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Power Grid Failure Dection

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ABSTRACT: This paper presents a multi objective control of neutral-point-clamped voltage source inverter for distributed generation based on renewable energy to the distribution grid. NPC VSI are to reduce voltage ratings for the switches, good harmonic spectrum, and good dynamic response. The proposed control technique compensate active and reactive power, and it's also achieved a reduced total harmonic distortion, increased power factor, inject maximum power of renewable energy by using multilevel converter as an interface to the AC grid.

KEYWORDS: Distributed generation, Multilevel Inverter, Rrenewable Energy, Hysteresis Modulation.

I. INTRODUCTION

Distributed generation systems based on renewable energy resources play an important role in electric power systems. And providing different benefits like cost reduction, reliability of main grid, emission reduction. Application of renewable energy resources such as wind turbines, photovoltaic, and fuel-cell in a power system may cause major changes in the design and operation of distribution networks. Several methods and strategies have been proposed to integrate renewable energy resources to the distribution grids, which consider different objectives, including technical aspects such as voltage profile and voltage stability improvements ,economical aspects such as network investment deferral active loss reduction ,and environmental aspects such as emission reduction.

All the proposed control techniques focused on compensating an important part of power system, but the proposed control strategy in this paper has this capability to do as a multi objective control technique for integration of renewable energy resources to the AC grid simultaneously. Application of power electronic devices introduces new alternatives for custom power devices in order to achieve flexible distribution networks. In some controllers based on park transformation are designed, and DC-link unbalance problems for different loading conditions of three-level VSI have been compensated by means of the switching strategy. In a static var compensator using three-level gate turn-off thyristor VSI has been presented for high-voltage, high-power applications. In this proposed model, a controller is designed using the small-signal model. The proposed model lacks a global description of the DC-link side and the AC-side dynamics.

The main objective of integration of renewable energy to the AC grid is to provide active power, nonetheless, by means of power electronic devices, reactive power can be compensated and DG systems can also be used like active power filters. These can be achieved by organizing an appropriate control method for power electronic interface circuits. A three level NPC VSI has been proposed for the interfacing between renewable energy resources and distribution grid in this paper. The main advantages of NPC VSI are to reduce voltage ratings for the switches, good harmonic spectrum (making possible the use of smaller and less expensive filters), and good dynamic response. However, control complexity increases compared to conventional VSI.

The proposed control technique can:
1) Inject maximum available power of NPC VSI to the AC grid;
2) Provide load active power;
3) Compensate load reactive power and track rapid variations in load reactive power;
4) Supply load harmonic currents and reduce THD of AC grid;
5) Increase power factor of system.

This paper presents three level neutral point diode clamped inverter was used. And modulation technique is hysteresis current control.

II.THREE LEVEL NEUTRAL POINT DIODE CLAMPED INVERTER

A. General description

The neutral point converter proposed by Nabae, Takahashi, and Akagi in 1981 was essentially a three-level diode-clamped inverter [16].A three-phase three-level diode-clamped inverter is shown in Fig. 1.These three inverter phases share a common DC bus, subdivided by two capacitors into three levels. The voltage across each capacitor is VDC/2; and the voltage stress across each switching device is limited to VDC/2 through the clamping diodes. The most commonly used multilevel topology is the diode clamped inverter, in which the diode is used as the clamping device to clamp the dc bus voltage so as to achieve steps in the output voltage. A three-level diode clamped inverter consists of two pairs of switches and two diodes. Each switch pairs works in complimentary mode and the diodes used to provide access to mid-point voltage. In a three-level inverter each of the three phases of the inverter shares a common dc bus, which has been subdivided by two capacitors into three levels. The DC bus voltage is split into three voltage levels by using two series connections of DC capacitors,C1 and C2. The voltage stress across each switching device is limited to Vdc through the clamping diodes Sa1 and Sa2. In general for an N level diode clamped inverter, for each leg 2(N-1) switching devices, (N-1) * (N-2) clamping diodes and (N-1) dc link capacitors are required. By increasing the number of voltage levels the quality of the output voltage is improved and the voltage waveform becomes closer to sinusoidal waveform. However, capacitor voltage balancing will be the critical issue in high level inverters. When N is sufficiently high, the number of diodes and the number of switching devices will increase and make the system impracticable to implement. If the inverter runs under pulse width modulation (PWM), the diode reverse recovery of these clamping diodes becomes the major design challenge. Though the structure is more complicated than the two-level inverter, the operation is straightforward.

Three-level diode-clamped converter in which the dc bus consists of two capacitors, C1, C2. For dc-bus voltage Vdc, the voltage across each capacitor is Vdc/2 and each device voltage stress will be limited to one capacitor voltage level Vdc/2 through clamping diodes. the neutral point n is considered as the output phase voltage reference point. And the assumption points are Voltage level Van= Vdc/2, turn on the switches S1andS2,Voltage level Van= 0, turn on the switches S2 and S1′, Voltage level Van= - Vdc/2 turn on the switches Sa1′,Sa2′.

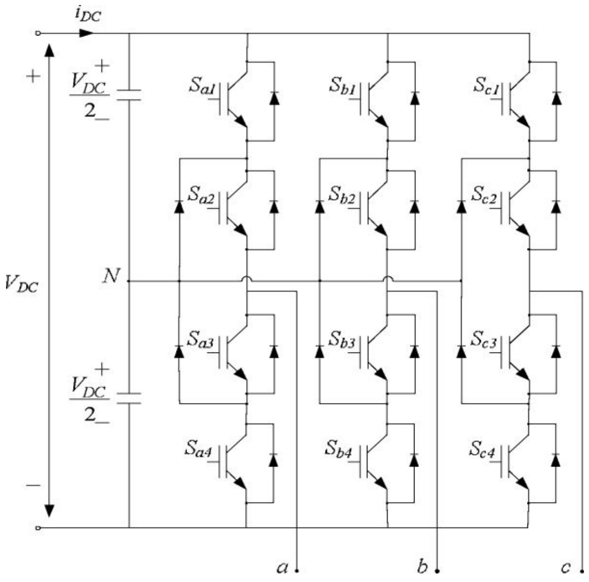


Fig 1. Circuit diagram of proposed NPC inverter

B. Control Technique

The MB hysteresis modulation scheme for the multilevel converters uses symmetrical hysteresis bands to control the switching so that the inner band causes switching between adjacent levels, while the outer band causes an additional switching level change whenever necessary. The process, first proposed and later used is shown in Fig. 2 in the form of current regulation. Whenever the current error crosses the inner boundary B, the inverter output is decreased or increased by one level (depending on which hysteresis boundary has just been crossed).Generally, this voltage change will cause the current error to reverse its direction without reaching the next outer band. However, if the error does not reverse, it will continue through the boundary of B to the next outer boundary (placed at ΔB out of B). At this point, next higher or lower level voltage will be switched. This process continues as discussed earlier until the current error direction reverses. It is important to note that if the voltage level applied at a boundary crossing of the current error is insufficient to force the error back, no next voltage level is applied as the error again crosses this boundary next time after the previous voltage level change with the same slope. The error in that case is allowed to go until the next voltage level change at

next higher or lower boundary crossing of the error to force it back as is evident from Fig. 2

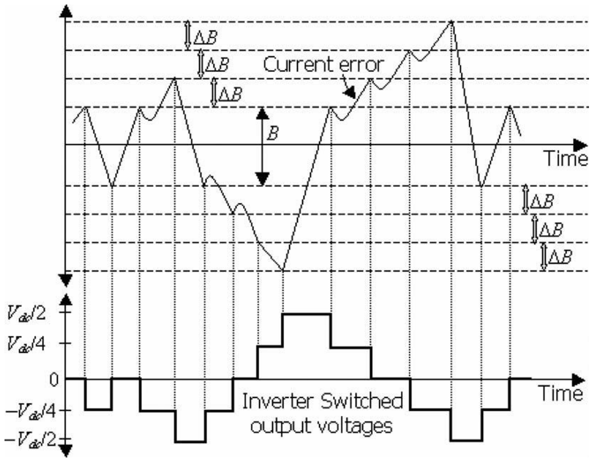


Fig. 2. Hysteresis current control

III. SIMULATION RESULTS

To describe and validate the capabilities of proposed control strategy, simulations are carried out for integration of renewable energy resources to the distribution grid via a NPC VSI, in a MATLAB/Simulink environment. The schematic diagram and principle of the proposed control technique in a distribution grid is shown in Fig. 3. MATLAB figures contain the three level neutral point diode clamped inverter and it's hysteresis modulation technique.

V=700V , Inverter = 350+350 V
Line voltage V_l=380 V
output voltage = 500 V
Load = RL load.

Fig. 4. Shows the output wave form for Grid voltage, Grid current, Load current, Inverter output voltage.The proposed control method on reactive power tracking with constant output active power are considered. During the simulation process, active power which is delivered from the renewable energy resources via NPC VSI to the AC grid is considered to be constant.Proposed control strategy for control of NPC VSI in providing active, reactive power and harmonic current components of linear and nonlinear loads.

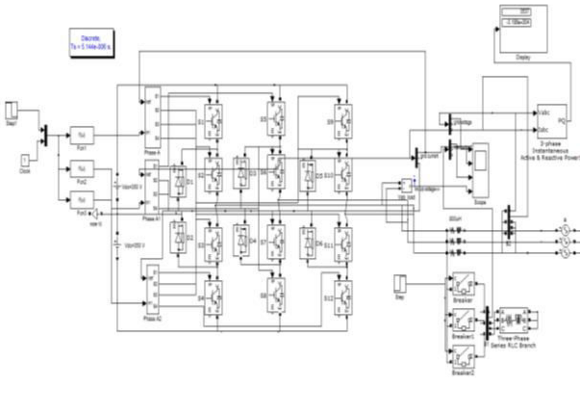


Fig. 3. Simulation diagram of proposed diagram

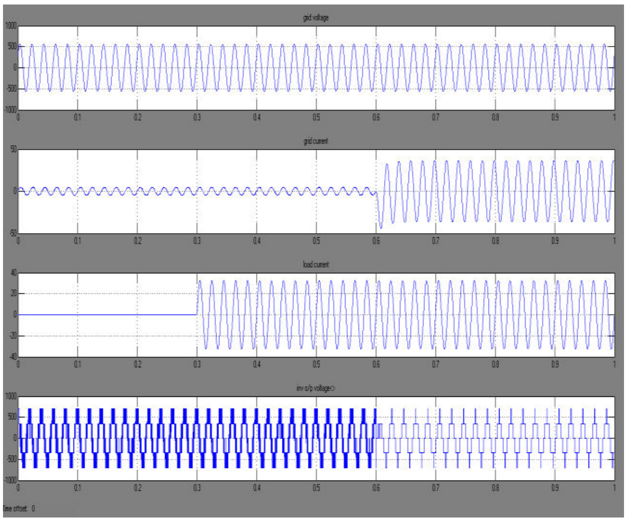


Fig. 4. Output wave form for proposed system

Fig. 5. Shows Three phase output wave form for Grid voltage. Grid current, Load current, Inverter output voltage

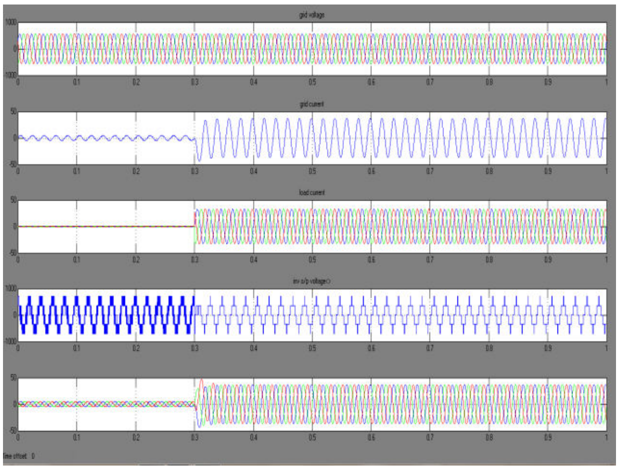
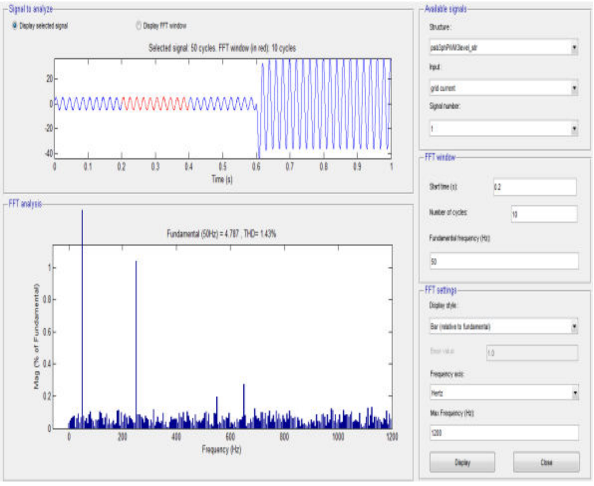


Fig. 5. Three phase output wave form for proposed system



Selected signal: 50 cycles. FFT window (in red): 10 cycles

Fundamental (50Hz) = 4.787 , THD= 1.43%

Structure: psb3phPWM3level_str

Input: grid current

Signal number: 1

Start time (s): 0.2

Number of cycles: 10

Fundamental frequency (Hz): 50

Display style: Bar (relative to fundamental)

Base value: 1.0

Frequency axis: Hertz

Max Frequency (Hz): 1200

Fig. 6. THD value for proposed system

IV. CONCLUSION

In this paper, a flexible control strategy for integration of renewable energy resources to the distribution grid was presented. The high performances of the proposed control strategy in both steady state and transient operation have been verified through simulation results. Simulation results clarified the ability of the proposed control strategy in compensation of active and reactive currents in fundamental frequency and harmonic current components.

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