# AN OPTIMIZED METHOD FOR EMPLOYING CHB TO ANALYZE THE THREE TERMINAL AC/DC VOLTAGES AND CURRENT GENERATION FOR HYBRID MICROGRIDS

**[1]L.NADAM, [2]G.KIRAN, [3]M.ANJANEYELU , [4]M.SINDHU**
[1, 2,3]Assistant Professor, [4]Student, Dept. of Electrical and Electronics Engineering, Brilliant Institute of Engineering and Technology, Hyderabad, Telangana, India

**ABSTRACT**
In this paper, one AC terminal and one AC terminal are proposed for a three-terminal Cascade H Bridge (CHB) based hybrid micro-grid. This method uses cascaded H-bridge (CHB) converters for the AC grid interface and two DAB converters for the DC sub-grid interface, which connects two isolated DC buses. The number of power discussion stages is reduced as a result of this interconnection. DC rails are used by DAB converters feeding CHB converters. An improved solution is proposed through zero-sequence voltage injection in the CHB converters to address the imbalanced grid voltage & currents and DC rail voltages difficulties created by this redesigned system configuration with only two power conversion stages.
**Key words -** cascaded H-bridge (CHB)converters, DAB converters and the zero- sequence voltage injection.

## 1. INTRODUCTION

Due to rapid increment in production of DC power generations like solar andfuel cell the applications of DC grids are growing. Almost all power semi conductor electrical vehicles and communication systems the need of DC supply is high. To fulfil the AC/DC loads the AC to DC converters are playing crucial role. In this paper CHB bi directional voltage sources are employed to integrate the hybrid powergenerations and utilize it. Flying capacitor (FC) and Neutral point clamped (NPC) are available in the literature instead of CHB multi level converters, CHB are more advantageous compared to FC and NPClike reduced switches, mode of operations and it is best suitable of medium and high power transmission systems. The conventional hybrid AC/DC grids include single AC bus and DC bus. These converters output terminals are integrated by three-phase bidirectional AC/DC converter. The output of AC terminal isconnected to grid (low voltage side). High frequency linear transformer is used to interconnect source and load. Linear transformer have few disadvantages like larger in weight, heavy volume and need more insulation oil. So instead of transformers AC/DC converters areemployable. Power semiconductor elements have more efficient compare to linear transformer. To achieve power demand multi terminal hybrid AC/DC Microgrid with CHB converters devices speed adjustable motor drives, excitation to the alternating machines. Micro grids are growing very popular. In advance multi terminal micro grid systems are using much. This have higher power transmission capability rate with more economical ratios. To get desired output multi terminal power transmission CHB topology is adoptable with dual active bridge (DAB) converters. The block diagram of traditional AC/DC micro grid system is shown in below figure.1

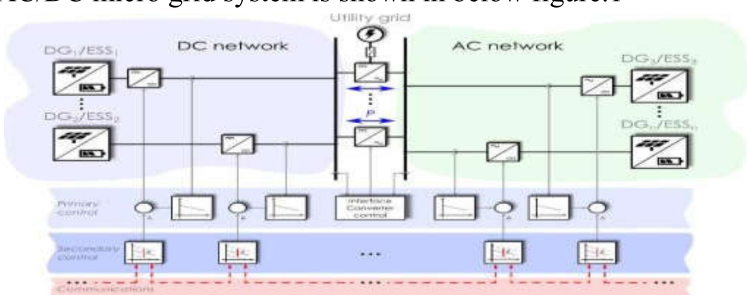

Fig.1. Block diagram of traditional AC/DC micro grid

## 2. SYSTEM CONFIGURATION

In Conventional Power quality is easilyimproved by using Active Power Filters(APFs) and the Distribution Static Compensators (DSTATCOMs). The DSTATCOM is a shunt voltage controller device. In this Voltage

Source Inverter (VSI) connected in shunt at the point of common coupling (PCC) of three phasedistribution systems. So many authors proposed various methods on DSTATCOM configuration. To reduce the harmonics in currents, inject reactive power, suppress the neutral wire current and improve power factor. Most of these configurations are designed based on VSI connection at the PCC. In this paper adopted CHB inverter rather than three leg inverters. The advantages four - leg VSI are; it reducesthe source neutral wire current completely and circum vent the problems associated with the others VSI topologies.

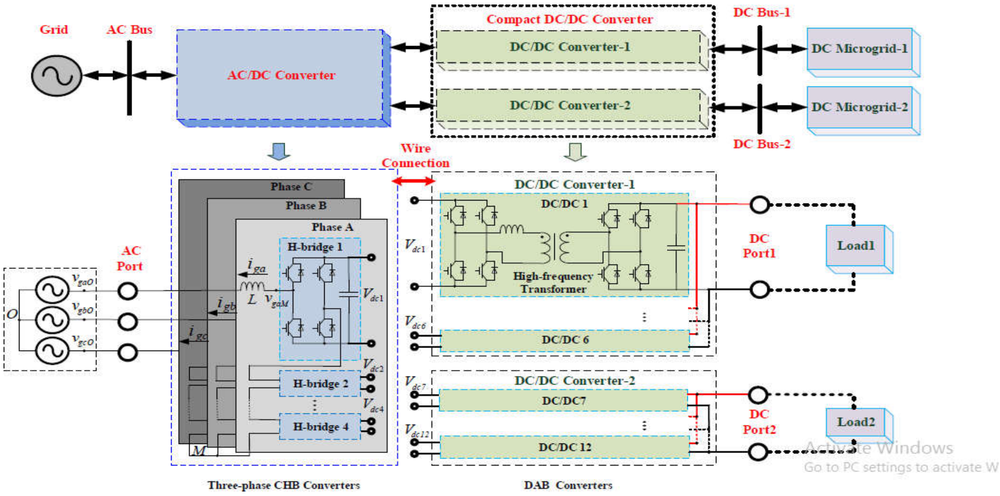


Fig.2. The proposed three-terminal hybrid AC/DC microgrid.

## 3. CONTROL SCHEME

To operate voltage source inverters(switch pattern) design controllers like sliding mode controller, cascade controllers, μ- synthesis method, model predictive power control (MPTC), adaptive control and direct power control (DPC). To implement these controllermethods requires a lot of process knowledge design PI controllers. It much depends on the proportional gain ($K_P$) value. Still the research is going on this era because in numerous cases intend of PID controllers are inadequately tuned, so as a result a few controllers are too destructive and some controllers are giving not acceptable response. In present decade modern control theory, PID control strategies are replaced with sophisticated control techniques such as model predictive control, are built as a supervisory control algorithm, which givesset points to PID controller. The complete block diagram of grid connected SECS system with employing PI control scheme is as shown in blow figure.3 Most of the conventional controller tuning methods aremanual controller strategies but they fails to achieve the desired response because presence of non linear loads (unbalance voltage, unbalance current), random disturbance and non- linearity's of dynamic systems. All these are causing system response unstable. These drawbacks can be overcome by using the digital control strategies; Hybrid-expert system based tuning methods (auto tuning PID controllers) and optimization tuningmethods in the literature

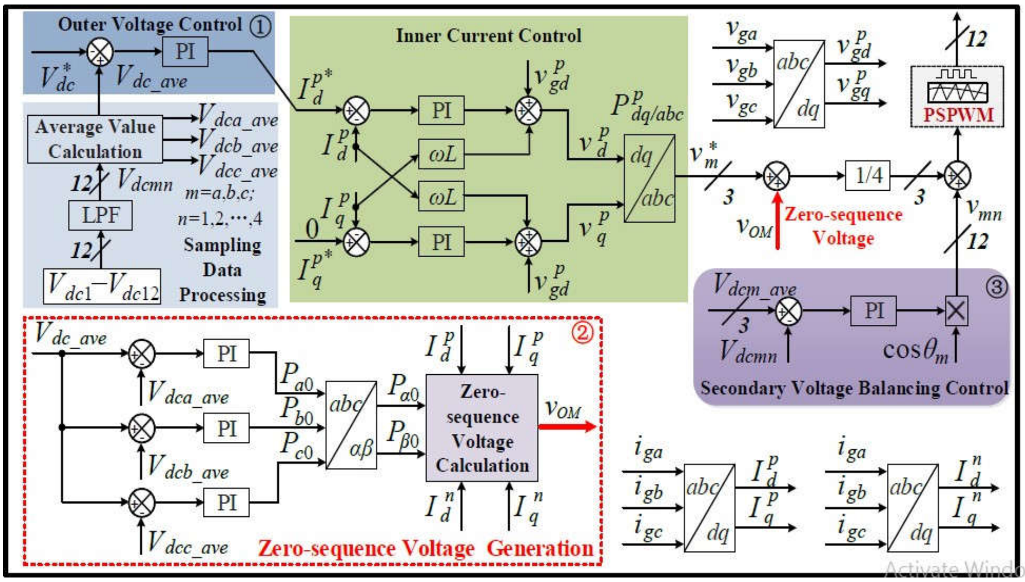


Fig.3. Control scheme for three-terminal hybrid AC/DC microgrid

## 4. MATLAB & SIMULATIONRESULTS

The Simulation results in conventional method are shown below figures 4.5 and 6 respectively.

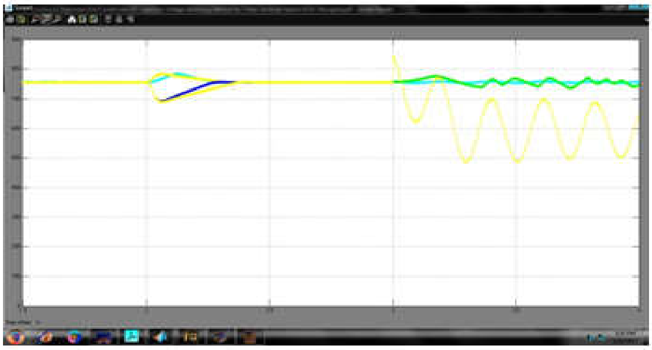

Fig .4. AC/DC converter output valtage

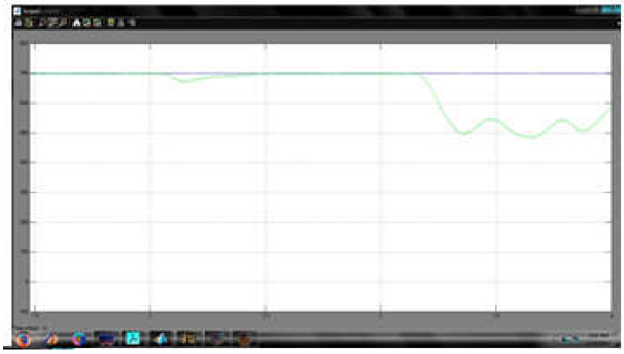

Fig.5. AC/DC converter output current

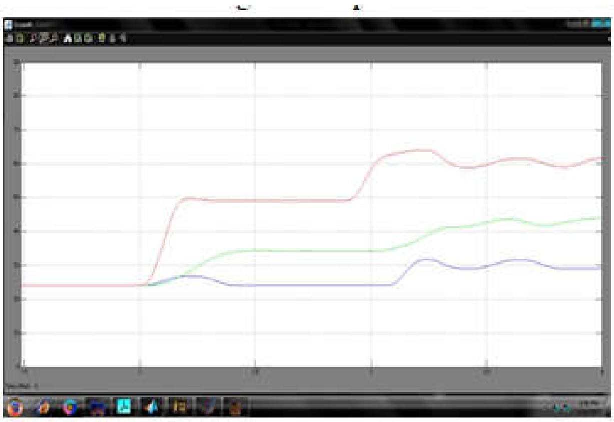

Fig.6 Rms current

The improved matlab simulation results in Proposed method at three terminal isshown below figures 7,8, 9, 10 and 11 respectively.

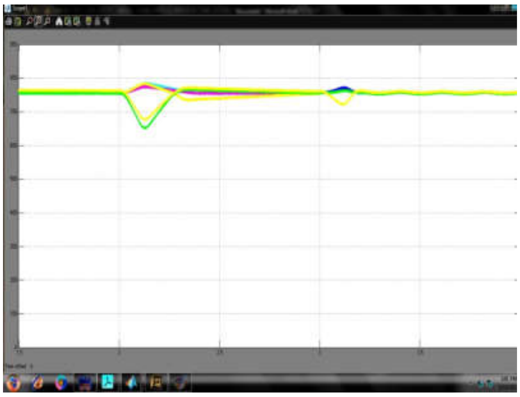

Fig..7. DC capacitor voltages of AC/DCconverter by the proposed method.

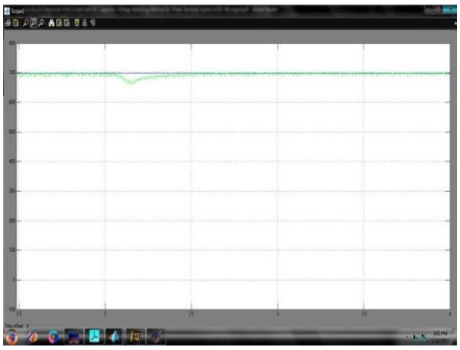

Fig.8. AC/DC converter output voltageand output current

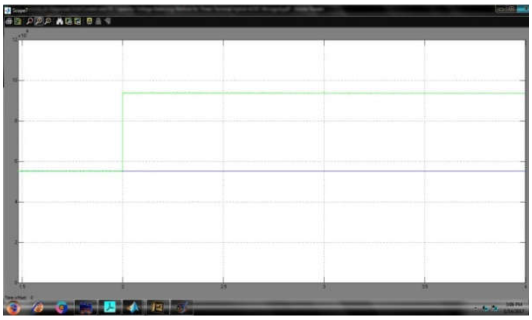

Fig.9. Dc microgrid power 1 & 2

Fig.10. Rms current

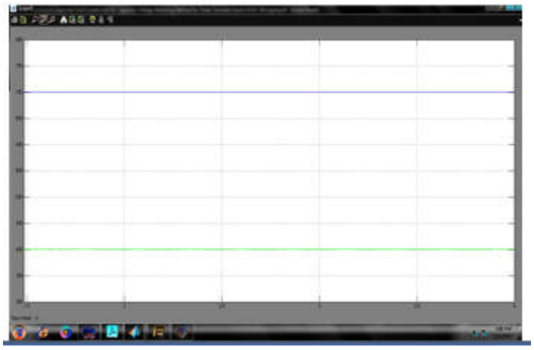

Fig.11 output Dc/dc voltages

The improved matlab simulation results in Proposed method at five terminal is shown below figures 12, 13,14,15, 16 and 17 respectively.

Fig.12 DC capacitor voltages of AC/DCconverter

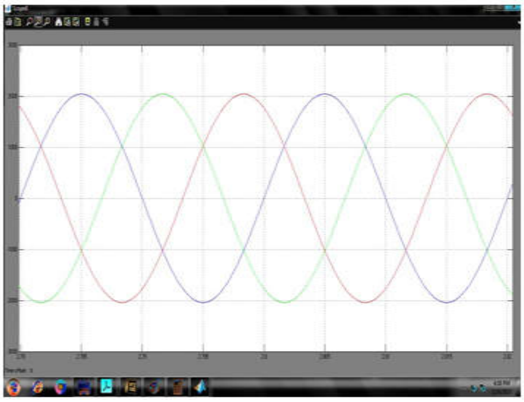

Fig.13.Micro grid powers

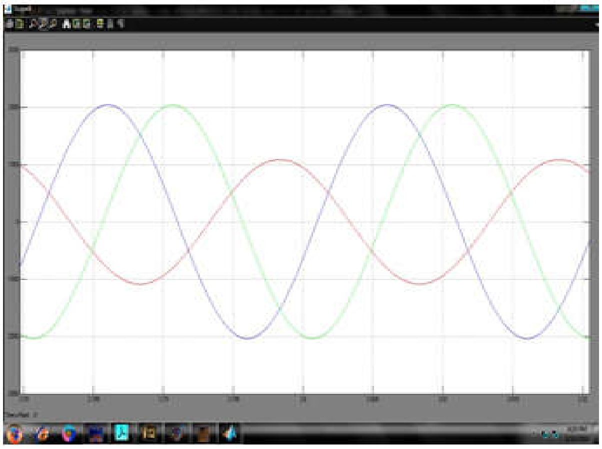

Fig.14 Grid-2 output voltages

## CONCLUSION

In this article, a two-terminal hybrid CHB microgrid structure with only two power conversion stages is discussed in detail and a three-terminal hybrid microgrid with two DC ports is mainly selected for case study. In order to solvethe issues of DC capacitor voltages andthree-phase grid currents unbalance causedby mismatched DC power between DC ports, an improved control method through the adoption of zero-sequence voltage injection is developed. It has been extensively verified that the grid current and CHB capacitor voltage balancing control can be achieved simultaneously even in the severe case with highly mismatched DC power, grid-voltage sags, or the changes of connection between AC and DC sub grids.

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