Simulation of Sinusoidal Pulse Width Modulation Controlled Voltage Source Converter

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Abstract

Voltage source converter based power systems have the ability to rapidly control the transmitted active power and also to independently exchange reactive power with transmission system. Thus, VSC with suitable control scheme can offer an alternative means to enhance transient stability, to improve power oscillation damping, and to provide voltage support. The proposed voltage sourced converter (VSC) with pulse width modulation (PWM) provides a faster control that is required in power system. VSCs are one of the most used power converters in distributed generator application as such it can operate either as inverter or as rectifier. The study of VSC and related principles as well as PWM method for controlling the power switches is carried out. MOSFET/IGBT can be invariably used as switches. The simulation of VSC is carried out in MATLAB/SIMULINK and PROTEUS. The results of which shows improvement in performance of transmission lines.

Keywords: Sensor, Power Electronics Devices, PWM, Voltage Source Converter (VSC), MOSFET, Reactive Power Compensation

I. INTRODUCTION

Power generation and transmission is a complex process, which does involve working of many devices to work in co-ordination for maximum power generation and transmission. It includes no. of power electronics devices, In fact a large part of it are power electronic devices. It is essential that the reactive power is maintained as per the requirement. Different inductive loads like motors , fans consume reactive power. To improve the performance of power system we need to manage this reactive power in effective way by using different power electronic devices. This is known as reactive power compensation. There are two aspects to the problem of reactive power compensation: load compensation and voltage support. Load compensation consists of improvement in power factor, balancing of real power drawn from supply, better voltage regulation etc. of large fluctuating loads. Voltage support consists of reduction of voltage fluctuation at a given terminal of transmission line. Two types of compensation can be used: series and shunt compensation. These modify the parameters of system to give enhanced VAR compensation. In , recent years voltage source converter and current source converter have been developed. These devices satisfactorily do the job of absorbing or generating reactive power with faster time response. This allows an increase in transfer of apparent power through transmission line and much better stability by adjustment of parameters that govern the power system i.e. current , voltage , phase angle , impedance and frequency.

II. SIMULATION OF VOLTAGE SOURCE CONVERTER

In the figure is shown the simulation of three phase voltage source converter with SPWM. Different blocks used are explained below the simulation. The simulation is done in MATLAB2011a/Simulink.

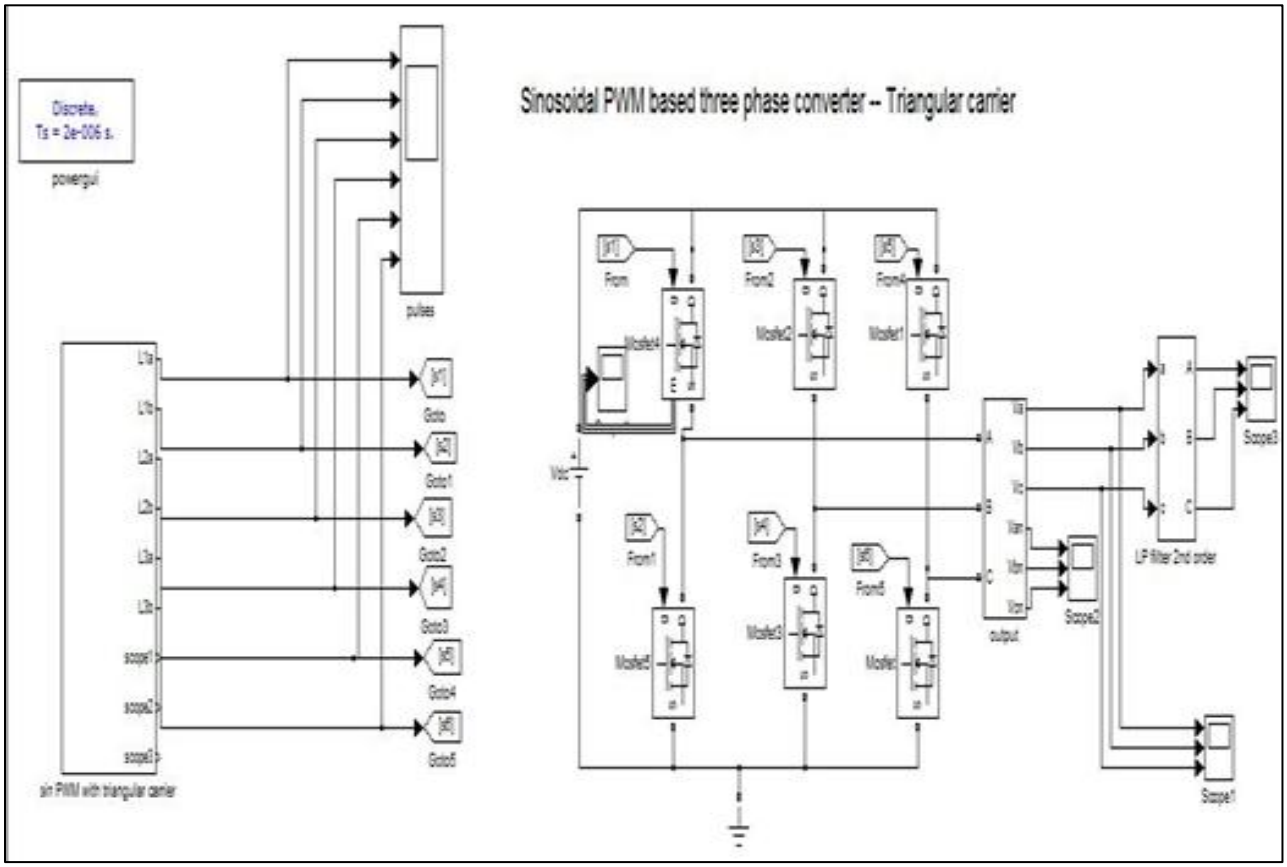

Fig. 1: Voltage source converter with SPWM

A. PWM with Triangular Carrier:

This block implements sinusoidal pulse width modulation using comparison technique, where it is compared with triangular wave of higher frequency. The different blocks are zero order hold, repeating sequence, sine wave generator, not logical operator and data conversion element. Each one of them is explained briefly here.

1) Repeating sequence: the repeating sequence block outputs a periodic scalar signal having a waveform that user specifies using the time values and output value parameter.
2) Zero-order hold: the Zero-Order Hold block holds its input for the sample period specified.
3) The block accepts one input and generates one output.
4) Not logical operator: The logical operator block outputs TRUE if input is false and vice versa.
5) Data type conversion element: the Data Type Conversation block an input signal of any SIMULINK data type to the data type you specify for the output data parameter.

B. MOSFET:

The metal-oxide semiconductor field-effect transistor(MOSFET) is a semiconductor device controllable by the gate signal(g>0). The MOSFET device is connected in parallel with an internal diode that turns on when the MOSFET device is reversed biased(VDS<0) and no gate signal is applied(g=0). The model is simulated by an ideal switch controlled by a logical signal(g>0 or g=0), with a diode connected in parallel. The MOSFET device turns on when a positive signal is applied at the gate input(g>0) whether the drain-source voltage is positive or negative.

C. SCOPE:

The scope block displays its input with respect to simulation time. The scope block can have multiple axes and all axes have a common time range with independent y-axes. The scope block allows adjusting the amount of time and the range of input values displayed. User can move and resize the scope window and user can modify the scope's parameter value during the simulation.

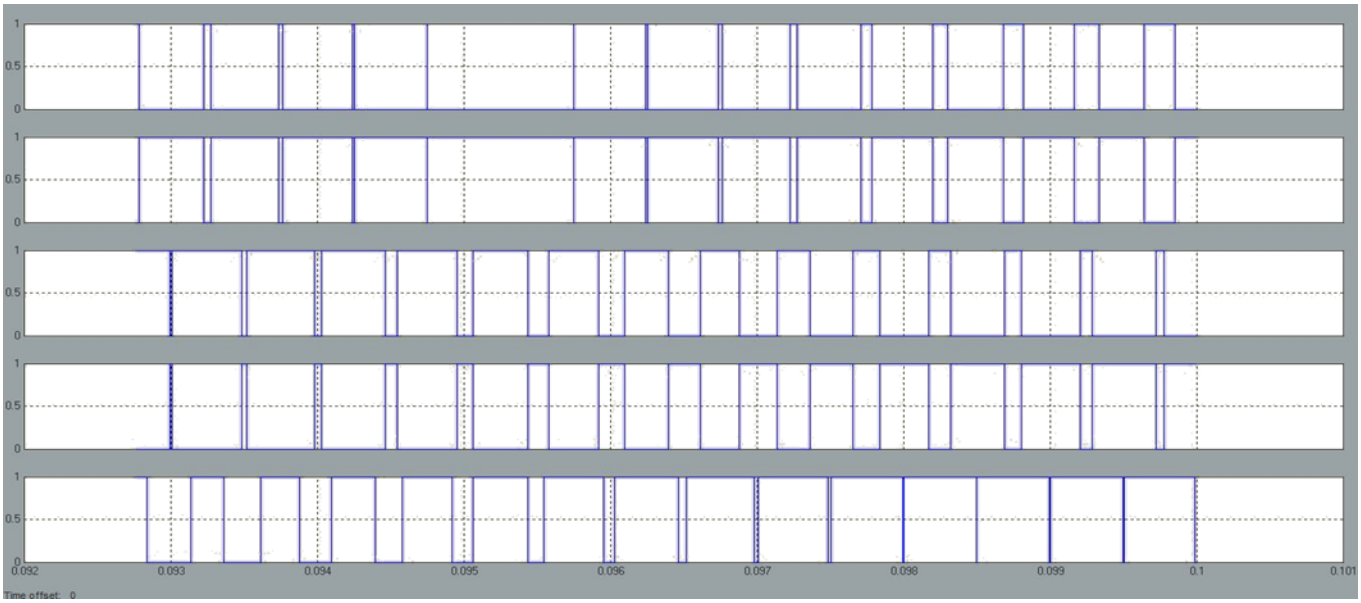

Fig. 2: Gate pulse from SPWM block

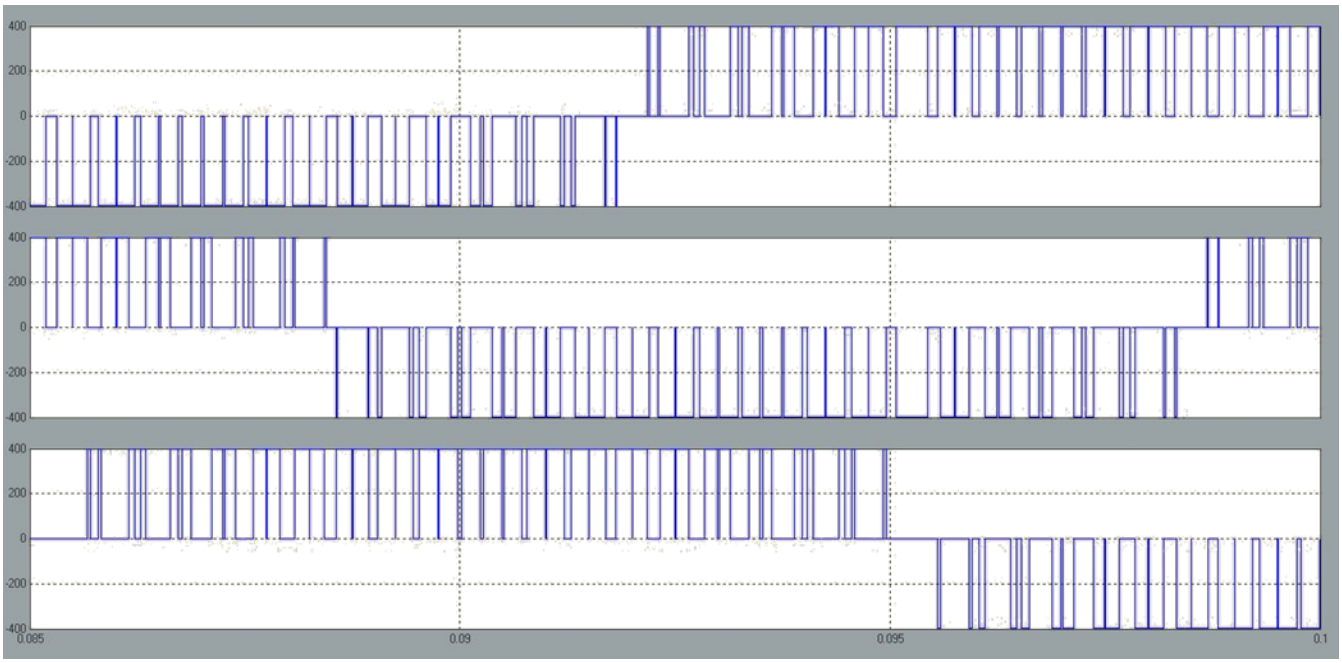

Fig. 3: Output from converter

III. APPLICATION OF VSC FOR COMPENSATION

In the Fig.6 is shown the VSC connected to the source and a load for compensation purpose the control strategy used here is SPWM itself. SPWM block:It contains MOSFET bridge, repeating sequence block, relational operator block, logical operator block. The whole SPWM sub-system is shown in fig.7.

1) Relational operator block: Two input- modes by default the relational operator blocks compares two inputs using the relational operator parameter that you specify. The first input corresponds to the top input port and the second input corresponds to the bottom input port.

A. Three Phase Programmable Voltage Source:

One can use this block to generate three phase sinusoidal voltage with time-varying parameters.

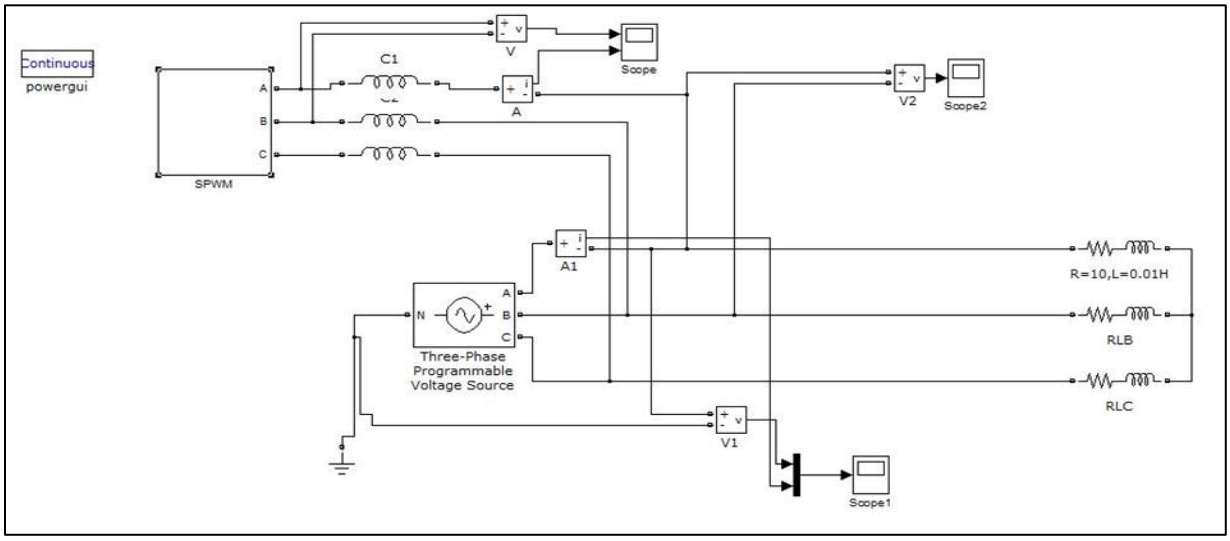

Fig. 4: VSC connected to load and source

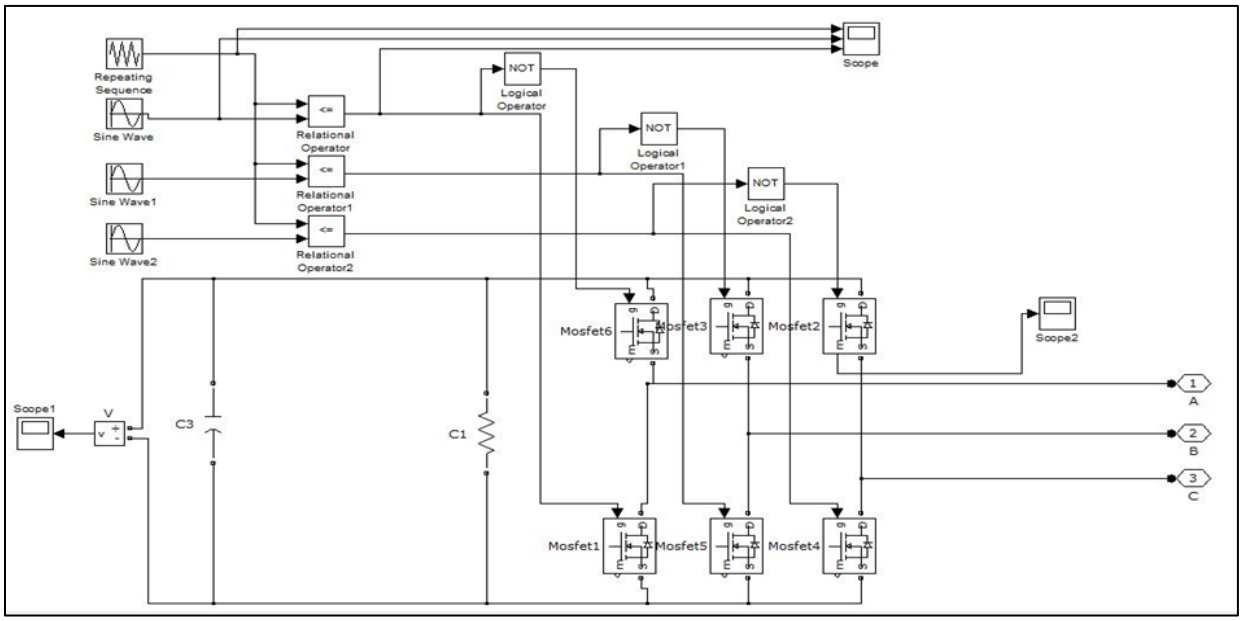

Fig. 5: SPWM subsystem

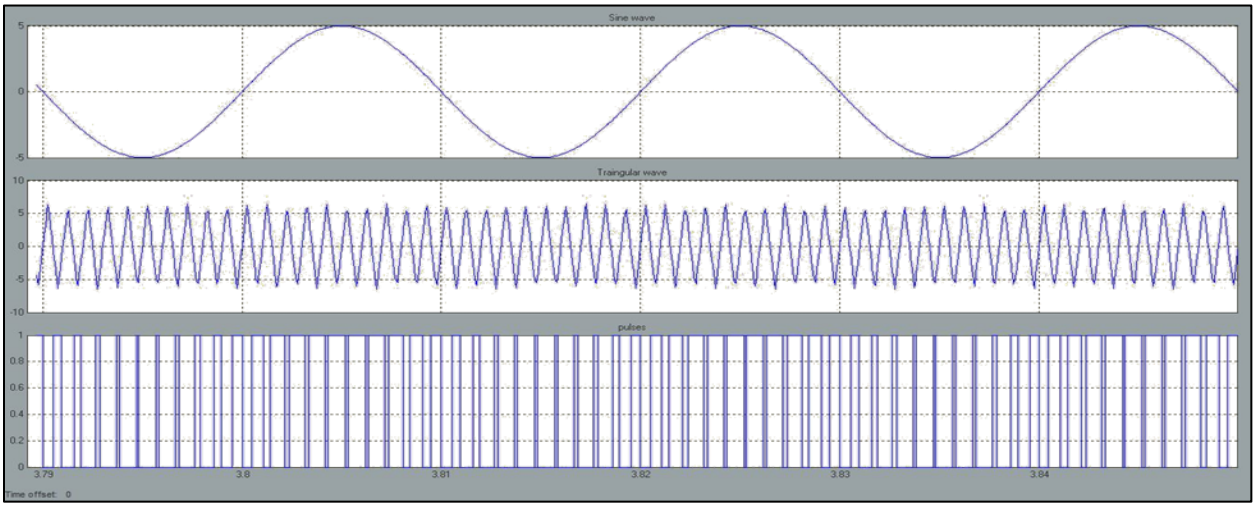

Fig. 6: input sine, triangular wave with comparison pulses

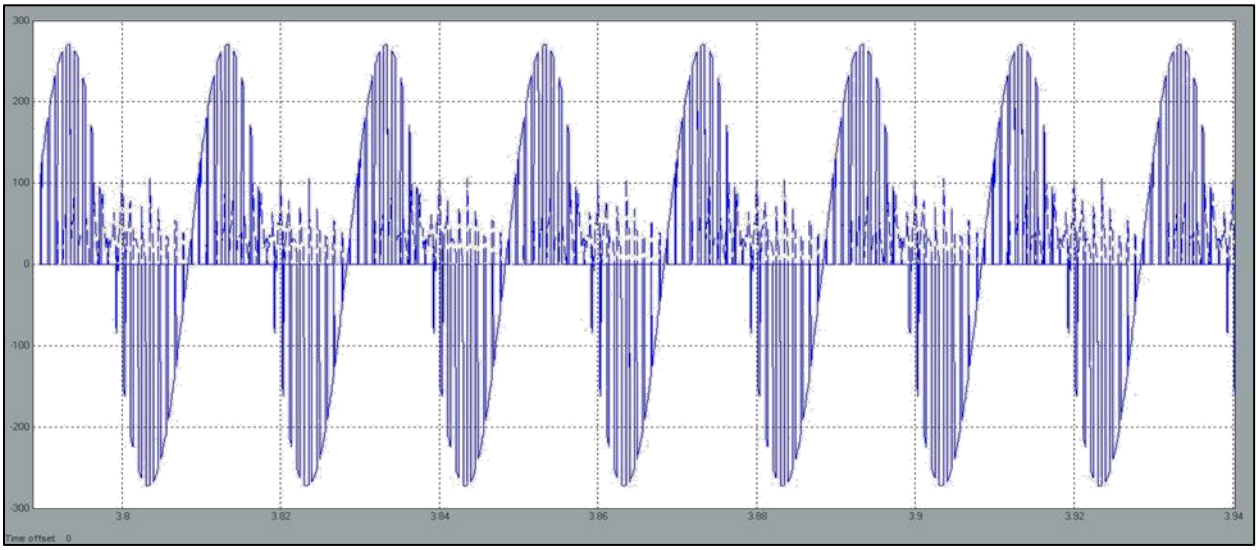

Fig. 7: MOSFET waveform from measuring port

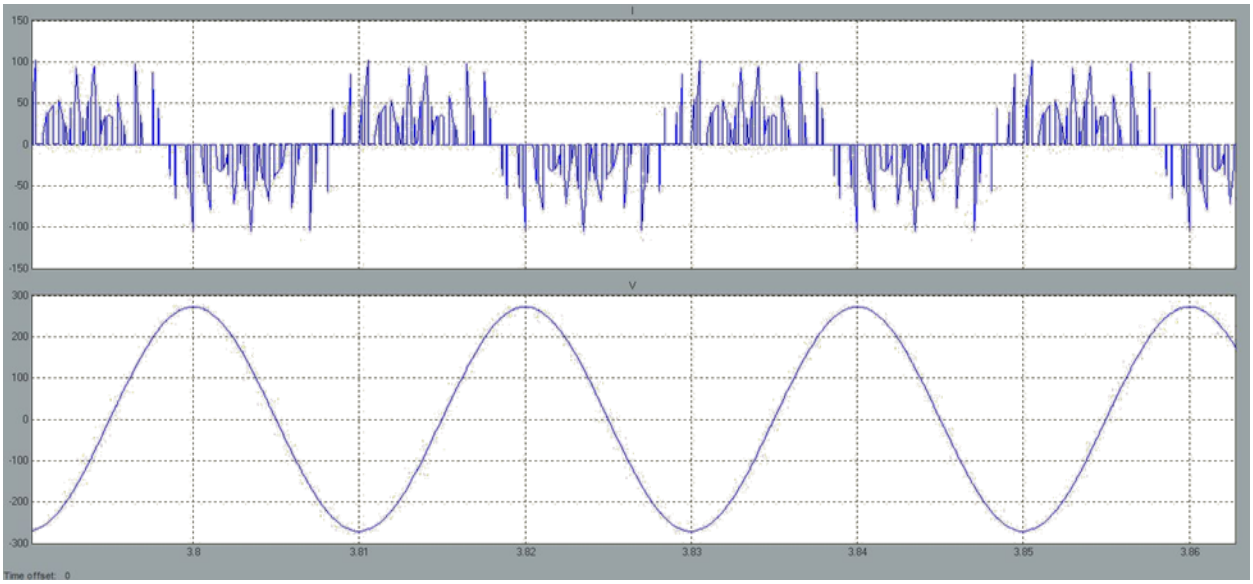

Fig. 8: waveforms from VSC

IV. CONCLUSION

In power system active power must be supported by reactive power. There is a large variation of reactive power due to loads like induction motor etc. which results in power system unbalance. "REACTIVE POWER COMPENSATOR WITH PWM CONTROLLED VSC" balances the reactive power of system with higher efficiency and increases the power transfer capability of system. And it also helps mitigate the harmonics.

REFERENCES

[1] Active and reactive power control of a VSC-HVdc
[2] H.F. Latorre, , M. Ghandhari , L. Söder Elseveir Journel
[3] "Power Electronic control in power systems" E.acha, V.G. Adelidis, T.G.D. Miller
[4] Prachi S. Dharmadhikari and Gaurav N. Goyal "Analysis & Hardware Implementation of Three-Phase Voltage Source Inverter"
[5] "Modified SPWM Control Schemes for Three-phase Inverters"
[6] Sumi Yoshihiko, Harumoto Yoshinobu, Hasegawa T, et al, "New Static Var Control Using Force-Commutated Inverters", IEEE Trans. on Power Apparatus and Systems, 1981, PAS-100(9); 4216-4224
[7] "POWER ELECTRONICS FOR DISTRIBUTED ENERGY SYSTEMS AND TRANSMISSION AND DISTRIBUTION APPLICATIONS" L. M. Tolbert, T. J. King, B. Ozpineci, J. B. Campbell, G. Muralidharan
[8] IJETAE An Extensive Review on Reactive Power Compensation using STATCOM & SVC Khaliq Ahmed1 , Prof. C Veeresh2
[9] IJETAE Implementation of Linear Controller of a STATCOM Design in DC Link Voltage Dayananda. B. R 1 , Velappagari Sekhar2 , Dr. Ramesh Babu. N 3