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A Grid-Connected Hybrid Generation System with Multilevel Inverter Using SVM Technique.

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Abstract:-The proposed system presents power-control strategies of a grid-connected hybrid generation system with versatile power transfer. This hybrid system allows maximum utilization of freely available renewable energy sources like wind, fuel and photovoltaic energies. For this, an adaptive MPPT algorithm along with standard perturbs and observes method will be used for the system. The objective of this paper is to study a novel Multi level multistring inverter topology for DERs based DC/AC conversion system. In this study, a high step-up converter is introduced as a front-end stage to improve the conversion efficiency of conventional boost converters and to stabilize the output DC voltage of various DERs such as PV, Wind and fuel cell modules for use with the simplified newly constructed multilevel inverter. The proposed multilevel inverter requires only six active switches instead of the eight required in the conventional cascaded H- bridge (CCHB) multilevel inverter, control with SVM technique. The inverter converts the DC output from nonconventional energy into useful AC power for the connected load. This hybrid system operates under normal conditions which include conventional and proposed cases of solar energy, fuel and wind energy. The proposed simulation results are presented to illustrate the operating principle, feasibility and reliability of this proposed system for Renewable resources.

Index Terms:-DC/AC Power Conversion, Multilevel Inverter.

I.INTRODUCTION

Nowadays, Photovoltaic (PV) energy appears quite attractive for electricity generation because of its noiseless, pollution-free, scale flexibility, and little maintenance. Because of the PV power generation dependence on sun irradiation level, ambient temperature, and unpredictable shadows, a PV-based power system should be supplemented by other alternative energy sources to ensure a reliable power supply. Fuel cells (FCs) are emerging as a promising supplementary power sources due to their merits of cleanness, high efficiency, and high reliability. Because of long startup period and slow dynamic response weak points of FCs [1], mismatch power between the load and the FC must be managed by an energy storage system. Batteries are usually taken as storage mechanisms for smoothing output power, improving startup transitions and dynamic characteristics, and enhancing the peak power capacity [2], [3]. Combining such energy sources introduces a PV/FC/battery hybrid power system. In comparison with single-sourced systems, the hybrid power systems have the potential to provide high quality, more reliable, and efficient power. In these systems with a storage element, the bidirectional power flow capability is a key feature at the storage port. Further input power sources should have the ability of supplying the load individually and simultaneously.

Many hybrid power systems with various power electronic converters have been proposed in the literature up to now. Traditional methods that integrate different power sources to form a hybrid power system can be classified into AC coupled systems [4], [5] and coupled systems [6]–[12]. However, the main shortcomings of these traditional integrating methods are complex system topology, high count of devices, high power losses, expensive cost, and large size. In recent years, several power conversion stages used in traditional hybrid systems are replaced by multi-input converters (MICs), which combine different power sources in a single power structure. These converters have received more attention in the literature because of providing simple circuit topology, centralized control, bidirectional power flow for the storage element, high reliability, and low manufacturing cost and size. In general, the systematic approach of generating MICs is introduced in [13], in which the concept of the pulsating voltage source cells and the pulsating current source cells is proposed for deriving MICs. One of the samples of these MICs is utilized in [14] to hybridize PV and

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wind power sources in a unified structure. Besides, a systematic method to synthesize MICs is proposed in [15]. This paper deals with two types of MICs: in the first type, only one power source is allowed to transfer energy to the load at a time, and in the second type, all the input sources can deliver power to the load either individually or simultaneously. As another basic research in MICs, in [16] assumptions, restrictions, and conditions used in analyzing MICs are described, and then it lists some basic rules that allow determining feasible and un- feasible input cells that realize MICs from their single-input versions. Two multiple-input converters based on flux additivity in a multi winding transformer are reported in [17] and [16].

Because there was no possibility of bidirectional operating of the converter in [17], and complexity of driving circuits and output power limitation in [16], they are not suitable for hybrid systems. In [17], a three port bidirectional converter with three active full bridges, two series resonant tanks, and a three- winding high frequency transformer are proposed. In comparison with three-port circuits with only inductors and Diode Bridge at the load side, it gives higher boost gain and reduced switching losses due to soft-switching operation.

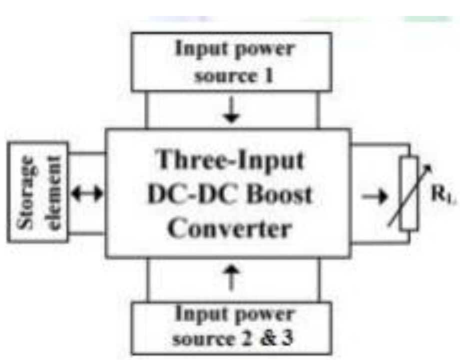

Fig 1. Proposed System over View

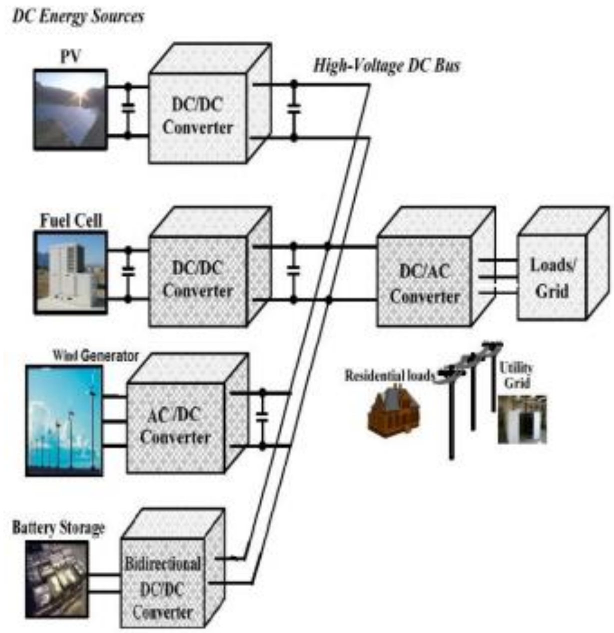

Fig.2 Configuration of multi string inverter for various

DERs application

In this paper, a new three input dc–dc boost converter is proposed for hybrid power system applications. As shown in Fig. 1, the proposed converter interfaces two unidirectional ports for input power sources, a bidirectional port for a storage element, and a port for output load in a unified structure. The converter is current source type at the both input power ports and is able to step up the input voltages. The proposed structure utilizes only four power switches that are independently controlled with four different duty ratios. Utilizing these duty ratios facilitates controlling the power flow among the input sources and the load. Powers from the input power sources can be delivered to the load individually or simultaneously.

2. POWER CONTROL TECHNIQUES FOR CONVERTER STAGES:

A. High Power Converter Stage:

In this study, high Power converter topology in is introduced to boost and stabilize the output DC voltage of various DERs such as PV and fuel cell modules for employment of the proposed simplified multilevel inverter. The architecture of a high power converter initially introduced from, epicted in Fig.7, and is

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composed of different converter topologies: boost, fly back, and a charge pump circuit. The coupled inductor of the high power converter in Fig. 7 can be modeled as an ideal transformer, a magnetizing inductor, and a leakage inductor. According to the voltage seconds balance condition of the magnetizing inductor the voltage of the primary winding can be derived as

B. Simplified Multilevel Inverter Stage:

To assist in solving problems caused by cumbersome power stages and complex control circuits for conventional multilevel inverters, this work reports a new single-phase multi string topology, presented as a new basic circuitry in Fig. 3. Referring to Fig. 7, it should be assumed that, in this configuration the three capacitors in the capacitive voltage divider are connected directly across the DC bus, and all switching combinations are activated in an output cycle. The dynamic voltage balance between the two capacitors is automatically controlled by the preceding high step-up converter stage. Then, we can assume Vs1=Vs2=Vs3=Vs.

This topology includes nine power switches three fewer than the CCHB inverter with nine power switches - which drastically reduces the power circuit complexity and simplifies modulator circuit design and implementation. The PD PWM control scheme is introduced to generate switching signals and to produce five output-voltage levels: zero, VS, 2VS, -VS, and - 2VS.

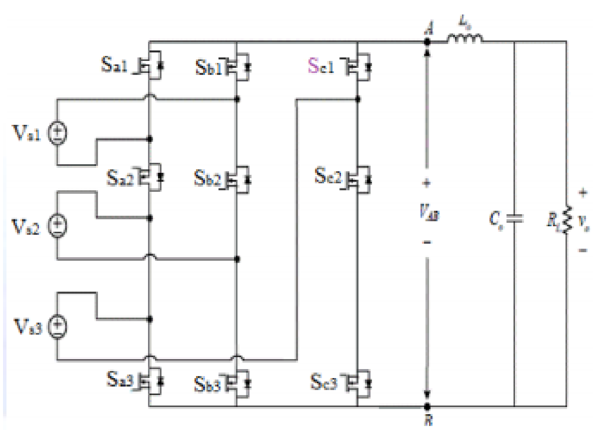

Fig.3. Basic five-level inverter circuitry.

This inverter topology uses two carrier signals and one reference to generate PWM signals for the switches. The modulation strategy and its implemented logic scheme in Fig.4 is a widely used alternative for phase disposition modulation. With the exception of an offset value equivalent to the carrier signal amplitude, two comparators are used in this scheme with identical carrier signals Vtri1 and Vtri2 to provide high-frequency switching signals for switches Sa1, Sb1, Sa3 and Sb3.Another comparator is used for zero crossing detection to provide line-frequency switching signals for switches Sa2 and Sb2.where is Vtri 3 and switching signals.

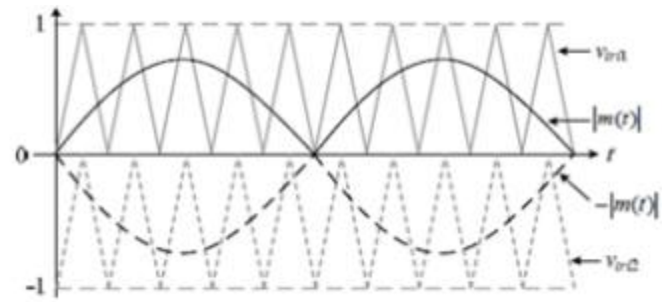

Fig.4 Modulation strategy: carrier/reference signals

To verify the feasibility of the single-phase fivelevel inverter, a widely used software program PSIM is applied to simulate the circuit according to the previously mentioned operation principle. The control signal block is shown in Fig. 4. m(t) is the sinusoidal modulation signal.Both Vtri1 and Vtri2 are the two triangular carrier signals.The peak value and frequency of the sinusoidal modulation signal are given as mpeak=0.7 and fm=60Hz,respectively. The peak-to-peak value of the triangular modulation signal is equal to 1, and the switching frequency ftri1 and ftri2 are both given as 1.8kHz.The three input voltage sources feeding from the high step-up converter is controlled at 100V, i.e. Vs1=Vs2=Vs3=100V. The simulated waveform of the phase voltage with five levels is shown in Fig. 5. The switch voltages of Sa1, Sa2, Sa3, Sb1, Sb2, Sb3,Sc1,Sc2 and Sc3 are all shown in Fig. 5.

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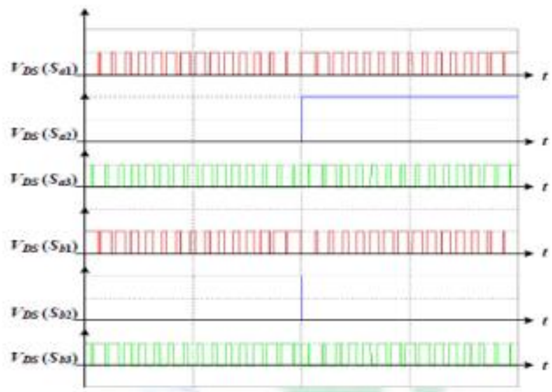

Fig.5. Simulated waveforms of switch voltage for inverter stage with in a line period[Scale:100V/div]

Because switches Sa2, Sb2 can only be activated twice in a line period (60Hz) and the switching frequency is larger than the line frequency (fs>>fm), the switching losses of the proposed circuit is approximated to 4Vsfs .obviously, the switching power loss is nearly half that of the CCHB inverter.

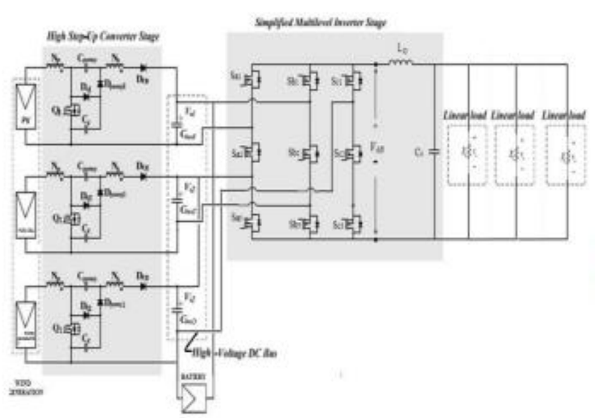

Fig.6.Multi-levelinverter topologies of CCHB inverter [15]

C. DC-AC Power converter space vector modulation Technique.

Nine power switches of inverter with 8 possible combinations shown in ―Figure. 6‖ are corresponding to effective voltage space vector U1 – U9 and 2 zero vector U0,U9. The phase angle between one effective voltage space vector and adjacent one is 40 degrees. They constitute 9 uniform segments. The three digits in brackets express the linking state between three-phase output A,B,C and the input DC, such as M=101 which represents the switching of the switches Sai,Sbj and Sck The output voltage space vectors and the corresponding switching states are represented in ―Fig. 7‖.

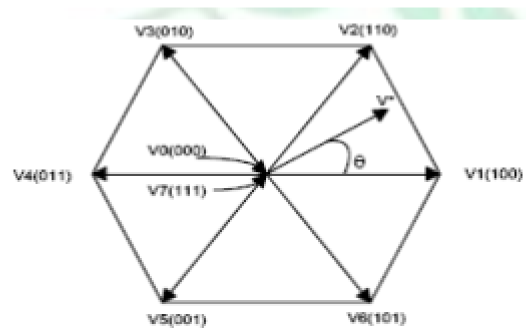

Fig.7,The composition of output voltage vector and Switching stages.

D. SVM Techniques

A different approach to SPWM is based on the space vector representation of voltages in the d, q plane. The d, q components are found by Park transform, where the total power, as well as the impedance, remains unchanged space vector shows space vectors in according to switching positions of inverter, V* is the phase-to-center voltage which is obtained by proper selection of adjacent vectors V1 and V2.

3. CONCLUSIONS:

The proposed system illustrates Renewable & Sustainable power generation strategies of a grid system with versatile power transfer. This grid system allows maximum utilization of freely available renewable energy sources like fuel cell,WTG and photovoltaic energies. For this, an adaptive MPPT algorithm along with standard perturbs and observes (P&O) method will be used for the Wind, PV & Fuel system with DC/AC Power Converter with SVM Technique. Also, this configuration allows the sources to supply the load separately or simultaneously depending on the availability of the energy sources. The turbine rotor speed is the main determinant of mechanical output from wind turbine to Permanent Magnet Synchronous Generator (PMSG) is coupled for attaining energy conversion system. Renewable energy resources like Fuel cell and Solar cell power generated are interconnected to DC Link. The inverter converts the DC output from non-conventional energy into useful AC power for the connected load (Industrial & Commercial Loads). This Grid system operates under normal conditions which include normal room temperature or At Any atmospheric Condition.

This work reports a newly-constructed single & three - phase multi string multilevel inverter topology that produces a significant reduction in the number of power devices required to implement multilevel output for DERs. The studied inverter topology with SVM Technique offer strong advantages such as improved output waveforms, smaller filter size, and lower EMI. Total harmonic distortion (THD) of the voltage and current at the output of the Conventional inverter THD =1.45 and Proposed CCHB multi-level inverter THD= 0.54.Simulation results show the effectiveness of the proposed solution. The Proposed simulation results are analyzed to illustrate the operating principle, feasibility and reliability of this proposed grid systems.

REFERENCES:

[1] Y. Li, D. M. Vilathgamuwa, and P. C. Loh, Design, analysis, and real-time testing of a controller for multi bus microgrid system,‖ IEEE Trans. Power Electronics, vol. 19,no. 5, pp. 1195-1204, Sept. 2004.

[2] N. Hatziargyriou, H. Asano, R. Iravani, and C. Marnay,Micro grids,‖ IEEE Power and Energy Magazine, vol. 5,no. 4, pp. 78-94, Jul./Aug. 2007.

[3] F. Katiraei, R. Iravani, N. Hatziargyriou, and A. Dimeas,Microgrids management,‖ IEEE Power and Energy Magazine, vol. 6, no. 3, pp. 54-65, May/Jun., 2008.

[4] C. L. Chen, Y. Wang, J. S. Lai, Y. S. Lee, and D.Martin, Design of parallel inverters for smooth mode transfer microgrid applications,‖ IEEE Trans. Power Electronics, vol. 25, no. 1, pp. 6-15, Jan. 2010.

[5] C. T. Pan, C. M. Lai, and M. C. Cheng, A novel high step-up ratio inverter for distributed energy resources (DERs),‖ IEEE International Power Electronics ConferenceECCE Asia, pp.1433-1437, 2010.

[6] C. T. Pan, C. M. Lai, and M. C. Cheng A novel integrated single-phase inverter with an auxiliary step-up circuit for low-voltage alternative energy source application,‖ IEEE Trans. Power Electronics, vol. 25, no. 9,pp. 2234-2241, Sep. 2010.

[7] F. Blaabjerg, Z. Chen, and S. B. Kjaer, Power electronics as efficient interface in dispersed power generation systems,‖ IEEE Trans. Power Electronics, vol.19, no. 5, pp. 1184-1194, Sep. 2004.

[8] D. G. Infield, P. Onions, A. D. Simmons, and G. A.Smith, Power quality from multiple grid-connected singlephase inverters,‖ IEEE Trans. Power Delivery, vol. 19, no.4, pp. 1983-1989, Oct. 2004.

[9] S. B. Kjaer, J. K. Pedersen, and F. Blaabjerg A review of single-phase grid-connected inverters for photovoltaic modules,‖ IEEE Trans. Industry Applications, vol. 41, no. 5,pp. 1292-1306, Sep./Oct. 2005.

[10] O. Lopez, R.Teodorescu, and J. Doval-Gandoy,Multilevel transformer less topologies for single-phase grid-connected converters‖ IEEE Industrial Electronics Conference, pp. 5191-5196, 2006.

[11] T. Kerekes, R. Teodorescu, and U. Borup, ―Transformer less photovoltaic inverters connected to the grid,‖ IEEE Applied Power Electronics Conference, pp. 1733-1737,2007.

[12] G. Ceglia, V. Guzman, C. Sanchez, F. Ibanez, J. Walter,and M. I. Gimenez, A new simplified multilevel inverter topology for DC-AC conversion,‖ IEEE Trans. Power Electronics, vol. 21, no. 5, pp. 1311- 1319, Sep. 2006

[13] N. A. Rahim and J. Selvaraj, Multi string five-level inverter with novel PWM control scheme for PV application,‖ IEEE Trans. Power Electronics, vol. 57, no. 6,pp. 2111-2123, Jun. 2010

[14] C. T. Pan, W. C. Tu, and C. H. Chen, A novel GZVbased multilevel single phase inverter,‖ Taiwan Power Electronics conference, pp. 1391-1396, Sep. 2010.

[15] W. Yu, J. S. Lai, H. Qian, C. Hutchens, J. Zhang, G.Lisi, A. Djabbari, G. Smith, and T. Hegarty, Highefficiency inverter with H6-type configuration for photovoltaic non-isolated AC module applications,‖

IEEE Applied Power Electronics Conference and Exposition, pp. 1056-1061, 2010.

[16] S. Vazquez, J. I. Leon, J. M. Carrasco, L. G. Franquelo,E. Galvan, M. Reyes, J. A. Sanchez, and E. Dominguez,—Analysis of the power balance in the cells of a multilevel cascaded H-bridge converter,‖ IEEE Trans. Industrial Electronics, vol. 57, no. 7, pp. 2287-2296, Jul. 2010.

[17] S. Daher, J. Schmid, and F. L.M. Antunes, —Multilevel inverter topologies for stand-alone PV systems,‖ IEEE Trans. Industrial Electronics, vol. 55, no. 7, pp. 2703-2712,Jul. 2008.