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Evaluation of the MPPT Techniques for Photovoltaic Applications To Grid Performance Using Three level Voltage source convertor

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***Abstract*—The highly increasing penetration of single-phase photovoltaic (PV) systems pushes the grid requirements related to the integration of PV power systems to be updated. These upcoming regulations are expected to direct the grid-connected renewable generators to support the grid operation and stability both under grid faulty conditions and under normal operations. Grid synchronization techniques play an important role in the control of single-phase systems in order to fulfil these demands. Thus, it is necessary to evaluate the behaviours of grid synchronization methods in single phase systems under grid faults. The focus of this paper is put on the benchmarking of synchronization techniques, mainly about Voltage based methods, in single-phase PV power systems operating under grid faults**

Keywords - *Multilevel Converter, Cascaded H-bridges, Photovoltaic, MPPT, PWM Technique, Photo –Voltaic panels.*

I. INTRODUCTION

Recently, the matured PV technology and the declined price of PV panels make more and more PV generation systems connected to the medium-voltage or high-voltage networks. However, the grid-connected PV generation units might cause severely negative impacts on the whole systems, because they cannot act like the conventional power plants composed of conventional synchronous generators. Thus, many grid requirements have been released in order to regulate interconnected renewable power generation [1]–[5]. Some basic requirements are defined in the grid regulations, like power quality, frequency stability and voltage stability, and some specific demands for wind power systems have also been issued [3]. Nowadays, the high penetration of grid connected single-phase PV systems really raises the concern about PV integration of low-voltage power systems [6], [7]. Therefore, reasonably technical requirements are in an urgent need to be put forward. Like the grid requirements for wind turbines, it is expected that the future grid-connected single-phase PV systems can not only maintain the stability and quality of the grid, but also have some ancillary functions, such as reactive Power support and fault ride through (FRT) capability [8]. In that case, the grid monitoring and synchronization techniques and the control strategies should be ready for single-phase PV applications. Many papers discuss the monitoring and synchronization for three-phase systems. Synchronization in single phase PV systems should also be investigated in details. The phase locked loop (PLL) based synchronization takes much more attention. Nowadays, there are mainly four different PLL-based synchronization techniques reported in the literature [3], [5], [9]–[13]. Among these PLL methods, the adaptive mechanism based synchronization techniques gain more attention because of their high robustness and fast response. This kind of PLL method may be the best one for single-phase PV systems operating in faulty modes. However, it will also cause undesired influences, like frequency swings as discussed in [14]. The intent of this paper is to benchmark and find the best synchronization candidate for single-phase grid-connected PV systems under grid faults defined by the basic grid codes of wind turbine generations, which are expected to be used in the future. Firstly, an overview of selected grid requirements is presented. Special focus will be moved to the synchronization methods, which are crucial for the single-phase PV systems to ride-through utility faults or operate under abnormal grid conditions in compliance with the existing grid requirements applied for medium and/or high-voltage networks. Finally, fault cases are examined and simulated in MATLAB/Simulink.

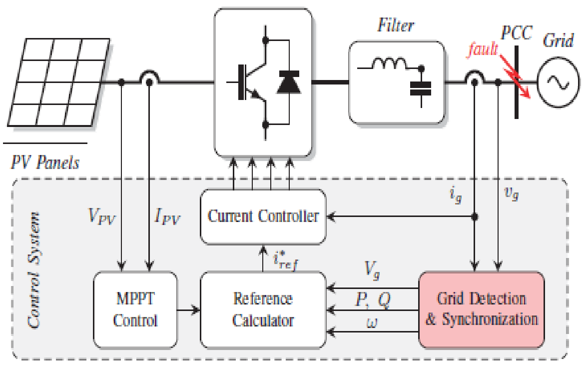

Fig.1.1: Overall control structure of a single-phase grid-connected photovoltaic system.

Boost and Voltage Source Convertor

the possibility to scale the system by plugging more strings. Traditional multilevel inverters include cascaded H-bridge inverter, diode clamped inverter, and flying capacitors inverter.In recent years, multilevel converters have shown some significant advantages over traditional two-level converters, especially for high power and high voltage applications. In addition to their superior output voltage quality, they can also reduce voltage stress across switching devices. Since the output voltages have multiple levels, lower dv/dt is achieved, which greatly alleviates electromagnetic interference problems due to high frequency switching. Over the years most research work has focused on converters with three to five voltage levels, although topologies with very high number of voltage levels were also proposed. In general, the more voltage levels a converter has the less harmonic and better power quality it provides. However, the increase in converter complexity and number of switching devices is a major concern for multilevel converter. There are several topologies available, being the Neutral Point Clamped [5], Flying Capacitor [6] and Cascaded H bridge inverter [7] . In above different topology we use in the paper cascaded bridge. In recent years many variations and combinations of these topologies have been reported, one of them is the cascaded H-bridge.

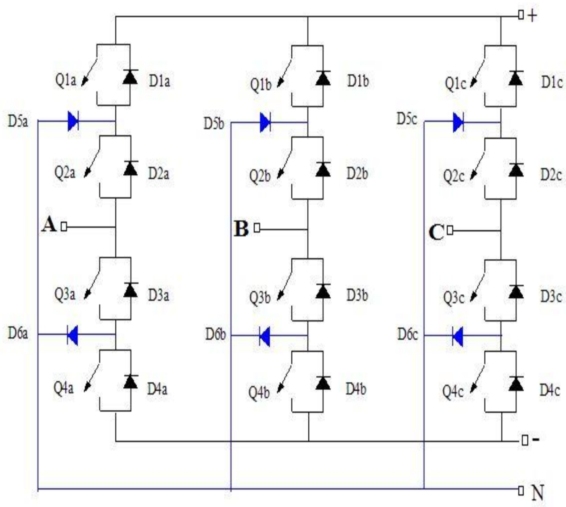

Fig:1.2. Three-Level Bridge block

II. PHOTO VOLTAIC SYSTEMS AND MPPT ALGORITHM

A Photovoltaic (PV) system directly converts sunlight into electricity. The basic device of a PV system is the PV cell. Cells may be grouped to form panels or arrays. The voltage and current available at the terminals of a PV device may directly feed small loads such as lighting systems and DC motors. [7] A photovoltaic cell is basically a semiconductor diode whose *p–n* junction is exposed to light. Photovoltaic cells are made of several types of semiconductors using different manufacturing processes. The incidence of light on the cell generates charge carriers that originate an electric current if the cell is short circuited. MPPT algorithms are necessary in PV applications because the MPP of a solar panel varies with the irradiation and temperature, so the use of MPPT algorithms is required in order to obtain the maximum power from a solar array. There are many MPPT techniques in MPPT Algorithm, Mostly we are using perturb and observation method. The P&O algorithm is also called hill-climbing. The concept of this inverter is based on connecting 7 half bridge converters in series to get a DC voltage output. The output voltage is the sum of the voltage that is generated by each cell. The number of output voltage levels are 2n+1, where n is the number of cells. After that this output voltage injected of an H-bridge inverter. The switching angles can be chosen in such a way that the total harmonic distortion is minimized.

III. SIMULINK MODELLING

Simulink is a software package for modeling, simulating, and analyzing dynamical systems. It supports linear and nonlinear systems, modeled in continuous time, sample time, or a hybrid of the two. Since MATLAB and Simulink are integrated, the simulation and analyzation the revision of models are done in either environment at any point. Figure 4 shows the overall simulation diagram. The simulation model for MPPT is shown in Fig-3.1

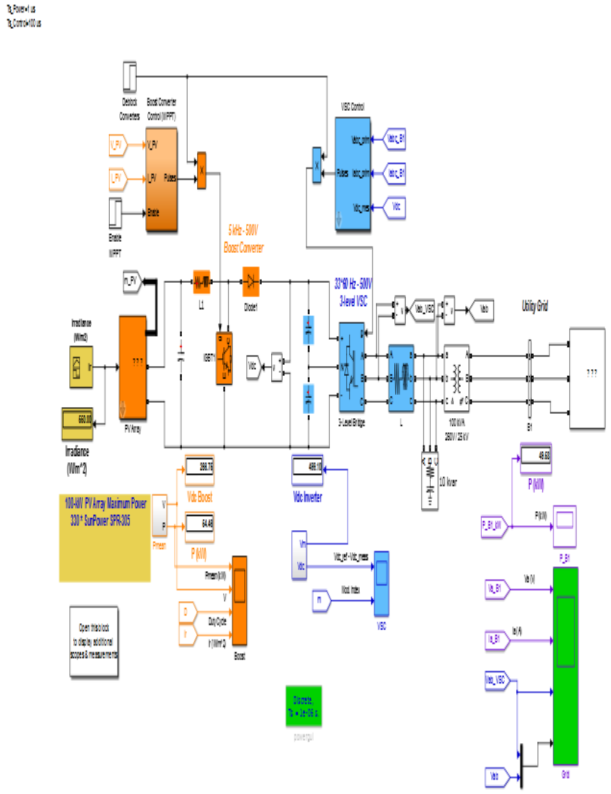

Fig: 3.1.simulation model Grid-Connected PV Array

IV. RESULTS

It applies discontinuous current manipulating technique to increase or decrease output voltage of PV, getting needed power which will be controlled through changing modulation rate of PWM. For one thing, it is unrelated with the delivery voltage of PV cells, it can put arbitrary power out to the load or system, for another, the value of power factor is high due to the control signal is in phase with the system. Finally, the circuit structure is simple and the cost is low. The greatest advantage of power type PWM inverter is that it can put power overall to the system. Show in fig 4.1.

The output of zero crossing detector is given in figure 5.2. Output of zero crossing detector is not only detecting the zero crossing of supply but also produce a high pulse of 500 V corresponding to the positive cycle of the supply

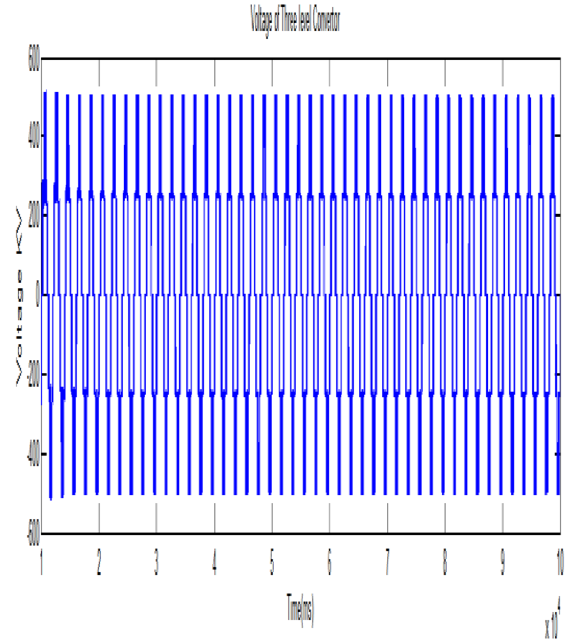

Fig.4.1: Three level voltage source Converter

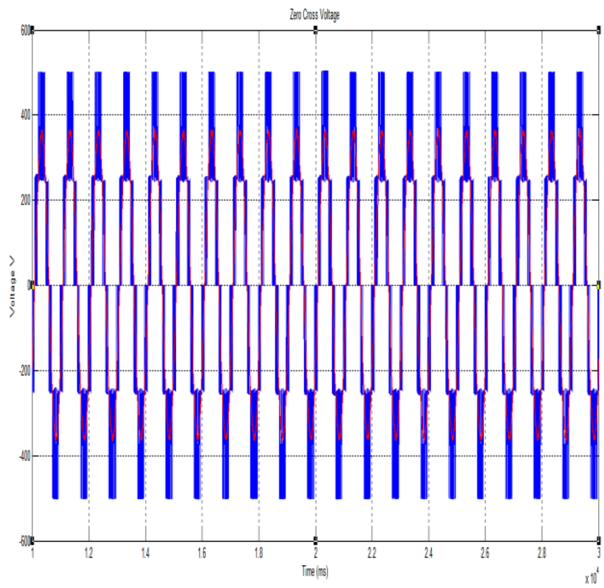

Fig.4.2 Zero Cross Voltage using PWM

PV Side Pulse and Generated Voltage must be synchronized with supply voltage and frequency the power grid. It is clear from the output voltage shown in figure 5.3 and current Figure 5.4 power is also show Fig 5.5

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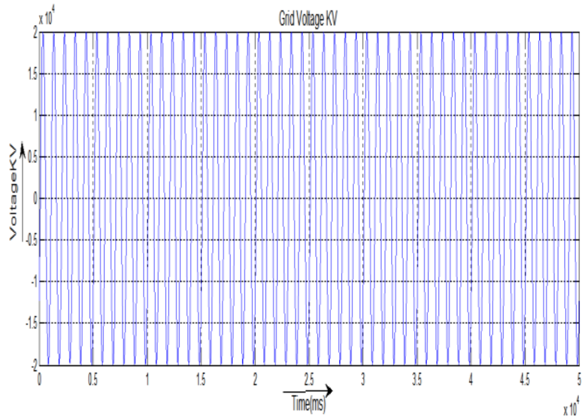

Fig.4.3:Grid Voltage

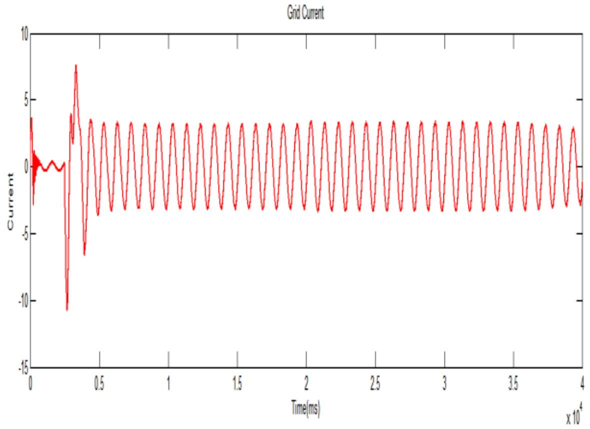

Fig.4.4:Grid Current

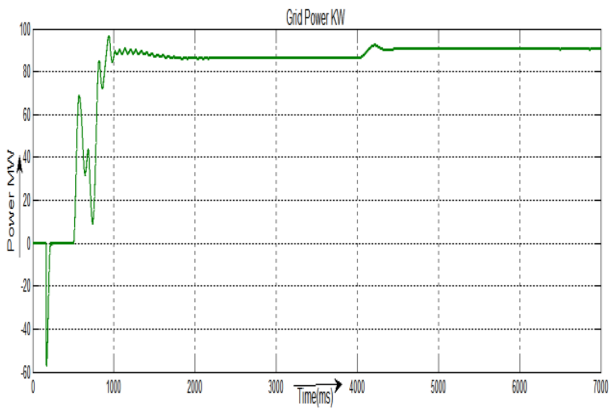

Fig.4.5: Grid Power

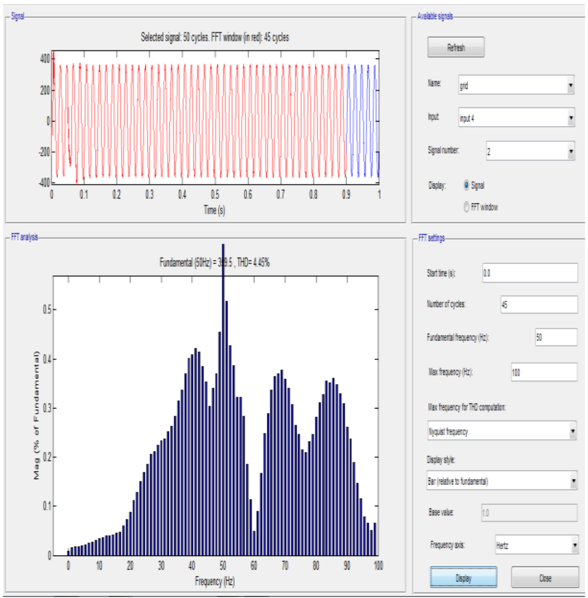

Fig.4.6 Harmonics of PV sysem Ganerated Voltage

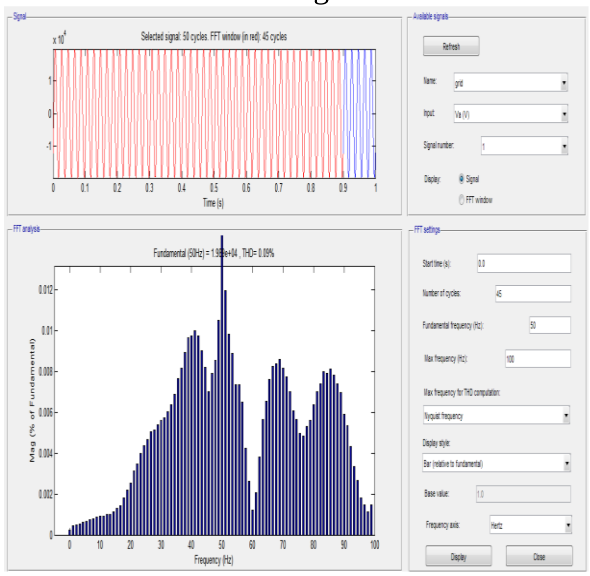

Fig.4.7 Harmonics of Grid syncronized voltage

V. CONCLUSION

The photovoltaic (PV) module is an all-electrical device that converts sunlight into electrical DC power. Solidstate power electronic inverters have been used to connect PV modules to the AC utility grid since the early seventies. The inverter has two major tasks: to inject a sinusoidal current into the grid, and to optimize the operating point of the PV modules, to capture the maximum amount of energy. Large, Megawatt, PV systems were connected to the grid in the eighties, but the trend is now to connect smaller systems to the grid, in order to overcome certain problems, like non-flexible designs, mismatch losses between the PV modules, etc. These systems are either based on the string-concept, with multiple modules connected in series, or on a single PV module

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