A Review on Hybrid Solar PV and Wind Energy System

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Abstract:- Hybrid solar PV and wind generation system become very attractive solution in particular for stand-alone applications. Combining the two sources of solar and wind can provide better reliability and their hybrid system becomes more economical to run since the weakness of one system can be complemented by the strength of the other one. The integration of hybrid solar and wind power systems into the grid can further help in improving the overall economy and reliability of renewable power generation to supply its load. Similarly, the integration of hybrid solar and wind power in a stand-alone system can reduce the size of energy storage needed to supply continuous power. Solar electricity generation systems use either photovoltaics or concentrated solar power. The focus in this paper will be on the photovoltaics type. Detailed descriptions of the different technologies, physics and basics of PV can be found in many textbooks and papers such as [4-7]. Kurtz [8] pointed out that ten years ago the concentrator cell was only ~30% efficient compared with more than 40% today with the potential to approach 50% in the coming years. Si cells have efficiencies of 26% and multi-junction III-V-compound cells have efficiencies above 45% (48% in the laboratory) as pointed out in reference [9]. PV modules produce outputs that are determined mainly by the level of incident radiation. As the light intensity increases, photocurrent will be increased and the open-circuit voltage will be reduced [10]. The efficiency of any photovoltaic cell decreases with the increasing temperature which is non-uniformly distributed across the cell [11]. The solar output power can be smoothed by the distribution of solar power in different geographical areas [12]. Electricity from solar PV and concentrated solar power plants is significantly expensive and requires significant drop in cost or change in policies by either subsidizing or forcing the use of these technologies to be able to achieve significant market penetration [13]. Global wind report (2012) indicated that the annual market grew by around 10% to reach around 45 GW and the cumulative market growth was almost 19% [14]. Detailed descriptions of the wind energy can be found in references [4] and [15]. Wind turbines (WTs) are classified into two types: horizontal-axis WT (HAWT) and vertical-axis WT (VAWT). The highest achievable extraction of power by a WT is 59% of the total theoretical wind power [15]. Hybrid solar-wind systems can be classified into two types: grid connected and stand-alone.

Key words: Hybrid, Renewable, Less complexity, Economical, Efficient

Literature Survey:

J.Godson et al. (2013) Renewable energy sources i.e., energy generated from solar, wind, biomass, hydro power, geothermal and ocean resources are considered as a technological option for generating clean energy. But the energy generated from solar and wind is much less than the production by fossil fuels, however, electricity generation by utilizing PV cells and wind turbine increased rapidly in recent years. This paper presents the Solar-Wind hybrid Power system that harnesses the renewable energies in Sun and Wind to generate electricity. System control relies mainly on micro controller. It ensures the optimum utilization of resources and hence improve the efficiency as compared with their individual mode of generation. Also it increases the reliability and reduces the dependence on one single source. This hybrid solar-wind power generating system is suitable for industries and also domestic areas.

Ali Diabat (2014) Among the wide range of problems facing our world today, there is global consensus that greenhouse gas (GHGs) emissions have the largest negative impact on our environment. GHGs include carbon dioxide, methane, nitrous oxide, sulfur hexafluoride, hydro fluorocarbons and perfluorocarbons. These gases help maintain the temperature of the earth at comfortable levels for organisms, and a decrease in their levels would result in a temperature that could be too low for us to survive. However, because GHGs allow sunlight to enter the atmosphere, but trap the heat radiated off the earth's surface, an increase in these emissions would result in an increase of the planet's temperature, or global warming, to levels that could be fatal to living organisms. Many scientists also believe that the increase in natural disasters is fueled by climate change, since atmospheric and oceanic patterns shift as the Earth's temperature increases.

Chandragupta Mauryan K.S et al. (2014) Nowadays Renewable Energy plays a great role in power system around the world. It is a demanding task to integrate the renewable energy resources into the power grid .The integration of the

renewable resources use the communication systems as the key technology, which play exceedingly important role in monitoring, operating, and protecting both renewable energy generators and power systems. This paper presents about the integration of renewable energy mainly focused on wind and solar to the grid.

Karim Mousa et al. (2014) Although solar and wind energy are two of the most viable renewable energy sources, little research has been done on operating both energy sources alongside one another in order to take advantage of their complementary characters. In this paper, we develop an optimal design for a hybrid solar-wind energy plant, where the variables that are optimized over include the number of photovoltaic modules, the wind turbine height, the number of wind turbines, and the turbine rotor diameter, and the goal is to minimize costs. Simulation studies and sensitivity analysis reveal that the hybrid plant is able to exploit the complementary nature of the two energy sources, and deliver energy reliably throughout the year.

Medugu et al. (2014) A hybrid power system consisting of PV-arrays and wind turbines with energy storing devices (battery bank) and power electronic device was designed and constructed in this paper. The system is aimed at the production and utilization of the electrical energy coming from more than one source, provided that at least one of them is renewable. The efficiency of the designed power electronic device is about 95% and 73% for capacitive and resistive loads respectively. The integration of the hybrid is to electrify a residential house and its surrounding in order to reduce the need for fossil fuel leading to an increase in the sustainability of the power supply. This approachis techno-economically viable for rural electrification.

Ashish S. Ingole et al. (2015) Now a day's electricity is most needed facility for the human being. All the conventional energy resources are depleting day by day. So we have to shift from conventional to non-conventional energy resources. In this the combination of two energy resources is takes place i.e. wind and solar energy. This process reviles the sustainable energy resources without damaging the nature. We can give uninterrupted power by using hybrid energy system. Basically this system involves the integration of two energy system that will give continuous power. Solar panels are used for converting solar energy and wind turbines are used for converting wind energy into electricity. This electrical power can utilize for various purpose. Generation of electricity will be takes place at affordable cost. This paper deals with the generation of electricity by using two sources combine which leads to generate electricity with affordable cost without damaging the nature balance.

Rashid Al Badwawi et al. (2015) proposed that due to the fact that solar and wind power is intermittent and unpredictable in nature, higher penetration of their types in existing power system could cause and create high technical challenges especially to weak grids or stand-alone systems without proper and enough storage capacity. By integrating the two renewable resources into an optimum combination, the impact of the variable nature of solar and wind resources can be partially resolved and the overall system becomes more reliable and economical to run. This paper provides a review of challenges and opportunities / solutions of hybrid solar PV and wind energy integration systems. Voltage and frequency fluctuation, and harmonics are major power quality issues for both grid-connected and stand-alone systems with bigger impact in case of weak grid. This can be resolved to a large extent by having proper design, advanced fast response control facilities, and good optimization of the hybrid systems. The paper gives a review of the main research work reported in the literature with regard to optimal sizing design, power electronics topologies and control. The paper presents a review of the state of the art of both grid-connected and stand-alone hybrid solar and wind systems.

Yashwant Sawle et al. (2016) Renewable energy systems are likely to become widespread in the future due to adverse environmental impacts and escalation in energy costs linked with the exercise of established energy sources. Solar and wind energy resources are alternative to each other which will have the actual potential to satisfy the load dilemma to some degree. However, such solutions any time researched independently are not entirely trustworthy because of their effect of unstable nature. In this context, autonomous photovoltaic and wind hybrid energy systems have been found to be more economically viable alternative to fulfill the energy demands of numerous isolated consumers worldwide. The aim of this paper is to give the idea of the hybrid system configuration, modelling, renewable energy sources, criteria for hybrid system optimization and control strategies, and software used for optimal sizing. A case study of comparative various standalone hybrid combinations for remote area Barwani, India also discussed and found PV–Wind–Battery–DG hybrid system is the most optimal solution regarding cost and emission among all various hybrid system combinations. This

paper also features some of the near future improvements, which actually has the possibility to improve the actual monetary attraction connected with this sort of techniques and their endorsement by the consumer.

Vaibhav J. Babrekar et al. (2017) Energy today, is the need of 21st century. The renewable energy resources therefore are used in tremendous amount as they are easily available and cost free. But these energies in standalone forms have disadvantages such as unpredictability, availability in all time etc. which can be overcome by hybrid energy systems. They are basically consists of combinations of number of renewable energy resources. They provide efficient response against voltage and frequency fluctuations, harmonic measures and power issues in standalone systems. Hybrid power system provide reduction in complexity, maintain lowest unit cost, energy fluctuations due to DPSP (deficiency of power supply probability), with the help of proper design, advanced fast response, good optimization and control feasibility. This paper provides review of hybrid solar and wind power system. The technical feasibility of PV wind hybrid system in given range of load demand was evaluated and economical evaluation of standalone PV, standalone wind and PV wind hybrid system have been developed using the model.

R. Chedid (2017) This paper presents a decision support technique to help decision makers study the influencing factors in the design of a hybrid solar-wind power system (HSWPS) for grid-linked applications. These factors relate mainly to political and social conditions, and to technical advances and economics. The Analytic Hierarchy Process (AHP) is used to quantify the various divergencies of opinions, practices and events that lead to confusion and uncertainties in planning HSWPS. The trade-off hisk method is used to generate multiple plans under 16 different futures and obtain the corresponding trade-off curves. Unlike the traditional 2-D simulation, a novel modelling of a trade-off surface in 3-D space is presented where the knee set is determined using the minimum distance approach. Robust and inferior plans are segregated based on their frequent occurrence in the conditional decision set of each future and hedging analysis to reduce risk is performed in order to assign alternati5.e options in case risky futures occur.

V. K. Gajbhiye et al. (2017) Energy is essential for the economic growth and social development of any country. The world 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.

Yazhini.B et al. (2017) In this paper, it reviews some communication technologies available for grid integration of renewable energy resources. Since most renewable energy sources are intermittent in nature, it is an important task to integrate a significant portion of renewable energy resources into the power grid infrastructure mainly the electricity flow takes place in one direction from the centralized plants to consumers. When compared to large power plants, a renewable energy plant is having less capacity. But as emerging resources renewable energy should be taken into account.

Conclusion

This paper has provided a review of challenges and opportunities on integrating solar PV and wind energy sources for electricity generation. The main challenge for grid-connected system as well as the stand-alone system is the intermittent nature of solar PV and wind sources. By integrating the two resources into an optimum combination, the impact of the variable nature of solar and wind resources can be partially resolved and the overall system becomes more reliable and economical to run. This definitely has bigger impact on the stand-alone generation. Integration of renewable energy generation with battery storage and diesel generator back-up systems is becoming a cost-effective solution for stand-alone type. The windbattery-diesel hybrid configuration can meet the system load including peak times. Energy management strategies should ensure high system efficiency along with high reliability and least cost. Good planning with accurate forecasting of weather pattern, solar radiation and wind speed can help in reducing the impact of intermittent energy. Voltage and frequency fluctuation, and harmonics are major power quality issues for both grid-connected and stand-alone systems with bigger impact in case of weak grid. This can be resolved to a large extent by having proper design, advanced fast response control facilities, and good optimization of the hybrid systems. The paper gave an overview of different research works related to optimal sizing design, power electronics topologies and control for grid-connected and stand-alone hybrid solar PV and wind systems. Solar PV and wind hybrid system can be connected in a common DC or common AC bus whether they are working in a grid-connected mode or a stand-alone mode.

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