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Microgrid A Best Solution for Developing India

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Abstract: *This paper presents method for power flow control between utility and microgrid through back-to-back converters for frequency isolation. This system can operate in two different modes. In mode 1, the amount of specified real and reactive power is distributed between microgrid and utility via, back to back converters. Mode2, is applied when power supplied by distributed generators reaches to its maximum limit in microgrid. In this system we are using voltage source converter with cascaded H-bridge topology for the conversion of dc output voltage of PV cells to ac supply. In this case, to eliminate the lower order harmonics or higher order harmonics which are produced in the system, pulse width modulation technique is used. This model of microgrid system is simulated in MATLAB.*
Keywords: *Back-to-back converters, microgrid, voltage source converter, filters.*

I. Introduction

The proposed system must provide solution to modern India for electrification hence remote placed in India will get electrified. Proposed system consists of a microgrid which is small scale power grid that can operate independently or in conjunction with the area's main electrical grid. Any small scale localized station with its own power resources, generation and loads and definable boundaries qualifies as a microgrid. Microgrid can be intend as back-up power or to bolster the main power grid during periods of heavy demands. Often, microgrids involve multiple energy sources as a way of incorporating renewable power. Other purposes include reducing costs and enhancing reliability. In India we have existing microgrid but they are not able to share their excess power to load distribution grid till. Microgrid interconnectivity and integration will improve system energy efficiency and reliability and provide enabling technologies for grid independence to end-user side. So, in proposed system back to back converter we are using for frequency isolation. Back to back converter is the combination of inverter as well as rectifier. According to purpose converter will change the mode (rectification or inversion). There is bidirectional power flow control between microgrid and utility. This bidirectional power flow can obtain by controlling both the converters. These back to back converters provide power quality isolation between microgrid and utility. here a relay breaker is used for protection during faults. This scheme ensures safe and quick islanding and inception of the fault as well as seamless resynchronization once the fault is cleared. In this system we are using voltage source converter which is used to convert dc supply into ac supply. For voltage source converter we use inverter topology i.e. H-bridge topology. Converter contains 3 H-bridge are connected to three single phase transformer for required isolation and boosting each bridge is having single dc voltage source is known as H-bridge topology and more than one H-bridge having a single dc source is known as cascaded H-bridge topology. In this voltage source converter, we have input of 3.3 kv and requirement is of 11 kV for that we have to connect transformer between each phase. It has capability to transformer power in either direction with voltage source converter the magnitude, the phase angle and the frequency of the output voltage can be control. This model mainly demonstrates a dc-ac converter. The three leg MOSFET operated inverter is constructed. It can be used to demonstrate the relationship of input dc modulation index, filter selection and switching frequency third harmonic injection features. The results are carried out with voltage measurement not the current, it is a voltage source converter. In the proposed system we are using cascaded H- bridge topology for converter and vector control for controlling of converter. In this system the microgrid is connected to the utility with back to back converters.

II. System Block Diagram

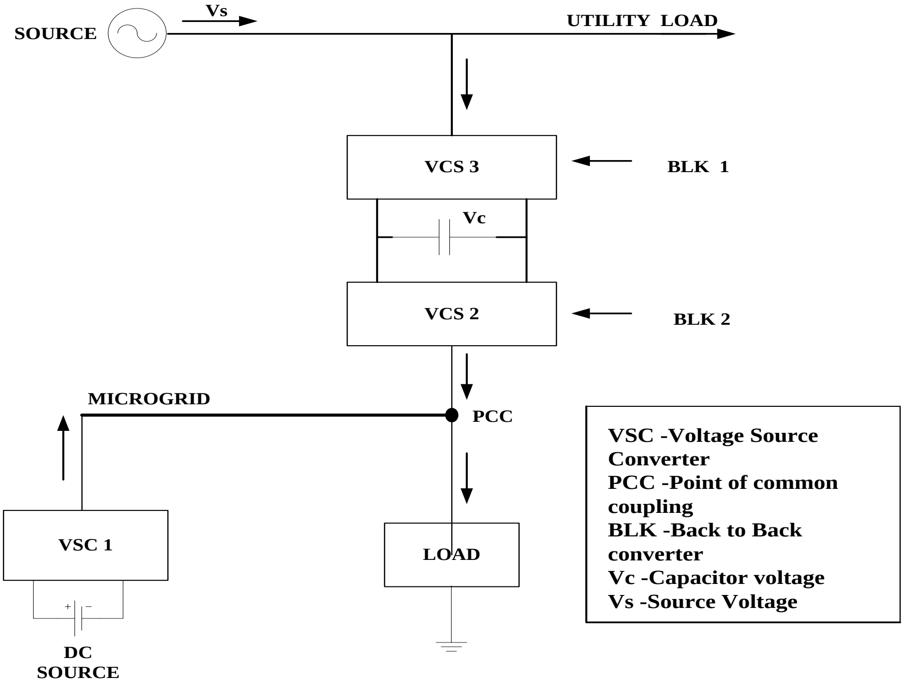

Fig.1 System Block Diagram

III. System & Control Parameters

Table-1

SYSTEM QUANTITES	VALUES
System Frequency	50Hz
Source Voltage (Vs)	11kv rms (L-L)
Feeder Impedance	Rs=3.025 Ω , Ls = 57.75mH
LOAD Impedance (Balance) Or Induction Motor	Rl=100 Ω,LL=300.0Mh Rated 40hp,11 kV rms (L-L)
DGs and VSCs DCvoltage(Vdc1,Vdc2) Transformer rating VSC losses (Rf) Filter capacitance (Cf) Inductance (L1,L2) Inductances (LG) Hysteresis constant (h)	3.3kV 3kV/11kV,0.5 MVA,2.5% reactance (Lf) 1.5 Ω 50 μF 20mH and 16.0 mH 28.86 mH e-5

IV. Simulation Modeling of Proposed System

Voltage Source Converter (VSC)

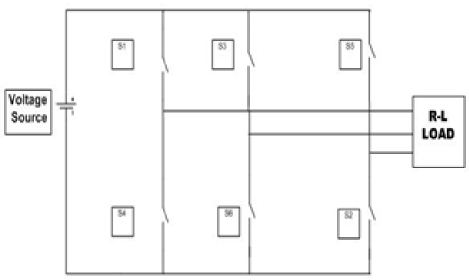

Fig.2 Model of Voltage Source converter

Switching table for voltage source converter

Table-2

0^0	**$60^{\ 0}$**	**120^0**	**180^0**	**240^0**	**300^0**
S1	**S2**	**S3**	**S4**	**S5**	**S6**

VSC with Cascaded H-bridge Topology

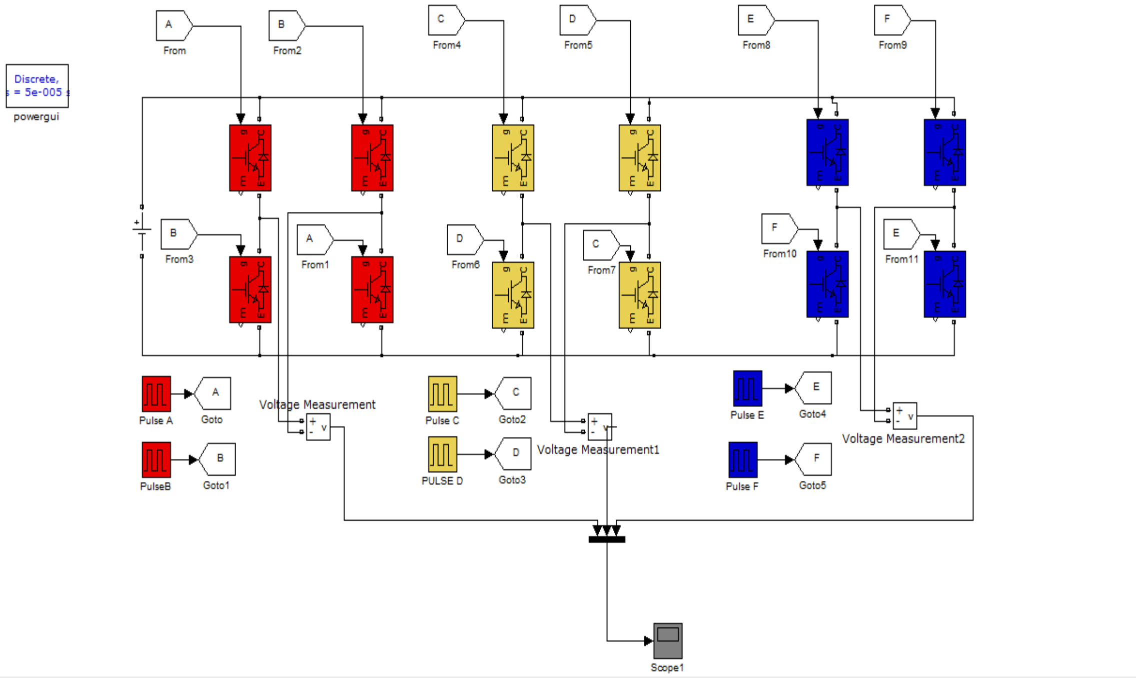

Fig.3 Voltage Source Converter with Cascaded H-Bridge Topology

Switching table for VSC with cascaded h-bridge topology

TABLE-3

0°	60 °	120°	180°	240°	300°
S1 S1'	S2 S2'	S3 S3'	S4 S4'	S5 S5'	S6 S6"

For voltage source converter inverter topology is used here i.e. H-bridge topology. It contains three H-bridge which are connected to three single phase transformer for required isolation and boosting. If each bridge is having single dc voltage source is known as H-bridge topology and more than one H-bridge having a single dc source is known as cascaded H-bridge topology. There is two mode of conduction one is 120 degree and second is 180 degree. In 180 degree mode of conduction every device is in conduction state for 180 degree. Where they are switched on 60 degree interval. If the terminals A,B,C are the output terminals of the bridge then they can be connected to the three phase delta or star connected of the load. In 120 degree mode of conduction each electronic device is in conduction state of 120 degree.

It is most suitable for delta connection in a load because it results in a six step type of waveform across any of its phase. Therefore, at any instant only two devices are connected because each device conducts at only 120 degree. A three phase voltage converter consists of six valve (S1-S1') to (S6-S6'). The designated type order (S1-S6) represents the sequence of valves operation in a time. It consist of three phase legs which operate in a 120 degree apart. The three phase legs that phase shift of 120 degree apart that means phase legs (S3-S6) switches 120 degree after leg (S1-S4) and phase leg (S1-S2) switches 120 after (S3-S5). Each valve alternately closes for 180 degree. More pulses means more switching losses so that gains from the use of PWM have to be sufficient to justify an increase in switching losses.

Device turn-on and turn-off according to crossing point of saw tooth of triangular waveform with sine wave. The negative slope of saw tooth wave across sine wave result in turn-on pulse for device. Similarly, positive slope of triangular wave crossing the sine wave result in turn-off of device. The output voltage waveform of PWM contains fundamental frequency component and harmonic. In this the pulses are wider at middle of sine wave as compared to the end of the half of sine wave. Saw tooth frequency is an odd integer multiple of main frequency so output voltage pulses are symmetrical about zero crossing of sine wave. Here we have simulated VSC (voltage source converter) using pulse generator. But with pulse generator we cannot make system closed loop so we are using PWM (Pulse width modulation). PWM is used to control the power that is supplied to various types of electrical devices, most especially to inertial loads such as ac/dc motors. It is also used to controlling the amplitude of digital signals in order to control devices and applications requiring power or electricity. Basically PWM t//multiple frequency.

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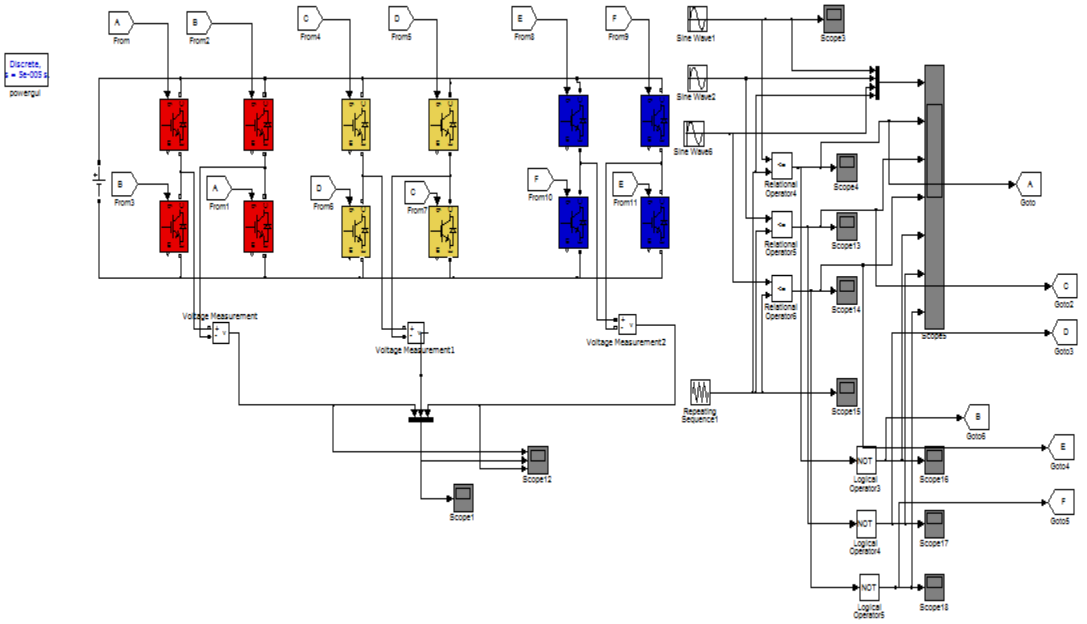
V. Simulation Modeling of Proposed System with Pulse Width Modulation



Advantages of Pulse Width Modulation.

1.Output voltage control is obtained without any additional components or stages.

2.Along with voltage control lower order harmonics can be eliminated or minimized.

3.Higher order harmonics can be filtered, thus filtering requirement are minimized.

4.Power loss in switching device is very low.

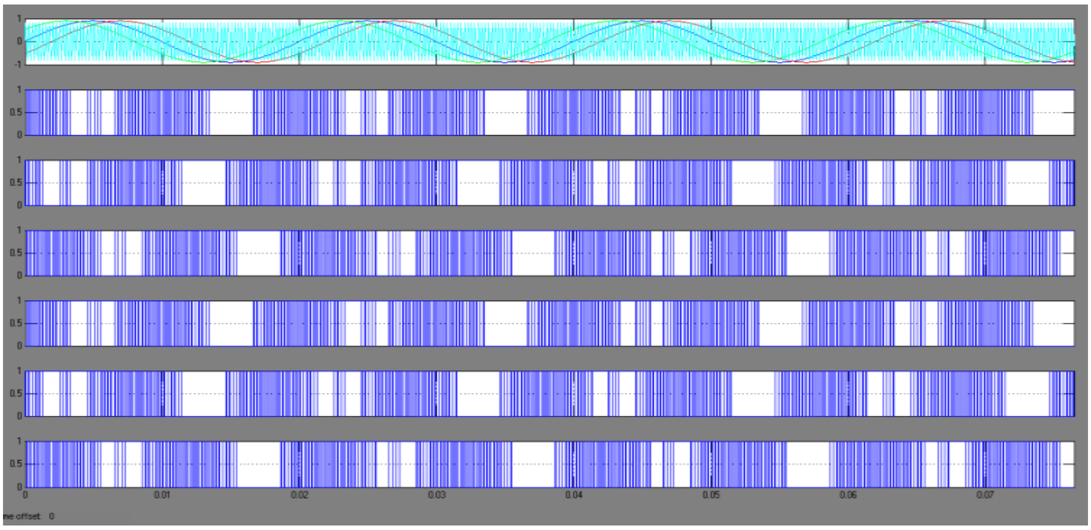


Fig.6 Output of VSC Using Pulse Width Modulation

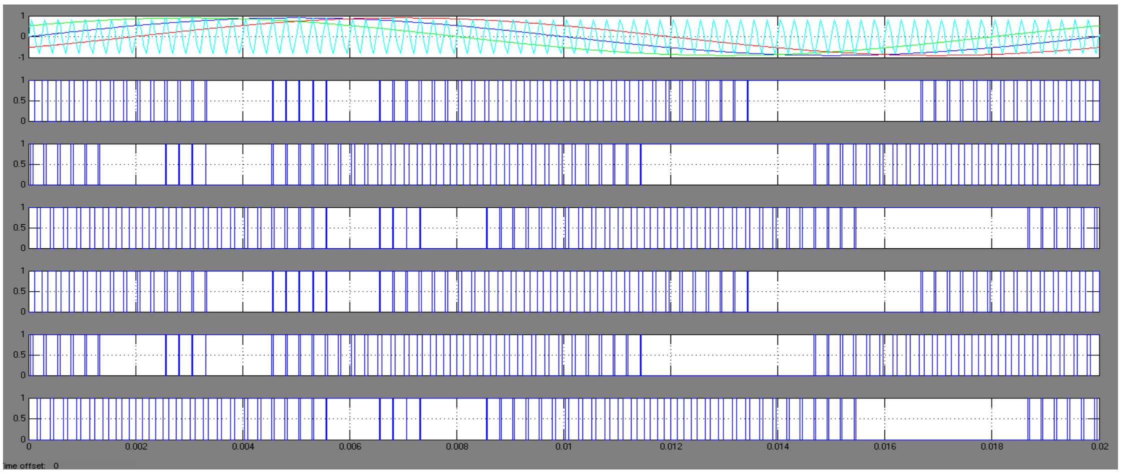


Fig.7 Output of VSC Using Pulse Width Modulation

VI. Conclusion

In this paper, load sharing between microgrid and utility and frequency isolation is proposed for utility connected microgrid. The distributed system is connected through back to back converters to the microgrid. In mode-1, power flow between utility and microgrid can be controlled by capacitor connected between two voltage source converters. The utility and microgrid are isolated by using pulse width modulation technique and filters so that there is no fluctuation in voltage or frequency hence, it do not affect the microgrid loads. Thus requirement of 11 kv with 3.3 kv input is fulfilled in this system.

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