Available Online at http://www.journalajst.com

ASIAN JOURNAL OF SCIENCE AND TECHNOLOGY

ISSN: 0976-3376

Asian Journal of Science and Technology
Vol. 11, Issue, 01, pp.10658-10661, January, 2020

RESEARCH ARTICLE

A SINGLE-STAGE RECONFIGURABLE POWER CONVERSION PV-BATTERY SYSTEM

[1,*]Mr. Rushikesh E. Pati and [2]Dr. Shah, P. J.

[1]PG Scholar, SSBT's College of Engineering and Technology, Jalgaon, Maharashtra, India
[2]Professor and HOD, SSBT's College of Engineering and Technology, Jalgaon, Maharashtra, India

ARTICLE INFO

Article History:
Received 25th October, 2019
Received in revised form
09th November, 2019
Accepted 27th December, 2019
Published online 30th January, 2020

Key words:
RSC Converter, PV Battery,
Photovoltaic (PV),
Solar System.

ABSTRACT

In this paper a new converter called reconfigurable Solar Converter (RSC) for PV-battery application. Particularly for utility scale PV-battery application is proposed. The basic concept of the converter is to use a single power conversion system to perform different operation modes for solar PV systems with energy storage. The suggested solution requires minimal complexity and modifications to the conventional three-phase solar PV converters for PV-battery systems. The new convertor is to use a single-stage 3 part grid-tie star PV convertor to perform each dc/ac and dc/dc operations. This convertor resolution is appealing for PV-battery application, as a result of it minimizes the quantity of conversion stages, thereby rising potency and reducing value, weight, and its volume.

Citation: ***Rushikesh Eknath Patil*, 2020.** "A single-stage reconfigurable power conversion pv-battery system", *Asian Journal of Science and Technology*, 11, (01), 10658-10661.

INTRODUCTION

Solar photovoltaic (PV) electricity generation isn't available and sometimes less available counting on the time of the day and therefore the weather. Solar PV electricity output is additionally sensitive to shading. When even a little portion of a cell, module, or array is shaded, while the rest is in sunlight, the output falls dramatically. Therefore, solar PV electricity output significantly varies. From an energy source standpoint, a stable energy source and an energy source which will be dispatched at the request are desired. As a result, energy storage like batteries and fuel cells for solar PV systems has drawn significant attention and therefore the demand of energy storage for solar PV systems has been dramatically increased, since, with energy storage, a solar PV system becomes a stable energy source and it are often dispatched at the request, which ends up in improving the performance and the value of solar PV systems (Rushikesh, 2017; Iman Mazhari et al., 2014; Hongrae Kim, 2013; Madhu Maraiah, 2015). There are different options for integrating energy storage into a utility-scale solar PV system. Specifically, energy storage is often integrated into the either ac or dc side of the solar PV power conversion systems which can contains multiple conversion stages. Every integration solution has its advantages and disadvantages.

Corresponding author: **Mr. Rushikesh E. Pati,**
PG Scholar, SSBT's College of Engineering and Technology, Jalgaon, Maharashtra, India.

Different integration solutions can be compared with regard to the number of power stages, efficiency, storage system flexibility, control complexity, etc (Rushikesh, 2017; Iman Mazhari et al., 2014; Hongrae Kim, 2013). This novel single-stage solar converter called reconfigurable solar converter (RSC). the essential concept of the RSC is to use one power conversion system to perform different operation modes like PV to grid (dc to ac), PV to battery (dc to dc), battery to grid (dc to ac), and battery/PV to grid (dc to ac) for solar PV systems with energy storage [Sarath, 2017]. The RSC concept arose from the very fact that energy storage integration for utility-scale solar PV systems is sensible if there's an enough gap or a minimal overlap between the PV energy storage and release time. Fig.1 shows completely different eventualities for the PV generated power time of use. just in case (a), the PV energy is usually delivered to the grid and there's basically no need of energy storage. However, for cases (b) and (c), the PV energy should be first stored within the battery then the battery or both battery and PV supply the load. In cases (b) and (c), integration of the battery has the very best value and therefore the RSC provides significant benefit over other integration options when there's the time gap between generation and consumption of power (Rushikesh, 2017; Iman Mazhari et al., 2014; Hongrae Kim, 2013; Madhu Maraiah, 2015; Sarath, 2017; Shaik Asha et al., 2015).

Reconfigurable Solar Converter (Rsc)

Introduction: A typical scheme structure of RSC is shown in Fig.2 which applies a single stage to three phase converters.

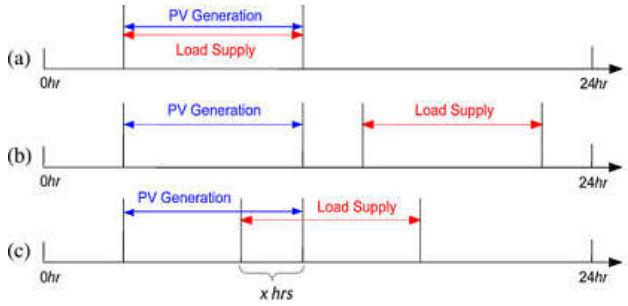

Fig. 1. Different scenarios for PV generation and load supply sequence

The RSC has some modifications to the traditional Three-phase PV inverter system. These modifications allow the RSC to incorporate the charging function within the conventional three phase PV inverter system. the whole proposed system is going to be tested using Matlab/Simulink and therefore the simulation results demonstrate the performance characteristics of the reconfigurable solar converter: A single-stage power conversion PV battery system (Hongrae Kim, 2013; Madhu Maraiah, 2015; Sarath, 2017).

Operation steps of the RSC: All potential operation Steps for the RSC are bestowed in Fig.2. In

Step 1: during this Step one, the PV is directly connected to the grid through a dc/ac operation of the convertor with risk of most electric receptacle pursuit (MPPT) management and therefore the switches S1 and S6 stay open.

In Step 2: during this Step two, the battery is charged with the PV panels through the dc/dc operation of the convertor by closing the switch S6 and gap the switch S5 during this Step, the MPPT perform is performed; thus, most power is generated from PV.

In Step 3: during this Step three, there's another Step that each the PV and battery offer the facility to the grid by closing the switch S1. This operation is shown as steps three. During this step three, the dc-link voltage that's the identical because the PV voltage is implemented by the battery voltage; thus, MPPT management isn't potential.

In Step 4: during this step four, represents associate operation step that the energy keep within the battery is delivered to the grid.

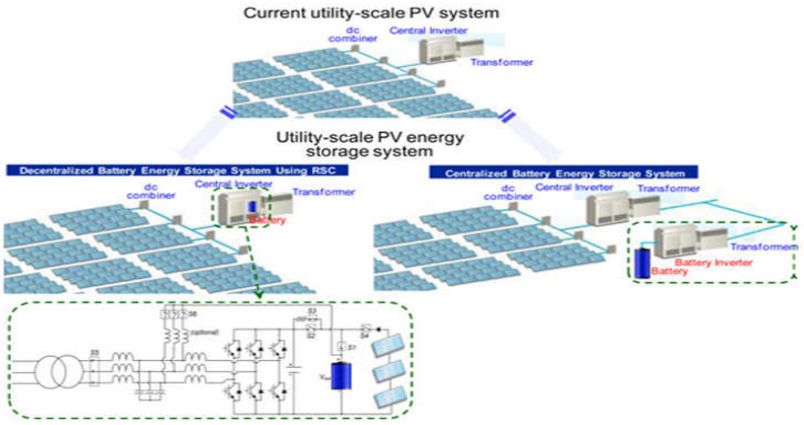

Fig.2 single stage to three phase converters

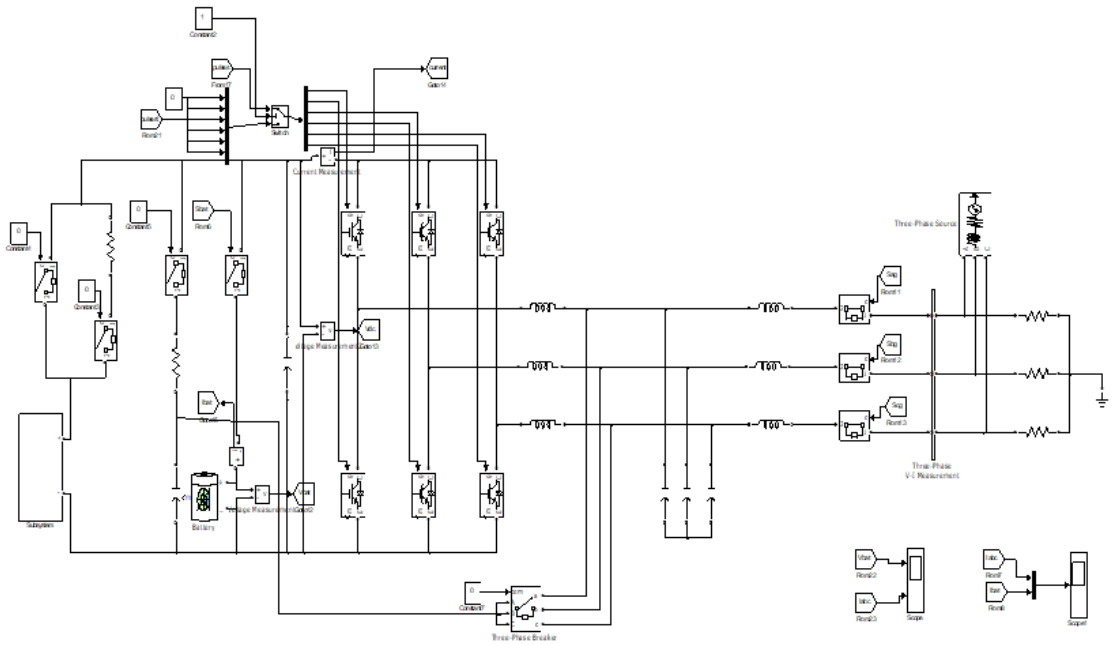

Fig. 3.RSC module with step - 1,2,3,4

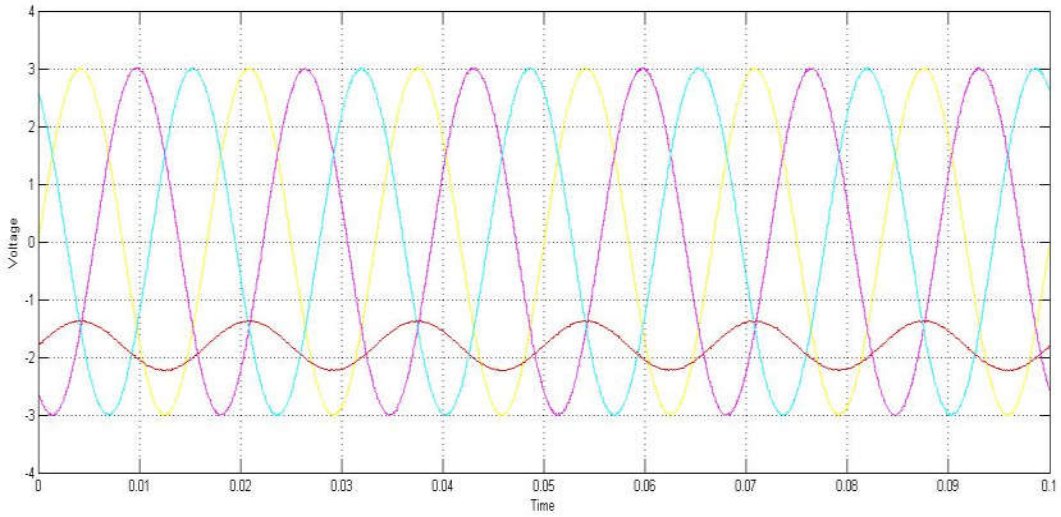

Fig .4 Steady state performance of DC/AC control in step 1

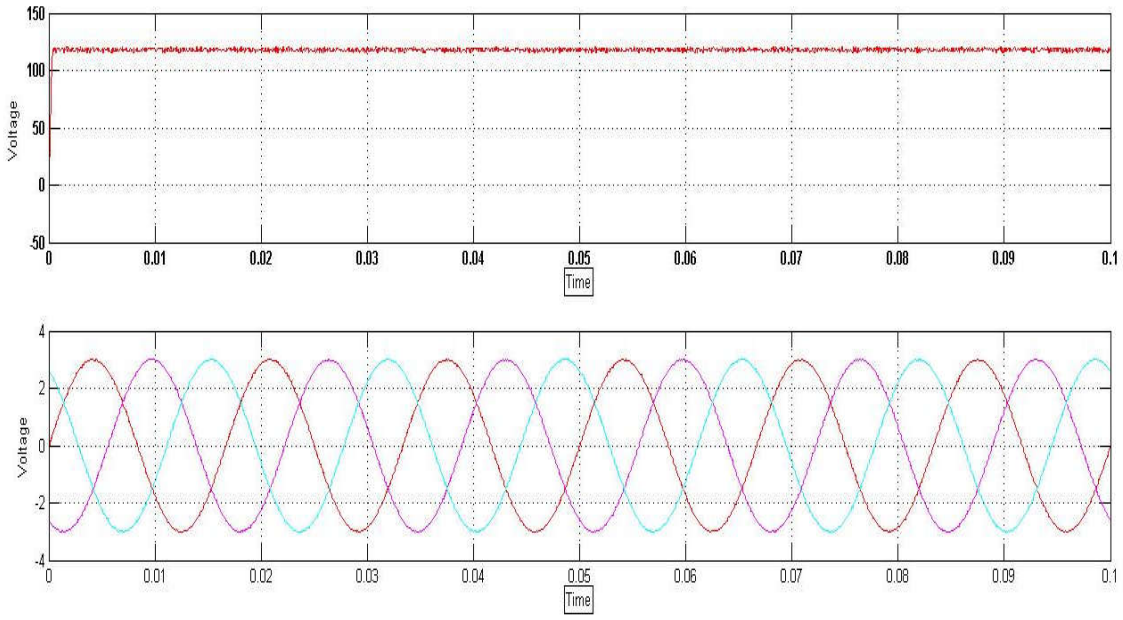

Fig .5. Steady state performance of DC/AC control in step 4

In Step 5: there's another step, Step five that the battery is charged from the grid.

System Benefits of Solar PV Power Plant with the RSC Concept: The RSC provides numerous advantages to system designing of utility-scale solar PV power plants. The PV energy storage solutions with the RSC and also the current progressive technology. the advantages of the RSC resolution are ready to produce are a lot of apparent in larger solar PV power plants. Specifically, exploitation the RSCs an out sized solar PV station will be controlled a lot of effectively and its power will be sent a lot of economically thanks to the flexibleness of operation. However, numerous system controls will be planned supported the requested power from the grid operator Preq and obtainable generated power type the plant P gen. RSC based solar PV power plants are as follows:

System control 1 for P gen>P req;

System control 2 for P gen<P req;

System control 3 for P gen = P req;

System control 4 for charging from the grid (Operation steps 5).

Module simulation with result

The Steady-state performance of DC/AC and DC / DC control in Steps 1 to 4

This RSC is a modification of conventional three-level inverter with of additional link and switches (switches S1 to S6) as shown in Fig 3. These modifications allow the RSC to perform battery charging function in addition to the inverter operation. Inductors L1 and L2 are ac filter inductance and C is filter capacitance. L3 is an optional inductor included for battery charging purpose if the ac filter inductance is not enough. The consumers loads are considered separately in this circuit. On comparing with the existing two-level RSC, the three-level topology used in this paper permits small values of filter inductance and capacitance without compromising the power quality [Madhu Maraiah, 2015].

The conventional grid-tie PV converter is connected to the grid and delivers the power from the PV to the grid. Therefore, the conventional grid-tie PV converter requires grid synchronization and power factor control functions. For RSC certification, the aforementioned functions are not implemented and tested. Since the RSC uses the same those functions as the conventional grid-tie PV converter, it is not necessary to verify them. Therefore, the RSC circuit is connected to a passive load. The conventional PV converter also performs the MPPT to extract the available maximum power from the PV. Fig. 4 shows the steady-state performance of dc/ac control in Step 1. In this test, the voltage on the dc side VDC of the inverter is set to 230 V. The current reference is set to 5 A peak for the frequency of 50 Hz. As shown in Fig. 4, a satisfactory steady state performance is obtained. Fig. 5 shows the steady-state performance of dc/ac control in Step 4. In the test, the voltage on the dc side VDC of the inverter is 118 V which is the battery voltage. The current reference is set to 3 A peak for the frequency of 50 Hz. As shown in Fig. 5, the satisfactory dc/ac steady-state performance is obtained. In Fig. 5, the current flowing into the battery is exhibited. The average battery charging current is 1.8 A. The battery charging current has about 0.85 A pk−pk current ripple with the frequency of 50 Hz. Step change control is the most important aspect of the RSC operation. To implement the step change control, MATLAB/Simulink state flow is used.

Conclusion

A replacement of convertor referred to as RSC for PV battery application, significantly utility-scale PV battery application. There essential construct of this RSC uses one power conversion system to perform totally different operation modes like PV to grid (dc to ac), PV to battery (dc to dc), battery to grid (dc to ac), and battery/PV to grid (dc to ac) for star PV systems with energy storage. A Single – Stage alternative energy convertor for PV Battery, what is more, the presence of associate energy storage system will create additional engaging grid-connected PV plant, due two some necessary extra capabilities not common of presently planned grid-current management for every section ought to be done a synchronously. Using the interleaving operation reduces the ripples on the charging current flowing into the battery. Thus, the filter capacitance value can be decreased considerably.

REFERENCES

Rushikesh E. Patil, Dr. P. J. Shah, “A Review: Reconfigurable Solar Converter- A Single Stage Process”, *International Journal of Science Technology Management and Research* (IJSTMR), Volume 2, Issue 03, pp.02-04, March 2017.

Iman Mazhari, Manohar Chamana, Badrul H. Chowdhury, Babak Parkhideh, “Distributed PV- Battery Architectures with Reconfigurable Power Conversion Units.” IEEE *Transaction on Industrial Electronic*, 978-1-4799-2325-0, pp 692-696, March 2014.

Hongrae Kim, Babak Parkhideh, Tim D. Bongers and Heng Gao,” Reconfigurable Solar Converter: A Single-Stage Power Conversion PV-Battery System,” IEEE Transactions on Power Electronics, Vol. 28, Issue. 8, pp.3789-3791, August 2013.

G.Madhu Maraiah, M.Lakshmi Naryana,” A Single-Stage Power Conversion Pv-Battery System Using Reconfigurable Solar Converter,” *International Journal Of Professional Engineering Studies* (IJPES), Volume V ,Issue 3, pp.230-232 ,Aug 2015.

Sarath.N, H. Ansarudeen,” Reconfigurable Solar Converter for Residential PV-Battery Applications”, *International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering* (IJAREEIE), Vol. 6, Issue 6, pp.4438-4442, June 2017.

Shaik Asha, Shaik Shareef, Dr.Abdul Ahad3,” Reconfigurable Solar Converter: A Single Stage Power Conversion Pv-Battery System”, *International Journal Of Advance Research In Science And Engineering* (IJARSE), Vol. No.4, Issue .01,pp.3604-3609, January 2015 .

Ajhar Shaikh, Prof. Mayuri Prajapati,” Review and Operation of Single-Phase Reconfigurable Inverter Topology for A Solar Powered Hybrid Ac/Dc Home”, *International Journal for Technological Research in Engineering* (IJTRE), Volume 5, Issue 8, pp.276-278, April-2018.

Shiva Kumar, B. Rakesh Vakati, 2017. “A New Proposal of Single-Stage Power Conversion System”, *International Journal of Scientific & Engineering Research* (IJSER), Volume 8, Issue 5,pp.411-416, May-2017 .

****