

A Review on Bi-Directional Battery Operation in Microgrid Island Operation

Vanshika Rathore^{1*}, Manish Kumar Chandrakar²

¹M. Tech. Student, Department of Electrical Engineering, RSR Rungta College of Engineering and Technology, Bhilai.

²Assistant Professor, Department of Electrical Engineering, RSR Rungta College of Engineering and Technology, Bhilai.

Abstract

In order to avoid this situation DC Microgrids used for dc loads as well as for ac loads. In DC microgrid systems closed loop has been designed based on voltage level are easy to design but in AC microgrid systems closed loop has been designed based on voltage and frequency in three phase system is complicated to design. DC bus voltage is very high as compared to battery voltage. It is difficult to use battery of same voltage as busbar have due to high cost, large size, transportation difficulty, therefore battery of small voltage in conjunction with converter are very efficient and advantageous in use. There are many topologies to design bi-directional DC-DC converter are discussed in different papers. It is very difficult to obtain high gain as well as high efficiency simultaneously in conventional bi-directional converter due to losses in switches, leakage inductance. Galvanic isolation in bi-directional converter has additional losses due to magnetic losses.

Keywords: *Microgrid; Island Operation; Energy; Power.*

* Corresponding author

1. Introduction

As the demand of electrical power increase around the world, we have to discover new ways of power generation in order to diminish carbon emission, which led to installation of DGs instead of traditional generators. The term microgrid is act as a solution of integration of large no. of micro generators generates electricity without disturbing the operation of utility grid. With coordinating loads and DGs, the distributed network subsystem would be less troublesome to utility grid rather than conventional micro generation. Microgrid provides local voltage control. In case of any disturbance in main utility grid, microgrid disconnect from main grid and continue to operate separately in isolated mode. Thus, this operation improves power quality of system connected to it and it will benefit to consumers. From grid's point of view, microgrid is considered as a single controlled unit in power system that can work as a single whole aggregated load. Customers can take benefit from microgrid as it is designed so to meet their local needs of uninterrupted power supply and heat. It reduces feeder losses, local voltage

control, storage of excess energy in battery to meet when required at peak time. Microgrid has a facility to operate either in grid tied mode or in isolated mode.

2. Literature Review

Pavan Singh Tomar, Manaswi Shrivastava, Arun Kumar Verma et al [2018] in this paper an isolated bi-directional converter without snubber circuitry has been proposed. Different frequency operation is performed in step-up and step-down modes to achieve ZVS in different directions. In the battery side, current fed half bridge boost converter is selected to achieve double the voltage from primary to secondary side of transformer.[1]

Zhiling Liao, Xinbo Ruan et al [2008] in this paper stand-alone photovoltaic system is proposed composed of uni-directional converter and bi-directional converter. Control strategy for BDC is discussed in three modes namely buck, boost, shut down mode and proper energy management is done for the system.[2]

Jigar Patel, Dr.Hina Chandwani, Vinod Patel, Hiren Lakhani et al [2012] in this paper design and simulation of 7.75-kW, full-bridge, bi-directional isolated DC-DC converter using a 12-kHz transformer and battery energy storage system is discussed. For battery charging and discharging switching actions are discussed. By connecting AFC(active front end converter), the output dc power can be converted to three phase a.c and feed to the grid. The overall system provides saving of energy. [3]

Shreelakshmi M. P., Moumita Das and Vivek Agarwal et al [2013] in this paper BDC with battery for standalone solar PV system is discussed. Switching action for step-up and step-down modes are discussed and efficiency of the converter is increased by using optimized components are reported and simulation is done in this paper.[4]

L.H.P.N.Gunawardena, D.R.Nayanasingh et al [2018] in this paper continuous and discontinuous conduction modes for charging and discharging actions are discussed for BDC design. Duty cycle of active power switches is changed for the charging action and during discharging action battery in parallel connection with dc link is reduced. Simulation results are discussed.[5]

Satyam Kumar Singh, Anand Kumar, Pradip Kumar Sadhu et al [2018] in this paper non-isolated instantaneous mode switching BDC is analysed and the results obtained using this technique shows that the time taken by the BDC to change from buck mode to boost mode is less as compared to traditional converter.[6]

Pavan Singh Tomar, Ashok Kumar Sharma, Kanak Hada et al [2017] in this paper proposed BDC converter is a combination of current-fed half bridge boost converter and LCL resonant circuit for soft switching. Boost

operation gain is obtained by the help of front end boost converter, LCL resonant tank and doubler. For buck operation, high side voltage is divided by half with capacitor divider. Soft switching by ZVS and ZCS are implemented and discussed.[7]

AiguoSun, Weige Zhang , Xiaohong Lin, Jingxin Li et al [2014] in this paper inductor coupled BDC is analysed and it overcomes from the shortage of small range of conversion ratio and high voltage/current stress in non-isolated system. Closed-loop control of proposed bi-directional DC/DC converter using the state space averaging method is discussed. The parasitic parameters and leakage inductance effect on stability have been considered and the unified compensation network has been designed under the constant battery current control target. At the same time, the corresponding stability analysis is reported.[8]

Burcu Gundogdu, Daniel Thomas Gladwin et al [2018] in this paper average value PWM VSC is designed for bidirectional power flow control in grid tied BESS. And vector control strategy with PI controller design is proposed and grid frequency regulation control is done.[9]

NourElsayad, HadiMoradisizkoochi, Osama A. Mohammed et al [2018] in this paper a new transformerless BDC is proposed. Simple circuit with synchronous rectification between the complementary transistors is employed in order to improve the converter efficiency and switches operate in ZVS for reducing switching losses. The system has good dynamic and steady state response.[10]

O. Cornea, E. Guran, N. Muntean, D. Hulea et al [2014] in this paper BDC with battery and dc bus simulation and experimental results are discussed. Simple hysteresis controller is used in this simulation for the stability and a smooth transition between battery charging and discharging modes.[11]

D. Habumugisha, S. Chowdhury, S.P Chowdhury et al [2013] in this paper DC-DC interleaved Forward Converters with double three winding transformer topology is used for providing high performances of DC Microgrid distribution and high conversion ratio, galvanic isolation are discussed.[12]

FeiXueRuiyang Yu ,Wensong Yu,Alex Q. Huang et al [2015] in this paper GaN transistor based bidirectional isolated DC–DC converter for stationary energy storage device (SESD) for 400V DC microgrid is analysed. Converter's operation range was expanded in light load conditions and efficiency under light load condition increased and due to low switching loss in on state resistance, under heavy load condition efficiency also increased. This converter is made of GaN and snubber circuit is omitted in this circuit are discussed. [13]

Bhatt Kunalkumar, R. A. Gupta, Nitin Gupta et al [2017] in this paper three stage isolated bi-directional battery charger with dual active bridge configuration used for high voltage rating and RCD snubber clamp circuit is used

for reducing current difference between source inductance and leakage inductance but voltage spikes and power loss takes place are discussed in this paper. Power fed to grid by the help of AFC. [14]

Mustafa Farhadi, Osama Mohammed et al [2013] in this paper real-time operation and harmonic analysis of isolated and non-isolated DC microgrid including hybrid energy sources and various loading schemes is analysed. An energy management algorithm based on the master slave control is proposed, in which the supercapacitor bank as the master, control the DC bus voltage while the other units are working in current control to share the required power. [15].

3. Problem Identification

In the power system, all generators and RES are linked together considering their power quality and system stability. DC microgrid are essential for long line transmission due to low power loss during transmission. Extensive researches have been carried out and still new researches going on to devise the features of microgrid. Nowadays, for street lightening, agriculture pumps, individual distant house lightening, rural electrification, satellite powered. are ruled by solar PV cells. Most of the microgrids are AC in nature, in order to power the electronic devices like computers, laptops, mobile charger, LEDs, etc. DC is required so adapter is used to convert AC supply to DC supply. In order to avoid this situation DC Microgrids used for dc loads as well as for ac loads. In DC microgrid systems closed loop has been designed based on voltage level are easy to design but in AC microgrid systems closed loop has been designed based on voltage and frequency in three phase system is complicated to design. DC bus voltage is very high as compared to battery voltage.

4. Conclusion

- Study the theoretical concept how isolated BDC works on both modes and implementing it in MATLAB Simulink in order to verify the results and find the advantage and disadvantage of the converter.
- Study the theoretical concept how non-isolated BDC works on both modes and implementing it in MATLAB Simulink in order to verify the results and find the advantage and disadvantage of the converter.
- Comparing the simulation results and find the optimum converter for our application purpose.
- Gate pulse provide for both BDC depends on switching action and power flow direction.
- While simulating what are the difficulties we faced are discussed.
- Integrating both BDCs with DC microgrid for performance analysis check.

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