e-ISSN: 2348-6848
p-ISSN: 2348-795X
Volume 05 Issue 12
April 2018

A Multilevel Voltage-Source Inverter With Separate Dc Sources For Static Var Generation

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ABSTRACT

The STATCOM is shunt connected devices of Flexible AC Transmission Systems (FACTS) family using the principles of power electronics. A new multilevel voltage-source inverter with separate dc sources is proposed for high-voltage, high-power applications. This paper discuss about implementation of VSC by using cascade H-bridge for reactive power compensation of transmission line. Conventional control and Fuzzy control schemes are implemented in order to achieve the complete close-loop operations achieve effective reactive power control. These control schemes are simulated for the real-time control along with real-time modeling and simulations. Relative Harmonic analysis is discussed.

INTRODUCTION

The voltage source converter (VSC) is the integral part of SATCOM FACTS device, which supply or absorb the reactive power in the transmission line to control of voltage(primary objective) of bus to which it is connected.VSC inject current into the system at the point where they are connected. They can be used as a good way to control the voltage in and around the point of connection by injecting current into the system. The importance of this device is increasing with time for various power system control applications. The basic principle of VSC STATCOM is well documented in the literature .The reactive power exchange between STATCOM and the AC system can be control by varying the magnitude and phase of VSC.

The successful functioning of VSC depends up on the generation of near sinusoidal voltage at output terminals. However, due to switching of IGBTs/ MOSFETs or GTO'S from converter circuit, harmonics are generated at the output of VSC, thus minimization of these harmonics to the acceptable level is one of the aspect of VSC control. To achieve this objective a general circuit structure of multilevel inverter has been reported. Typical 48-pulse inverter for static VAR generation consists of eight 6-pulse inverters connected together through eight zigzag arrangement transformers using the harmonic cancellation technique connected through Wye/Delta and Delta/Delta; in order to reduce harmonic distortion and to reach high voltage.

These transformers or harmonic neutralizing technique has following drawbacks,

a) They are most expensive equipment in the system;

b) Produce about 50% of the total losses of the system;

c) Occupy up to 40% of the total system's real estate, which is an excessively large area.

d) DC magnetizing and surge overvoltage problems resulting from saturation of the transformers. The multilevel inverter has many advantages such as better utilization of the switching devices. A diode-clamped multilevel VSC and a flying-capacitor multilevel VSC have been proposed for VAR generator applications [8]. This inverter can reach high performance without transformers, however, require additional clamping diodes, these clamping diodes not only raise costs but also cause packaging problems, dc voltage unbalance problem and exhibit parasitic inductances, thus the number of levels for a multilevel diode-clamped inverter may be limited to seven or nine in practical use.

The multilevel flying –capacitor inverter is supposed to be able to solve the voltage unbalance problem and excessive diode count in multilevel diode clamped inverters. In this inverter, however, a large number of flying capacitors are needed. In addition, control is very complicated, and higher switching frequency is required to balance each capacitor voltage. Multilevel H Bridge can solve all the above-mentioned problems of the conventional multi-pulse and multilevel inverters. This multi level inverter eliminates the excessively large number of 1) bulky transformers required by conventional multi-pulse inverters, 2) clamping diodes required by multilevel diode clamped inverters, and 3) flying capacitors required by multilevel flying-capacitor inverters. In Case of H-bridge cascade VSC can operate at lower switching frequency. Therefore, the cascade H-Bridge VCS is suitable for an application to the high power/high voltage SVC system. For high power transmission system application, the switching frequency of the semiconductor switches is limited to below 500 Hz. Hence multi-step cascade

H-Bridge configurations of STATCOM have been chosen for experiment and testing.

It has the following features;

1) It is much more suitable to high-voltage, high-power applications than the conventional inverters.

2) It switches each device only once per line cycle and generates a multistep staircase voltage waveform approaching a pure sinusoidal.

3) Since the inverter structure itself consists of a cascade connection of many single-phase, full-bridge inverter (FBI) units and each bridge is fed with a separate dc source, it does not require voltage balance (sharing) circuits or voltage matching of the switching devices.

4) Output switching frequency is nc times of individual unit, so it can operate at lower carrier frequency, hence less switching losses. As reported high power applications uses 48 module with 150 Hz carrier frequency to synthesis a 50 Hz sinusoid , despite of low pulse number (mf =3) used ,the first un-cancelled carrier appear at 48*150= 7200 Hz.

5) Packaging/layout is much easier because of the simplicity of structure and lower component count.

EXISITING SYSTEM

A new multilevel voltage-source inverter with separate DC sources is proposed for high-voltage, high power applications, such as flexible AC transmission systems (FACTS) including static VAr generation (SVG), power line conditioning, series compensation, phase shifting, voltage balancing, fuel cell and photovoltaic utility systems interfacing, etc. The new M-level inverter consists of (M-1)/2 single phase full bridges in which each bridge has its own separate DC source. This inverter can generate almost sinusoidal waveform voltage with only one time switching per cycle as the number of levels increases. It can solve the problems of conventional transformer-based multipulse inverters and the problems of the multilevel diode-clamped inverter and the multilevel living capacitor inverter. To demonstrate the superiority of the new inverter, a SVG system using the new inverter topology is discussed through analysis, simulation and experiment.

PROPOSED SYSTEM

A new binary multi-level voltage-source inverter (BMVSI) with separate dc sources for high voltage, high power applications is introduced, which can be used for the dynamic compensation and real time control of power flow in transmission and distribution systems. The new M-level inverter, where M is 2n+1 - 1, consists of only n single-phase full bridges for each phase, in which each bridge has its own separate dc source. This inverter can generate almost sinusoidal voltage waveform.

CONCLUSION

A new BMVSI with capabilities of modularization and soft-switching which can exchange both reactive and real power with the ac system is introduced. Fast active and reactive power control of this new inverter provides an extremely effective tool for transient and dynamic stability improvement of the power system.

Using very few components, the proposed modular BMVSI not only solves the harmonics and EM1 problems, but also avoids possible high frequency switching which induce motor failures.

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