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Original Research Paper

Engineering

WORKING OF SOLAR CAR WIND GENERATOR

Vinod Kumar	Department of Mechanical Engineering, IIMT College of Engineering, Greater Noida, U. P., India
Shivam Singh	Department of Mechanical Engineering, IIMT College of Engineering, Greater Noida, U. P., India
Vimal Katiyar	Department of Mechanical Engineering, IIMT College of Engineering, Greater Noida, U. P., India
Shiv Pratap Singh	Department of Mechanical Engineering, IIMT College of Engineering, Greater Noida, U. P., India

ABSTRACT Energy is essential for the economic growth and social development of any country. The world is facing the problem of power generation. The fossil energy sources are limited and needed to use properly. This power generated increases the greenhouse effect. The used of the combined solar and wind power system can be more benefits in order to make useful throughout year. In this presented research the review is carried out on the different types of solar and wind associated hybrid system for developing the proposed research study.

KEYWORDS : Solar Energy, Wind Energy, Hybrid System

1. INTRODUCTION

Energy is vital for the progress of a nation and it has to be conserved in a most efficient manner. Not only the technologies should be developed to produce energy in a most environment-friendly manner from all varieties of fuels but also enough importance should be given to conserve the energy resources in the most efficient way. Energy is the ultimate factor responsible for both industrial and agricultural development. The use of renewable energy technology to meet the energy demands has been steadily increasing for the past few years, however, the important drawbacks associated with renewable energy systems are their inability to guarantee reliability and they are lean in nature. Import of petroleum products constitutes a major drain on our foreign exchange reserve. Renewable sources are considered to be the better option to meet these challenges. It is obvious that the known resources of fossil fuels in the world are fast depleting. The importance of renewable energy sources was recognized in the early 18th century. During the past three decades, a significant effort has gone into the development, trial and induction of a variety of renewable energy technologies for the use in different sectors. Energy consumption has been growing rapidly in developing countries like India where, about 15% of the world's population live.

1.1 Solar PV Energy

Solar energy is a very large, inexhaustible source of energy. The power from the sun intercepted by the earth is approximately 1.8 x 1010 MW, which is thousands of times more than the present rate of energy consumption on earth. Solar energy could supply all the present and future energy needs of the world on a continuous basis, which is one of the most promising nonconventional energy sources and it is an environmentally clean source of energy that is available over almost all parts of the world [1]. The sun provides the basis for life on earth and sufficient energy to meet all our needs. Photovoltaic is a technology to convert sunlight directly into electrical energy. It has many advantages like, no noise and wear due to absence of moving parts, environmentally benign operation, suitable source for remote applications. Photovoltaic systems are prominently suitable for remote places where there is no grid power supply. Also space programmes have proved the technical feasibility of photovoltaic system, because of its high performance and reliability. Photovoltaic generation is gaining an increased importance as renewable energy source due to its innate advantages like absence of fuel costs, fuel supply problem and system reliability with little or no maintenance. Performance and reliability of photovoltaic systems have been demonstrated in a large variety of small and medium scale standalone application as well as MW grid connected power stations. The main obstacle for using multi MW scale photovoltaic system is the very high initial cost of the module. The solar photovoltaic systems may be operated in several modes such as standalone system with or without storage battery, hybrid and grid connected in accordance with their several applications. The ultimate objective of the solar photovoltaic system design procedure is to obtain the size of photovoltaic array and the battery bank, which can deliver power to load without failure. The performance of the system exclusively depends upon the solar resource at the site, system configuration and load parameters. The input energy for solar photovoltaic systems is the incident solar radiation, which depends on the location, time of the day, day of the year as well as solar energy receiving angle and other relevant environment conditions. The solar photovoltaic (SPV) array output also depends on the solar cell operating temperature, which is affected by the ambient air temperature. These parameters continue to change hourly, daily, monthly and yearly.

1.2 Wind Energy

Wind energy is an important part of solution for world energy demand and pollution problems. With an average wind speed of 7.1m/sec, annual wind energy production is estimated as almost 60 million kWh, enough to supply 20,000 households with clean electricity. In other words, the wind turbine avoids discharging to the environment 50,000 tonnes of CO2, 200 tonnes of SO2 and 2,500 tonnes of ash as a consequence of operating thermal power plants, in order to produce same amount of energy. Wind has emerged as the most suitable candidate as a renewable energy source in the immediate future. Technology for wind electricity generation has nearly matured. Wind energy output depends on wind velocity and swept area. However, the output varies with the climatic conditions. In India, wind velocity depends on the monsoon circulations namely, the strong south-west summer monsoon commencing from June and the north-east winter monsoon commencing from October. Extensive wind resource assessment comprising wind monitoring and wind mapping include complex terrain projects that were taken up in 1985 covering all the states and union territories of India. The projected conservative estimate of the potential is about 60,000 MW.

1.3 Hybrid System

At present, standalone solar photovoltaic, wind systems; have been promoted around the globe on a comparatively larger scale. These

independent systems cannot provide continuous source of energy, as they are seasonal. For example, standalone solar photovoltaic energy system cannot provide reliable power during non-sunny days. The standalone wind system cannot satisfy constant load demands due to significant fluctuations in the magnitude of wind speeds from hour to hour throughout the year. Similarly, continuous supply of bio-diesel fuel is difficult because of low-commercialization of bio-diesel generator fuel. Therefore, energy storage systems will be required for each of these systems in order to satisfy the power demands. Usually the storage system is expensive and its size has to be minimised to make the renewable energy system cost effective. Integrated hybrid power system can therefore be used to reduce energy storage requirements. Integrated or hybrid system is a combination of one primary energy system with one or more secondary energy systems for power supply. In photovoltaic hybrid system, PV system is the main source of energy and a variety of other energy sources namely bio-diesel generator, wind turbine generator and biomass gasifier can be combined as secondary energy systems.

2. LITERATURE REVIEW

The different researches were carried out on the solar and wind power generation. The utilization of renewable energy required system. The literature carried out with categorization of the different system stand alone as follows:

2.1. Stand Alone Solar System

Abhaya Swarup et al [1] developed a model for energy management of PV based energy system. This model has been mainly proposed to raise the public awareness and education levels of solar systems in an interesting and entertaining way. The results indicate that the problems with PV systems were not due to PV array and instead it was due to the performance of the battery units. Martina et al [2] have discussed about multilevel converters that are effectively used to connect single-phase grid with solar photovoltaic systems. An overview of different multi level topologies and the suitability for single-phase grid connected photovoltaic systems has also been presented. Vivek Kapil et al [3] have developed an Artificial Neural Network (ANN) model for designing PV systems for remote areas and presented the influence of various parameters on the design of PV systems. The results of ANN model showed a variation of 5% as compared to other models with more reliability and accuracy. The application of solar power is varied and the scope of PV systems being employed even in domestic applications appears to be bright. Bhattacharaya et al [4] developed a simplified design approach and economic appraisal of a solar PV system. In this model, the PV array and battery bank sizes for a standalone PV system were estimated. Also a cost comparison of the standalone PV system with a PV diesel hybrid system was presented. The results indicate that the hybrid systems were cost effective than standalone systems for a given location.

Kshitij Kaushik et al [5] developed a knowledge based model for the design of standalone solar photovoltaic system. This approach combined both the site and array characteristics as a single parameter, referred to as an equivalent unit array output.

Hamid Marafia [6] studied the feasibility of photovoltaic technology for power generation and presented comparative economic analysis of power generation with a conventional gas turbine. The results indicate that the solar photovoltaic systems are not economical as compared with a conventional gas turbine. However, it was concluded that PV systems could become economical when the system cost reduces to below $2.50 per peak Watt with conversion efficiency above 20%. Mohanlal Kolhe et al [7] has analyzed the economic viability of a standalone solar photovoltaic system with the most likely conventional alternative system i.e. a diesel powered system for energy demand through sensitivity analysis of life cycle cost computation. The analysis has been carried out for the energy demand for different key parameters, such as discount rate, diesel fuel cost, diesel system lifetime, fuel escalation rate, solar isolation, PV array cost and reliability. The result showed that the PV powered systems could be a cost effective option at a daily energy demand up to 15 kWh even under unfavourable economic conditions. Usha Bajpai et al [8] developed a model to optimize the size of PV panel and battery in a standalone photovoltaic powered system. Optimization of PV system was done based on the cell area, efficiency, and cell power and array inclination. Hence this type of standalone PV power system can be more reliable, viable and acceptable. Similar work was also carried out by Philip (2003) on the studies of system design, installation and performance of a standalone wind-diesel power supply systems for remote applications. The result shows that the system performance was satisfactory.

2.2 Standalone Wind Systems

Aydogan Ozdamar et al [9] have analyzed and presented a case study on wind energy utilization in a house in Izmir, Turkey. The developed model determines the number of batteries needed for continuous energy supply, for each wind turbine taking into account of the economical aspects. It was found that the wind battery hybrid system was not economical in the areas of low wind potential. Kanat A. Baigarin et al [10] have discussed about the potential of wind energy resources available in central Asia. The equations used for determining the distribution of wind energy output, energy density, energy cost and efficiency have been discussed in detail. Suresh H. et al [11] have developed a model to investigate the optimum sitting of wind turbine generators based on site and wind turbine type. The methodology of analysis was based on the accurate assessment of wind power potential of various sites. The analytical computation of annual and monthly capacity factors has been carried out by using the weibull statistical model employing cubic mean cube root of wind speeds. A judicious choice of potential sites and wind turbine generator systems can be made using the model proposed. Wen-jei Yang [12] adopted the same principle for determining the power generation by a wind machine and discussed about the utilization of excess wind power for hydrogen storage and subsequent secondary power generation. Rogers et al (2002) studied experimentally the design requirements for a medium sized wind turbine for remote and hybrid power systems. Also, the operational problems of installing medium and large sized wind turbines at remote locations have been addressed.

2.3. Solar Photovoltaic Wind Hybrid System

Bhave A.G [13] studied the techno-economic feasibility of installing solar photovoltaic-wind hybrid system. This system uses electrical storage by lead acid battery and auxiliary power from AC mains. The result from the above study showed that 80% of the energy demand was satisfied by the solar photovoltaic wind hybrid system. But it was cost effective, only when the system cost was considerably reduced or the current electricity cost raised to a much higher level. Habib M.A. et al [14] have developed a model for optimizing the size of a hybrid photovoltaic wind energy system. The procedure was applied for the sizing of solar wind hybrid system designed to produce a constant load of 5 kW in the Dhahran area, Saudi Arabia. The analysis indicates that a hybrid system power output can be optimized to suit specific applications with variable or constant power loads. Francois Giraud et al [15] analyzed a model for design of wind–photovoltaic system with battery storage for grid connected rooftop system. The system was designed to meet a typical load demand for a given loss of power supply probability. The various parameters like system reliability, power quality, loss of supply and effects of the randomness of the wind and the solar radiation on systems design have been studied. The results showed that the wind and solar systems were complementary to each other and resulted in improved reliability of the system. Rajesh Karki [16] developed a simulation method for photovoltaic and wind energy utilization in small isolated power systems based on reliability/cost implications. This simulation method provides objective indicators to help system planners decide upon appropriate installation sites, operating polices selection of energy types, sizes and mixes in capability expansion. In this model, cost and reliability are the main parameters to be considered as it has a significant impact on the design. Celik A.N.[17] developed a novel optimization technique for

techno-economic analysis for autonomous small scale photovoltaic wind hybrid energy system. An optimum combination of the hybrid photovoltaic wind energy system could provide higher system performance than either of the single system. It was shown that the magnitude of the battery storage capacity has important influence on the system performance of a single PV and wind system. Yang H.X.et al [18] have proposed an optimization technique following the Loss of Power Supply Probability model for a hybrid PV-wind system taking into account the reliability of the system. They demonstrated the utility of their model through a case study of a hybrid unit for a telecommunication system. It has made a techno-economic analysis and optimization of a PV-wind hybrid system and reported a comparative study against a standalone solar and wind system for the same conditions of load, isolation and wind velocities. In the previous studies design was based on the worst month, which resulted in a costly and non-optimal system in terms of techno-economics. An alternative method was applied in the work by incorporating a third energy source into the system instead of increasing the hardware sizes excessively for the worst month which facilitated a techno-economically more optimum system. It developed a model for a reliable wind/PV/storage power system for remote radio base station, which explores the current practicalities of PV-wind hybrid power generation solution for the cellular phone base station. It is concluded that the application of PV is not technically or commercially viable for this application because a large capacity of PV modules and batteries are essential. Also it is concluded that wind power generation is technically viable and has some practical possibilities being integrated with the radio mast. The longer-term intermittence of the wind, demands a back-up power supply best provided by a diesel generator. The battery will minimize the start/run demand on the diesel engine, which in turn will minimize the required size of the battery storage capacity. It developed a probabilistic model based on the closed form solution approach to convolute long term performance of a hybrid solar wind power system for both standalone and grid applications. For estimating the energy performance of hybrid system, the reliability analysis is performed by the use of the energy index of reliability. The model enables the study of range periods from one year to one hour, thus allowing the inclusion of time value of energy as appropriate in economical assessment. The model is validated by an illustrious numerical example and the results are compared to those resulting from the time domain simulation. A statistical approach alternative to a time step simulation is used for the evaluation of long-term average performance of a hybrid system.

3. CONCLUSION

The utilization of renewable resources is greatly demanding in the world. The world facing the problem of global scarcity of electricity and pollution can be easily overcome with renewable energies. The presented paper is based on the different researches on the utilization of the natural resources like solar and wind. The combination of solar and wind hybrid system is also presented in the paper. Overall the aim of the research study to utilised the presented literature for developing the proposed research work.

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