PERFORMANCE ANALYSIS OF WIND AND SOLAR HYBRID POWER PLANT IN MADHYAPRADESH

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Abstract The combination of renewable energy sources, wind & solar are used for generating power called as wind solar hybrid system. This system is designed using the solar panels and small wind turbines generators for generating electricity. To better understand the working of solar wind hybrid system, we must know the working of solar energy system and wind energy system. Solar power system can be defined as the system that uses solar energy for power generation with solar panels. Energy is critical to the economic growth and social development of any country. Indigenous energy resources need to be developed to the optimum level to minimize dependence on imported fuels, subject to resolving economic, environmental and social constraints. This led to a boost in research and development as well as investment in renewable energy industry in search of ways to meet energy demand and to reduce dependency on fossil fuels. Wind and solar energy are becoming popular owing to abundance, availability and ease of harnessing for electrical power generation. This paper focuses on an integrated hybrid renewable energy system consisting of wind and solar energy. This thesis provides an insight into the energy scenario and present situation of renewable energy development in India.

Key Words: *Hybrid, solar, wind, power*

1. INTRODUCTION

Energy is one of the major inputs for the economic development of any country. In the case of the developing countries, the energy sector assumes a critical importance in view of the ever increasing energy needs requiring huge investments to meet them. This paper provides a review of challenges and opportunities for hybrid system of solar PV and wind. The paper reviews the main research works related to optimal sizing design, power electronics topologies and control for both grid-connected, stand-alone hybrid solar and wind systems. Table below shows installed capacity of renewable energy in INDIA Solar and wind power is naturally intermittent and can create technical challenges to the grid power supply especially when the amount of solar and wind power integration increases or the grid is not strong enough to handle rapid changes in generation levels.

1.1 Solar Energy- Solar energy is that energy which is gets by the radiation of the sun. Solar energy is present on the earth continuously and in 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. Only problem with solar system it cannot produce energy in bad weather condition. But it has greater efficiency than other energy sources. It only need initial investment. It has long life span and has lower emission.

1.2 Wind Energy- Wind energy is the energy which is extracted from 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 is depend upon the speed of wind flowing.

Table- 1: Installed capacity of non-conventional renewable power

TYPE	CAPACITY IN (MW)
Wind	**34,046.00**

Solar	**21,651.48**
Small Hydro Power Projects	**4,485.81**
Biomass Power & Gasification	**8,700.80**
Waste to Power	**138.30**
Total non-conventional renewable Power - Grid Connected	***69,022.39***

2. SOLAR WIND HYBRID SYSTEM

The hybrid power generation concept is a system aimed at the production and utilization of electrical energy coming from more than one source within an integrated arrangement. The hybrid system studied in this thesis is one combining solar PV and wind turbines with power conditioning units such as inverters. Hybrid wind turbine and solar PV modules offer greater reliability than any one of them alone, because local energy supply cannot depend entirely on any one of these sources. Other advantages of the hybrid system are the stability and reliability of the system and the lower maintenance requirement thus reducing downtime during repairs and routine maintenance. In addition to this, as well as being indigenous and free, renewable energy resources also contribute to the reduction of pollution emissions. In this thesis, the proposed hybrid power generation system makes use of solar PV and wind turbine to produce electricity and supply the load by connecting to the grid. A schematic of a typical grid connected wind-solar hybrid system can be shown in figure.

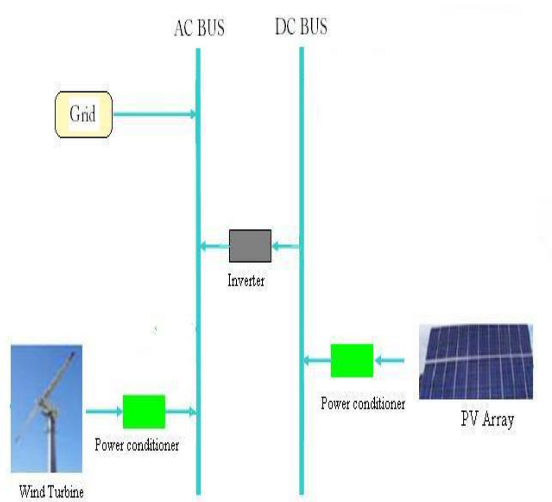


Fig-1: Layout of hybrid system

The availability of renewable energy resources at a site is an important factor to develop the hybrid projects. In many parts of the India, Wind and Solar energy are abundantly available which pay way for their optimal integration. Wind speed is low in summer whereas the solar radiation is brightest and longest. The wind is strong in monsoon months whereas less sunlight is available owing to cloud cover. Because the peak operating times of wind and solar systems occur at different times of the day and year, hybrid systems are more likely to produce, dependable power to our demands. When neither the wind nor the solar systems are producing, most hybrid systems provide power through the energy stored in batteries. If the batteries run low, the engine generator driven by conventional fuels can also be integrated to recharge the batteries, so that continuous power will be supplied meeting to the load demands from time to time.

3. DATA OF EXISTING PLANT OF MP

Data collected from existing power plant in MP is given below in table2 and table3; on the basis of this data results are discussed. The solar and wind data for the exact location of the plant were not available from the NREL. Consequently, available solar and wind data for the locations from the plant were used. For the wind data which included wind velocity and direction on hourly basis, an average value for sites surrounding the property was obtained.

Table-2: Atmospheric condition data of existing plant

Month	Air temperature	Relative humidity	Daily solar radiation horizontal	Atmospheric pressure	Wind speed	Earth temperature	Heating degree-days	Cooling degree-days
	°C	%	kWh/m²/d	kPa	m/s	°C	°C-d	°C-d
January	23.4	0.47	4.98	96.9	2.1	26.3	0	409
February	26.1	0.405	5.78	96.8	2.4	30.2	0	445
March	30.1	0.349	6.39	96.5	2.4	35.7	0	608
April	31.1	0.419	6.66	96.3	2.6	36.7	0	624
May	32.8	0.4	6.48	96	3	37.8	0	700
June	29.2	0.616	4.83	95.9	3.4	31.9	0	570
July	27	0.709	4.19	96	3.3	28.6	0	522
August	26.6	0.708	4.05	96.1	3.1	27.9	0	510
September	26.9	0.674	4.67	96.3	2.3	28.6	0	505
October	26.2	0.6	5	96.6	2	28.1	0	498
November	24.6	0.485	4.91	96.9	2.2	26.6	0	432
December	22.9	0.45	4.72	97	2.2	25	0	393
Annual	27.2	0.524	5.22	96.4	2.6	30.3	0	6216
Measured at (m)								

Table- 3: Wind speed available at plant location

Year	WIND SPEED (m/s)											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2004	4.38	4.61	4.67	6.13	6.57	6.53	5.96	6.37	3.56	3.15	3.08	3.91
2005	4.75	4.90	5.06	5.24	5.61	6.46	6.23	5.43	4.25	3.83	2.97	4.54
2006	4.59	4.08	4.23	5.24	6.56	5.69	7.08	6.70	3.83	3.10	3.34	4.14
2007	4.45	4.70	4.98	5.22	6.31	6.10	6.20	5.37	3.98	3.48	3.29	4.31
2008	5.09	4.94	4.51	5.40	7.72	6.60	6.07	5.55	3.68	2.90	4.17	3.97
2009	4.69	4.70	4.65	5.42	7.29	6.64	6.51	5.94	4.58	3.46	3.67	3.38
2010	4.43	4.29	5.20	5.87	7.01	6.49	5.35	4.29	4.26	3.41	4.10	3.93
2011	4.50	4.39	5.06	4.63	7.15	7.14	5.57	5.19	4.93	2.99	3.31	4.05
2012	4.67	5.09	4.94	5.83	6.44	7.69	6.93	5.49	3.88	3.54	4.64	4.55

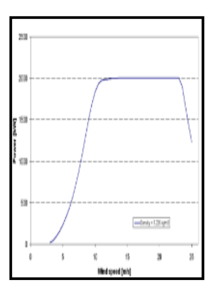
Year	WIND SPEED (m/s)											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2013	5.43	5.18	4.52	4.91	7.06	6.17	5.76	5.65	3.77	3.52	4.05	3.59
2014	4.55	4.31	4.57	4.59	6.07	7.87	6.81	5.68	4.20	2.93	3.03	4.74

Table-4: Inverter Output of solar system

DATE	INVERTER.1 unit in(KWh)	INVETER.2 unit in(KWh)	INVERTER.3 unit in(KWh)	INVERTER.4 unit in(KWh)
1	2337	2211	2341	2406
2	1765	1602	1783	1811
3	2106	1958	2102	2118
4	2718	2472	2729	2782
5	2567	2352	2629	2665
6	2547	1782	2580	2631
7	742	800	810	804
8	1835	1678	1911	1921
9	1595	1413	1666	1626
10	2367	2154	2413	2448
11	892	846	958	953
12	2166	2048	2181	2205
13	2287	2212	2312	2334
14	1925	1671	1971	1983
15	1304	1178	1383	1385
16	1093	1145	1146	1155
17	752	712	797	785
18	1083	1005	1104	1098

4. RESULTS

Wind speed [m/s]	Power [kW]
3	14
4	94
5	236
6	438
7	714
8	1084
9	1508
10	1836
11	1973
12	1992
13	1998
14	2000



15	2000	
16	2000	
17	2000	
18	2000	
19	2000	
20	2000	
21	2000	
22	2000	
23	2000	
24	1676	
25	1234	

Chart-1: Variation of wind speed and mechanical power output

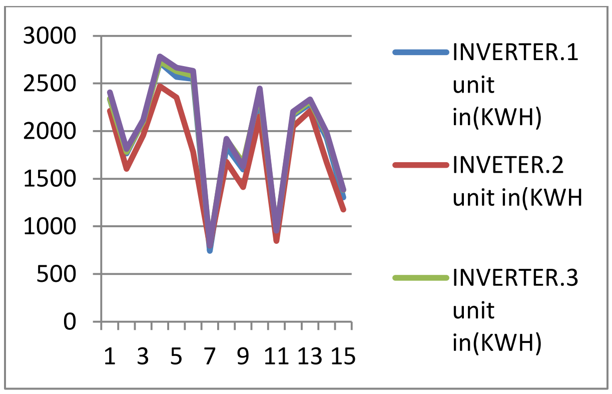


Chart-2: Inverter output of solar system

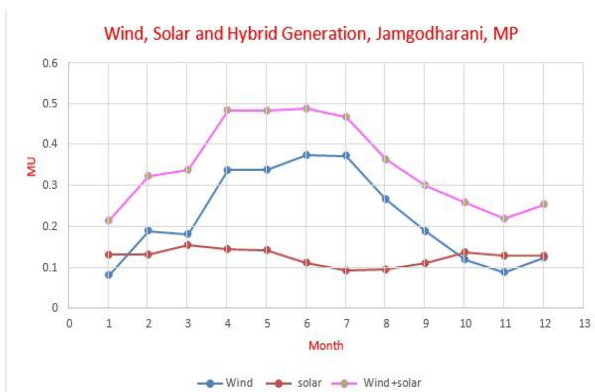


Chart-3: Variation of solar wind and hybrid system output

CONCLUSION

The goal of this work is to propose a design strategy of an off-grid solar-wind hybrid power system and to evaluate the performance of the strategy. The purpose of this investigation was to design a renewable energy supply system for a rural property with a high level of reliability and total independence from the mains grid. The primary focus of this study is the development of dynamic models for a small standalone hybrid power generation system. The developed model of the solar-wind hybrid power system consists of a combination of solar energy generation system and a wind power generation system with a storage bank. A detail model of the wind-solar hybrid power generation system is presented in this work. With typical load profiles, solar irradiation and wind speed profiles of a typical site, the sizing approaches of each energy sources and the battery bank capacities are also discussed in this work. These data were used for the discussion of total energy generation and distribution in load. Six different scenarios have been considered in this work for the existing strategy and also for the proposed strategy. In first scenario peak load with maximum solar irradiation and maximum wind speed has been considered, in second scenario peak load with average solar irradiation and average wind speed has been considered. In third scenario peak load with minimum solar irradiation and minimum wind speed has been considered. For the rest of the three scenarios average load with the previous three combinations of solar irradiation and wind speed have been considered

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