SIMULATION OF STANDALONE PHOTO-VOLATAIC HYBRID SYSTEM FOR POWER QUALITY IMPROVEMENT

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ABSTRACT *The PV array integrated through dc-dc boost converter and controlled using a MPPT algorithm to obtain the maximum power under various operating conditions. The admittance based control algorithm is used for load balancing under three phase four-wire linear and non linear loads. The proposed system compensates the neutral current during the unbalanced linear and non linear loads by using BESS The performance of proposed system is observed by using MATLAB/ SIMULINK.*

Keywords: *pv panel, mppt controller, boost converter, buck converter ,battery energy storage system, matlab/ simulink.*

I. Introduction

A developing country like India has more energy demand compared to othercountries. Nowadays, most of the energy comes from fossil fuels such as coal,diesel, petrol and gas, which is 80% of our current energy production. This energydemand is expected to rise by almost half over the next two decades.Renewable energy is a good option to tackle worldwide increasing energy demand. Because it gives green and clean energy free of co_2 emission. In recent years, there is rise in intensive research on renewable energy technologies such as pv, hydroelectric, wind, thermal and tidal system as they become global priority. Among all therenewable energy sources, solar power is popular for its environmental friendly features and plug-N-play operation. Solar energy has become a promising, popular and alternative source because of its advantages such as abundance, pollution free, renewability and maintenance free.In late 1950s the first conventional PV cells were produced and throughout the next ten years PV cells were mainly used for providing electrical power for earth-orbiting satellites.. Nowadays, production of PV modules is growing at approximately 25% per year, and the implementation of PV systems on buildings and interconnection to utility networks are rapidly increasing and become major programs of developed countries like Japan, U.S. and Europe. This PV system has been used for over50 years in various specialized applications and grid-connected PV systems have been in use for over 20 years. PV installed capacity had increased approximately to 177 GW worldwide in 2014. That is sufficient for supplying 1% of electricity demand globally. So the approximately 200 GW capacity of PV power is installed till date which is 40 times the installed capacity of 2006. Worldwide, maximum PV systems are utility connected where large amount of PV capacity is involved..Due to diurnal cycle of the earth and weather condition solar energy in not continuous and constant throughout the day. And also sometimes the PV generation is not sufficient to fulfill the power demand of the varying local load. Which makes the system unstable so we make the intermittent pv power more dispatchable and stable by using storage devices. Among all available storage devices batteries, ultra capacitor, compressed air system etc., have highest importance in pv system as they can store energy through the electrochemical process and thus have quick response in charging and discharging.

In standalone pv system as solar is the only source of energy better is used to achieve the following objectives:

1. To maintain power balance between generation and distribution.
2. To supply power to local load at regulated voltage
3. To achieve fast dynamic performance undet wide source and load fluctuation.
4. To store electrical energy when there is an excess is available and to provide it when required.
5. To supply power to the local load for a short time during peak hours.

Block Diagram:

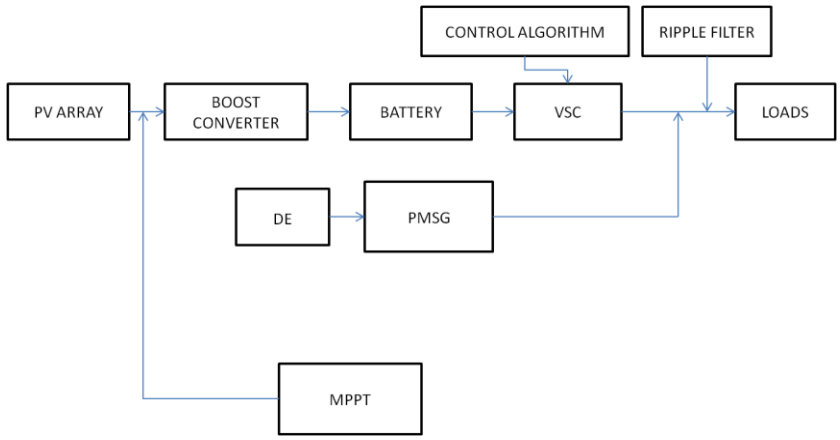

fig 1. Block diagram

II. Proposed system

The proposed system consists of a diesel engine driven withpermanent magnet synchronous generator (PMSG),PV array and battery energy storage (BES).

This is a representative solution for typical rural hospital power supply system's, which needs to ensure uninterrupted constant power supply for 24x7 hours. The PV array has been provided with the MPPT controller in order to operate at the maximum power point at any given temperature and insulation level.

i. Boost converter:

It is used to boost the voltage to feed power to the battery. The design parameters for boost converter depends upon the current ripple , voltage ripple and power rating. The boost converter is interfaced with MPPT controller for tracking the maximum power. It is a DC-to-DC power converter that steps up voltage from its input to its output, while stepping down current. It is a class of switched mode power supply.

ii. Solar photovoltaic array:

Complete power generating unit, consisting of any number of PV modules and panels. The light generated current of the PV array depends linearly on the solar radiation and is also influenced by the temperature. The IC method performs good with noise rejection and less confusion due to system dynamics.

iii. Battery energy storage system:

The battery is connected at the DC link of the V_{SC}.A 2.8 KWH capacity battery rack is used for the energy storage. In case of reduced load demand, the battery charges from the available PV power once the load demand is satisfied.

It extracts the fundamental component of the loads using admittance control technique. The evaluation of the control algorithm demonstrates the robustness and relatively faster response. Systemperformance improves with control algorithm.

iv. Neutral current compensation:

The fourth leg of V_{SC} provides direct control over the source neutral current. The reference neutral current (Isn*) is compared with the sensed source neutral current(I_{sn}).These are used in hysteresis current controller to produce switching signals for 4-leg V_{SC}.

III. Simulation result

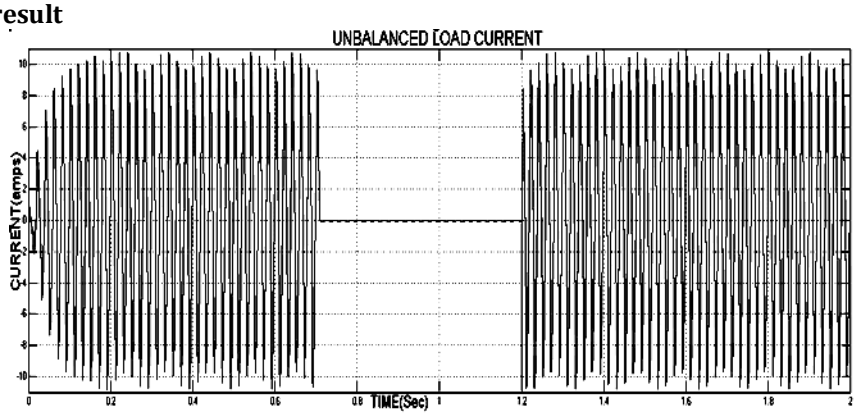

Fig 2. Performance of proposed system under unbalanced

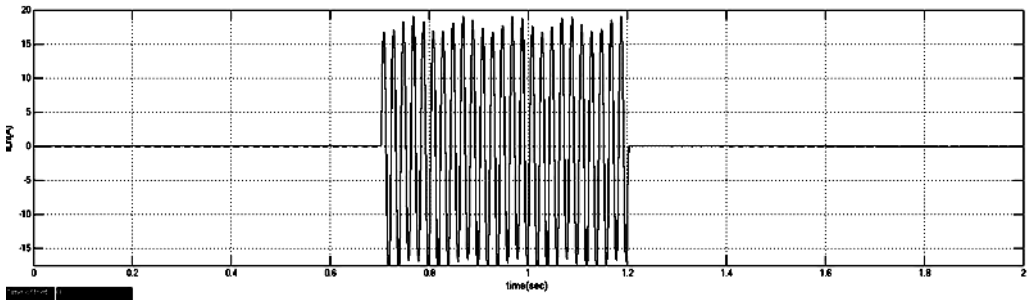

Fig 3 .Actual neutral Current

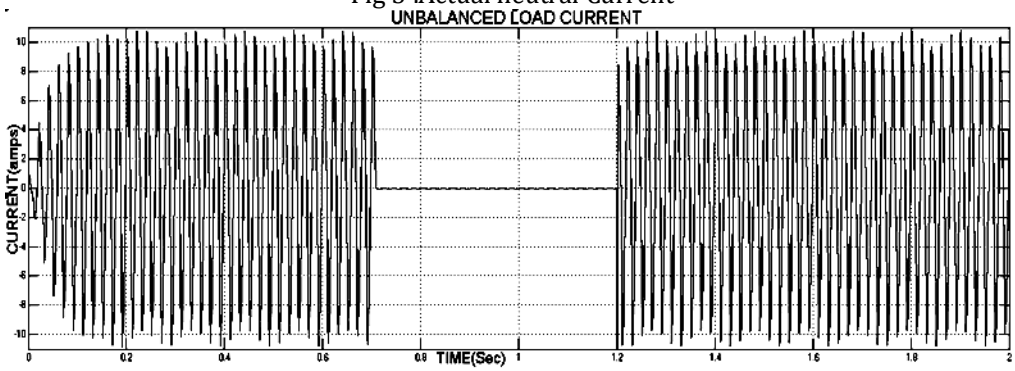

Fig 4. Performance of proposed system under unbalanced

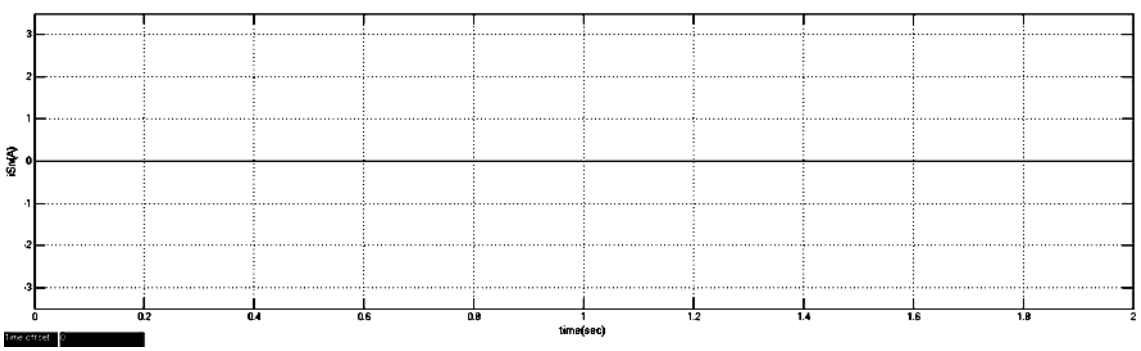

Fig 5 Neutral current at source side

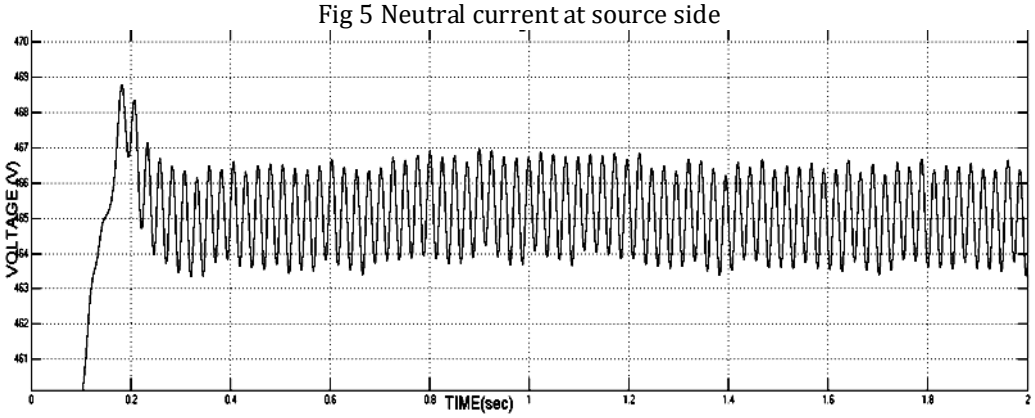

Fig 6.Voltage across capacitor

Applications:

- Household appliances
- Remote missions
- Data communications
- Tele communication systems
- Hospitals

- Electric aircrafts
- Solar cars

Advantages:

- Clean power
- Portable in nature
- Employed for various small scale application.

IV. Conclusion

The admittance based control technique has been used for a PV-dieselbattery hybrid system for an uninterrupted power supply and power quality improvement. The technique has been demonstrated to load balancing.Eliminatingneutral currents without effecting source side.

V. References

[1] H. Mahmood, D. Michaelson, and J. Jiang. A Power Management Strategy for PV/Battery Hybrid Systems in Islanded Microgrids.IEEE Journal of Emerging and Selected Topics in Power Electronics, 55(1):1{14, Jun. 2014.

[2] H. Mahmood, D. Michaelson, and J. Jiang. Control Strategy for a Standalone PV/Battery Hybrid System. In IECON 2012-38th Annual Conference on IEEE Industial Electronics Society), pages 3412{3418, 25-28 Oct. 2012.

[3] W. A. Omran, M. Kazerani, and M. M. A. Salama. Investigation of Methods for Reduction of Power Fluctuations Generated From Large Grid-Connected Photovoltaic Systems. IEEE Trans. Energy Convers., 25(1):318{327, Mar. 2011.

[4] H. Fakham, D. Lu, and B. Francois. Power Control Design of a battery charger in a Hybrid Active PV generator for load-following applications.IEEE Trans. Ind. Electron., 58(1):240{250, Jan. 2011.

[5] R. Bhatt and B. Chowdhury. Grid frequency and voltage support using PV systems with energy storage. In North American Power Symposium (NAPS), pages 1{6, 4-6 Aug. 2011. [6] S. Adhikari and L. Fangxing. Coordinated V-f and P-Q Control of Solar Photovoltaic

[6] Generators With MPPT and Battery Storage in Microgrids. IEEE Trans. Smart Grid, 5(3):1270{1281, May. 2014.

[7] R.-J. Wai, W.-H.Wang, and C.-Y. Lin. High-Performance Stand-Alone Photovoltaic Generation System.IEEE Trans. Ind. Electron., 55(1):240{250, Jan. 2008.

[8] H.-L. Tsai, Ci-S.Tu, and Yi-J.Su. Development of Generalized Photovoltaic Model Using MATLAB/SIMULINK. In World Congress on Engineering and Computer Science (WCECS), pages 1{6, 22-24 Oct. 2008.

[9] J.B. Copetti and F. Chenlo. A general battery model for PV system simulation.Journal of Power Sources, 47:109{118, 1994.

[10] O. Tremblay and L.-A.Dessaint. Experimental Validation of a Battery Dynamic Model for EV Applications. World Electric Vehicle Journal, 3:2032{6653, 2009

[11] O. Tremblay, L.-A.Dessaint, and A.-I Dekkiche. A Generic Battery Model for the Dynamic Simulation of Hybrid Electric Vehicles. In Vehicle Power and Propulsion Conference 2007 VPPC IEEE, pages 284{289, Sep. 2007.

[12] Q. Bin and M. Yundong. Research on Control Strategies of a Stand-alone Photovoltaic System. In International Conference on Renewable Energies and Power Quality (ICREPQ12), pages 1{6, 28-30 Mar. 2012.