Qualified hybrid power system model with fault ride through attainment

P.Sangeetha
Department of EEE,
Sri Krishna College of Technology,
Coimbatore, India
sangeethaeeeau@gmail.com

S.Suja
Department of EEE
Coimbatore Institute of Technology,
Coimbatore, India
suja@cit.edu.in

Abstract—Stability is the focusing criterion in recent years of technological development. Power electronics along with Renewable energy (RE) plays a vital role in this concept. This article follows the streamline for shoot through and stability. In conventional system PV is used as a source and ZSI along with battery is used for storing the generated power. In this article, QZSI is implemented without battery. Flower pollination algorithm is used instead of PI controller to provide qualified power. Thus this article explains the performance and output efficiency of QZSI and maximum boost power from hybrid system (PV and Wind system) by using Vienna rectifier and B4 inverter.

Keywords-QZSI; FP algorithm; Hybrid system; Vienna rectifier

I. INTRODUCTION

In the current scenario, 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. Various forms of ac conversion devices are available. However, the preferred ones concentrated in this article are the z-source and quasi-Z-source conversion devices. The pros of applying these devices are as follows: unswerving operation is observed; and the response in one stage is obtained with value either equal to or greater than the excitation value. This idea holds good for 1-Φ and 3-Φ networks. Never exhausting energy sources like sun radiation and air fetched from nature is presented in this article for spawning electrical output. We have used interleaved DC-DC converter to improve the power and Quasi Z-source (QZS) to provide the continuous current to load during shoot through of the inverter. Vienna rectifier usage in airflow system undergoes not only conversion process from ac to dc, but also maintains the factor of ratio between the sustainable least value to the specified parameter value of the device and mode of fatalities transition among turning on and off. Proportional integral controller employing soft computing DE technique is used in the B4 conversion component. This method proves good for optimization. The proposed simulation module is designed using MATLAB simulink and the outputs are verified.

II. LITERATURE SURVEY

An efficient method of topology for quick continuous automatic electric power supply with reduced harmonics is proposed. This is achieved using ac to ac converter of z source [1]. Details about merits and features of various types of QZSI are presented. The features are checked and confirmed through simulation [2]. Frequency doubling concept while using a capacitor producing harmonics is discussed. Authors present ZSI based capacitors for high efficient output [3]. Using the essence of idea of using such inverters, routed for simulation idea of this article work and the results are shown in the following sections. Not stopping with simulation part alone, practical implementation of such hybrid system is carried out and the block diagram details are presented in [10]. So automatically, economic factor is discussed. This article involves hybrid system source implementation.[23-25] discuss the MPPT based tracking to gain high power from solar cells. [11] states the importance of usage of flower pollination algorithm and this idea is concentrated in practical system and the results obtained highlights the importance of FPA.

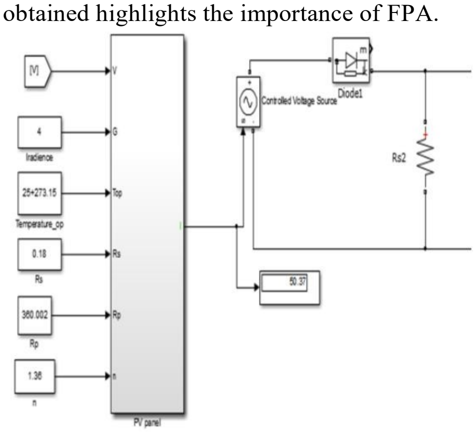

Fig. 1. PV Simulink Model.

Putting together all these ideas, in this article, in the existing system, PV is used as the source, for usage in low and medium power applications. PV system is not used effectively. Power factor is poor. The efficiency of the system is low. QZSI along with battery is used for improving efficiency. However, such system reduces the output power when compared with QZSI without battery based system.

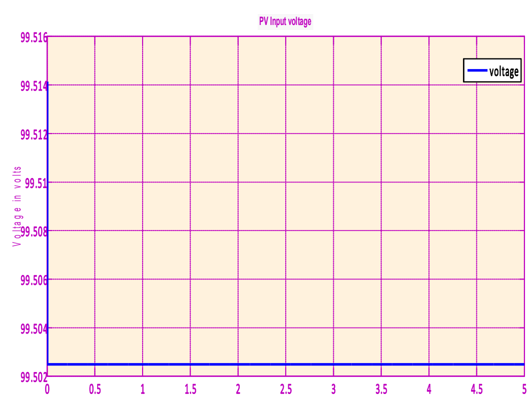

Fig. 2. PV Input Voltage.

III. SIMULINK MODEL

A. Insolation System

In the PV array we have parameters regarding shunt resistance, series resistance, operating temperature and number of cells in PV module. All the above said criterions work to achieve ultimately high gain and better system effectiveness.

B. Tracking

As the name indicates, the peak value of the insolation is attained by using this facility of Perturb & observe method, also known as P&O method. In this method voltage or current of the PV array is modified to reach the Maximum Power Point Tracking (MPPT) values.

C. Wind System

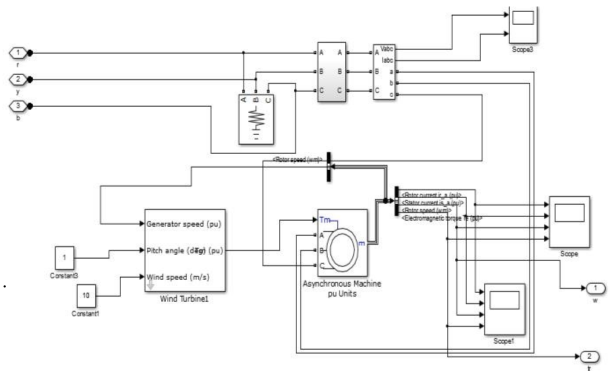

Fig. 3. PV Wind System Simulink model.

The above figure shows the wind system simulation module. Here we have wind turbine and wind synchronous generator. The output voltage generated from the wind system simulation is shown in Fig.4 and the output current is shown in Fig.5.

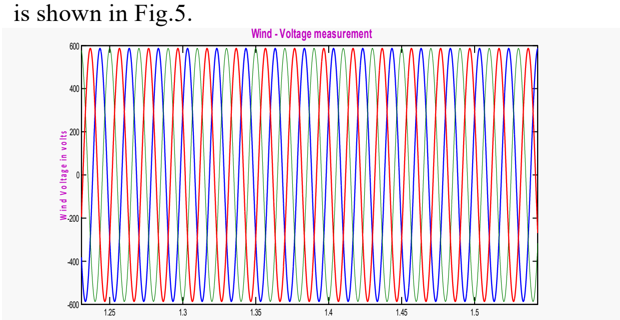

Fig. 4. Output Voltage from Wind System.

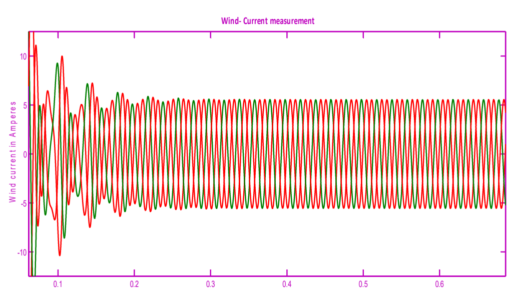

Fig. 5. Output Current from Wind System.

IV PERFORMANCE OF QZSI

A. Storage component enhanced inverter modeling

Storage components are meant for charging and discharging. While discharging, power inadequacy occurs. However, the phenomenon of continual change of power is overcome in this circuit. Steadiness is observed from the designed circuit. Hence constant output current is not obtained and the discharging duration of the battery is fast.

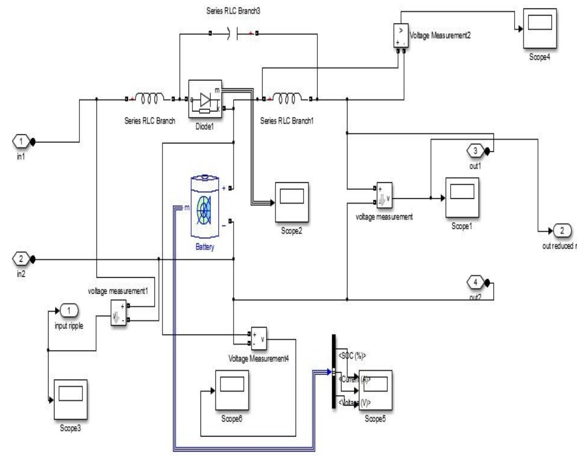

Fig. 6. Simulation module QZSI with battery

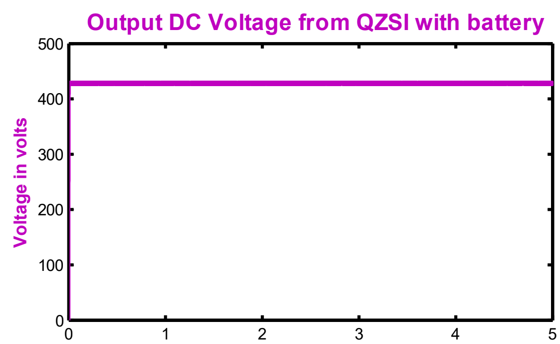

Fig. 7. Output DC Voltage from QZSI with battery.

B. Inverter lacking storage component modeling

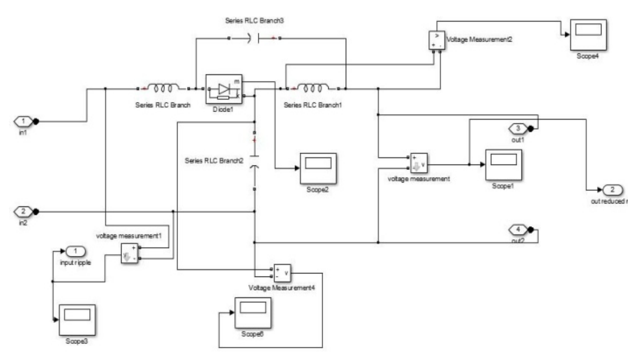

Fig. 8. QZSI without battery.

When compared among the output DC voltage of QZS without and with battery, the voltage amplitude level differs. With battery network, the fetched output voltage is little bit lower than without battery network waveform.

The three-channel interleaved boost converter with low input current ripple can achieve better MPPT accuracy. In addition, can increase the total output power of PV system. The variation of phase among the two major electricity criterions gets decreased. This component operates with the maximum value of UPF, thus supplying with high value of excitation. It has the ability of adjusting the output capacitor voltages and low reverse voltage on power transistors.

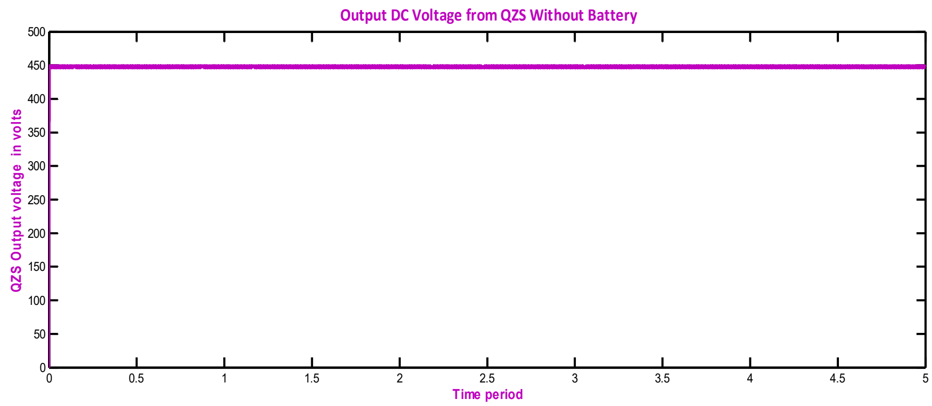

Fig. 9. Output DC Voltage from QZS Without Battery.

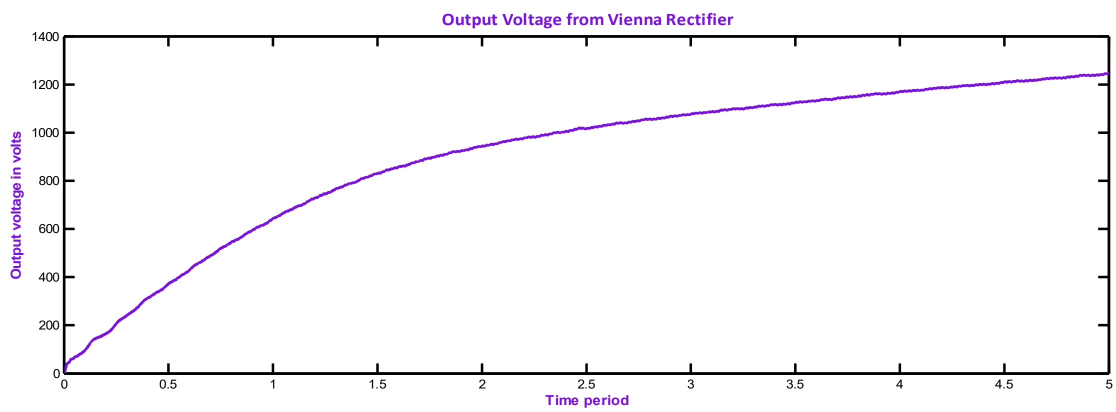

Fig. 10. Output Voltage -Vienna Rectifier.

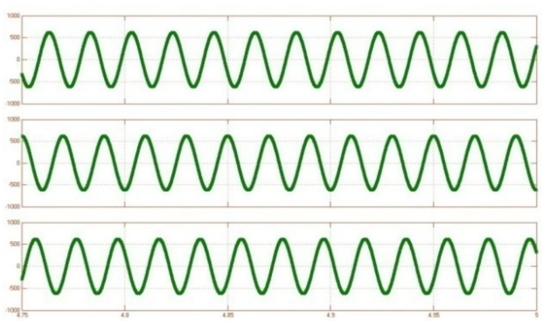

Fig. 11. Inverter Output Voltage Waveform without Battery.

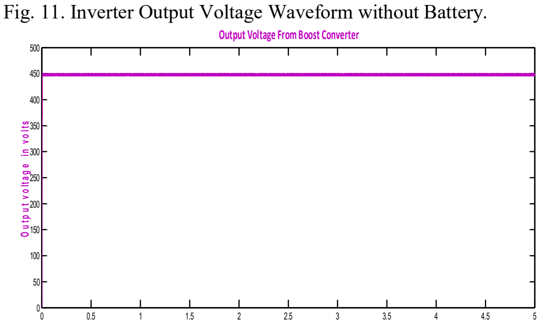

Fig. 12. Output Voltage from Three Boost Converter.

This system has high efficiency. The B4 inverter has advantageous factors over the traditional B6 inverter. It has reduced count of interface circuits to provide logic signals. Switching loss is minimized. It has the ease of control algorithm to generate logic commands. The interfacing dealings amid making and breaking circuits get reduced, and automatically the probability for destruction becomes low. The statistical determining procedures to deal with practical tasks are lessened. Quasi Z Source can achieve buck-boost power conversion in a single-stage without extra switching device. Insertion of null state shoot through in the ac conversion of making or breaking circuitry helps in boosting the response. The responses obtained through simulations are shown in the figures from Fig.9 to Fig.12.

Charging of power takes place in the impedance portion of the circuit in the circumstances of shoot-through. Discharging occur later supplying energy to the devices and load as per the requirement. The buck-boost function makes the QZSI very suitable for wide input voltage variation. It is also used to reduce the input ripple content in the input and provide continuous supply to the load. Output Voltage obtained from QZSI without battery shows the boosting up of efficiency.

V USAGE OF FP ALGORITHM

Flower pollination algorithm is a recent heuristic nature inspired algorithm. The merit of using this algorithm is that output is attained with minimum number of iterations in lesser moments. Flexibility and Precision in the output is obtained, compared to the PID controller. Levy's flight parameter and the probability values add more advantage to this algorithm. Complexity of PID solving is overcome by usage of FP, comprising to deal with only less number of parameters.

VI HYBRID CONTROLLER

A Simulation of the System with Hybrid Controller

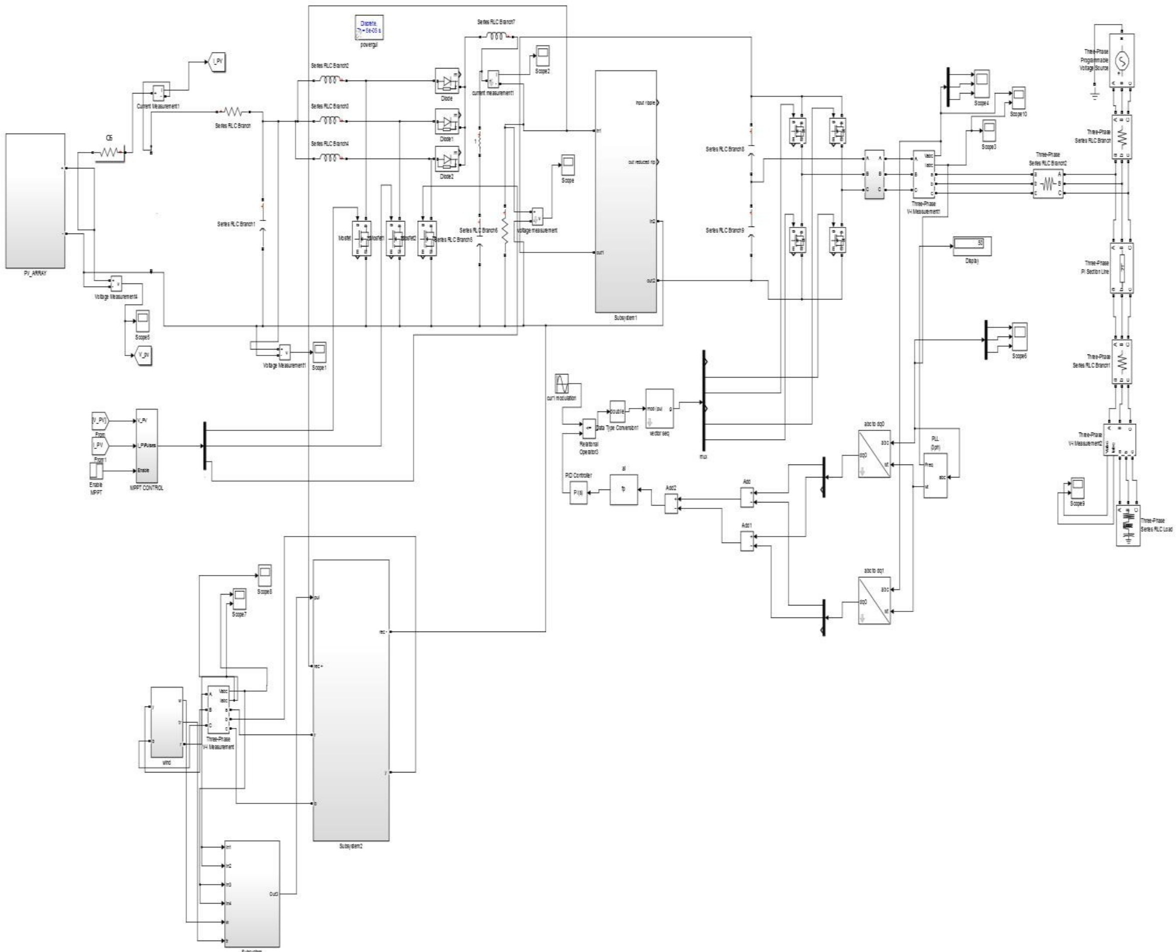

Fig. 13. Hybrid controller circuit .

B Experimental Waveforms

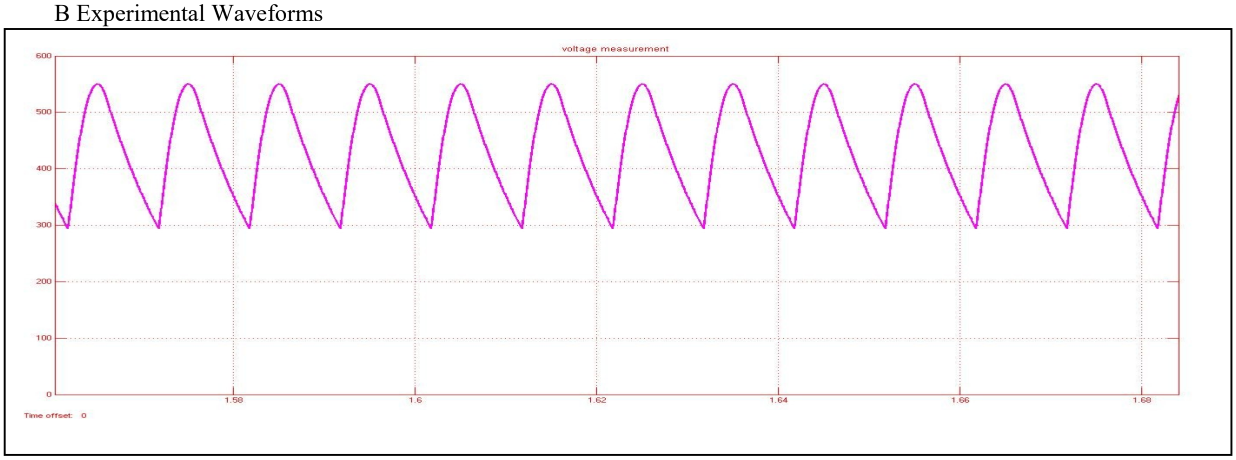

Fig. 14. DC Output Voltage of Hybrid Controller.

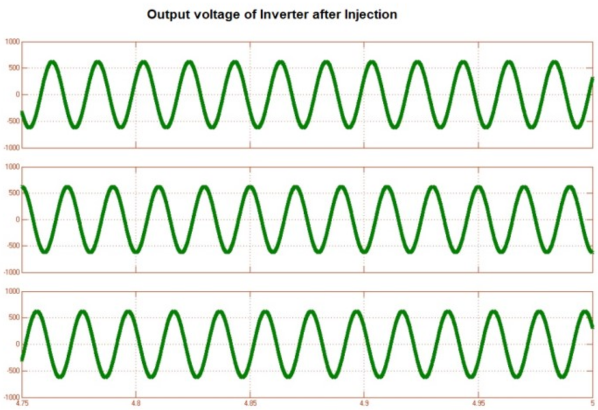

Fig. 15. Output Voltage of Inverter after Injection.

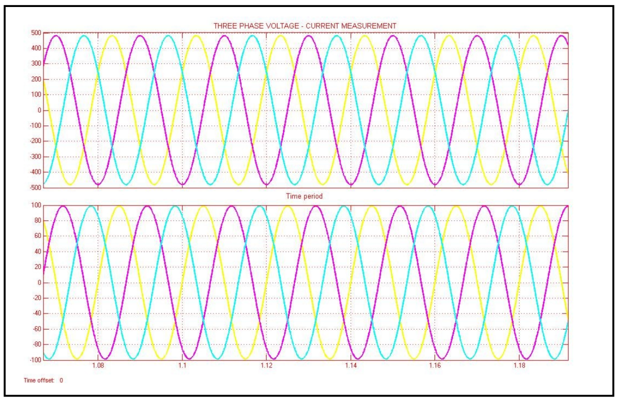

Fig. 16. Output Current and Voltage Waveform after Injection.

C Battery Parameters Waveforms

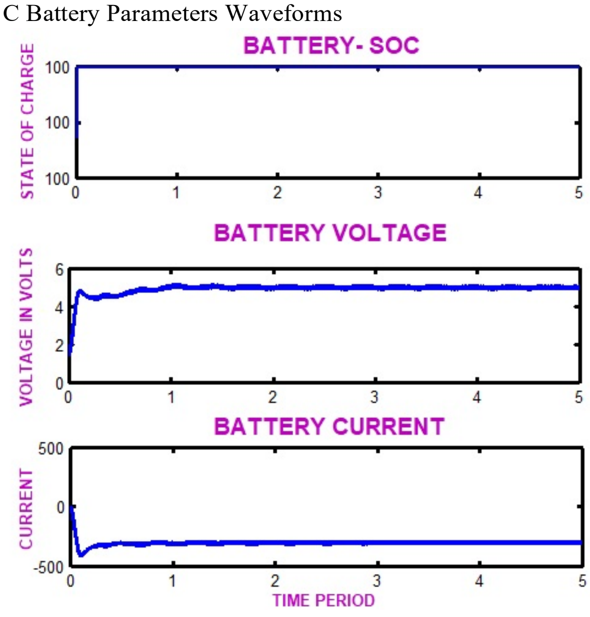

Fig. 17. Battery Performance.

This section deals with the simulation of Hybrid system comprising of both solar and wind together thus compensating the availability and supply to the load without any interruption and the controller circuit is shown in Fig.13 and the voltage waveform is shown in Fig.14.After injection, waveforms obtained are shown in Fig.15 and 16. Battery performance curves are shown in Fig.17.

VI CONCLUSION

In this article, a hybrid energy harvesting system has been designed for grid tied applications. With that the efficiency of the energy harvesting by different techniques and converters is improved. PV system is used effectively by implementing three port interleaved DC-DC converter to boost maximum power and by implementing MPPT technique as well. Hybrid system with hybrid controller is proposed in the system which is used for high power applications. Due to proposed algorithm the power quality problems are reduced. Power factor is good in proposed system. Efficiency of the system is high.

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