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Pre-Feasibility Analysis of Solar Wind Hybrid Energy System for Domestic Purpose

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Abstract – Renewable energy sources are good source of energy because they are always available and not produce any harmful gas For any developing nation the energy play an important role because for any purpose energy is required this paper presents Analysis and design of a efficient and economical solar wind hybrid energy system with battery bank with MPPT module .For domestic purpose.

Key Words: Solar PV, Wind Turbine, Hybrid Controller, Battery Bank, Power Conditioning Unit5, etc.

1. INTRODUCTION

For development of any nation the energy play an important role without energy we cannot go for development, but the energy sources are limited on earth and due to these sources the pollution is also increase and the amount of greenhouse gases so we can find the sources which are replace the conventional energy sources these sources are non-renewable energy sources like solar wind small hydro tidal energy biogas etc. solar and wind are the major source of energy and they cannot produce greenhouse gases which can use in place of conventional energy sources but solar and wind also have some limitations like solar energy are not present all time it present only in day so there is no solar energy at night and wind energy is not constant al the time so to overcome these limitations we combine these two energy sources so we can produce energy by wind at night and at day time energy is taken By solar and wind both this combine system is called hybrid energy system. Figure 1 shows the block diagram of solar wind hybrid energy system

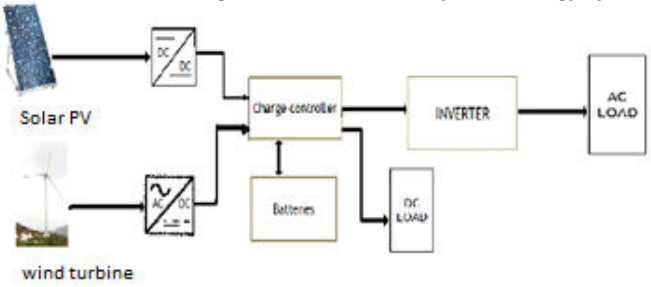

Figure 1 Block diagram Solar wind hybrid energy system

2 ENERGY RESOURCES

2.1 Nonrenewable energy sources

Nonrenewable energy resources are those resources which are limited on earth and decay with time and which cannot be reuse such as coal, oil, wood, natural gas etc.

2.2. Renewable energy sources

Renewable energy sources are those which are available on earth and renewing itself with time, these energy sources are reuse and they cannot produce the greenhouse gases such as solar wind tidal biomass wave energy etc.

2.2,1 Solar Energy

Sun is a big source of energy solar photovoltaic can convert the solar power into electrical power directly a solar PV cell is made by semiconductor when the light emits on the solar PV ions absorb the thermal energy they break their covalent bonds and moves because of electron drift current will flow so direct transform from solar power to electrical power is done. The solar power generation for any solar radiation is predicted by the formula given below

$$P = A x^2 + B x + C$$

Where, X = solar radiation P = power generation A, B, C are the constants which can derived be measured data.

2.2.2 Wind Energy

Wind turbine is used to convert the wind energy into electrical energy. Electric generator inside the turbine converts the wind power into electrical power the energy produce by wind turbine is depend on wind velocity

Wind direction is an important parameter for knowing because by slightly change in direction wind velocity varies knowing the predominant wind direction we can select the ideal spot for wind turbine

We cannot convert the all wind power into electrical power by Betz criteria we can convert maximum 59% of wind energy into electricity, when using the optimized system the power available is

P = (1/2).p. A. v3 (in Watts)

Where,

A = Area perpendicular to air flow in meter square.

p = density of air approximately 1.2 kg per meter cube.

v = velocity of air m/s.

3 Solar wind hybrid energy system

3.1 Solar PV power generation

A 500 watt solar pv module 12 x 42 wp are connected in series and parallel the panels are installed on rooftop of ENERGY CENTRE MANIT Bhopal INDIA the panels are kept in south direction with approximately 23.4 tilt . When the sunrays strikes on the solar PV it produce electricity. The solar PV power can be estimated from the solar radiation data. The average solar radiation is 5.67 kwh/m2/day. The maximum and minimum solar radiation is 7.51 and 4.36 KW/m2/day.

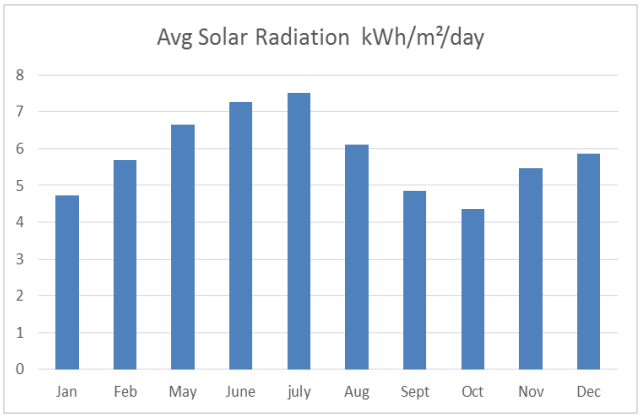

Figure 2 monthly average solar radiation profile

3.2 wind power characteristic

A 3 blade 1000 watt horizontal axis wind turbine is installed in energy center MANIT Bhopal INDIA .it convert wind energy into electrical energy. The wind power generation from the turbine can be predicted from the equation discussed in section 2.2.2

Wind power generation is varies with wind velocity and it can generate the power when wind energy is more than 3.5 m/s. which is called cut-in speed of wind turbine .The wind velocity in Bhopal is

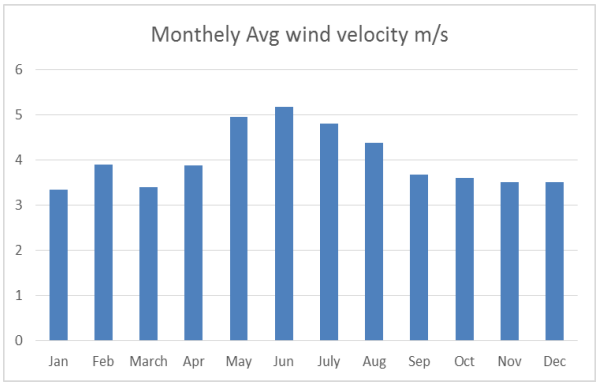

Figure 3 Monthly average wind velocity

3.3 charge control unit

The 48 volt charge control unit includes a DC voltmeter (0-100volt) and ammeter (0-15 Amp.) it is connected between the generation side and battery. Batteries are charged when solar or wind power is available the charge controller disconnects the batteries when they are charge up to 49 volts. And reconnect at 48 volt.

3.4 1KVA inverter and battery bank

The inverter converts the 48 volt DC battery voltage to 230 volt AC, 50 Hz supply. The output power rating of inverter is 1kWA the battery bank consist of 8, 12 volt batteries connected 4 batteries in series so 2 set of 48 volt configuration. The batteries are discharge up to 80%

3.4 Power conditioning unit

The power conditioning unit (pcu) is designed in two modes Mode A and mode B in mode A if the generation is more it draws power from solar wind hybrid energy system when the generation is less as compared to load mode B automatically work in mode B grid power is used to fulfill the load requirement .

4 System setup and results

Figure 7.1 illustrates the set-up of the PCU's for Solar and Wind Inputs. The Solar PCU is connected with the output of the Solar Arrays and the Wind PCU with output of the Wind Generator. Both these PCU's work on nominal 48 VDC inputs.

Figure 4 Power Control Units setup for Solar & Wind

4.1 Solar PV output

The site location is energy center Bhopal the Latitude and Longitude are 23.2599° N and 77.4126° E. Facing is toward south so azimuth angle is 0° and Tilt angle23° table 1 shows the output of 500 watt wind turbine. The excess energy is stored in batteries

S.N	Load (Watt)	Voltage (Volt)	Current (Ampere)
1	60	51	1.5
2	65	51	1.7
3	65	52	1.7
4	90	54	2.0
5	90	57	2.1
6	100	57	2.1
7	120	61	2.4
8	120	60	2.6
9	110	62	2.6
10	100	55	2.9
11	90	53	2.5
12	90	51	2.1
13	60	49	1.6

Table number 1

4.2 Wind turbine output

The site location is energy center Bhopal the Latitude and Longitude are 23.2599° N and 77.4126° E. Table 2 shows the output of 1000 Watt wind turbine the excess energy is stored in batteries

S. No	Load (Watt)	Voltage (Volt)	Current (Ampere)
1	60	51	3
2	65	50	3.1
3	65	48	3.2
4	90	48	3.0
5	90	48	2.9
6	100	48	2.8
7	120	48	2.8
8	120	48	2.9
9	110	48	2.9
10	100	50	2.7
11	90	48	2.8
12	90	48	2.9
13	60	48	3.0
14	60	50	3.9
15	50	50	3.8
16	60	52	3.9
17	60	48	3.2
18	40	51	3.5
19	40	53	3.5
20	50	51	4.0
21	40	52	4.1
22	50	51	3.9
23	50	52	4.0
24	60	52	4.2
25	60	51	3.9

4.3 Solar wind hybrid system

Figure 5 shows the graph of energy generation by solar wind hybrid energy system

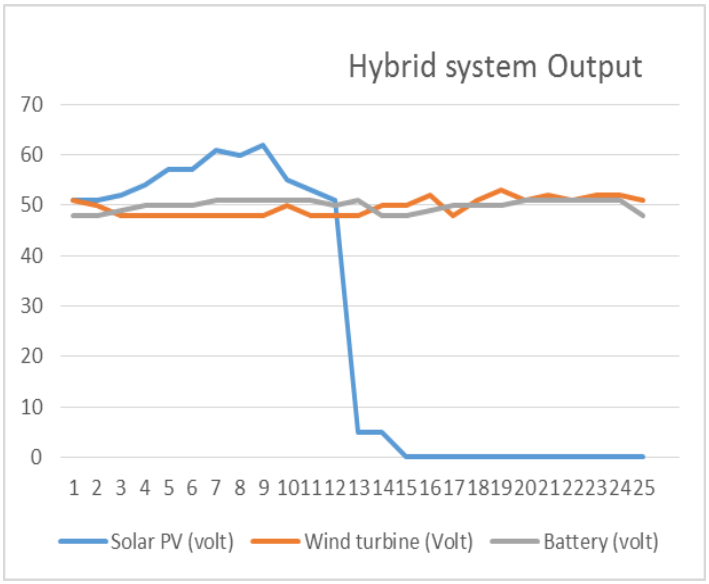

Figure 5 voltage Variation with time

Figure 6 shows the current variation with time in this solar PV current Wind Turbine current and battery current are showing with respect to time

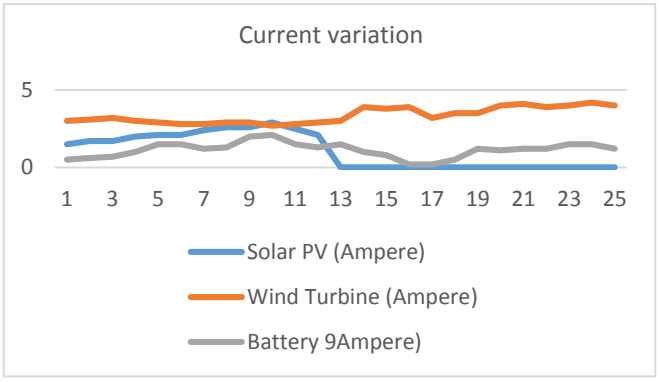

Figure 6 current variation with time

5. CONCLUSIONS

In this paper the effective and economical Solar Wind Hybrid System is proposed to setup in remote areas for our nation because of non-availability of any other source of energy of limited sources are available. Solar and wind are major source of energy so that the efficiency of hole system is good. The fuel consumption also reduced by using nonrenewable energy sources considering operating cost and Maintenance cost, an autonomous site powered by wind solar Hybrid system pay-off after 2-5 years in a good sunny and Windy location.

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