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MULTILEVEL INVERTER BASED POWER QUALITY IMPROVEMENT FOR STATCOM

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ABSTRACT

The proposed work deals with comparison of grid connected STATCOM based multilevel inverter. The conventional method using five level inverter based grid connected statcom generating more harmonics. And the proposed system using nine level inverter generating low harmonics due to using of PWM based pulse modulation technique. The AC output voltage is obtained by the series cascading of the output voltage of the two inverters. The voltage across the load decreases due to the addition of extra load and the load voltage are restored back to normal value by using grid connected statcom. The ability of open loop system to bring the voltage and reactive power back to the set value is represented in this paper. The simulation studies for open loop systems are performed on a standard bus system.

Keywords: multilevel inverter, STATCOM, pulse width modulation.

1. INTRODUCTION

Power Quality is a major issue in electric utilities and distribution end. Unbalanced voltages and currents are one of the concerns under the power quality issue. These problems can be eradicated by Selective harmonic Elimination based optical pulse width modulation which is frequently used in two level and multilevel inverters to minimize the switching frequency and total harmonic distortion. This Unbalance can cause extra losses in generators, motors, transformers and transmission lines. To compensate the unbalance voltage and currents FACTS devices can be employed in transmission systems.

The Static Compensator (STATCOM) recently presented in. It is a powerful device in the FACTS family, which provides very lower cost and comparable high reliability. It is derived from the STATCOM and has the same capability of simultaneous adjustment of all the parameters in the power system such as line impedance, transmission angle, and bus voltage magnitude. Within the STATCOM, the common DC link between the shunt converters is presented, which provides flexibility for independent placement of shunt converters. The STATCOM uses the transmission line to exchange reactive power within converters at odd harmonic frequency. Instead of one large single-phase converter. This concept reduces the rating of the components and providing a higher reliability because of the redundancy. MLI based STATCOM plays major contribution in power systems for improvement for power quality.

2. CONVENTIONAL FIVE LEVEL STATCOM SYSTEM

The Open loop conventional STATCOM system is shown in Figure-1 inverters inject the voltage in shunt with the line as shown in Figure-1. The simulation results of various testing parameter are given in subsequent figure with detailed descriptions.

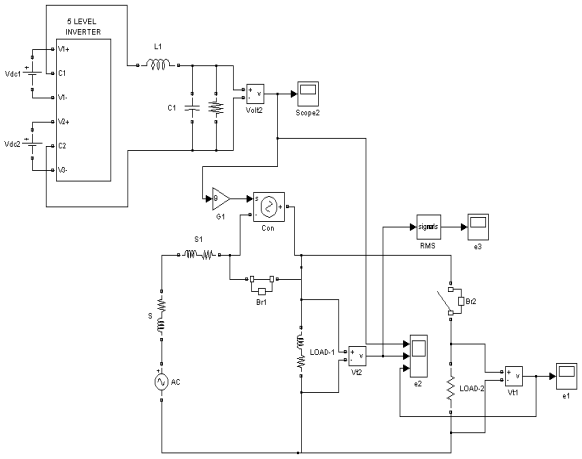

Figure-1. Open loop five level STATCOM system.

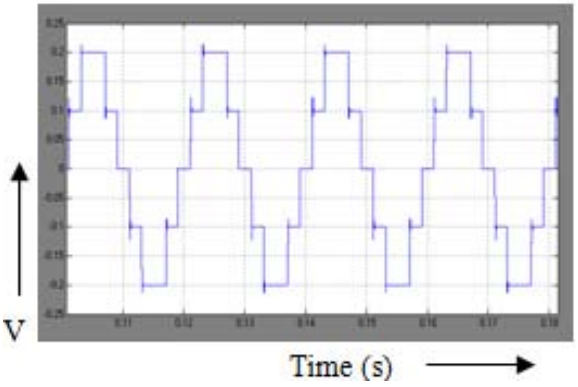

Figure-2. Output voltage of five level.

Five level output voltage can be shown in Figure-2.

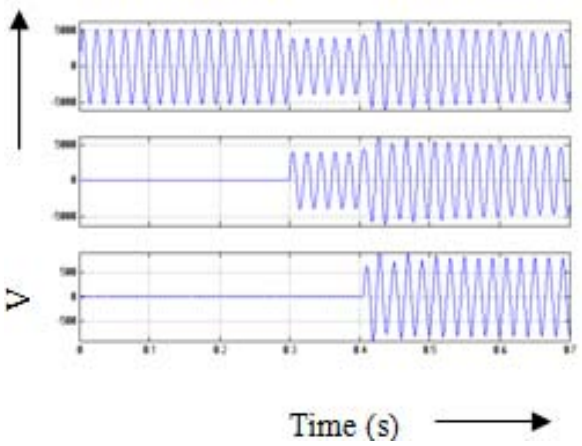

Figure-3. Voltage at the receiving end.

At t = 0.3 sec, the second load is connected. The voltage decreases from 350 V to 1000V after statcom on 0.4sec voltage can be compensated. The reactive power also increases as shown in Figure-4.

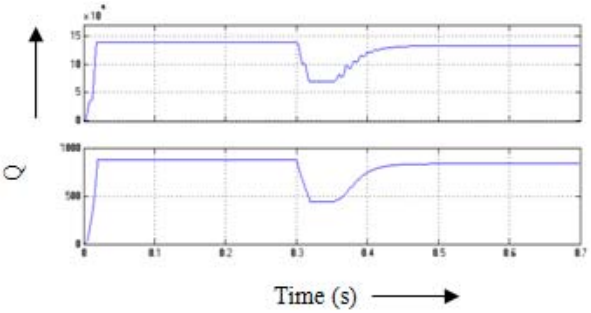

Figure-4. Real and reactive power.

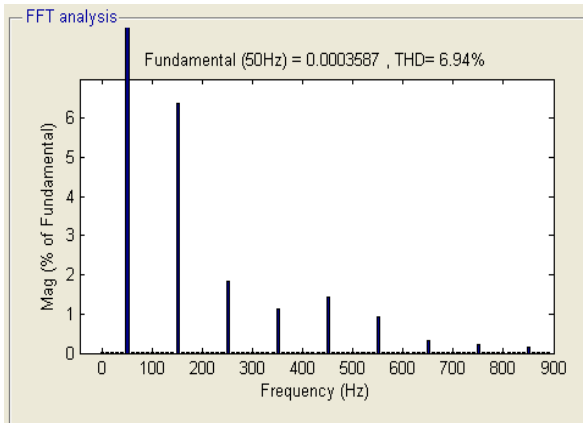

Figure-5. THD.

3. PROPOSED NINE LEVELS STATCOM SYSTEM AND RESULTS

Open loop nine level inverter is shown in Figure-9. The circuit MLI based grid connected system used to compensate voltage sag.

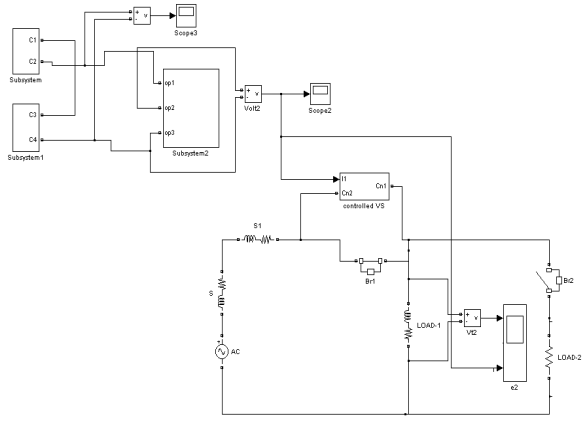

Figure-6. Open loop nine level STATCOM system.

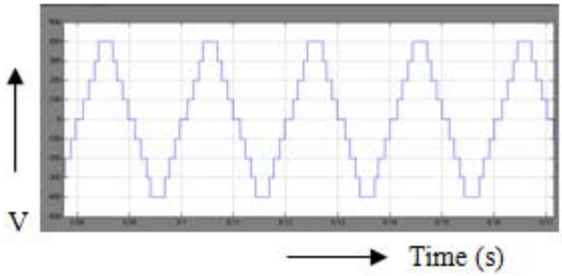

Figure-7. Output voltage of nine level inverter.

Nine level output voltage of multilevel inverter can be shown in below Figure-3, the voltage at the receiving end wave for shown in the Figure-10.

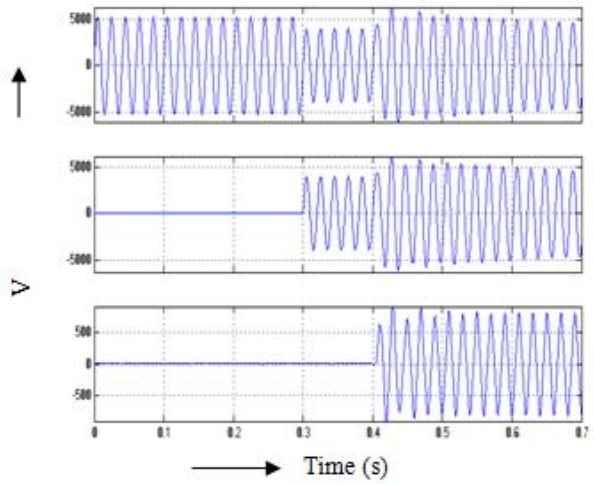

Figure-8. Voltage at the receiving end.

At t = 0.3 sec, the second load is connected. The voltage decreases from 450 V to 1000V after statcom on 0.4sec voltage can be compensated. The reactive power also increases as shown in Figure-9.

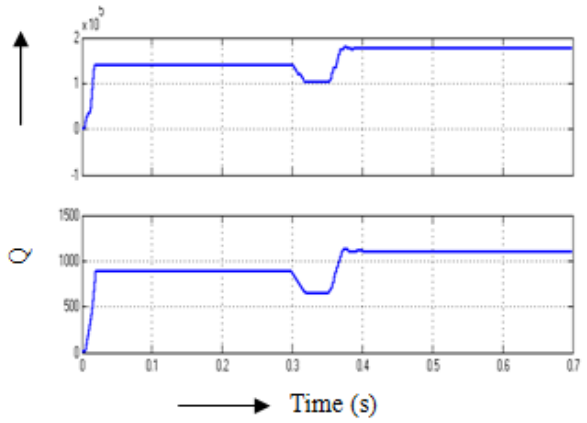

Figure-9. Real and reactive power.

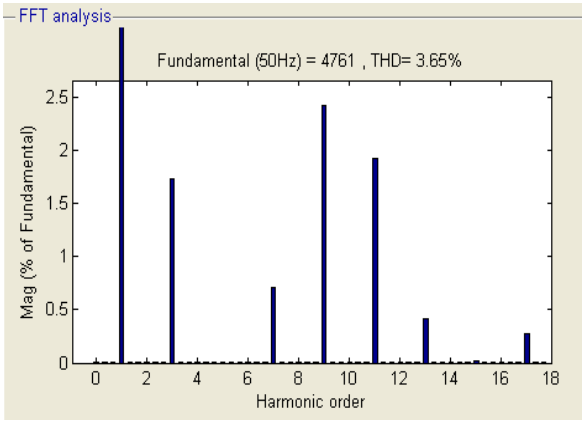

Figure-10. THD.

The comparison of various parameters with Conventional five level systems and proposed nine level systems are tabulated below:

Table-1. Comparison of existing and proposed method.

Description	Existing Five level Inverter	Proposed Nine level inverter
Real Power Mw	0.0014	0.215
Reactive Power Mvar	.0067	0.15
THD %	6.94	3.65

CONCLUSIONS

STATCOM based grid connected MLI systems controlled by open loop PWM controllers are designed, modeled and simulated using Matlab Simulink. The simulation results of open loop systems are presented. The proposed system is successfully employed to maintain constant reactive power. The response of PWM controlled system is found to be superior to the open loop system. And harmonics 6.94% of five level systems the proposed system to reduce the harmonics of 3.65%.it can be voltage sag also compensated. The advantages of STATCOM are improved voltage and reactive power profiles.

The scope of the work is modeling and simulation of reactive power controlled two bus systems using open loop PWM controllers. The studies will be extended with closed loop to improve the dynamic response

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