TECH-CHRONICLE
AN INTERNATIONAL E-JOURNAL ON
EMERGING TRENDS IN SCIENCE, TECHNOLOGY AND MANAGEMENT

High Performance Utility By Improving Power Factor In PV Grid System

Sonam V. Allewar[1], **Radharaman Shaha**[2]

[1]M.Tech Student,AGPCE,Nagpur,Maharashtra,India

[2]HOD, Electrical Engineering Department,AGPCE,Nagpur,Maharashtra,India

Abstract— the analyzes and compares the performance of a new inverter topology with two types of input sources: Solar PV source and Ideal dc source (battery). It is shown that when the solar panel is connected, spikes are obtained in output voltage waveform. These spikes are eliminated by inserting a capacitor. The capacitor is chosen for a particular power factor which is optimum with respect to cost size and power quality. Total Harmonic Distortion, Active Power, Reactive Power, RMS Voltage and RMS Current are measured for different load power factor. Finally these results are compared with those obtained using battery with same input voltage magnitude. This shows that for Solar Panel Circuit, THD, P and Q are less for 0.8 and above power factor, however below 0.8 PF, the THD, active and reactive power transfer are more. This means that the performance of Solar Panel in the proposed circuit topology is seen to be better as compared to the same circuit with battery within a range of power factor.

Keywords —Solar photo voltaic(PV) systems, RMS Voltage, RMS Current, Total Harmonic Distortion (THD).

I. INTRODUCTION

Electricity Recently, renewable energy resources are becoming popular due to the depletion Of conventional fuel sources and their negative impacts on the environment. Solar energy Is one of these alternative renewable energy resources. It is converted to the electrical energy By photo voltaic (PV) arrays. PV arrays do not generate any toxic or harmful substances that pollute the environment and have long life. Another considerable feature of them is the requirement of low maintenance. Due to the development in photo voltaic technologies, the efficiency of the PV arrays has been improved.Therefore, studies on PV systems have increased gradually. Multilevel inverters have received increasing interest for power conversion in high-power applications due to their lower harmonics, higher efficiency and lower voltage stress compared to two-level inverters. Multilevel inverters generate a staircase waveform. By increasing the number of levels in the output voltage, the harmonic content and therefore THD are reduced. Therefore, they produce high quality output voltage by increasing the level number. The level number can be easily increased. As a result, voltage stress is reduced and the output voltage wave shape move closure to the sinusoidal shape. In this study, a single phase multilevel inverter system is proposed. The principle of the proposed method will be explained for a 15-level inverter. However, the structure can be easily adapted to any number of levels. A proposed control design of grid connected PV systems for power factor correction in distribution power systems is presented.The proposed control enables the PV system act as a reactive power compensator during low radiation and day night. This helps the grid to maintain voltage stability during high reactive power loads. Also, the PV system can supply the load reactive power during high radiation and day morning. This decrease the active power due to the maximum inverter current limits. The proposed system is tested under different test cases. It is found that the PV system with the proposed control system has the capability of power factor correction. [7].

II. LITERATURE SURVEY

The chief objective is to improve the power quality by continuously monitoring the load power factor. When the load power factor falls below a certain value it results in the increase of line current, resulting in more line loss and greater voltage drop. Thus, the aim is to inject capacitance of required values when the power factor falls below the specified level. Primarily, a signal of pulse width proportional to the phase difference is generated. From the ON time period of each pulse the power factor can be determined. The exact value of the capacitance to be injected is then found out using some mathematics. Finally, the value of capacitance, so obtained, is to be approximated with the standard values of capacitance. Micro-controller will switch all the capacitors, which taken together is very close to the exact value of the capacitance.

The electricity power generated from photo voltaic (PV) array depends mainly on climate conditions. So, the PV solar grid connected inverters should equip with control system to meet fast response of solar irradiance change. This paper describes steady state performance of the PV grid-connected system at different solar irradiances. The proposed system model is built on MATLAB/Simulink, including the PV array with a modified perturb and observe (MP&O) tracker connected to DC-DC boost converter, the three-phase three level electronic power inverter that is connected to the utility grid (UG) through low pass filter and coupling transformer and synchronizing control system of PV inverter and UG. The proposed system is simulated under daily weather conditions to test its operating performance. The simulation results of the proposed system satisfy requirements grid performance with high power quality [1][2].

Renewable energy resources such as Solar, wind and hydro are pollution free, easily erectable, and limitless so they represent reliable alternatives to conventional energy sources e.g. oil and natural gas. However, the efficiency and the performance of these systems are still under development. Among them, Photo voltaic systems are mostly used as they are light, clean and easily installable. This systems connection to the grid requires specialconditions to obtain a high-quality electric power system. This paper presents interfacing of three-phase grid connected PV system. DC-DC boost converter with maximum power point tracking (MPPT) is used to extract the maximum power obtained from the sun and transfer it to the grid. In any PV based system, the inverter is a critical component responsible for the control of electricity flow between the dc source, and loads or grid so a voltage source inverter (VSI) is used to convert the dc power into AC power before injecting it into the grid. A comprehensive simulation and implementation of a three-phase grid-connected inverter are presented to validate the proposed controller for the grid-connected PV system. Solar energy is becoming increasingly popular day by day, so are grid-connected solar power generation systems[4]. This paper proposes a solar power generation system with a seven-level inverter. A DC-DC power converter is used to boost the output voltage of the solar panel, which is controlled using MPPT. The capacitors of the capacitor selection circuit are charged with multiple relationships by the DC-DC power converter. These capacitors serve as input voltage sources for the seven level inverter. The output of the seven level inverter is fed into the utility grid such that the output current is sinusoidal and in phase with grid voltage. The inverter contains only six power electronic switches which is less complex when compared with conventional multilevel inverters. Design, technical and financial analysis, and optimization of 100 kW grid connected solar photo voltaic system at each division of Bangladesh have been carried out using RET Screen along with NASA's data of location and solar radiation. Slope and azimuth of placing solar panels affect absorption of solar irradiation by the panels and this has considerable impact on the amount of electricity being generated by a solar grid, the technical and financial aspects of the solar grid. Bangladesh is an Asian country having eight divisions. Due to varying geographical locations, the amount of solar radiation being incident on the divisions varies significantly. Thus, placing solar panels at the same slope and azimuth in all the divisions does not allow the panels to absorb maximum amount of solar radiation. This paper discusses about the design of 100kW grid connected solar photo voltaic system, performs technical analysis and demonstrates the optimum slope and azimuth of placing solar panels at different divisions of Bangladesh. This paper also represents financial analysis of the solar grid for all the divisions [6]. The optimized solar grid is capable of reducing approximately 166 tons of carbon dioxide emission annually which is equivalent to eliminating the use of 30.4 cars and light trucks annually. The paper presents the design, implementation, and evaluation of a fuzzy logic (FL) controller to manipulate an alternating current (AC) synchronous motor's delivered reactive power (VAr), thereby improving the power factor (PF) of an industrial plant. The FL controller mimics the action that would be carried out by a human operator when adjusting the synchronous motor to deliver the necessary VAr to achieve the desired PF value. The controller provides flexibility with its nonlinear gain characteristic and adaptive operation. The FL controller performs adequately under all test conditions. The FL controller was observed to perform successfully under both rapidly and slowly changing load conditions[8][9]. The FL controller performance was highly satisfactory in tracking and improving the plant PF to achieve the set point in a reasonable time frame and motivated by the proportional integral derivative (PID) concept. The FL controller in conjunction with a synchronous motor represents an innovative new approach to the problem of PF improvement in industrial plants. Reactive power to bring the entire system to the optimum operating point is presented. The FL controller performs adequately both rapid and slow changing load condition. The FL controller performance was highly satisfactory in tracking and improving the plant PF to achieve the set point. The FL controller in conjunction with a synchronous motor represents a new practical method to take advantage of Renewable Energy Sources by dynamically monitoring plant electrical parameters and automatically bringing the system to the optimum operating point, and someday could be implemented in an industrial plant environment that may require PF improvement with a high degree of accuracy. A power factor correction (PFC) topology with fuzzy logic controller (FLC) for light-emitting diode (LED) lighting applications is presented in this paper. Nowadays, high brightness white LED's becomes feasible in residential, industrial and commercial applications to replace the incandescent bulbs, halogen bulbs and even compact fluorescent light (CFL) bulbs. Since LED lighting represents a green technology, the issue of power factor is very important. A valley-fill circuit is combined with the single-ended primary inductance converter (SEPIC) to achieve power factor nearer to unity. The fuzzy logic controller is implemented to drive the SEPIC-PFC topology. The performance of the proposed design will be analyzed in terms of power factor using the Matlab/Simulink simulation results[11]. The paper presents a two-stage, single-phase power converter system fed from PV and Wind Turbine energy sources, and a new control methodology for transferring the output power to the grid, leading to reduce harmonics in the grid current, and controlled power factor. The proposed control depends on comparing the total power from the renewable energy sources with the power required to supply the nonlinear load, leading to a controlled distribution of power requirement from the sources. A key outcome of the paper is that excellent power factor and good harmonic reduction is obtained from the perspective of the grid, with no requirement for an intermediate battery due to the inherent ability to provide leading reactive power to the grid when necessary. Simulation and experimental results are used to support the proposed control methodology. This research is to formulate a paradigm that will use Fuzzy Logic as a tool to control Synchronous motor that will track and correct Power Factor of a plant. in the United States, Power Factor correction is commonly done at the local (equipment) level or through the use of a large capacitor bank, but this work will address the solution using and appropriately sized AC synchronous motor to match the plant in question. Many plant use synchronous motors in different areas of operation, hence eliminating the cost of purchasing extra hardware. The synchronous motor will provide a smooth transient and more precise correctional value compared to capacitor bank when correcting the power factor.

Sr. No	Title	Author	Methodology	Advantage	Disadvantage
1.	Automatic power factor improvement using micro controller	Reetam Sen Biswas; Satadal Mal	improve the power quality by continuously monitoring the load power factor. When the load power factor falls below a certain value it results in the increase of line current, resulting in more line loss and greater voltage drop.	signal of pulse width proportional to the phase difference is generated	load power factor falls below a certain value it results
2.	Performance analysis of grid-connected PV system	Adel A. Elbaset; M. S. Hassan; Hamdi Ali**IEEE *Explore***: 02 February 2017	The electricity power generated from photovoltaic (PV) array depends mainly on climate conditions. So, the PV solar grid connected inverters should equip with control system to meet fast response of solar irradiance change	including the PV array with a modified perturb and observe (MP&O) tracker connected to DC-DC boost converter	state performance
3	Grid connected Photovoltaic system	Abdalla Y. Mohammed; Farog I. Mohammed; Mamoun Y. Ibrahim **IEEE *Xplore***: 02 March 2017	A comprehensive simulation and implementation of a three-phase grid-connected inverter are presented to validate the proposed controller for the grid-connected PV system.	DC-DC boost converter with maximum power point tracking (MPPT)	efficiency and the performance of these systems are still under development.
4	Grid-connected PV system with a seven-level inverter	N Reshmi; M. Nandakumar**IEEE *Xplore***: 16 February 2017	solar power generation system with a seven-level inverter	capacitors serve as input voltage sources for the seven level inverter	conventional multi-level inverters
5.	Design, analysis and optimization of grid-connected solar photovoltaic system	Shagorika Mukherjee; M. Abdur Razzak**IEEE *Xplore***: 09 March 2017	Design, technical and financial analysis, and optimization of 100 kW grid connected solar photovoltaic system	absorption of solar irradiation by the panels	financial analysis of the solar grid for all the divisions

III. COMPARATIVE ANALYSIS

IV.RESEARCH METHODOLOGY

- After the literature survey following benefits has been noted for using power factor PV system.
- Strategy of PV systems for the purpose of power factor.
- Correction to prevent the instability of the grid voltage for the point of common coupling.
- After the literature survey following points has been noted.

It is known that the efficiency of the solar PV module is low so, it is desirable to operate the module at the peak power point in order to maximize the delivered power to the load under varying temperature and solar radiation conditions. Hence, maximization of power improves the utilization of the solar PV module. The dc-dc converter serves the purpose of transferring maximum power from the PV module to the load by changing the duty cycle. The load impedance as seen by the source is varied and matched at the point of the peak power with the source. So, the maximum power is transferred. The available dc-dc converters are step down converter, step up converter and step up-step down converter. In the buck converter is selected in order to use a battery with low voltage to provide power continuity at the day night. The converter is used to reduce input voltage when the output requires a lower voltage. It consists of a power switch that is followed by an inductor, a diode and output capacitance.

Multiple photovoltaic (PV) needs to be maintained inside of the utility requirement range. One solution is to utilize the communications capabilities of protective relays, meters, and PV inverters to integrate an active control system. This system compares the common-point power factor to the utility requirements and calculates a control signal to adjust the outputs. The scheme can be implemented in a real-time automation processor or an industrial computing platform .The predominant usage of induction motors in industrial plants poses the problem of heavy inductive loading and therefore, causes poor power The purposed control depends on comparing the total power from the renewable energy sources with the power required to supply the nonlinear load, leading to a controlled distribution of power requirement from the sources. Key outcome of the paper is that excellent power factor and good harmonics reduction is obtained from the perspective of the grid, with no requirement for an intermediate battery due to inherent ability to provide leading reactive power to the grid when necessary. Simulation and experimental results are used to support the purposed control methodology. This presents a new method for power factor correction with low cost drives. Power factor control is a major role in the improvement of power system stability. Many of the existing systems are expensive and difficult to manufacturer. Nowadays, many of the converters have no input power factor corrections circuit. The effect of power factor correction circuit is used to eliminate the harmonics present in the system. This type of power factor corrections circuit is mostly used in Switched Reluctance Motor Controller device. Fixed capacitor systems are always leading power factor under at any load conditions. This is unhealthy for installations of power systems. The proposed embedded systems drive is used to reduce the cost of the equipment and increase the efficiency of the systems. Experimental results of thefactor. Poor PF has been costly for both utility and industrial companies. With the utility companies being forced to deliver excess power to satisfy demand, and the industrial companies being penalized for low PF, there are emerged a number of solutions and taking advantage of renewable energy sources the poor PF issues could be tackle.

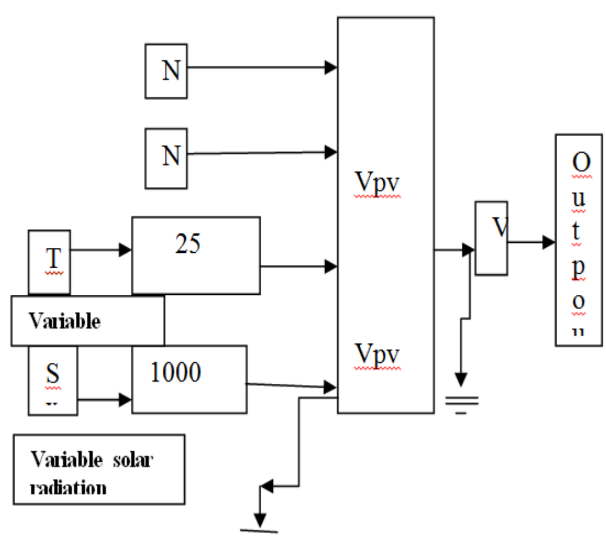

Figure1: PV Array model used in the proposed circuit

Purposed systems are included. It is better choice for effective cost process and energy savings.

V.CONCLUSIONS

A proposed control design of grid connected PV systems for power factor correction in distribution power systems is presented. The proposed control enables the PV system act as a reactive power compensator during low radiation and day night. This helps the grid to maintain voltage stability during high reactive power loads. Also, the PV system can supply the load reactive power during high radiation and day morning. This decrease the active power due to the maximum inverter current limits. The proposed system found that the PV system with the proposed control system has the capability of power factor correction.

VI. REFERENCES

[1] E. Beser, S. Camur, B. Arifoglu and E. Kandemir Beser, "A Grid Connected Photovoltaic Power Conversion System with Single Phase Multilevel Inverter," *Solar Energy*,Vol. 84, No. 12, 2010, pp. 2056-2067.

[2] E. Kandemir Beser, B. Arifoglu, S. Camur and E. Beser,"Design and Application of a Single Phase Multilevel In-verter Suitable for using as a Voltage Harmonic Source,"*Journal of Power Electronics*, Vol. 10, No. 2, 2010, pp.138-145.

[3] E. Beser, S. Camur, B. Arifoglu and E. Kandemir Beser,"Design and Application of aovelStructureandtilevel Inverter," 2008 *International Sym-posium on Power Electronics*, *Electrical Drives*, *Automa-tion and Motion*, Ischia, 11-13 June 2008, pp. 969-974.

[4] M. Ahmad and B. H. Khan, "New Approaches for Har-monic Reduction in Solar Inverter," *IEEE Conference on Students Conference on Engineering and Systems*, Alla-habad, 16-18 March 2012, pp. 1-6.

[5] I. H. Altas and A. M. Sharaf, "A Photovoltaic Array Simulation Model for Matlab-Simulink GUI Environ-ent," *International Conference on Clean ElectricalPower*, Capri, 21-23 May 2007, pp. 341-345.

[6]http://www.wwindea.org

[7] M.G. Sugirtha, P. Latha," Analysis of power quality problems in grid connected wind power plant", International Conference on Recent Advancement in Electrical, Electronics And Control Engineering, pp.19-24, 2011.

[8] http://www.wrwcrenewables.org/documents/targets-2040/EREC_Scenario%202040.pdf

[9] B. Chen, P. Sun, C. Liu, C.L Chen, J.S Lai, W. Yu, "High efficiency transformer less photovoltaic inverter with wide range power factor capability". IEE pp 575-582. 2012

[10] S.K Khadem, M. Basu, M.F Conlon,"Power quality in grid connected renewable energy systems: Role of Custom Power Devices", ICREPQ Spain. March 2010.

BIOGRAPHIES

Ms. Sonam V. Allewar
(Electrical Eng.)
From P.I.G.C.E, Nagpur, She is pursuing M.Tech (Integrated Power system)
From A.G.P.C.E, Nagpur