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Methods of Voltage Regulation for Radial DC- Microgrid

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Abstract - *The power generation from renewable power sources is variable in nature, and may contain unacceptable fluctuations in case of the wind power generation. High fluctuations in power generation may negatively impact the voltage stability of the microgrid. Various control methods are discussed on the coordinated operation of the DG's for a single bus system, which have their own merits and limitations. Droop control method is used for constant voltage but it is having some limitations. Modified droop control technique utilize dc bus signalling and adaptive adjustment of droop co-efficients. All these systems focused only on one bus system. The voltage drop problem in DC grid can be eliminated by placing the DG in the bus. The DG is supplying part of the load power and hence reduces the voltage drop along line. Series voltage Regulator dynamically injects voltage in series with the dc microgrid. The SVR uses a dual active bridge dc-dc converter followed by a full-bridge dc-dc converter. DAB provides unipolar DC voltage. The dc-dc converter in second stage regulates output voltage as per requirement. As a result, the voltage level at the different points of the grid becomes independent of load variation and stays within the specified limit. In this work, the voltage regulator is connected at the mid-point of the grid, but it may be connected in some other locations to get optimal rating of the same. The simulations are carried out using MATLAB software. The results show the effectiveness of such voltage regulator for radial dc microgrid, especially under critical load condition.*

Key Words: Series Voltage Regulator, Dual Active Bridge, DC-DC Converter etc.

1. INTRODUCTION

Due to increase in demands on energy, renewable energy has attracted extensive interest. Distributed generation has number of advantages as compared to the centralised power generation. Because cenratralised power generation units construction is complicated, it's cost is more as compared to the distributed generation units. After connecting distributed generation with local loads and energy storage, a microgrid is formed. There are two types of microgrid ac and dc. DC microgrids does not required frequency, phase or reactive power control. DC system is used for developing rural area and small scale commercial facilities such as data center, residential buildings. For voltage regulation purpose number of methods are used droop control method is one of them. But it is having disadvantages such as current drop. Droop index is introduced to minimize this problem. In this paper co-ordination of DAB and DC-DC converter is used .Dual Active Bridge provides constant DC output and with the help of dc-dc converter adjustable output voltage is provided.

2. RELATED WORK

2.1 SIMULINK Model

The simulation for SVR is explained here. A solar plate of 250W is connected to it's input side. Stray capacitances are connected for removing ripples contents at the output side. Subsystem consists of full bridge rectifier. It is the combination of thyristors and linear transformer. Here transformer is used for isolation purpose. On the output side load of 400V is connected. Figure 1.1 shows SIMULINK Model of SVR.

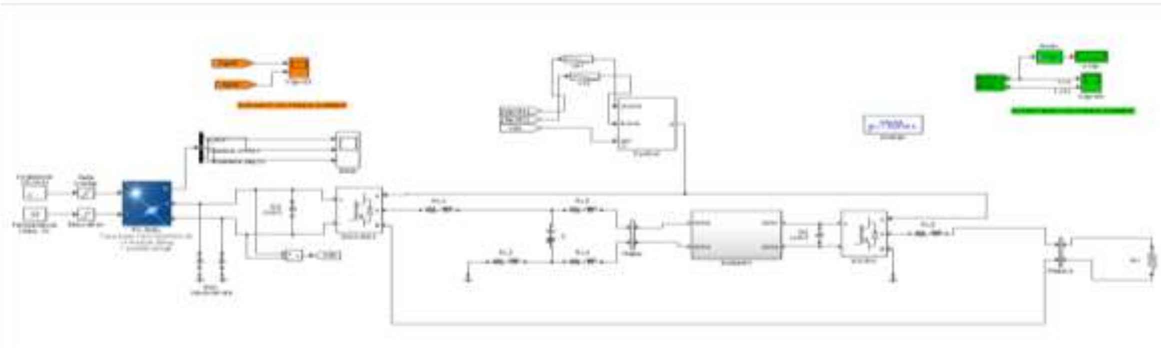


Figure 1.1: SIMULINK Model for SVR

2.2 Rating of the components

Parameters of PV Array

Module Type	Trina solar TSM-250PA05.08
Number of cells per module	60
Number of series connected modules per string	14
Number of parallel strings	1
Module specifications	
Voc	37.6
Isc	8.55
Vmp	31
Imp	8.06
Series resistance, Rs ohms	0.247
Diode saturation current	2.038
Diode quality factor	0.99766

2.3 Simulation Results:

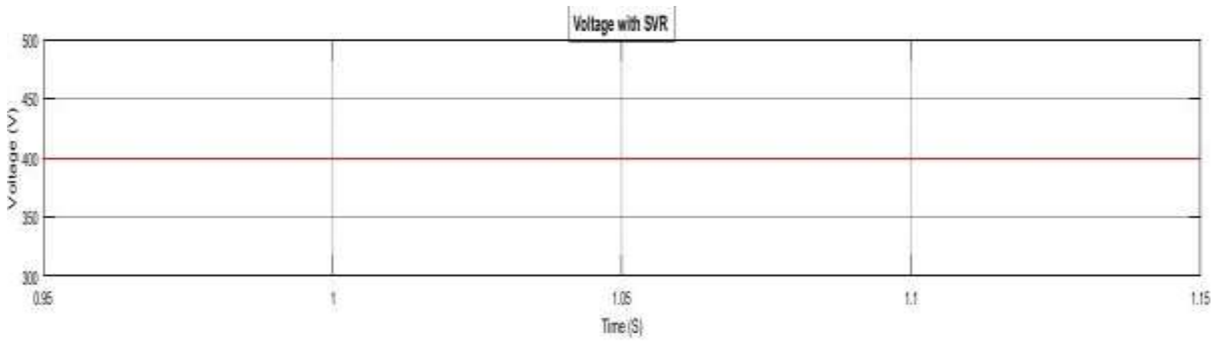
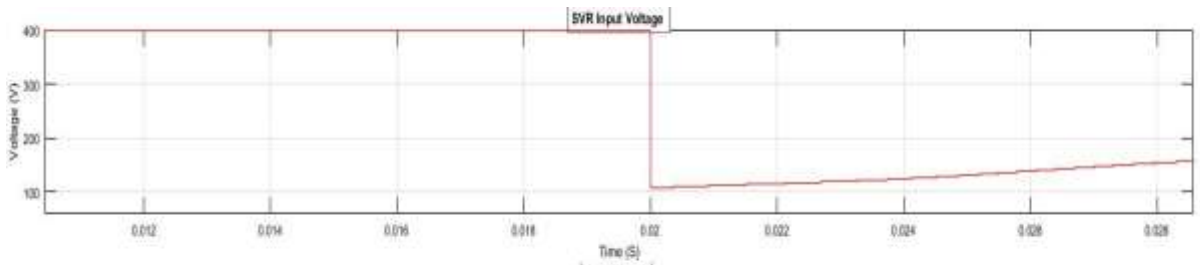


Figure 1.2: SVR output voltage

Here output voltage is 400V, so that we get constant voltage as compared to existing system. That is this system is more stable.



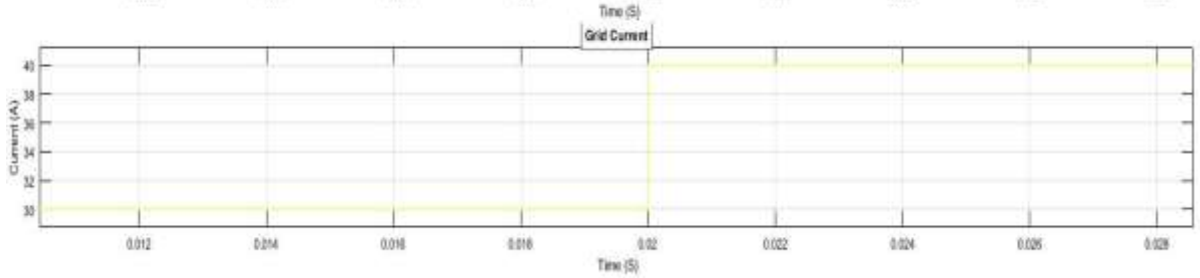


Figure 1.3: (a) Simulation result of SVR input voltage

Figure 1.4: (b) Simulation result of Grid Current

As shown in above figures input is given to the above circuit and we get constant output. That is system is giving constant output, means satisfactory performance is there.

3. CONCLUSION

In this paper the working details of SVR is explained, here SVR is the combination of DAB and full bridge converter. With the help of this simulation we get constant output voltage. Also, it's performance is checked through simulation. It also indicates the impacts of connecting different loads such as resistive load and inductive load.

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