A Review Paper on Residential Grid Connected Solar Photovoltaic System Using Matlab Simulink

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Abstract: *In today's world population are increasing exponentially and there are a huge demand for energy. There are two types of sources of energy renewable and not renewable. Nonrenewable is also known as a fossil fuel, for example, coal, petrol, diesel and much more. Fossil fuels produce a huge amount of hazards gaseous which directly or indirectly affects us and another big problem is that as per today's demand in near future on renewable sources would be depleted. To see this scenario an approach for renewable energy sources would be taken and currently all around the world every country focussing on renewable energy resources due to various advantageous. First of all renewable energy is clean energy and there is no emission of hazards components which affects our health system. Generally renewable energy consist solar energy, hydro energy, wind energy, thermal energy and many more. Out of these resources solar energy is best one as sun is the resource and provide us huge amount of energy continuously. Now main focus is to convert solar energy into usable form and for this process various option are available and in our research work we will used Polycrystalline Silicon PV Module. Efficiency of this panel is not so much high that's why various methods are available to boost DC energy. In our research work Maximum Power Point Tracking will be used. Now DC voltages have to convert into AC using various circuits and by doing this distortion will came into existence. If distortion will be more then further advanced technique must be used so that distortion cam is minimized as per IEEE standard, therefore, Hysteresis Current control Technology will be used. In this method, we used two loop that is voltage loop and current loop and both loops are very important because voltage loop is used to maintain power factor equal to one and current loop is used to reduce total harmonic distortion (THD). To achieve this we also used a controller that is the proportional controller.*

Keywords: Total Harmonic Distortion, MPPT, Renewable, Polycrystalline, Grid, Hybrid Renewable Energy Systems.

I. INTRODUCTION

The demand for electrical energy is increasing twice as fast as overall energy use and is likely to rise 76% by 2030 [1] [2]. The conventional electric power generation systems in the world are based on fossil fuels (coal, oil and natural gas), nuclear power and hydropower.
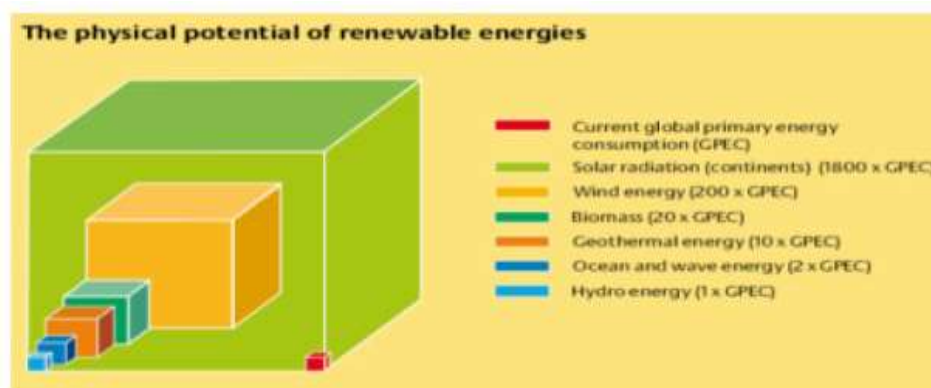

Figure1 Physical potential of different renewable energy sources

The fossil fuels and nuclear fuels are not renewable and reserves of these fuels will run out some day in the future, where as in the case of hydropower, sources are not enough and the sites are normally far away from load centers. Further, generation of power via conventional means is also causing damage to the environment, due to large scale combustion of hydrocarbon-rich fossil fuels, which adds a large amount of dangerous gaseous pollutants to the atmosphere. Among these, the release of CO_2, a major greenhouse gas, is largely responsible for Global Warming [3]. Another point of concern is that in many overpopulated countries, like India, there is a dearth of power generating resources and as a result, many cities and towns are facing constant load shedding and blackouts. The existing centralized power generation units are not sufficient to meet the continuously rising power demand. Many consumers are forced to invest huge amounts of money to meet their contingent load during power cuts and also to cater to the peak load demand locally by using conventional diesel generators [7-9].
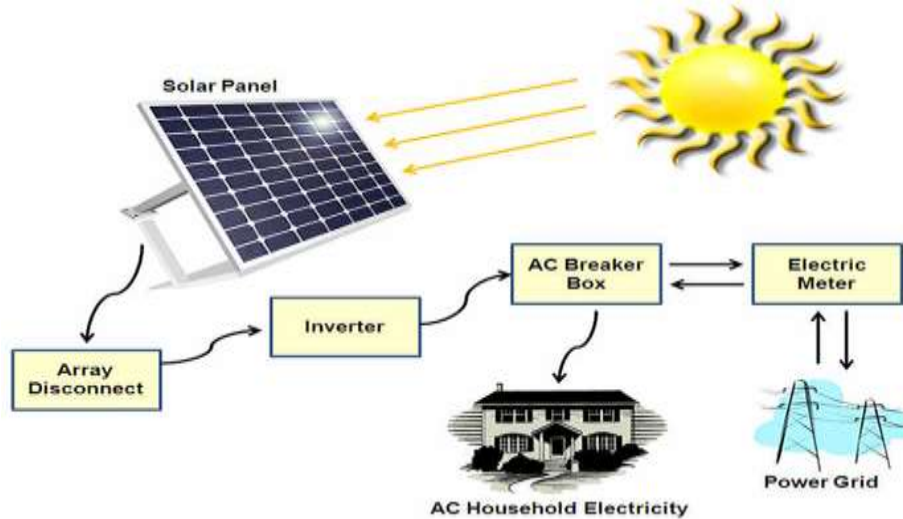

Figure 2 Solar System Description

Thus there is a growing interest in alternative energy resources such as solar energy systems to produce clean and sustainable electrical energy [6]. The exploitation of solar energy has become an essential measure to address present energy shortages and environmental problems. We have several reasons to be optimistic as there is great excitement about the possibilities opening up before scientific community in the field of solar PV.

II. LITERATURE SURVEY

Natarajan Pandiarajan, Ramabadran Ramaprabha, and RanganathMuthu: Developed Circuit model of PV module is presented in their research and that can be used as a common platform for material scientists and power electronic circuit designers to develop better PV power plan. Detailed modeling procedure for the circuit model with numerical dimensions is presented using power system block set of MATLAB/Simulink. The developed model is integrated with DC-DC boost converter with closed-loop control of MPPT algorithm. Simulation results are validated with the experimental setup [17].

Juan A. Lazzús, Alejandro A. Pérez Ponce, and Julio Marín: developed an artificial neural network for the estimation of hourly global solar radiation using data measured from a meteorological station. In this model data used were: wind speed, relative humidity, air temperature, and soil temperature and finally results were compared with the original data and other models available in the literature, and shows that the neural network obtained can be properly trained and can estimate the hourly global radiation with acceptable accuracy. The meteorological data used have influential effects on the good training and predicting capabilities of the chosen network [16].
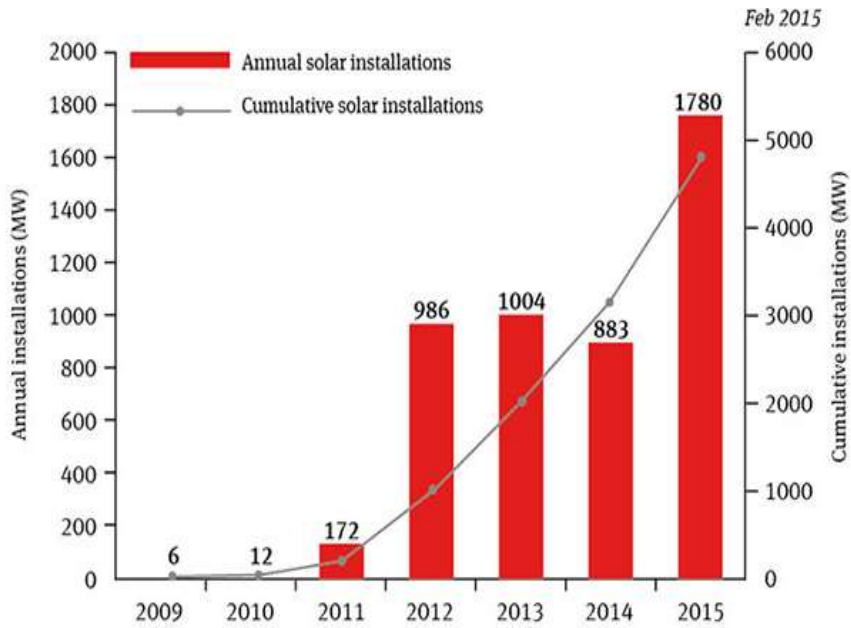
Figure 3 Solar Energy growth rate up to 2015 in INDIA

Various researchers find a technique on a DC/DC converter that is used to adapt a varying output voltage from a solar panel to demands of an electrolyzer unit or battery charging purposes. Converter covers a range of input voltage from 9 V-24 V with the output voltage of 12 V which has a maximum current of 50 Ampere. A modular topology of the converter is described along with a microcontroller control strategy. Finally, the efficiency increase of the synchronous interleaved buck-boost converter in various operating modes and load changes is experimentally evaluated and compared to the 2-transistor buck-boost converter. DC/DC converter that is to be used in a process of hydrogen generation with an electrolyzer and supplied from a solar panel is described. The main attention was paid to the variable input voltage from the solar panel due to a non-constant solar radiation. The proposed converter consists of four MOSFET transistors with low-voltage drops to minimize the energy losses. In order to implement low current MOSFETs, a modular topology of the converter is introduced and analyzed.

III.PLANNING OF WORK/METHODOLOGY

(A) Polycrystalline silicon

Polycrystalline silicon also is known as poly silicon is a high purity, a polycrystalline form of Si, used as a raw material by the solar PV and electronics industry. Poly silicon is produced from metallurgical grade silicon by a chemical purification procedure, called the Siemens process. Following process have steps of distillation of volatile Si compounds, and their decomposition into silicon at very high temperatures. An emerging, alternative process of refinement uses a fluidized bed reactor. The ph0tovoltaic industry also produces upgraded metallurgical-grade silicon, using metallurgical instead of chemical purification procedure. In our research work we simulate our result for three different solar PV modules and after that, we will analyze which will be better [12].

Figure: 4 Block Diagram of Polycrystalline PV Solar Module

(B) Monocrystalline Photovoltaic

Monocrystalline PV electric solar energy panels have been the go-to choice for decades. They are among the oldest and most efficient and favorable & dependable ways to produce electricity from the sun. Each and every module is fabricated from a single Si crystal, and is more efficient, though it is more costly than the newer and cheaper polycrystalline and thin-film Photo Voltaic panel technologies [15]. You can recognize them by their color which is generally typically black or iridescent blue.
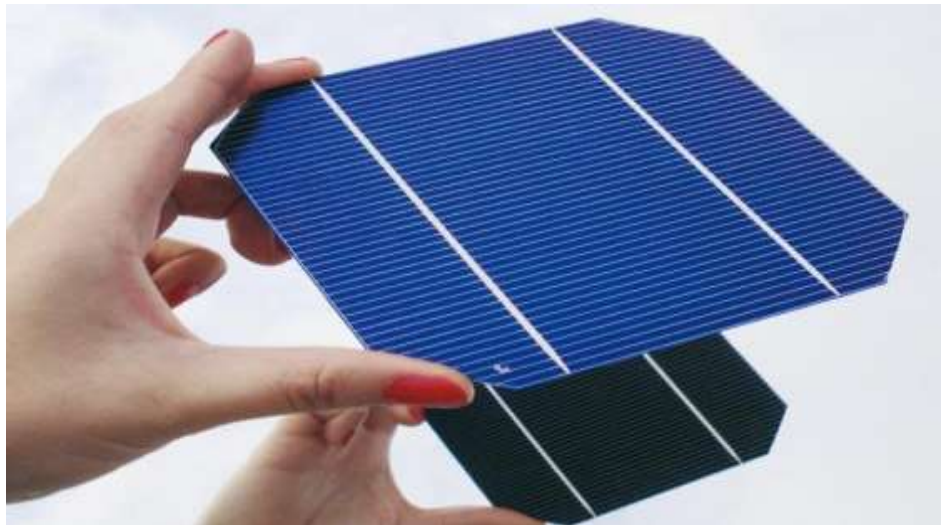

Figure 5 Block Diagram of Mono Crystalline PV Solar Module

Next, a Si seed crystal is put into an apparatus known as Czochralski growth, where it is dipped into melted polycrystalline Si. The traditional way of adding boron (B), is to introduce a small amount of boron during the Czochralski procedure. The seed crystal rotates as it is withdrawn, forming a cylindrical ingot of very pure silicon [11-12]. Wafers are then sliced out of the ingot and after that sealed back to back and p1aced in a furnace to be heated to slightly below the melting point (MP) of silicon (1,410 deg Celsius) in the presence of phosphorous (P) gas.

(C)Thin-Film Solar Cell

A thin-film solar cell is a 2nd generation solar cell that is manufactured by depositing one or more thin layers on a substrate, for example, glass, plastic or metal. Thin-film solar cells are commercially used in several technologies, including CdTe, CIGS, and a-Si, TF-Si. Film thickness can vary from nanometers to 10 of micrometers, 1st -generation crystal1ine silicon solar cell that uses wafers of up to two hundred μm. This permit thin film cells to be very flexible, and low in weight [14]. It is used to manufacture integrated Photo Voltaic and as semi-transparent, PV glazing material which can be laminated onto doors and windows. Thin-film technology has always been cost effective but less efficient as compared to conventional c-Si technology. However, it has significantly grown over the years. During testing in lab efficiency of CdTe and CIGS is approximately 21 %.

Figure6 Block Diagram of Mono Crystalline PV Solar Module

IV. SOFTWARE USED AND SIMULATION RESULT

Software: MATLAB Version R2015a: It is powerful software that provides an environment for numerical computation as well as a graphical display of outputs. In Matlab, the data input is in the ASCII format as well as binary format.

It is a high-performance language for technical computing integrates computation, visualization, and programming in a simple way where problems and solutions are expressed in familiar mathematical notation.

- Acquisition, Data Exploration, Analysing &Visualization
- Engineering complex drawing and scientific graphics
- Analysing of algorithmic designing
- Mathematical and Computational functions
- Modelling and simulating problems prototyping
- GUI (graphical user interface) building environment.

CONCLUSION

After studying various research papers finally, we came to know that to meet the demand of world in future energy must be renewable for example solar energy, wind energy, hydro energy and much more. Out of this Photovoltaic solar electricity is the most elegant method to produce electricity without moving parts, emissions or noise and all this by converting abundant sunlight without practical limitations. The relevance of solar energy specifically PV can be justified mainly with the factors like scalability, environmental impact and the security of source. The scalability means the abundant availability of the solar radiation to be utilized for PV. Solar cells are zero emission electricity generators, which prove its environmental friendliness. And the security of the source means individual and the country does not have to rely on others for source unlike fossil fuels, nuclear power etc. This is the reason why there is a worldwide major push to solar PV, despite its higher generation cost compared to the conventional counterparts. Improvement can be done by tracking the maximum power point in changing environmental conditions such as variation in solar irradiance as well variation in temperature.

REFERENCES

[1] TrishanEsram and Patrick L. Chapman, "Comparison of PV-Hydro Diesel Array Maximum Power Point Tracking Techniques,"IEEE Transactions on Energy Conversion, Vol. 22, No. 2, June 2007.

[2] C. S. Chin, P. Neelakantan, et al., "Weight Tuning Based MPPT for PV-Hydro Diesel Modules Influenced by Solar Irradiation and Cell Temperature," UKSim 13th International Conference on Modelling and Simulation, 2011.

[3] Prof. Dr. IlhamiColak, Dr. ErsanKabalci and Prof. Dr. GungorBal, "Parallel DCAC Conversion System Based on Separate Solar Farms with MPPT Control," 8th International Conference on Power Electronics - ECCE Asia, The ShillaJeju, Korea, May 30-June 3, 2011.

[4] S. G. Tesfahunegn, O. Ulleberg, et al., "A simplified battery charge controller for safety and increased utilization in stand-alone PV applications," IEEE, 2011.

[5] Yuncong Jiang, Ahmed Hassan, EmadAbdelkarem and Mohamed Orabi, "Load Current Based Analog MPPT Controller for PV Solar Systems," IEEE, 2012

[6] Weidong Xiao, Nathan Ozog and William G. Dunford, "Topology Study of PV-Hydro Diesel Interface for Maximum PowerPoint Tracking," IEEE Transactions on Industrial Electronics, Vol. 54, No. 3, June 2007.

[7] Hcoman Dehbonei, Chem Nayar. Lawrence Borle. "A Combined Voltage Controlled and Current Controlled 'Dual Converter for a Weak Grid-Connected Photovoltaic System with Battery Energy Storage". IEEE Conference 011 Power Electronics Specialists. Vol. 3. pp: 1495-1500. 2002.

[8] J. S. Siva Prasad and B. G. Femandes_. "Active Commutated Thyristors CS1 for Grid-Connected Photovoltaic Applications". The 4m International Conference on Power Electronics and Motion Control. Vol. 3, pp: 1767-1771. 2004.

[9] Anastasios Ch. Kyritsis. Nikolaos P. Papanikolaou. "Design and control of a current source fly-back inverter for decentralized grid-connected photovoltaic systems." European Conference on Power Electronics and Applications. pp: p.1-p.10, 2005.

[10] Qingrong Zeng. Liuchen Chang. "Novel SVPWM Based Predictive Current Controller' for Single-phase Grid Connected Inverters". Canadian Conference on Electrical and Computer Engineering. pp: 1262-1265. 2005.

[11] Juan Jose Negroni. Carlos Meza. Domingo Biel. "Control of a Buck Inverter for Grid-Connected PV Systems: a Digital and Sliding Mode Control Approach ".IEEE International Symposium on Industrial Electronics. Vol. 2. pp: 739-744. 2005.

[12] Yi Huang, Miaosen Slien, and Iin Wang. "Z-Source Inverter for Residential Photovoltaic Systems". IEEE Transaction on Power Electronics. Vol.21. No. 6, pp: 1176-1782, 2006.

[13] Yang Chen, Keyue Smedley, "A Cost-effective Single-phase Grid-connected Inverter with Maximum PowerPoint Tracking". IEEE Conference on Industrial Applications (41st IAS annual meeting). Vol.2. pp: 995-1000. 2006.

[14] Hoorman Dehhonei and C.V. Nayar, "A Grid-Connected Photovoltaic System with Direct Coupled Power Quality Control". 32nd IEEE Annual Conference on Industrial Electronics. pp: 5203-5208, 2006.

[15] Bahak Parhang. Shahnokh Farhangi, "Comparison of Z-Source and Boost-Buck Inverter Topologies as a Single Phase Transformer-less Photovoltaic Grid-Connected Power Conditioner". 37th IEEE Conference on Power Electronics Specialists. pp: 1-6. 2006

[16] Juan A. Lazzús, Alejandro A. Pérez Ponce, Julio Marín," Estimation of global solar radiation over the city of La Serena (Chile) using a neural network**",** Applied Solar Energy March 2011, Volume 47, Issue 1, pp 66–73

[17] Natarajan Pandiarajan, Ramabadran Ramaprabha, and Ranganath Muthu," Application of Circuit Model for Photovoltaic Energy Conversion System", International Journal of Photoenergy Volume 2012 (2012), Article ID 410401, 14 page.

[18]Vijeta PalSourabh Maheshwari, Ameer Faisal**.** "Design and Analysis of Hybrid Nanogrid." *International Journal of Advance Research, Ideas and Innovations in Technology* 3.3 (2017). www.ijariit.com.