H-bridge multilevel inverter for PV/Wind hybrid energy system

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Abstract

In hybrid generation one of the major issues to hamper performance of the interconnection of power conditioning units. Lower order harmonics, lower switch losses, high power quality and higher frequency are highly critical components to analysis any electrical system. Multilevel electrical converter will increase power to a remarkable level with regard to traditional inverters by using series and parallel combination of switches. In this work, Five, nine and fifteen levels of cascaded H-bridge multilevel inverter are made up for PV/Wind hybrid energy system is developed in MATLAB environment for compensation harmonic and reactive power.

Keywords: Multilevel inverter, hybrid energy system, MATLAB

1. INTRODUCTION

Small price of ripple is main issue for creating any inverters. as a result of varied losses and distortion, traditional inverters have restriction in operational at high voltage facet uses. Power switches area unit utilized in series and parallel combinations so as to handling voltage and current. THD generation level in typical 2 level inverters is approximate sixty % at traditional operational conditions. Numerous power options area unit tormented by increase in doctorate price. once move to high voltage facet, series combination of switches area unit created needed voltage. Reverse voltage sharing is modified as a result of charge distinction in stop state of switches. For highest transient voltage, those switches used that have least recovered charge. Uneven characteristics of switches causes sharing of load current aren't equal [3]. Switches are connected in parallel for handing higher current. once power switch carries additional current as compare alternative switch then power dissipation will increase. As a results of increase in power dissipation, junction temperature increase and internal resistance decrease. Switches characteristics aren't sleek. So, devices fail in vital time. range of switches area unit used, depends on specific arrangement. A switches cluster which offer positive 0.5 cycle at output is named as positive cluster switches and another switches cluster that provides negative 0.5 cycle called negative cluster switches.

As convertor are utilized in hybrid energy system for DC to AC however as a result of power quality problems converters area unit replaced by multilevel electrical converter for higher performance of electrical system. for prime voltage and high power applications uses of construction inverters increase in recent year. Management ways are raising topic within the analysis supported construction electrical converter. Construction electrical converter provides irregular amplitude in output. This amplitude isn't management with the assistance of traditional management ways. Power losses, magnetic attraction interference and pulsing torques in AC motor drives occur as a result of non basic current harmonics. Performances of inverters area unit strictly associated with harmonic reduction by any switch strategy. In construction electrical converter, numerous modulation management technique want to decrease harmonics.

Multilevel electrical converter will increase power (m-1) times with regard to traditional inverters by using series and parallel combination of switches. By using construction inverters outputs have lesser harmonic elements and interference drawback decreases as comparison to traditional inverters. Numerous simulations work and hardware implementations performed on construction electrical converter as a result of these benefits.

1.1 MULTILEVEL INVERTER TOPOLOGY

Multilevel inverters are essentially appropriate blend of switches and wellsprings of voltage. Appropriate switch position is additionally name as topology, which is essential prerequisite of any multilevel inverter plan since they choose its activity, control rating, applications and effectiveness. Principle topologies utilized as a part of multilevel inverter are:

1. Diode clamped inverter
2. Capacitor clamped inverter
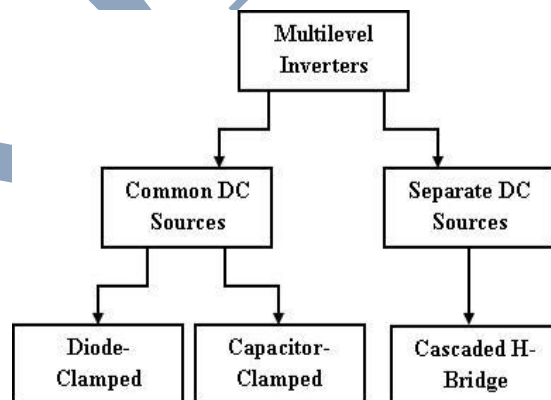3. Cascaded H-bridge inverter [1]

Fig. 1 Multilevel Inverter Topologies

Different applications are performed by unbiased braced multilevel inverter since they are simple in plan and need normal wellspring of voltage. It has primary issue of DC-connect capacitor is voltage swinging. Over four levels diode clipped multilevel inverter, limitations with respect to execution and multifaceted nature happens

because of absence of balance in voltage. Flying capacitor inverters required more number of capacitors and condenser produces troublesome size issue for high voltage utilized.

Fell H-bridge multilevel inverter does not have any DC-interface voltage unbalancing and not require huge size capacitors. It requires a few isolated DC sources which is significant favorable position for rechargeable batteries. For high voltage engine drive uses of basic load, inverter is worked by battery of appraised unit and they are joining in arrangement. Uses of Cascaded multilevel inverter are SVC (Static VAR Compensators), HVDC transmission framework and voltage stabilizers. The primary favorable circumstances of fell H-bridge multilevel inverter are its basic format of circuit and if there should be an occurrence of disappointment of any gadgets units are supplanted effectively.

2. MATLAB Environment for CHB-MLI

Cascaded H-bridge multilevel inverter reduces operation losses & work properly at main operation in drive of motor. SDC perform effortlessly exchanging in fell H-bridge multilevel inverter and increment framework adaptability and activity. Power solidness, adaptation to non-critical failure and upkeep are primary preferred standpoint of secluded structure. MATLAB implies framework research center and uses for specialized figuring. Representation, calculation and simple programming can be accomplished by utilizing MATLAB [22].

2.1 Single Phase with Seven Level Cascaded H-Bridge Multilevel Inverter

Seven level single phase CHB-MLI in MATLAB environment is shown in fig. 2. Seven level single phase cascaded H-bridge multilevel inverters are consists of six H-bridge and they are connected in series.
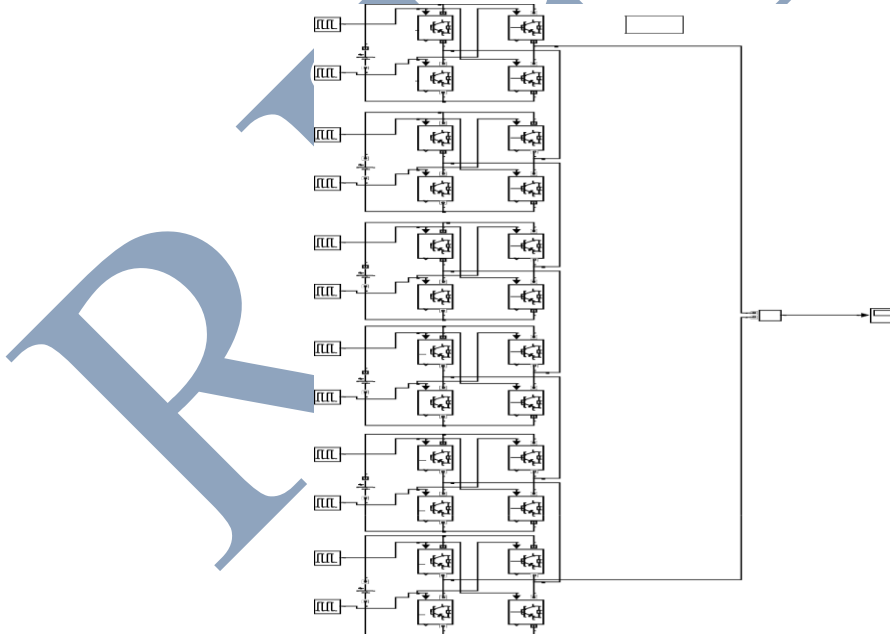

Fig. 2 Single phase with seven level cascaded H-bridge multilevel inverter

3. CHB Multilevel Inverter

Cascaded H-bridge multilevel inverters separated DC sources is introducing for new power inverter structure. Multilevel inverter of cascaded H-bridge type is shown in fig. 4. Inverter of single phase is interconnected with

each SDC. AC terminal voltages of different level cascaded H-bridge inverter are connected in series. Output phase voltage is the sum of output of four inverters. Three level outputs +V dc, 0 and –V dc are generates by each single phase full bridge inverter. This is done by connecting DC sources to AC side via four semiconductor power devices. Four switches are present in each level of full bridge inverter. If switch 1 & 4 are energized then voltage +V dc obtain & when switch 2 & 3 are energized then voltage -V dc obtain. If all switches not energized then zero voltage obtain [26].
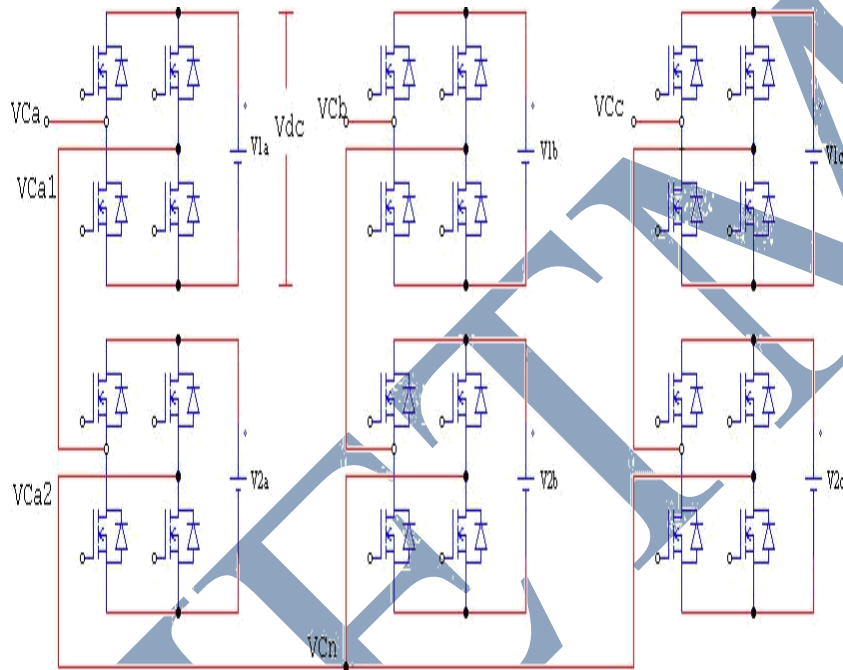

Fig. 3 Multilevel inverter of Cascaded H-bridge Type

Cascaded H-bridge Multilevel Inverter (CHB-MLI) is uses rapidly in high power applications. Number of H-bridges makes a cascaded H-bridge multilevel inverter and they are connected in series. (P-2)/2 single phase full bridges are the components of p-level cascaded H-bridge multilevel inverter. Individual sources are provided for every H-bridge. Cascaded H-bridge multilevel inverters generate almost sinusoidal output voltage waveform as improve level of multilevel inverter for one time cycle of switching.

Frequency used in carrier is equal to frequency used in switching in cascaded H-bridge multilevel inverter. The switching frequency is less than or greater than carrier frequency in multilevel PWM and function of displacement angle between carrier set & modulation waveform. Each half cycle gives various pulses as result and various widths in respective pulses is given by SPWM. Amplitude of any wave is depends on width of separate pulses. SPWM method improves harmonic spectrum of inverter by voltage harmonic components value moves to higher frequencies side [28].
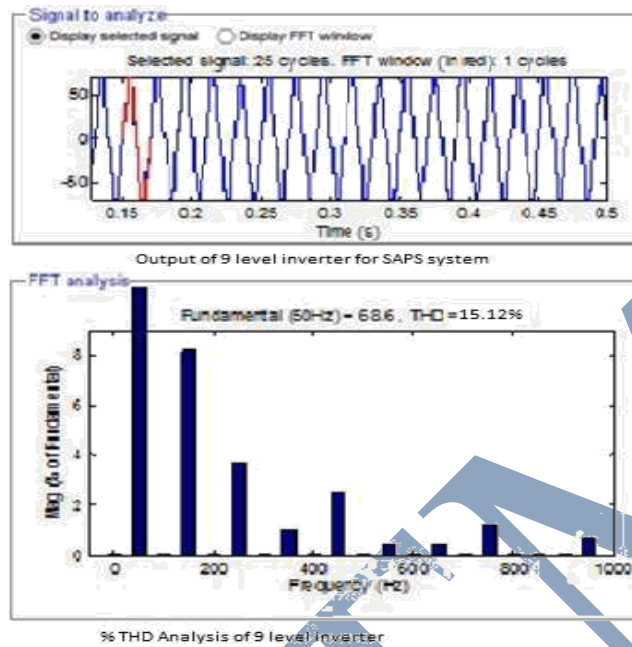
4. SIMULATION RESULTS

Fig. 4 Analysis of THD in three phase with nine level

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