DEVISE AND ANALYSIS OF 9 LEVEL INVERTER TECHNOLOGIES FOR RENEWABLE ENERGY STATIONS

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Abstract-This project presents an improved cascaded multilevel inverter based on a highly efficient and reliable configuration for the minimization of the leakage current. Apart from a reduced switch count, the proposed scheme has additional features of low switching and conduction losses. The proposed topology with the given pulse width modulation (PWM) technique reduces the high frequency voltage transitions in the terminal and common mode voltages. Avoiding high-frequency voltage transitions achieves the minimization of the leakage current and reduction in the size of electromagnetic interference filters. Furthermore, the extension of the proposed CMLI along with the PWM technique for 9 levels is also presented. The proposed PWM technique requires only a single carrier wave for 9 levels of operation. The total harmonic distortion of the grid current for the proposed CMLI meets the requirements of IEEE 1547 standard. A comparison of the proposed CMLI with the existing PV multilevel inverter topologies is also presented in the paper. Complete details of the analysis of PV terminal and common-mode voltages of the proposed CMLI using switching function concept, simulations, and experimental results are presented in this project.

Keywords- *CMLI; PWM; 9 Level converter; High frequency voltage; PV terminal; RES.*

I. INTRODUCTION

Utilization of renewable energy resources is the demand of today and the necessity of tomorrow. With advancement in power electronic technology, the solar photovoltaic energy has been recognized as an important renewable energy resource because it is clean, abundant and pollution free. The PV power supplied to the utility grid is gaining more and more visibility, while the world's power demand is increasing [1]. Not many PV systems have so far been placed into the grid due to the relatively high cost, compared with more traditional energy sources such as oil, gas, coal, nuclear, hydro, and wind. Solid-state inverters have been shown to be the enabling technology for putting PV systems into the grid. The price of the PV modules were in the past the major contribution to the cost of these systems. A downward tendency is now seen in the price for the PV modules due to a massive increase in the production capacity of PV modules [2]. The cost of the grid-connected inverter is, therefore, becoming more visible in the total system price. A cost reduction per inverter watt is, therefore, important to make PV-generated power more attractive. Solar-electric energy demand has grown consistently by 20%–25% per annum over the past twenty years, which is mainly due to the decreasing prices of the PV products, an increasing efficiency of solar cells and manufacturing technology improvements [3]. PV inverter, the heart of the grid connected and stand alone PV system, is used to convert dc power obtained from PV modules into ac power to be fed into the grid. Improving the output waveform of the inverter reduces its respective harmonic content and hence the size of the filter used and the level of electromagnetic interference (EMI) generated by switching operation of the inverter. In recent years, multilevel inverters have become more attractive for researchers and manufacturers due to their advantages over conventional three-level pulse width modulated (PWM) inverters. They offer improved output waveforms, smaller filter size, and lower EMI, lower total harmonic distortion (THD).

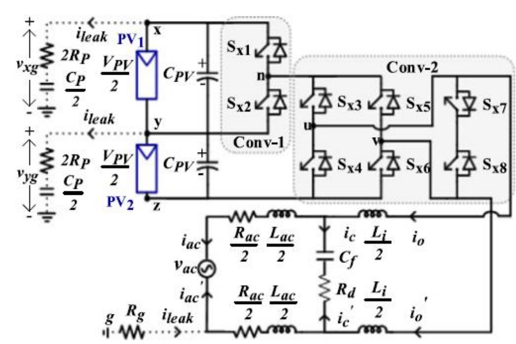

Fig.1.1: Model diagram.

II. PREVIOUS STUDY

The battery requires a large capacity transformer for connecting to the power system. As a result, the whole system becomes large, heavy and has low efficiency. Recently, a transformer less battery energy storage system based on a cascaded multilevel inverter has been proposed. A cascaded multilevel inverter has a simple structure that has promoted its application at megavolt level. By using it, the whole system can be reduced in size, weight, and cost. The cascaded multilevel inverter synthesizes a desired voltage from several independent sources of DC voltage, which may be obtained from batteries, fuel cells or PV cells. This DC voltage must be filtered, not only clean but also well regulated. However, if the current source is directly loaded, then the output voltage will change. Therefore, it need a DC voltage control, thus the equipment can work according to its ability. By using it, the whole system can be reduced in size, weight, and cost. The cascaded multilevel inverter synthesizes a desired voltage from several independent sources of DC voltage, which may be obtained from batteries, fuel cells or PV cells [7]. This DC voltage must be filtered, not only clean but also well regulated. However, if the current source is directly loaded, then the output voltage will change. Therefore, it need a DC voltage control, thus the equipment can work according to its ability. Nevertheless, leak inductance concerns that connect to the Voltage Spike and also effectiveness stay substantial. An included Boost-- soar back converter based upon a paired inductor along with higher performance as well as higher step-up current increase has actually appeared. The electricity saved in the leak inductor is actually reused in to the result in the course of the turn off duration. Thereby, the effectiveness could be improved and also the current stress and anxiety on the energetic button may be decreased. A lot of step-up converters, which make use of an outcome current piling to raise the current increase, exist.

III. PROPOSED SYSTEM

Transformer less multilevel inverter (MLI) topologies are gaining importance due to their advantages such as high efficiency, low switch count, low weight, and reduced size. However, removal of the transformer eliminates the galvanic isolation between the photovoltaic (PV) array and the output load. Removal of galvanic isolation increases the leakage current compromising the safety in PV systems. It has led to the development of various safety standards for the PV systems, which restrict the value or magnitude of leakage current flow in the PV system. Apart from leakage current minimization, there is a continuously increasing demand for high-quality power output to be fed into the grid from the PV system. This requirement has led to the use of MLI in the transformer less PV systems. Classification of multilevel inverters based on DC voltage source is shown in Fig. A single-phase structure of an mlevel cascaded inverter [8] is illustrated in Fig.5. Each separate dc source (SDCS) is connected to a single-phase full-bridge, or H-bridge, inverter. Each inverter level can generate three different voltage outputs, +Vdc, 0, and –Vdc by connecting the dc source to the ac output by different combinations of the four switches, S1, S2, S3, and S4. To obtain +Vdc, switches S1 and S4 are turned on, whereas –Vdc can be obtained by turning on switches S2 and S3. By turning on S1 and S2 or S3 and S4, the output voltage is 0. The ac outputs, shown in Fig.5 of each of the different full bridge inverter levels are connected in series such that the synthesized voltage waveform is the sum of the inverter outputs.

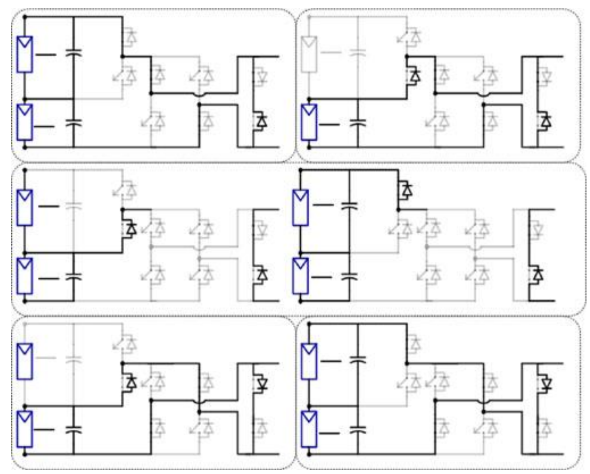

Fig.3.1: Operation of circuit diagram.

IV. SIMULATION RESULTS

In simulation Figs. the terms *Pc* and *P*sw refer to the conduction and switching losses, respectively, for each of the MLI topologies reported in the literature. Conduction and switching losses of the individual switches in each MLI topology are shown in different color blocks in the bar chart of *Pc* and Psw, respectively. It can be observed that the proposed nine-level CMLI shows higher efficiency compared to the other existing topologies. Hence, the proposed five-level CMLI is efficient and economical.

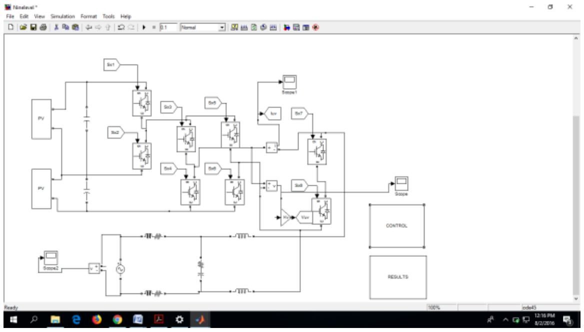

Fig.4.1: Simulation circuit.

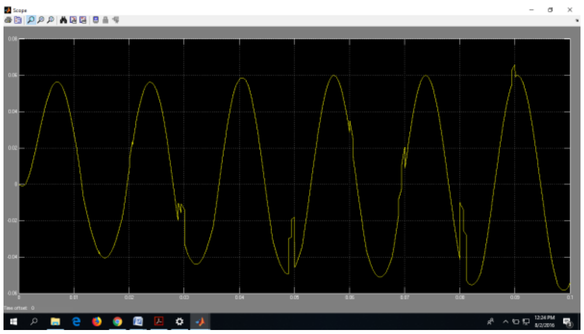

Fig.4.2: Voltage across the receiving end side.

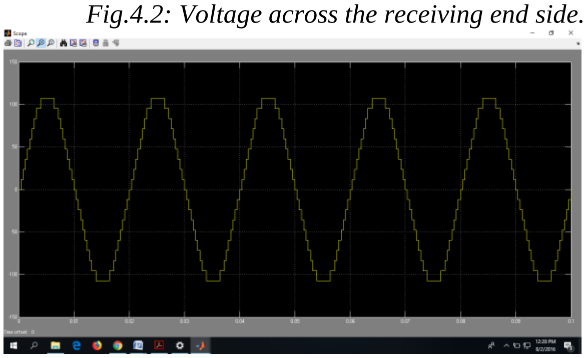

Fig.4.3: 9 Level inverter output results.

V. CONCLUSION

In the project an improved five-level CMLI with low switch count for the minimization of leakage current in a transformer less PV system was proposed. The proposed CMLI minimized the leakage current by eliminating the high-frequency transitions in the terminal and CMVs. The proposed topology also reduced conduction and switching losses which made it possible to operate the CMLI at high switching frequency. Furthermore, the solution for generalized 9 levels CMLI was also presented in the project. The given PWM technique required only one carrier wave for the generation of 9 levels. The operation, analysis of terminal, and CMVs for the CMLI was also presented in the paper. The simulation and experimental results validated the analysis carried out in this paper. The MPPT algorithm was also integrated with the proposed five-level CMLI to extract the maximum power from the PV panels.

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