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Review Paper on Solar Wind Hybrid Energy Generation System

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ABSTRACT

Renewable energy is an alternative solution for power generation in the day today life. Power generation from conventional energy is having a drastic effect to the environment and the ecological life of humans. The energy from renewable sources are abundantly available over theuniverse. Energy from renewable sources are clean, ecofriendly, efficient and reliable. Solar and wind are gaining much importance in the present world. The project aims to develop a grid connected hybrid power generation system using solar and wind energy in the Matlab/Simulink software. The model is designed based on the availability of solar irradiance, sunshine hours,temperature, wind speed, wind direction and topography. Based on the datas, a model can bedeveloped combining the energy from solar and wind resources. Anaverage solar irradiance of5.68KW/m2/day and wind speed of 12.9mph is available overthe parts of Kerala. The average temperature range in the parts of Kerala is 28°C since it is located in between Tropic of Cancer and Equator. Standalone models for a PV and wind is also simulated. The hybrid model consistsof solar panels, (P&O) MPPT, boost converter, inverter, wind turbine, PMSG generator allconnected to a grid. Under different irradiance and temperature conditions the PV model issimulated, and output is observed. The hybrid model is simulated, and the Matlab results are analyzed.

Keywords: - Hybrid Energy System, Solar Power Applications, Wind Power Applications, Combined Power Applicatins, Continuous Power Supply

INTRODUCTION

Energy is an important factor for the human development and a reason influencing the global prosperity. It supports the economic growth, human welfare and the quality of life of a nation. The energy from conventional source has major drawbacks to the present and future ecological balanceb and safety both locally and globally. It's a known fact that the world's existing main energy resources will be depleted in a few years' time. Therefore, in today's energy demanding world, renewable energy sources which is clean, non-polluting and ecofriendly is a better option.Renewable energy is a continuous form of energy available in plenty from the natural sources such as sunlight, wind, rain, waves, geothermal heat and tides. Energy generated from the natural sources are carbon free with less pollution and capable enough to compensate the energy generated from coal and other fossil fuels thus preserving these resources for the future generation.

In the present world, the need for electrical energy is increasing very rapidly. The excessive use ofconventional sources such as coal, petroleum, oil and other by products for energy has led to drastic depletion of these resources and major impacts to the environmental conditions such as greenhouse gas emission which causes an imbalance in the ecosystem. At the same time with the existing conventional energy sources the needs cannot be met. Therefore, an alternative means of energy is from non-conventional energy sources which plays an important role in meeting the demands of the world and these renewable energy sources are clean, ecofriendly and reliable for energy generation.

LITERATURE REVIEW

1. Shen, Izadian : The paper aims in describing the techniques involved for controlling and tracking of maximum power from solar and wind energy. Here the system includes a solar, wind, power converters and a battery. Explains five possible types of results the renewable energy sources can produce and how it can be utilized and charged to a battery. This paper also points out the advanced methods to develop a stable power supply and

energy storage. The basic idea behind the system is to have a control over the source of power generated to be supplied to grid or to the battery for storage.

2. Fesli, Bayir : The paper focus in development and design of a hybrid system utilizing the solar and wind energy sources with the help of a microcontroller. This model is mainly adopted for domestic purpose applications. Photovoltaic cells help to convert the solar energy into electrical energy or heat energy. This system is mainly of two types one is line dependent and line independent. The line dependent system is not in need of batteries for storing energy. It directly supplies the energy to the demand with the help of an inverter. This line system is also used at times of low sun beam.The line independent system, as the absence of line electricity batteries or accumulators are required for supplying energy at times of demand. The dc output needs to be converted to ac for supplying to electrical appliances. The wind energy is based on the capacity for producing power.

3. Katti : This paper details about a solar-wind hybrid power generation system which is becomi ng economical on considering the life cycle cost and the environmental benefits. Hybrid systems have an advantage of maintaining a balanced system with uninterrupted power supply from any of the sources. The energy produced by this combination is fed to a hybrid controller. Then it is supplied to a battery for load requirements. The hybrid controller used here is a microcontroller. This controller has a control over the voltage generated by solar and wind to be fed to the battery. The figure is the flow chart for a system sizing. This system is supported by a relay which gives an alarm when an over current or over voltage is detected. This paper also summaries the details regarding the life cycle cost of a hybrid system such as initial capital cost, replacement cost for a battery and maintenance and operation cost.

4. Gowtham and Royrichard : This paper describes about the hybrid PV-wind system connected to grid and the techniques involved for maximum power tracking in wind and solar. In wind energy system, variable speed wind turbines along with permanent magnet synchronous generator is used. This system provides high reliability and efficient output without the help of any external support. There are dc link converters connected to grid to maintain constant voltage. In PV systems, the load is connected directly to grid.

5.Huang, Xu : The paper highlights the different methods used for maximum power point tracking in hybrid solar wind system with the perturbation tracking algorithm. Due to DC/DC charging unit, the whole 12 circuit and control unit is simplified. With the maximum power point tracking technique, the output from the solar and wind is separately controlled. Due to control methods, the system becomes complex and the production cost is high therefore, the total output production is controlled by MPPT tracking at maximum power point. By recognizing the maximum power from wind or solar the MPPT algorithm tracks accordingly. The MPPT techniques allows the system to work near to the maximum power point. For wind, tip speed ratio control, power signal control methods are used to have MPPT while in PV systems, observation perturbation method, constant voltage control method and incremental conductance methods are used to attain the MPPT. The simulation results apply not only for the controlling methods of the hybrid solar-wind system but also the output current of the system is stable and reliable. The impact of overcharging on batteries are reduced.

Methodology

The methodology adopted for the design of a hybrid power generation system using solar and wind power is connected to a grid system for the transfer of power to meet the demands. The hybrid system is combined use of solar energy and wind energy from available resources with efficient and maximum utilization along with power-control. Based on the climatic conditions and availability of solar and wind power this system allows to supply power to load and the grid. The energy from solar is available and is tracked with MPPT technique such as Perturb and Observe method. According to the available voltage of the solar cells and the temperature the output solar energy is produced. The energy from solar is boosted with the help of DC-DC boost converters to supply to a DC-AC inverter circuit to supply to the load. For a wind energy system, the speed of rotor of the wind turbines are captured by permanent magnet synchronous machines and the output wind energy is coupled with the turbines to convert to electrical energy. The output is fed to inverters for conversion of DC to AC to supply to load.

1. Renewable Energy in Kerala

Fig .1 : Map Showing the Parts of Kerala

For developing a hybrid power generation system using renewable energy the first and most required data is the availability of the renewable energy resources over an area. For solar energy,the irradiance and maximum sunshine hours must be known along the temperature. Sun's radiation and temperature are the main factors influencing the generation of solar energy. While for wind energy, the wind speed and the topographical changes effecting the wind speed needs to be known. A detailed analysis of solar radiation and wind speed is required to calculate an average monthly output of energy the area can produce. The data from Kerala is shown as a reference to prove that the place is feasible for an installation of hybrid power generation unit using sun and wind energy. Kerala has a high accessibility to sun and wind energy, combining these two resources will give maximum output for power generation.

2. Solar Energy in Kerala

The parts of Kerala have wide solar energy availability and by the March 2017 the installed capacity of solar power was 75.42MW. The studies show that the daily sunshine hours on an average in the parts of Kerala is about (7-9) hours daily with an average annual solar irradiance of 53 about 5.68kWh/m2/day with average daily temperature of 28°C. The month of March, April, Mayis the hottest, having an average temperature of 29°C and a sunshine of 8 hours daily. While the month of march is the hottest with an average solar irradiance of 6.68kWh/m2/day

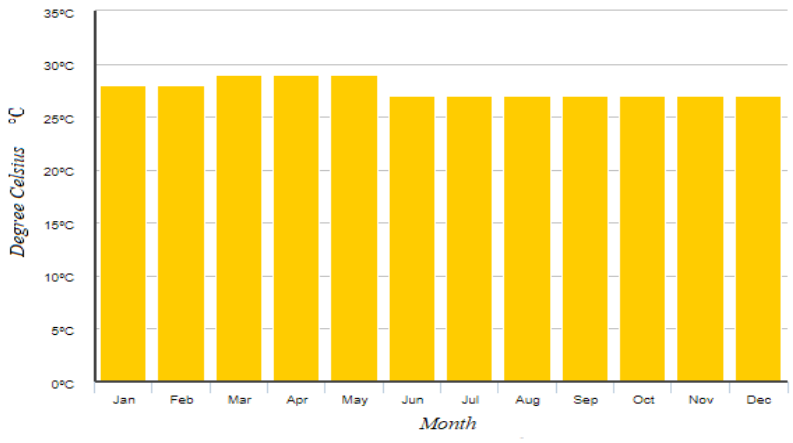

Fig .2 : Average Monthly Temperature in Kerala

The above figure represents the average monthly temperature range in the parts of Kerala.From the figure it is clear the highest temperature is in the month of March, April and May with 29°C which is the hottest. The month of January and February are having average temperature with 28°C very close to the highest month temperature. The remaining months are having temperatures with the range of 27°C close to the highest range and these months are warm but not hot.

3. Wind Energy in Kerala

The wind speed is mainly based on the topography and the various climatic factors. The wind speed and direction changes rapidly rather than on hourly basis. The daily wind speed on an average in the parts of Kerala is about 12.9mph and varies with climatic conditions.

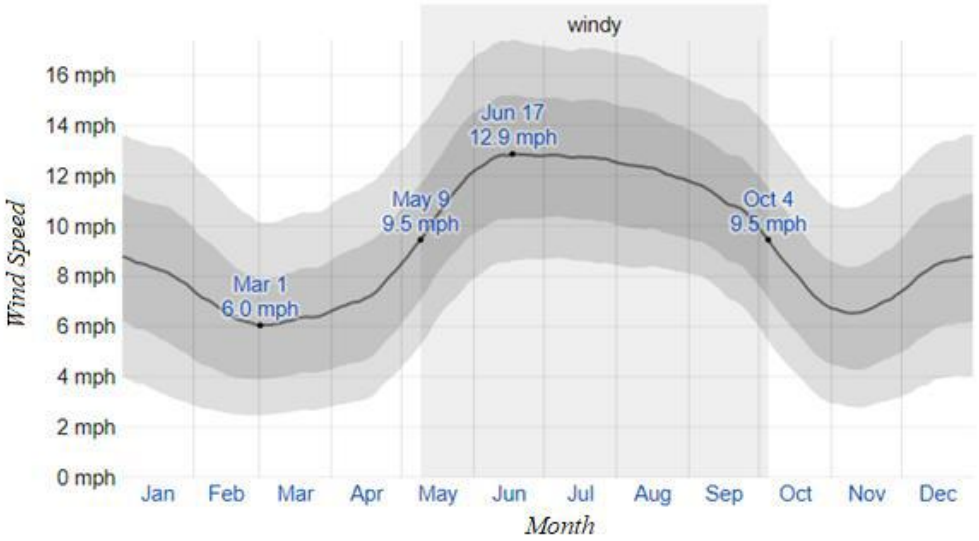

Fig.3 : Average Hourly Wind Speed

The above figure represents the average hourly wind speed in Kerala. From the diagram it is clear the highest wind speed is available during the month of June with an average hourly wind speed of 12.9mph. the wind speed is manly based on the location topography and climatic condition. The speed and direction of wind changes hourly. From the figure it shows, the most 56 available wind speed is during the months starting from May to October with an average hourly wind speed of 9.5mph. The least available wind speed is during the month of Marchwith 6mph and from October to May the wind speed available hourly is within the range of (6-8.5) mph on an average.

FUTURE SCOPE OF THE PROJECT

The project is efficient for a continuous power generation, but power quality issues effects the performance of the overall systems. Power quality issues includes voltage sag, voltage swell, harmonics, transients which is mainly reduce the quality of power generation from the solar and wind energy. The usage of more power electronic devices also has an impact of the energy output leading to fluctuations. To overcome the power quality issues, it is recommended to use some techniques like implementing static compensators, series type LC filters UPQC. DSTATCOM helps to eliminate the harmonics, power factor correction and balance the load. For stability purpose STATCOM is used. Advanced methods need to be used to record the solar and wind data so that an estimation of power can be calculated for a continuous energy supply. Different MPPT techniques are available for tracking of the resources.

CONCLUSION

Generation of power from single source of renewable energy cannot meet the load demands therefore, hybrid PV-Wind model is proposed to compensate the effects of environmental factors and climatic variations of the resources affecting the continuous operation of power generation. For efficient tracking of solar energy Perturb and Observe(P&O) MPPT technique is used and a boost converter is used to eliminate fluctuations at the

Inverter to convert to AC power. Wind energy system with permanent magnet synchronous generator produces sinusoidal AC power. the two energy sources are combined to power the grid to meet the demands.Solar Wind Hybrid energy Systems become reliable for small power applications. To improve the solar Photovoltaic power generation efficiency, wind energy is integrated to form as hybrid energy system. The proposed systems help to reduce air pollution caused by the conventional power generation system. By installing SWHES to every house, the burden on the conventional power generating system reduces. The storage of the battery will give power for some time, even no generation takes place by this system. Almost in all field of electric power usage, the SWHES are being used. It provides the power to inaccessible convention power places. SWHES are more reliable and efficient energy generating system with less effect on the environment and almost no maintenance.

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