REVIEW ON WIND-SOLAR HYBRID POWER SYSTEM

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ABSTRACT: The demand for electricity power is increasing day by day, which cannot be met with the satisfied level without non-renewable energy resource. Renewable energy sources such as wind, solar are universal and ecological. These renewable energy sources are best options to fulfill the world energy demand, but unpredictable due to natural conditions. The use of the hybrid solar and wind renewable energy system like will be the best option for the utilization these available resources. The objective of this research paper is to study thevarious aspects of hybrid solar and wind system. The application and different theories relatedto the development of hybrid also discussed in this paper.

Keywords: ***Solar energy, Hybrid system, Wind energy***

1. INTRODUCTION

For development of any country energy plays an important role. It is very essential part of growth & economy of country. Our primary source of generating energy is from coal, oil and natural gas. As we all know that energy is needed for industrial, agriculture, commercial and domestic purpose. World's energy demand is increasing day by day. There are many sources of generating energy from coal, fossil fuels, oil and other gases [3]. But all these sources are harmful to the environment so that there are limitations of using these sources and they are limited. Due to global warming and pollution in environment we need clean energy source. In today's world all focus is on Eco green energy, means generating energy without harming environment. In that case we have option of renewable energy sources like solar, wind, small hydro & biomass, bio-fuel etc. Renewable energy is having very much potential to achieve energy demand. But there are also some difficulties occur to use these energy sources, many research is going on to improve the efficiency of renewable energy source. Because main aim is to conserve the natural resources, make system to avoid global warming & carbon emission. Generating energy from renewable source instead of coal or fossil fuel will be cost effective to the country. If we use this renewable source to generate energy it is predicted that it will reduce CO2 emission [9]. As mentioned above there are many renewable energy sources but wind & solar energy is most prominent. Because if we talk about renewable energy source the first thought is about wind- solar, it is well known source of energy and widely distributed everywhere. Single source of energy such as wind & PV is not totally reliable due to climate change or sunshine in night hours or rainy season and wind speed variation [1].

Normally wind & solar energy are separately used to generate power but both are having some losses. Like our environment is changes every day the climate changes affect these systems, solar radiations are not consistent and wind speed varies every time so it affect the system & its performance. Whatever cost require for installing single system it will reduced up tosome extent in this combine hybrid system. So instead of using single system, if we combine these two it will help each other to overcome losses. Like when sunshine hour's solar PV system will generate electricity and wind turbine system will extract energy from wind source. When wind conditions are not strong enough to produce power that time its have backup to fulfill load demand & that will generate from the solar

system. For more convenience of hybrid wind-solar system many researcher have used different combinations to make system more reliable. They used combination of wind-solar and other sources like diesel/wind/PV, wind/diesel, and PV/diesel hybrid system [12].

There are some basic steps which have to follow for design and planning of hybrid system.

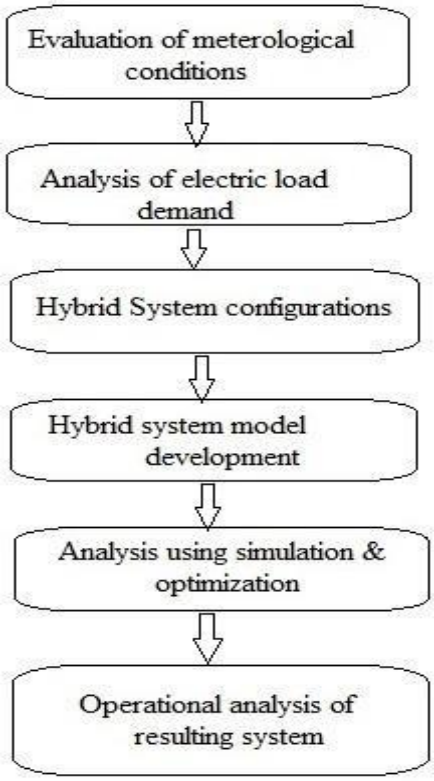

Fig.1. Basic steps for design & planning of hybrid system

2. HYBRID WIND-SOLAR POWER SYSTEM

This system is combination of wind energy and solar energy, used to generate power from each other. Hybrid system is having advantage than system those which are totally depend onsingle source of energy. Researchers have very tough task to maximize the total energy output from the system with lower cost & reliability [8]. Generally wind-solar hybrid power system consists of wind turbines, photovoltaic array, controller and storage battery. Wind turbines is used to convert wind energy into mechanical energy and then into electric energy. Whatever electric energy is generating from this system is alternate & unstable. So some controlling units or inverters are used to make it continuous and store into battery. This energy utilize for domestic purpose or other. Photovoltaic array having solar panels through series or parallel, converts solar energy into electrical energy. This energy is in DC form, it isstored in battery and controller supply power for AC or DC loads. This system having high daily electricity generation capacity, low fabrication cost, maintenance is low and has other advantages also [13].

3. REQUIREMENTS OF WIND-SOLAR HYBRID POWER SYSTEM

To develop this system & to investigate performance, modeling and mathematical calculations have to develop. Different models of hybrid system have covered in literature. Following are the components from review of literatures:-

3.1 Meteorological data: - Meteorological analysis of the location has to be made foroptimization process. It is important for total utilization of PV/Wind sources. Measuringsolar and wind resources data is main input of the hybrid system. That all data should bemeasured hourly, daily and as per weather or climate change.

3.2 Load Demand: - It is necessary part of system to design & analyze. To find out the exactload demand it is very complicated and difficult to decide. Load variation for different seasons is not predictable, so system have to design for nearer or more than load demandto full fill requirements.

3.3 System Configuration: - By studying all data like solar radiation, wind speed and load demand proper selection of equipments have to be made. But sizing of system will be according to the environmental conditions. Because producing power from solar-wind isdepend upon the location which is to be selected.

4. LITERATURE STUDY ON THE HRES SYSTEM

The utilization of hybrid solar wind is necessity for the development of the country. The differentresearches were carried out on the development and performance assessment of the solar and wind hybrid system. Makbul A.M. Ramli [2] et.al, presented case study model on the hybrid solar and wind system on the techno-economic energy analysis for in Saudi Arabia. The study is carried out for economic production for the electric using the hybrid system; the differentparameters are taken into consideration for economic production. Vikas Khare [3] et.al, presented the review on the HRES. The presented research concentrated on the different issues related with HRES such as optimum sizing, feasibility analysis, modeling, control aspects and reliability. Binayak Bhandari [4] et.al, in this paper author differentiates power produced from both the photovoltaic (pv) and wind turbine base on weather conditions. They found that by using storage system for backup we can improve the system and make it more convenient.

According to that they apply various optimization techniques for hybrid system & make component specifications according to that. Again they focus on the present scenario of environmental crises. Renu Sharma [5] et.al, this paper main focus is on rural development in India by using separate hybrid system. They study combinations of hybrid system for generating power. By calculating load demand for rural villages, load is divided into phase on that basis further analysis is done. Getachew Bekele [6] et.al, design the hybrid wind and photovoltaic power generation system for the Ethiopian remote area. The research studies design the system for basic electrification requirement. The data for the study collected from national agency. The simulation of that hybrid system is analyzed by using the HOMER software. The results of the study concluded with satisfied working of the system and the shortage of electricity is coveredup to 20%. Y.M.Irwan [7] et.al, Asserted the new techniques in Perlis Malaysia for hybrid powergeneration. The power generation form the wind is used for cooling of the PV module. The combination of Savinious and Darrieus is used with PV module. The new approach for hybrid system design can improve the performance.

Mohammed Gwani [8] et.al, this system is used for energy generation using hybrid solar-wind but this is combination of vertical axis wind turbine with omni directional guide vanes (ODGV). Author design ODGV to get maximum poweroutput from wind energy which works on venturi effect. By using this combination in hybrid system, they successfully improved power output of the system. Power generated from this system used for lightning street lights and other appliances. Prabhakant [9] et.al, Developed the optimized techniques for hybrid solar and wind power generation in remote areas. This presentedstudy associated with saving of coal and carbon production during the power generation.

Yahia Bouzelata [10] et.al, Explored about the optimal design and performance in the hybrid solar and wind energy system. The Doubly fed induction generator used for generation of electricity with WECS. The results of the study concluded that the used power electronics for electricity generation improved the power quality. Palash Jain [11] et.al, Discussed on the performance prediction and fundamental of small scale VAWT for blade pitching during variable amplitude. The different design issues were studied and concluded that the maximum from turbine is due wide ranges of wind speed and tip speed ratio and amplitude of blade pitching varied with wind speed and tip speed ratio.

Sunanda Sinha [12] et.al, presented the prospects for installation of micro wind and PV hybrid system in the Western Himalayas region. The analysis of the hybrid system is carried out on the basis data available from NASA and ANN predicted data, measured data for Hamirpur and estimated data for eleven locations of Himachal Pradesh.

5. CONTROLLER FOR SOLAR AND WIND HYBRID POWER SYSTEM

Power efficiency or voltage stability are key challenges for wind and solar hybrid systems. The production for each source depends on itself since all sources are renewable. The wind speed is not constant as well as sunshine varies all day long. The solar system does not work in the rainy season. It stops voltage from being stable but impacts power efficiency. To maintain stability and improve power quality, these different controllers are used. The UPFC D-STATCOM, IPFC, SVC, SSSC, and Fuzzy Logic Controllers were used for energy conservation and power continuity. The tensile stability of the power system has been reduced by the swell, slope, and harmonics produced in the system. Unless the fee is given, the FACTS devices are linked to the inverter output terminal. These Information tools help to reduce current waveform harmonics, which increase power efficiency. STATCOM is static synchronous compenser used to reduce dynamic power compensation, boost device constancy and transient stability. This is used to compensate for reactive or aggressive strength.

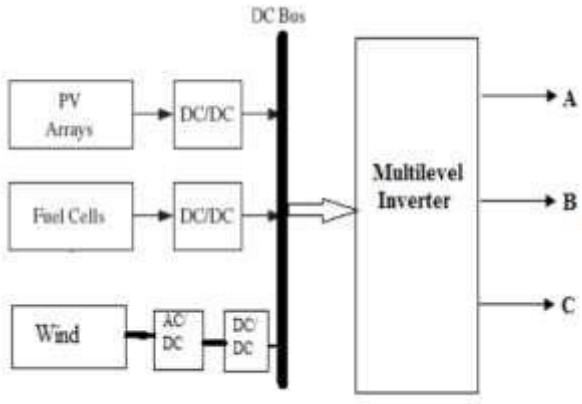

Fig.2.Block Diagram of Hybrid System with Multilevel Inverter

6. IMPROVEMENT OF POWER QUALITY IN HYBRID SYSTEM WITH MULTILEVEL INVERTER

Multi-level inverter power efficiency depends on the number of stages. The multi-level inverter has the primary advantage of generating peak voltages with low harmonics. The harmonics induce the development of present that leads to a favorable rise of current. These inversions are used for high power applications. Inputs are first connected to the dc-dc converter in hybrid systems or multilevel inverters. Specific converter topologies such as two-stage voltage converters are being used; 3-stage clamped voltage source converter diode, 4-story convector, or H-bridge mounted voltage converterseries. Voltage converter. diode clamped inverter is the mostwidely utilized converter,

whereby a diode is used to push dc bus voltage into three-phase output voltage so that seveninverters may be used. As the number of rates increases, low order harmonic amplitude decreases. Since high-frequencyharmonics are simple to detect, a low pass detect is usually added to the inverter. By can lower order harmonics, the efficiency of multilevel inverters can be increased. The DC busvoltage at a consistent value can also be regulated via the PI controller.

Renewable electricity, like wind, was given a huge boost soonafter the first major oil crisis in the second half of the 1970s. Financial problems at the time were the most significant considerations and the interest in these systems declined as oilprices plummeted. The need for this is inspired by construction expenditure in renewable energy. the strong influence of the use of fossil energy systems. Around half of the energy hits thesurface of the earth and the other half is transmitted by the atmosphere to the outer space. the Sun, that gives over 150,000terawatts of electricity to Earth. Only a tiny portion of the solarenergy generated on Earth will meet the world's anticipated need for electricity. Although most green energy sources are wind, we are talking about the actual use of solar radiation through the application of solar electricity. One of our biggestscientific and technological prospects is the creation of efficient ways of capturing, transforming, processing and using solar energy at an affordable cost. Solar energy networkshave two major drawbacks:

- The energy costs resulting are not yet sustainable and
- When required, solar power is not always available.

Substantial attempts to explore strategies that can help solve these disadvantages; one such technique is power. While the primary source of energy (fuel) in many power generation processes can be controlled as it is the main control element solar Power System cannot be controlled as solar power is themain source of energy (Camacho et al. (1997)) as it changes seasonally regularly and is a control condition. Solar plants have all the technologies necessary to deal with changing environments for innovative management approaches (nonlinearities and uncertainty). Since fixed PID controllers are incapable of dealing with any of the above issues, they must be discarded with small gains, result in sluggish answersor when tuned near, they may generate strong oscillations as process dynamics differ due to shifts in environmental or operational conditions. Using more effective control techniques to boost reactions will maximize the number of solar hours plants, thereby reducing costs produced per kW-h.This paper discusses the current hybrid power system as well as the issues with management and how control systems should increase their performance.

7. SOLAR ENERGY

The photovoltaic cell can provide solar-powered power or the CSP can specifically be produced using the photovoltaic cell and the power generation turbine. Specific control is based onthe photovoltaic effect, which is that light-photons smashelectrons into higher levels of energy. PV generation systems are used for everyday use, including enclosed buildings, boats,water pumps, electric vehicles, emergency route phones, and remote sensing, which are not limited to electric vehicles.
The solar concentrative thermal system uses sun-tracking devices and optical equipment (usually mirrors) to focus a wide area of sunlight in a smaller receiving zone. A conventional power plant instead utilizes distributed solar energy as a heat source. Many integrated developments have been developed A) the most critical target conditions areparabolic boiling, b) solar panels, c) rectangular fresnels, and
d) solar towers. The oriented solar electricity is based on lowtemperatures and hence high thermodynamic performance.

A. Irradiation – Data from various sources have been analyzed and source based on the definition of accuracy insuch a study established.

B. Performance ratio – The efficiency ratio is found to be dependent on irradiation, optimum tilt angle, air

temperature, the geometry parameters, module size, inverter efficiency, etc. The tests were obtained using RETscreen tools based on the above parameters. Some information on the newly deployed Indian network linked power stations was related to the results.

C. **Degradation –** Over 25 years, every producer guarantees its efficiency, with 90% production for the first 12 years, and up to 80% after 25 years of service. Related analyses of the extenuation of modules during long-term field service by world-renowned organizations. Such results areevaluated to obtain the final findings.

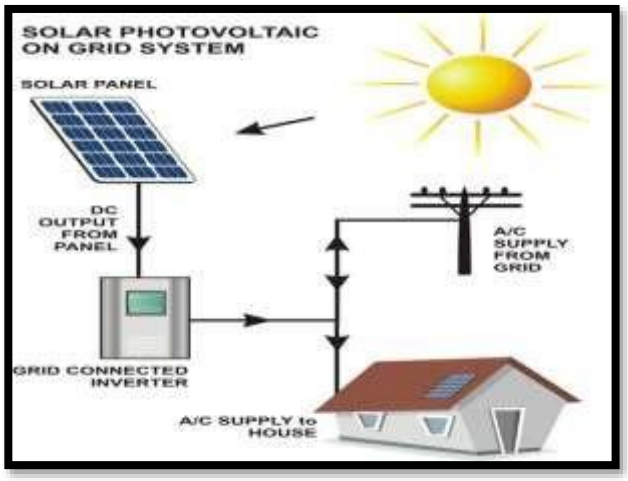

Fig.3. Solar power System

D. **Life expectancy –** Trends in panel, inverter, system support and cabling accelerated tests were investigated.

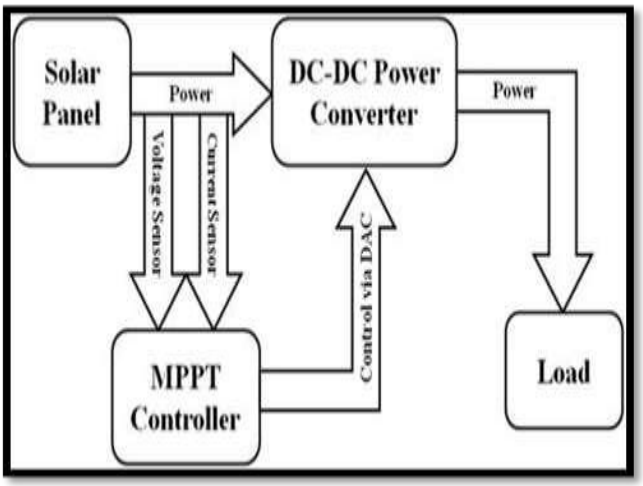

Fig.4.Block of control circuitry

1. Technology for Solar power plants

- Solar energy can be classified loosely into two groups Solar PV technologies.
- Solar thermal power plants.

2. Solar Photovoltaic (SPV) technologies

Semiconductor machines are photovoltaic transformers that transform most of the solar radiation incident into electricity directly. most increasing PV cells are made of silicone with single glass, yet cell substrates, design or development processes vary significantly. Amorphous cells including cadmium telluride, copper indigenous Silicon, CIGS, DSSC sensitized solar cells, as well as other emerging developments like silicon nanoparticle manufacturing, carbon nano tubing, or quantum dots, are possible. or CIGS, CD-Te Crystalline Silicone, and Silicium Amorphous Cells are possible.

Table.1.Solar Module efficiency

Sr.No	Module	Efficiency
1	Thin film	12-14%
2	Polycrystalline	15-16%
3	Monocrystalline	16-18%

3. Performance of solar power plants

The productivity of solar power plants is also measured in the Facility Usage (CUF), which is the ratio of the plant's actual production to its estimated yearly production. The approximate solar power plant output is measured using standard software and is based on design parameters. But, considering that the final product from a plant has many factors, CUF varies over a number. This may be due to inadequate panel quality, derived modules at a higher temperature, other architecture parameters such as ohmic failure, Variables in the climate such as increased cloud cover or dung. Therefore, various factors that contribute to variation in plant production are important to note. Also, the performance of plants depends on many factors, like facility position, solar insolation level, in general, climatic temperature conditions, cable technological loss, module mismatching, land loss, MPPT losses, transformer losses or inverter loss System failure or module deterioration by aging can also lead to losses.
Many of them are defined by the manufacturer like power production dependency on temperature recognized as a coefficient of temperature. Main success metrics are known as the following:

- site radiation
- PV system losses
- temperature and atmosphere conditions
- Plant architecture parameters
- Inverter performance
- Module aging degradation

a) Solar Radiation Basics and Definition

Solar radiation for several physical, biological & chemical treatments on the surface of the planet is the main catalyst. Full and accurate solar radiation data are important for science and engineering fields as architecture in a specific area., Industry, forestry, the environment, hydrology, irrigation, water, limnology, oceanography, and environmental sciences. Furthermore, the solar ray data are an integral component of solar power applications like photovoltaic power generation systems, solar heating collectors, building solar-powered air conditioning and passive solar power systems [3]. Several analytical formulas for measuring solar radiation have been established using different parameters. Many plays have taken advantage of sunlight season, daylight hours, relative humidity and temperature, and rainy days, sunlight periods and a feature that varies based on latitude and height. The primary condition for the construction of any renewable power plant is the correct solar radiation data. device must be known for accurate construction measurements. Instantly or mixed results may be measured (irradiance), usually over one hour or one day for a long period (irradiation). Data for a pulse, scattered or absolute radiation, or horizontal or

sloping field. Also important is awareness of types of measurement instruments for thesemeasures.

b) Losses in PV Solar systems

All systems losses measured lead to a lower grid voltage thanfor power produced by photovoltaic modules system losses. Such failure is caused by many factors, like cable drops,inverters, the soil on modules and atmospheric conditions, differing amounts of insolation, etc. We must take into accountall potential losses when planning a PV network.

c) Reflection losses

At normal test conditions, PV module power ratings, which include perpendicular incident light, are calculated. Larger incidence angles are generated under field conditions, leadingto higher reflex losses than the nominal power value. Measurements display an average reflection loss as contrastedto STC of approximately 1% in equator facing modules with alatitude angle of tilt.

d) Soiling

The deposition of dirt and dust will contribute to the soiling ofsolar panels. The dust is normally washed off by moisture fromthe panel sheet, but soil such as bird dropping can linger evenafter heavy rains. The lower edge is the most essential elementof a module. Silting occurs at the edge of the frame, particularly with very low inclinations. The water accumulation between the frame and the glass also accumulates in the shallow puddle and consequent debris for evaporation. The dirt decreases the strength from a battery while the cells are shaded. Losses are normally 1%, so when the modules are washed the control is returned.

e) Mismatch effects

The connectivity of solar modules in sequence and concurrently induces wrongdoing damages. The modules that do not have the same property or have different conditions. Mismatch errors in PV modules and arrays are a significant concern as, in worse circumstances, the efficiency of the entirePV system is calculated by the lowest-performance solar cell.The choice of modules is thus very significant in the overall production of the plant.

f) Maximum Power Point Tracking (MPPT)

Changes in solar panel output in the direction of the sun, raisesunset but differ in temperature. The curve of the PV module (power vs. voltage) only has one total power. This assumes that

a high voltage nor current is identical to the same voltage. As the output of the module is low, the module should be run at ahigh power level, to provide full power to the load under varying temperatures and insolations conditions. It increases the usage of the solar PV module by optimizing capacity. Utilizes an MPPT to remove full power from the solar PV module then transmit this energy to load. A dc / dc conversionsystem aims to convert maximum energy into a charge from the solar PV panel. High power point control means that the output of the panel is still at the highest PowerPoint. The use of MPPT raises solar power plant production substantially. maximum power point for a mono-crystalline solar cell is achieved at the intersection of the current or voltage curve fora certain irradiation frequency.
Cable, converter, inverter and switch networks experiencedamages that are normally easy to assess.

g) Inverter efficiency

A solar photovoltaic inversion is an electric converter intendedto transform DC energy for household equipment or to be fedinto the grid from photovoltaic to alternative current (AC). These generators may be independent inverters on isolated systems or inverters for connection of power plant to the grid.Inverter's output depends on how often DC voltages are converted into AC. There are efficiencies of 96 to 98.5% for currently available grid-connected

inverters, so a right inverteris critical for the design process. Lower inverters are also lesseffective than 95 percent. If used at the low end of their full strength, the inverters are therefore much less effective. In 30 to 90 percent power range, the majority of inverters are most powerful.

8. WIND ENERGY CONVERSION SYSTEM

WECS consists of a rotor that consumes kinetic force in the air, and a power train to increase the rotary speed of the shaft.The WECS mechanism consists of a piston. This article uses avariable wind turbine with the option to adjust the speed from'ATE' to' V' of wind turbine continuously. According to the used motor, ECS with dual feed inductance generators is the most important listed variable speed wind turbines. The abilityto control pitches through efficient power transmission through active or reactive power control has been made very appealing, as wind power is increasingly influenced by the electricity network. The stator (stationary) of generators is directly connected to grid & rotor power is managed via converters in these types of generators. There are three main components of that model: wind turbine rotor, drive train as well as the generator. By generating torque, the wind turbine rotor transforms the wind's cinematic energy into mechanical energy. As energy in wind is like kinetic energy.

9. CONCLUSION

The use of solar–wind hybrid renewable energy system is ever-increasing day by day and has shown incredible development in last few decades for electricity production all over the world. By using this development of new technologies and researches in the field of solar wind hybrid renewable energy system, a new difficulty arises, which become much more easily solved with new techniques. The presented review paper reported the different techniques and ideas about theHRES and its energy utilization.Sustainable solar power generation is one of today's big technological problems. The Control is one of the methods that allow this goal to be accomplished. This paper shows the major control issues of solar systems operation.

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