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Adaptive Cascaded H- Bridge Multi level Inverter for Grid integration of renewable energy resources

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***Abstract*— Penetration of power generation from renewable energy resources into the Indian power system is increasing day by day. This is because of the availability of renewable energy like solar, wind, etc. and the technology which can convert these resources into energy. In this paper a technology for grid integration of renewable energy with the utility grid is presented. The proposed technology is based on three phase current source inverter feed-back control loop. A cascaded single phase multi level inverter (MLI) is designed first and its output is connected to the three phase two level six pulse universal bridge providing current control to the inverter. 100% synchronized three phase 415 V rms voltage wave is obtained from the CSI to be fed to the grid. The proposed inverter topology is compared with the conventional topology, the harmonic content are nil as compared to 27% as obtained in conventional one. The system is modeled in matlab simulink simulation tool.**

***Keywords*— Distributed energy Resources (DERs), Renewable Energy Sources (RES), Three Phase Multi level inverter (MLI), Grid Integration, Cascaded H-Bridge Inverter, Total Harmonic Distortion (THD), Current Source Inverter(CSI).**

I. INTRODUCTION

More we generate power using Distributed energy Resources (DERs) lesser will be the dependency upon conventional sources of electricity generation like coal, diesel etc. which are now shortening day by day. To out source power obtained from PV system to the grid an intermittent converter topology is required since output voltage generated from renewable resources like solar, wind, etc. is DC and grid voltage is AC. In literature [1-5] numerous converter topology has been proposed for conversion DC power into AC power for grid integration. One such topology is MLI [2] which is widely used for RES interface with grid for reduced harmonic because one of the prominent criteria for grid integration is lesser THD. To obtain lesser harmonics sinusoidal three phase voltage and current, MLI configuration with LC filter is incorporated. Conventional MLIs started with three level outputs such as 0V - Vdc – 0V. Later there were more number of configurations on inverter topology has come out. Since the inverter generates multi stepped wave output, the harmonic profile can also be improved. Further the advantages of MLI's

are higher efficiency, reduced dV/dt stresses on the load, lower electromagnetic interference (EMI) [6]. The proposed work focuses on to develop a MLI utilizing cascaded H-bridge In Phase Disposition PWM (IPDPWM) technique [7-9]. This is dual stage converter where at first stage a single phase MLI is developed whose output is connected to the three phase CSI using three arm six pulse universal bridge. In the CSI topology inverter control is provided where grid current signal is fed to the three phase PLL for grid synchronization of the RES through PI controller. The universal bridge is triggered with the two level Pulse width modulator through feed back signal of grid current. In the proposed topology no harmonic content are obtained since the inverter topology is capable of interfacing 100% RES with the grid voltage and current.

The paper is organized as; in first section literature survey and general back ground of the proposed work is discussed. Section II presents various MLI topologies. Proposed work is discussed in section III. Simulation model is presented in section IV. In section V results obtained are discussed.

II. VARIOUS TOPOLOGIES OF MULTI LEVEL INVERTER (MLI)

The RES produces DC which is applied to the MLI input terminal. MLI are broadly divided into DC source and separate DC source type as shown in Fig-1. In separate DC source type MLI for each branch separate Dc source is required, while in common DC source type, a common DC voltage applied across MLI terminals. This work deals with separate DC type MLI where at 0 crossing Vdc and 2Vdc voltage is applied to the inverter branch, where Vdc is 100 volts. In the proposed work cascaded 11-level H-bridge topology is designed for the grid integration of renewable energy resources as shown in Fig-2.

III. PROPOSED WORK

The proposed configuration represents the grid connection of single phase inverter. In this research work an eleven level inverter is designed using cascaded H-Bridge topology. The DC sources can be obtained from renewable energy sources such PV/wind and fuel cell which is not focused in this work. The following levels can be obtained 0, Vdc, 2Vdc, 3Vdc, 4Vdc and 5Vdc in quarter cycle of the output waveform. Vdc is selected as 100V and therefore the peak amplitude of an inverter output is 600V. The MLI has been synchronized with the utility grid using Current Source Converter and PLL (Phase Lock Loop). An eleven level inverter is designed with reference sine wave generator as carrier wave and phase shifted triangular wave to generate pulses for PWM. The output of the single phase eleven level inverter is interfaced with three phase current source converter to meet the characteristics of the grid. Fig-3

The overall system is analyzed as two cases