Design and Construction of Solar Wind Hybrid System

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Abstract- ***This paper deals with the design and construction of solar wind hybrid system. The main objective of this paper is to provide the energy demand by using the renewable energy sources. In this paper, energy system is suggested for a stand-alone application.***

Indexed Terms- ***solar energy, wind power, PV cell, renewable energy***

I. INTRODUCTION

The electricity energy demand is growth in all countries around the world. Renewable energy sources are expected to be given importance in the energy planning. Wind power has now become the least expensive source of new power generation and has highly growth rate in installed generation. Modularity of PV and wind system is even more important. The advantages of renewable energy are that they are sustainable and essentially clean and environmentally friendly. Hybrid energy system is the integration of two or more than two power producing technologies together with some energy storage system to supply power to the load.

II. POWER SYSTEM

A. Solar Energy

Solar energy is the most ancient source and the root for almost all fossil and renewable types. In solar power generation system, solar energy is directly transformed into electrical energy. A solar power generation system comprises of one or more than one photovoltaic panels in series or parallel in order to deliver required voltage and current. The output power of the solar array depends upon the area of the solar array, solar irradiance and efficiency of the solar array.

B. Wind Power

Wind has been an essential source of power for even longer. Wind energy (or wind power) refers to the process of creating electricity using the wind, or air flows that occur naturally in the earth's atmosphere. Generation of electricity from wind is depend upon the speed of wind flowing.

C. Hybrid System

A hybrid energy system is more efficient and provides continuous power to consumers with more reliability than a single source based system Wind-solar hybrid power systems are essentially complementing each other in the energy and supplying power to the load together. A wind-solar hybrid power system has a high stability and reliability, which can get more stable output.

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

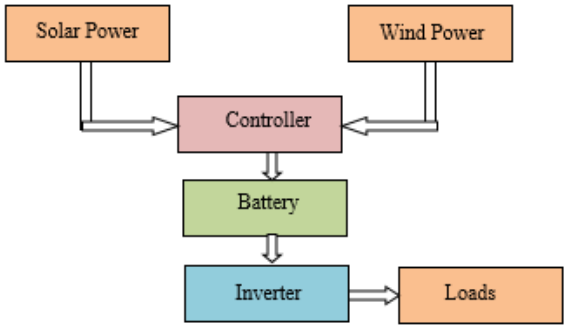

Fig. 1 Flow Chart of Solar Wind Hybrid System

III. SYSTEM COMPONENTS

A. Wind Turbine

Wind turbine is a device for extracting kinetic energy from the wind and converts electrical energy. By removing some of its kinetic energy the wind must slow down but only that mass of air which passes through the rotor disc is affected. Wind turbines are the absorption and conversion equipment of wind energy. According to the aerodynamic characteristics of the wind turbine, the wind turbine output mechanical power can be expressed as:

$$Pm = \frac{1}{2} Cp\ p\pi R^2 V^3$$

Where,

C_P = the wind power coefficient

R = the radius of the wind wheel,

p = the air density.

V = wind speed.

B. PV Cell

Photovoltaics are solar cells that convert sunlight to D.C electricity. These solar cells in PV module are made from semiconductor materials. When light energy strikes the cell, electrons are emitted. The electrical conductor attached to the positive and negative scales of the material allow the electrons to be captured in the form of a D.C current. PV panels are made up of a series of solar cells. A single, typical solar cell can generate approximately 3 watts of energy in full sunlight.

The power extracted from solar array can be calculated as follows;

$P_{solar} = A \times H \times \eta$

Where,

A = the area of the solar array

H = solar irradiance

η = the efficiency of solar array

C. CONTROLLER

Controller prevents the PV array and wind turbine over – charging the battery. Most modern controllers maintain system voltage regulation electronically by varying the width of DC pulses they send to the batteries. The controllers to be used required the following features:

- Prevent feedback from the batteries to PV modules
- It should have also a connector for DC loads
- It should have a work mode indicator.

D. INVERTER

The inverter is a power electronic converter converting DC power into AC power by turn on and turn off semiconductor power switching device. In independent wind solar power generation systems, the most of the load are AC load, so conversion efficiency and stability of the inverter directly affects the conversion efficiency and stability of the machine. The input voltage, output voltage and frequency, and overall power handling depend on the design of the specific device or circuitry. The inverter does not produce any power; the power is provided by the DC source.

E. BATTERY

Battery is the storage device of the wind-solar power generation systems. It belongs to the electrochemical batteries, it can convert chemical energy into electrical energy. Battery bank size can be chosen per the load requirement so that it should fulfill the requirement of load for calculating the battery bank size based on the following data

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

IV. SPECIFICATIONS OF SYSTEM COMPONENTS

Table 1. Specification of wind turbine

Model	
Number of Blade	3
Radius of Blade	1.2 m
Rated Voltage (V)	12 V
Rated Wind Speed	10 m/sec
Weight (Kg)	10 kg
Height (ft)	15 ft

Table.2. Specification of PV Cell

Model	18V300Wp*1pc

Rated Maximum Power (W)	300
Tolerance	± 3%
Voltage at Pmax (Vmp)	18.1 V
Current at Pmax (Imp)	16.57 A
Open Circuit Voltage	22.3 V
Short Circuit Current	17.47 A
Maximum System Voltage	1000 VDC
Maximum Series Fuse Rating	20 A
Production Application	Class A
Cell Technology	Poly-si
Weight	22.3 kg
Dimension (mm)	1956 x 992 x 45

Table.3. Specification of Controller

Model	LCD 40A
Rated PV power voltage (V)	16.5 to 36
Battery voltage	12V/24V automatic identification
Max input current (A)	44
Battery float charging voltage (V)	14.8/29.6 ± 0.2
Low voltage (V)	10.7/21.4 ± 0.2
Resume (V)	12.5/ 25 ± 0.3
Operating Temperature Range	-25°C to +60°C
Weight (Kg)	0.73
Packing Size (mm)	240 x 200 x 65

Table.4. Specification of Battery

Model	7965N-NFA-7116
Power(W)	1000
Continuous Output Power(W)	800
Open Output Power(W)	2000
Rated voltage (V)	12
Rated capacity (AH)	100
Plate Number	66
Length	330
Width	173
Height	217
Total Height	220
Weight (Kg)	26.5

Table.5. Specification of Inverter

Model	7965N-NFA-7116
Power(W)	1000
Continuous Output Power(W)	800
Open Output Power(W)	2000
Rated input voltage (V)	13±0.2 V DC
Rated output voltage (V)	205 – 235 AC
Output frequency (Hz)	50 ± 2 Hz
Over voltage protection (V)	15.5 ± 0.5 V
Low voltage protection (V)	10.5 ± 0.3 V
Over load protection (W)	1100
Over temperature protection	110° C
Weight (Kg)	1.28
Size (mm)	233 x 147 x 65

Fig.1. Project Photo of Wind Turbine and Solar Panel

(a) Controller (b) Inverter

Fig 2. Components of Hybrid System

Fig 3. Wind Solar Hybrid System

V. ESTABLISHMENT OF A HYBRID SYSTEM

The hybrid system contains two complete generating system, a solar cell system and wind turbine system.

- In PV system, The 12V, 300 W PV panel is used.
- PV cell' output is connected to controller.
- Wind Turbine is installed on the top of the tower.
- Turbine's blade are made of the plastic.
- Turbine's output is connected to the controller.
- The Controller output is connected to inverter and the loads.

The inverter is connected to the battery for energy storing.

VI. CONCLUSION

Hybrid power generation system is good and effective solution for power generation than conventional energy resources. In wind-solar hybrid power generation systems, energy conversion system is the core part of the whole system. It includes aspects of energy storage and energy conversion sectors. Energy transformation refers to the inverter; the DC power was converted into AC power and supplied to the loads in the process of energy storage.

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