fuels, improve the quality of the air we breathe, offset greenhouse gas emissions, and stimulate our economy by creating jobs in the manufacturing and installation of solar and wind energy systems. By using solar and wind integrated system we can electrify remote area also it is applicable for metro cities in future to avoid unwanted load shedding. 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. 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. Overall it is good, reliable and affordable solution for electricity generation.

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