ISSN: 2350-0328

International Journal of Advanced Research in Science, Engineering and Technology

Vol. 5, Issue 3 , March 2018

Survey of Hybrid Renewable Power Generation

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ABSTRACT: Integration and combined utilization of renewable energy sources are becoming increasingly attractive. A hybrid wind solar energy system (PV and wind combined) with battery storage and its control systems are presented in this paper. The proposed system consists of a wind turbine, a solar panel, a battery storage unit, SEPIC Converter and a set of loads. A power electronics interface, based on various converters, is used to integrate the renewable energy sources and the storage device to the main DC-bus feeding a single phase AC load. The main challenge of the hybrid system is to maintain the load demand under various conditions. The objective of the proposed SEPIC converter is to ensure a proper conversion and accuracy. This paper also highlights the future trends of Hybrid energy systems, which represent a promising sustainable solution for power generation. .

KEYWORDS: Renewable Energy Source (RES), Solar (PV), wind, battery backup, SEPIC Converter, hybrid Renewable Energy Sources (HRES)

I. INTRODUCTION

India is a vast country. More importantly, it is still developing. There are still vast areas which are completely cut off from the grid. It is not physically possible to connect some of the areas to connect to the grid. Since India is a developing country, its energy requirements are always greater than what it is producing. In order to meet this ever growing requirement, India needs to do something. Since non renewable sources are lacking in availability and are polluting ways, alternative sources of energy. This is the reason of looking the renewable energy sources.
But, renewable energy sources such as solar, wind, biogas is not able to produce continuous power to reach our load demand. To overcome these limitations this paper presents the hybrid renewable energy sources.

In Power engineering, the term 'hybrid' describes a combined power and energy storage system. [1] It is more important to choose correct combination of sources. It is mainly depends the location of the power plant. Hybrid systems provide a high level of energy security through the mix of generation methods, and often will incorporate a storage system (battery, Fuel cell).

In this proposed system HRES with back storage is presented.[3] In case of absence of both renewable sources or in demand conditions the battery will supply to the load. The battery should operate in better SOC level. If its operation under low battery SOC it will have very bad impact on batteries lifetime.[4] This is very crucial aspect in the design, since there are usually many alternative possibilities related to which individual components will be included in a hybrid energy system [standalone and hybrid wind].Many studies explained the PV/solar based hybrid renewable energy sources. [2]

In this paper the conversion speed and accuracy has been increased using SEPIC converter which can be used as a both buck and boost converter.

II. SOLAR AND WIND COMBINED POWER GENERATION WITH STORAGE

The following papers are referred for this survey.

- HRES with battery storage
- HRES with optimization of back up storage(fuel cell)

ISSN: 2350-0328
International Journal of Advanced Research in Science, Engineering and Technology
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- HRES Based on intelligence optimization technique
- hybrid system with new converter configuration.

III.HRES WITH BATTERY STORAGE

Kamal Anoune etal., proposed the HRES to maximize the electrical power production with use of storage battery.

Now a days, due to the lack of availability and increase of cost of fossil fuels non renewable power generation is not preferred that much so that many researches are carried out for combining two renewable sources mainly solar and wind due to their availability. [3]

The energy from solar and wind are controlled by MPPT controller using Maximum Power Point Tracking Algorithm. The voltage and current are sensed from the power produced by solar and wind by using solar and wind sensors.

MPPT controller which is extracting maximum power from the source. MPPT checks the PV module and then compared with battery voltage then fixes the voltage level for the battery. MPPT send the input to DC-DC boost converter as a duty cycle or voltage which converts low input into higher input. Then it is send to the load usage.

In case of lack of both resources there will be a demand problem. To overcome this problem battery storage is used which stores extra energy. The stored energy is used when the power is lacking.

Lead Acid battery is mostly preferable due to its cheap cost and performance ratio. Te State of Charge is calculated by using

$$SOC = SOC_0 + \int_0^t \frac{I_{bat}}{C_{bat}}$$

IV.HRES WITH OPTIMIZATION OF BACK UP STORAGE

It is necessary to stable source in case of bad weather condition. When the production is not meet the demand battery is used. The battery SOC is maintain between maximum and minimum range. If it reaches maximum control system stop charging and minimum means it disconnect the load. When SOC is high battery life time will be high or else it has negative impact on its lifetime.[5]

Batteries are disconnected depending upon its optimization. Solar is connected to DC bus through DC-DC boost converter. To control this boost converter MPPT technique is used. It controls the maximum power whatever the temperature and irradiation level of the solar. It requires voltage and current of the solar panel.

The output from wind is determined by the generator and also varies depending upon its climate. Rectifier is used to rectify the output of the wind system. The rectifier output is increased to a fixed DC by boost converter.

The battery is necessary to adjust the reference voltage and the power demand. If there is an excess of energy produced by HRES the battery will be recharged. Lead acid battery is normally used because of its high voltage and energy storage.

The batteries are connected to the DC bus through DC-DC converter for charging and discharging purpose. The inverter control having two blocks. They are DC bus voltage control loop (external loop) and current control loop(internal loop). In current control loop current is adjusted by PWM technique. After this control method LCL filter is used to reduce the harmonics. Battery optimization depends upon the battery state and is used to connect the battery to system. EMS system compares the input to their limits and decides the operation.

It is necessary to set maximum and minimum limit to the battery SOC for the beginning. When both source are absent batteries are used until reaches the SOC minimum level.[4] Energy management based on load forecast, energy generation forecast and energy selling forecast.

V. BASED ON INTELLIGENCE OPTIMIZATION TECHNIQUE

Due to the intermittent nature of renewable energy sources reliability is reduced. To avoid this problem some optimization techniques are used. Renewable energies are aims to get non pollutant energy. One solution to avoid reliability problem is proper design. HRES combinations depends on availability of resources. In this study solar and wind are chosen.

ISSN: 2350-0328
International Journal of Advanced Research in Science, Engineering and Technology
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A.OPTIMIZATION TECHNIQUES:

The size optimization is one of the key areas of the HRES to provide a balance between the system cost and reliability. The correct sizing to determine the number of wind generators, the number of PV panels and number of battery bank needed. There are different intelligence optimization techniques which are used to optimize HRES in order to maximize economical benefits. Some of optimization techniques are genetic algorithm, artificial neutral networks and fuzzy logic.

Genetic algorithm is most preferred algorithm because of its ability to handle complex problems with linear and non linear cost functions.[6] And main advantage f this technique is that the execution doesn't depend on error on surface. Which makes multi criteria optimizations [7], [8].

VI. HYBRID SYSTEM WITH NEW CONVERTER TOPOLOGY.

The hardware used are Wind system, Solar system, MPPT controller, Cuk converter, SEPIC converter, Hybridized converter.

The software used is Matlab/Simulink.

Solar and wind energy are corporate by using combined converter system. The combined converter system consist of cuk and sepic converter[11]. They have the capacity to neglect high frequency current faults in wind system and provide standalone or continuous operation. The solar cell convert sunlight to dc energy also having advantage of no noise and no maintenance[10].The energy from the solar is given to the CUK converter and the energy from wind is given to the SEPIC converter[9]. The system is highly efficient and reliable. The solar and wind are highly unreliable due to their unpredictable nature[12].

DC-DC converter having switched mode regulator used to convert unregulated DC to regulated DC. Generally BJT, MOSFET or IGBT are used. The CUK converter using step up or step down operation. The output is negative with respect to common. It is always works on continous conduction mode. It operates through transformation of energy from capacitor [9].

The SEPIC converter having operations of BUK ,BOOST and BUCK-BOOST. It is similar to buck boost converter. The output is positive with respect to common[9]. The wind energy is least expensive source in existing energy sources[11]. The CUK output inductor is shared to the SEPIC converter. This allow the converters operate individual when the other source is absent.

The system is modelled by using MATLAB/SIMULINK software. The solar with CUK converter with MPPT control and wind with SEPIC converter with MPPT control are modelling and output is taken by using simulink software. The hybrid system provide the realistic form of power generation. The CUK and SEPIC converter used to failures of other converter. This allows two sources work independently. This system having low operating cost and used to transfer the power to remote areas.

VII. CONCLUSION

The hybrid system having voltage stability and automatic load sharing capacity. So these system are very useful to transfer power where the places doesn't provide electricity through transmission tools like disaster places. It has long life and eco friendly system. it Doesn't cause any pollution like fuel. The power loss is low because the energy is used by the place where it is produced. This survey is very useful to the persons who doing research in the area of hybrid power generation. The final prediction is to produce electric power using different control method for improving the electrical power production.

ACKNOWLEDGMENT

We would like to express our gratitude to our Institute for providing a chance for research. We would like to emphasize that, we have not been able to complete this research without the help of our guide Mrs. A.Umaamaheshvari.

ISSN: 2350-0328

International Journal of Advanced Research in Science, Engineering and Technology

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