MCPWM FOR LVRT IMPROVEMENT OF PV SYSTEM BY SDBR

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ABSTRACT

In grid connected system may have various types of faults like L, LL, LLL or ground fault. When a fault occurs in grid side, at that time voltage on point of common coupling may go very low which may damage inverter. Also a generated voltage sag may disconnect a PV system from grid and this kind of shutdown of large PV plant may affect the power system operation. Here a concept of series dynamic braking resistance emerges which helps to overcome effect of fault and prevents voltage sag in grid side. Multicarrier phase shift pulse width modulation technique in transformer less PV inverter helps to improve LVRT capability of power plant. MCPWM method injects third harmonic and eliminate the leakage current in transformer less PV inverter. The proposed technique is implemented in MATLAB and extensive simulations are carried out for harmonics and power quality analysis.

Keyword: - *Series dynamic braking resistance, PV, Multi carrier phase pulse width modulation, fault*

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1. INTRODUCTION

Demand of renewable energy sources is being increasing continuously as the demand for power supply is drastically increasing across the world. It is the world's fastest growing technology with continues improvements in maximum power point tracking and fault tolerance methods. Because of clean and economical characteristic energy generated from PV cell is considered as a prospective for future energy resources. It can be predicted that in future scenario a demand of PV power will be increase by more percentages and for that it is necessary to analyze the characteristics of Grid connected PV power plant with some disturbances and method to overcome it.

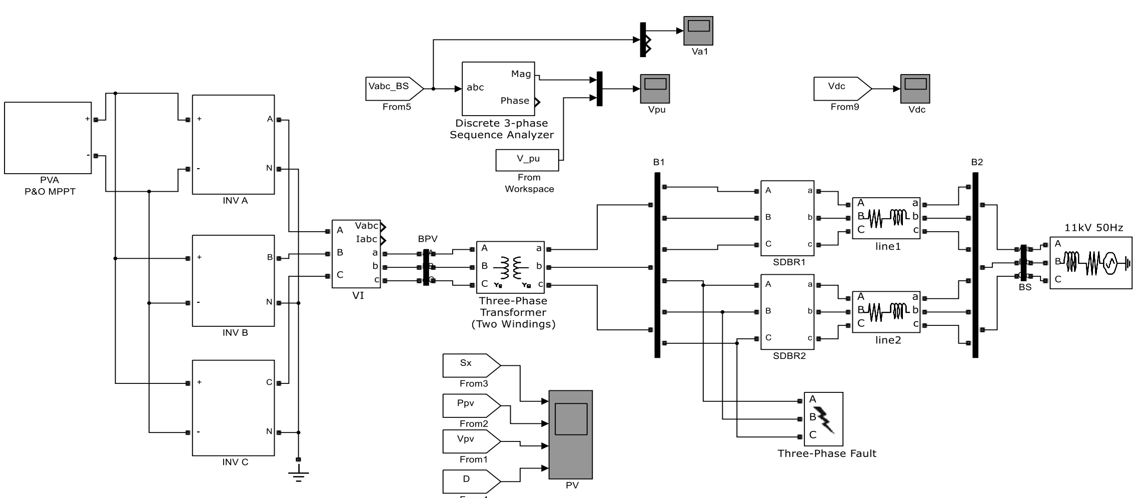


Fig 1: Total system with SDBR with TF

2. SYSTEM COMPONENTS AND IMPLEMENTATION

2.1 PV System modelling

Renewable energy sources are in a great demand now a days, and research on various new resources are going on across the world. But whatever available is, we need to get maximum from it without losses. A Photo voltaic is also one of the renewable energy source. It works on luminance intensity fall on it. General analysis shows that 1000lm of intensity with six arrays and 96 cells can generate 9MW of power, but to get maximum from this we require a technique of power tracking. MPPT and Incremental conductance are methods which are used widely. Among available of two methods, this paper describes MPPT technique. Figure shows implementation of PV cell which generates voltage and current.

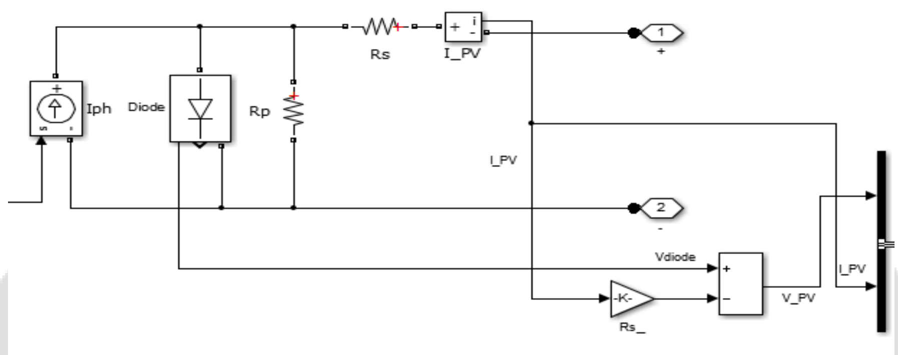


Fig 2: Modelling of PV system

Parameters of PV Plant:
Each PV Array is composed of, 96 cells in each PV Panel, 5 Series PV Panels, 12 Parallel PV Panels.
This configuration is capable to generate 100kw of power.

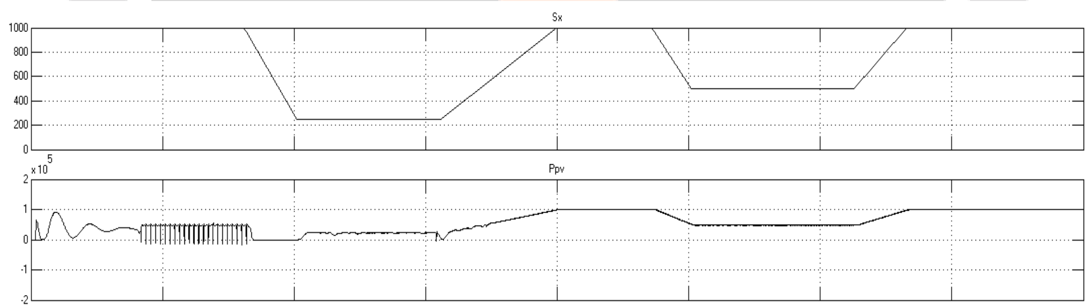


Fig 3: Luminance intensity and power generated from PV

Here we can see that as the luminance intensity is changing, generated power is also changing.

2.2 5-level DC-AC converter output voltages

As we know that PV cell is generating DC voltage, and demand of power is AC. We need to convert this generated DC power into AC for demand as well long distance transmission. For long distance transmission, generally AC supply is preferred with low amount of current to minimize transmission losses because loss is directly proportional to current. We boost the voltage using boost converter of 5 kHz-500Volt, so current is getting reduced with power being constant.

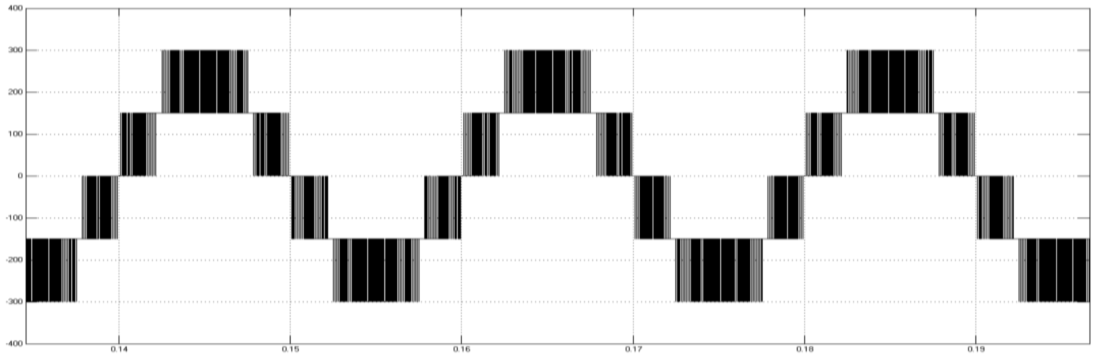


Fig 4: Five level DC-AC converter

Here figure at below shows inverter voltage with filter. In inverter topology LCL filter is used which helps to reduce harmonics and to get pure sinusoidal voltages. A proposed modulation technique reduces harmonics to a very low level.

2.3 Inverter voltage with filter

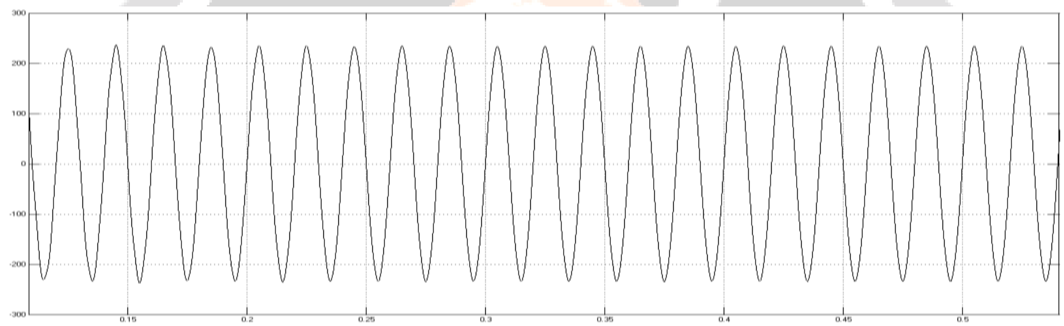


Fig 5: Inverter voltage with LCL filter

2.4 MCPWM Technique

In Dc to AC conversion in inverter four IGBT are used and two more switches are used to limit the current flow from PV array side to grid side. As well a parasitic capacitor is used which protects a device from being damage when there is a zero voltage state and it isolates a PV side from grid side, this also reduces a leakage current to considerable amount.

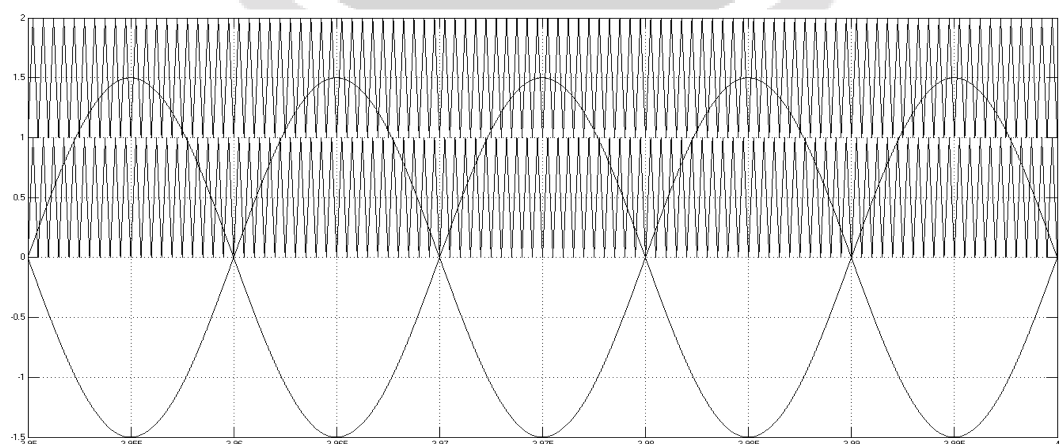


Fig 6: MCPWM modulation for PV inverter gating signal

In multilevel inverter, the amplitude modulation index m_a and the frequency ratio m_f are defined as
$m_a = A_m/(m\text{-}1)A_c$
$m_f = f_c/f_m$

Figure.7 shows a m-level inverter and m-1 carriers with the same frequency f_c and the same amplitude A_c are disposed such that the bands they occupy are contiguous. The reference wave form has peak to peak amplitude A_m, the frequency f_m, and its zero centred in the middle of the carrier set. The reference is continuously compared with each of the carrier signals. If the reference is greater than s carrier signal, then they active device corresponding to that carrier is switched off.

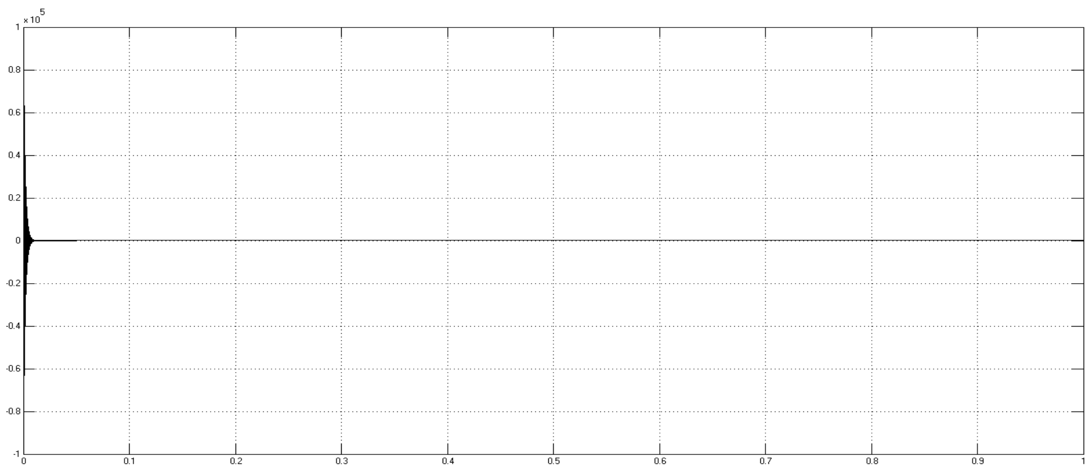


Fig 7: Leakage current in PV inverter

2.5 SDBR

Here while we do not use SDBR at that time, duty ratio is varying and there is fluctuation there while fault occurs, but we get a steady and constant duty ration when we use SDBR. Duty ration should not go to zero to avoid unwanted shutdown of plant operation.

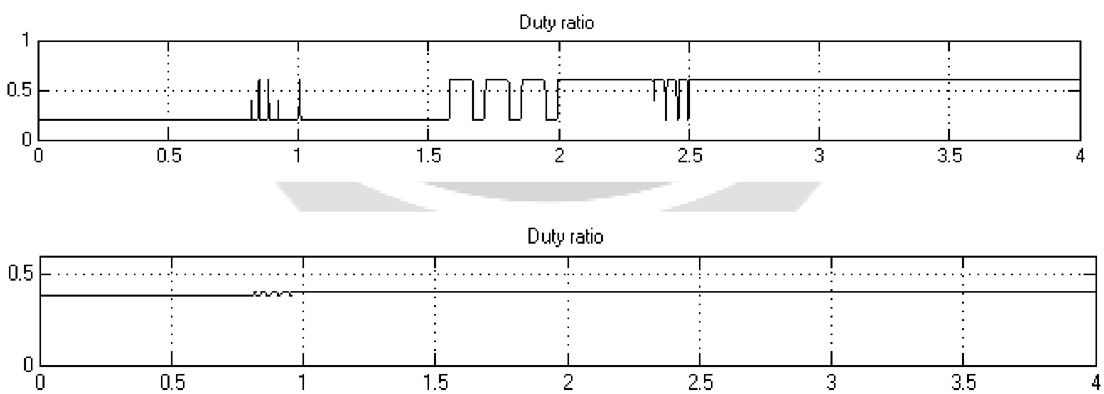


Fig 8: Duty ratio (a) Without SDBR (b) With SDBR

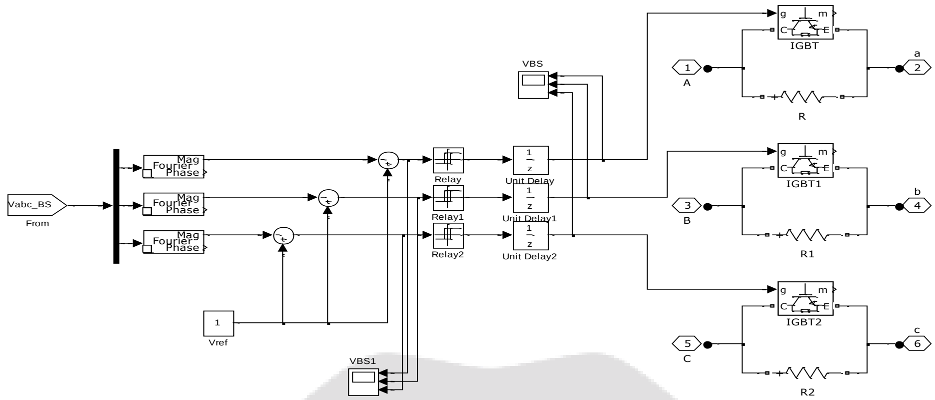


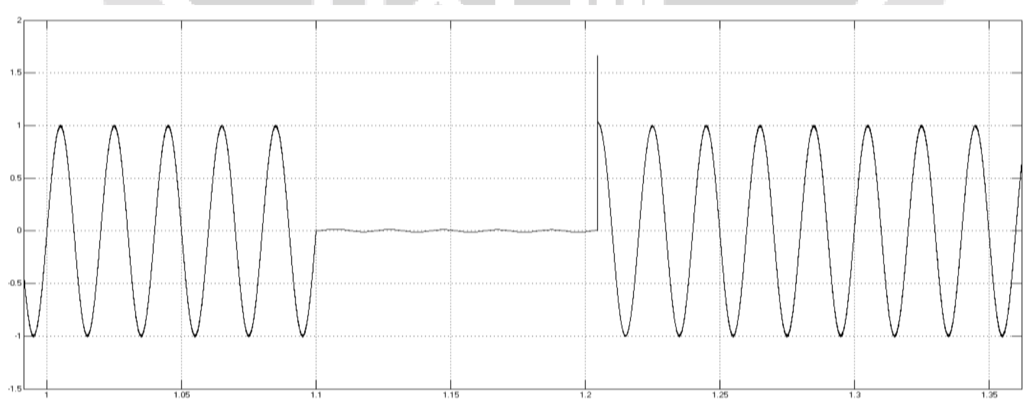
Fig 9: SDBR concept implementation in MATLAB

Series dynamic braking resistance is employed to provide voltage stability in system while fault period. A concept of braking resistance is employed in parallel with switch. In normal condition switch is normally closed allowing a power to flow through it. When fault occurs, at that time DC link voltage goes very high and it instantaneously causes a switch to trip and total power flows through resistance and here a considerable amount of voltage is dropped, and it saves a connected devices from being damage. When fault clears, then again switch activate bypassing the braking resistance, and healthy operation continues.

3. SIMULATION RESULTS

3.1 Voltage of source with and without SDBR

When the PV plant is in operation, a power is being delivered from plant side to grid side continuously. When fault occurs in line then it may disturb the plant operation, and unwanted shutdown of plant may take place. A concept of Series dynamic braking resistance helps to overcome this problem. Here a transformer is used in line and SDBR is connected after it. Figure at below shows a voltage of source side when fault occurs and figure 1 shows voltage of source with SDBR concept. Here we can see that there is a considerable amount of improvement is voltage



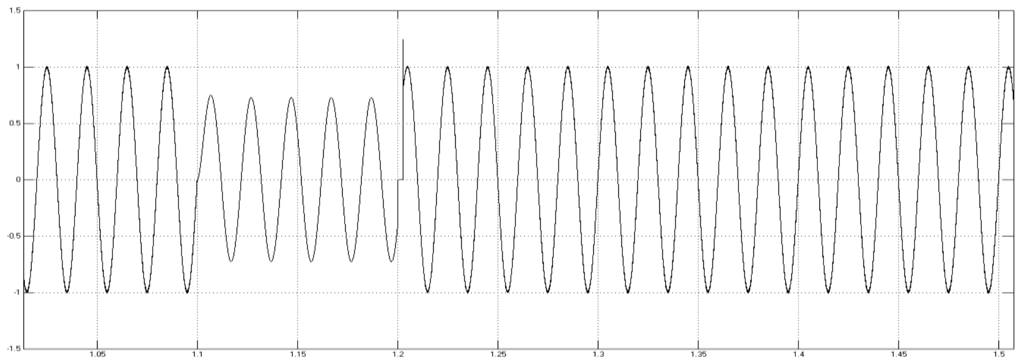


Fig 10: Voltage of source (a) Without (b) With SDBR

Here figure at below shows a harmonic analysis of transformer less PV inverter. When we use a LCL filter in inverter then harmonics produced in AC source is too less because of used modulation technique in generation of gating signals. As well this helps to reduce leakage current. We can observe that without filter, harmonics are more, and this may disturb the stability of voltage source.

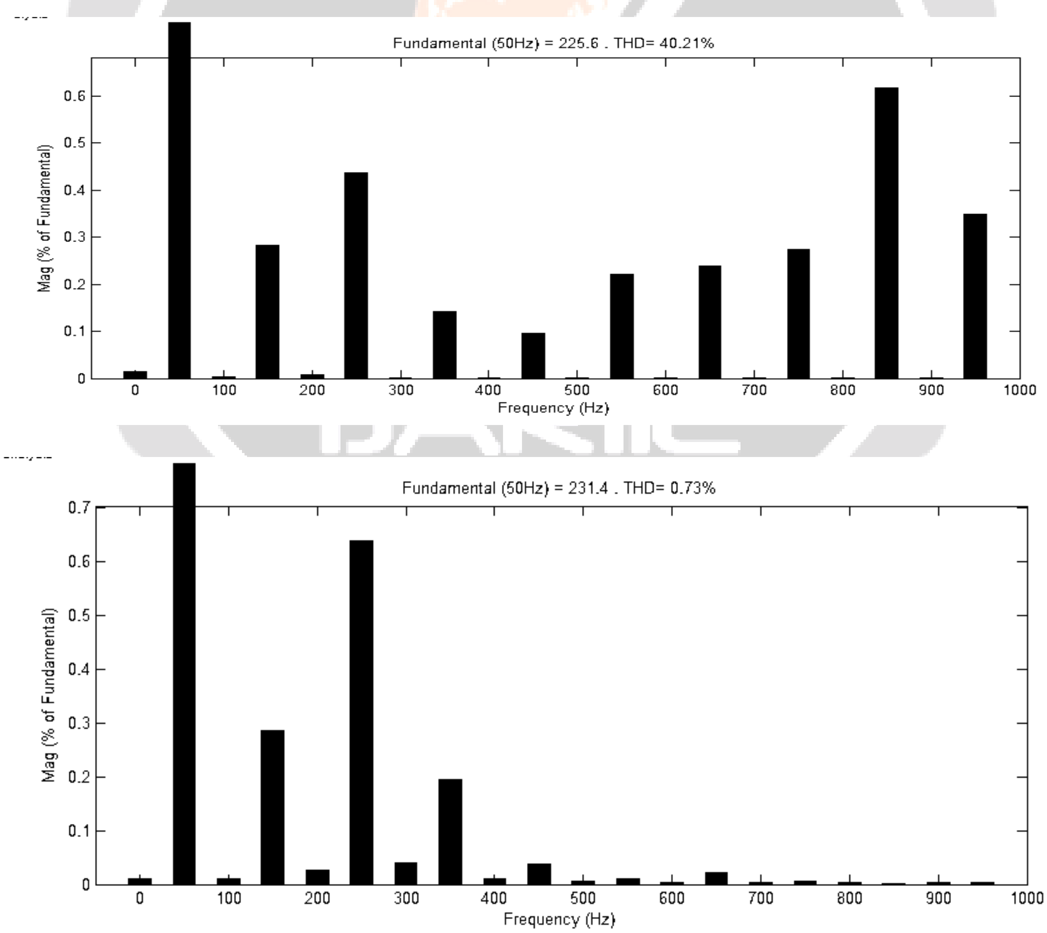


Fig 11: THD of Inverter (a) Without (b) with filter

4. CONSLUSION

1. This paper describes an application of Series dynamic braking resistance in improving a voltage capability of grid connected PV system when fault occurs. Here there is some conclusion which can be obtained from implemented simulation.
2. Proposed method of modulation technique for transformer less PV inverter and concept of SDBR helps in improvement of grid voltage when fault occurs.
3. While fault occurs, plant may trip. This proposed methods prevents such tripping.
4. Harmonics are much less while using LCL filter and MCPWM technique in PV inverter.

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