SOLAR PV GRID CONNECTED SYSTEM ANALYSIS

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Abstract - *The various kinds of alternative strength solar power heat, solar pv electric phenomenon, solar thermal power, and solar pv electricity supply a easy, climate-friendly, extraordinarily copious and in-exhaustive energy aid to world. Solar electricity is that the conversion of solar light into electric power, either directly exploitation electrical photovoltaic (PV), or not directly exploitation targeted solar strength (CSP). The analysis has been current in view that terribly starting for the occasion of a reasonable, in-exhaustive and smooth alternative strength era for extended term edges. Solar power technology PV (photovoltaic) generation may be a key but still evolving era with the quickest growing renewable-primarily based marketplace worldwide inside the final decade. During this sector with wonderful capacity for electricity protection and financial development, grid-linked PV systems have end up nowadays the most necessary application of solar PV technology. Supported this trend, PV system designers want accurate and reliable tool so as to expect the dynamic performance of grid-tied PV systems at any in operation conditions. This can enable evaluating the effect of PV technology on the power grids.*

This paper presents an intensive characterization of the performance and dynamic behavior of a grid-related PV energy conversion machine. The PV system is developed, simulated and validate by the use of the MATLAB/Simulink software environment.

Key Words: *Solar PV Array, AC Grid etc*

1. INTRODUCTION

The world constraint of fossil fuels reserves and additionally the ever growing environmental pollutants have driven powerfully throughout ultimate many years the occasion of renewable strength sources (RES). The necessity of getting obtainable property power systems for substitution bit through bit trendy ones demands the improvement of systems of power provide based on smooth and renewable resources. At present, solar electric photovoltaic (PV) era is ahead redoubled significance as a RES application because of distinctive blessings like simplicity of allocation, high responsibility, absence of gasoline value, low preservation and absence of noise and wear thanks to the absence of moving factors or practical's. Moreover, the alternative energy characterizes a clean, pollutants-loose and inexhaustible power supply. Additionally to those elements are the declining value and expenses of solar pv modules, associate degree increasing efficiency of sun cells, producing generation enhancements and economies of scale [1].

The grid integration of RES packages supported sun PV structures is popping into these days the foremost essential software of PV systems, gaining hobby over historical standalone systems. This trend is being exaggerated because of the numerous blessings of victimization RES in distributed (aka spread, embedded or decentralized) era (DG) energy structures.

These benefits embody the favorable incentives in several international locations that effect squarely on the enterprise attractiveness of grid-related PV systems [2,3]. This condition imposes the requirement of getting sensible first-rate developing with tools so one can predict the dynamic overall performance of grid-tied PV structures at any operative conditions. This suggests no longer entirely to spot the prevailing voltage (IeV) traits of PV modules or arrays however conjointly the dynamic performance of the ability getting to know system (PCS) had to convert the energy created into helpful power and to deliver wishes for facility interconnection. This can permit evaluating appropriately the impact of PV era on the power grids.

Now comes the financial part. Producing electricity using renewable assets is greater high-priced than producing strength using non-renewable ones. But an engineer need to continually suppose from an monetary point of view. Therefore considering all of the fields of generation, transmission, distribution and usage of electric power, the project must be economic sufficient which will maintain well in competitive market scenario. So, the engineer should adopt the most convenient, easily accomplishable but the cheapest way for generation, transmission and distribution. Again for authorities grant, the venture must be surroundings friendly, no longer ruining nature's properties, as a consequence here; monetary load dispatch comes into play. The manner to meet the electricity demand of the natives must additionally be capable of cut down the diverse system constraints. The engineer must also keep in mind the truth that there is constantly a rate hike for greater or much less every commodity within the market, each year. Therefore the numerous recurring costs like maintenance fees, running charges of the venture will increase day via day. To get an optimum power generation, consequently, hybrid electricity is used in order that the increase in price because of use to renewable assets may be compensated. Moreover keeping in thoughts the various blessings of hybrid system like green technology, quick set up of components, inexhaustible fuel etc. Hybrid gadget is chosen for this work.

2. PROPOSED APPROACH

Figure 1 shows the solar pv grid connected system block diagram. As throughout the day solar energy is present but due to the sun intensity and unpredictable shadows by the clouds, birds, trees etc the solar irradiation levels varies. Due to this cause solar energy is unreliable and less used. The PV side the output of the PV array is connected with a dc-dc boost converter to rise the output voltage up to a desire level. This solar PV grid connected system implemented using MATLAB simulink software.

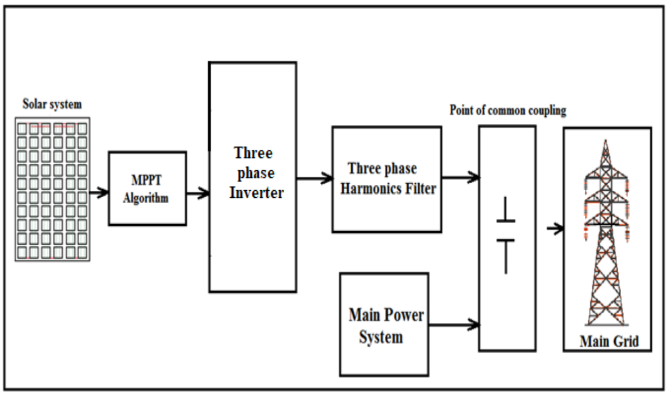

Fig.-1: Block diagram of proposed solar pv grid connected system

Figure 1 shows the basic idea of proposed approach. In this approach solar pv array 4.5 kw system integrated with 11 KV AC grid system using 180 degree mode inverter system. Also in parallel with small 33kv power system is connected with main grid power system.

3. MATLAB SIMULATION MODE

Figure 2 shows the complete matlab simulink model of solar pv grid connected system. Blue block is consist of solar pv subsystem model, green color block is consist of three phase 180 conduction mode inverter with inverter controller subsystem, Light blue color block is consist of LC filter for harmonics reduction from inverter output voltage and current. Gray color block is consist of coupling transformer, pink color block is consist of three phase infinite grid, yellow color block is consist of three phase power system model and dark green color is consist of bus bar measurement subsystem for bus bar three phase voltage and current.

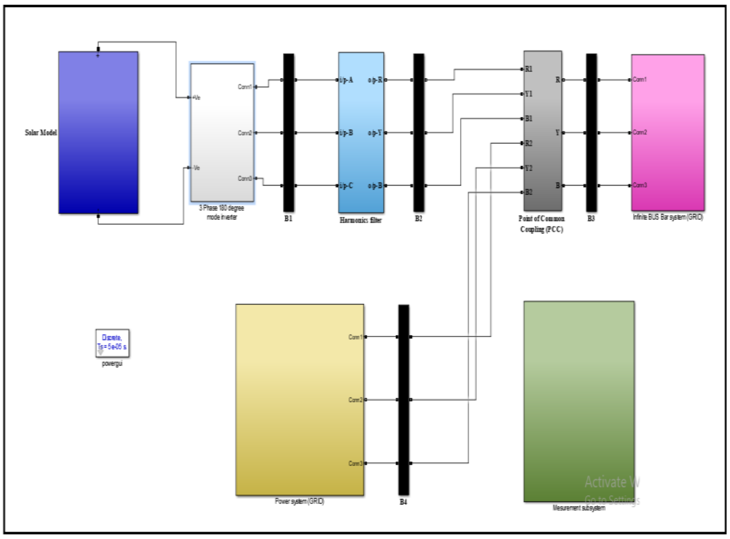

Fig-2: Proposed matlab simulation model of solar grid connected system

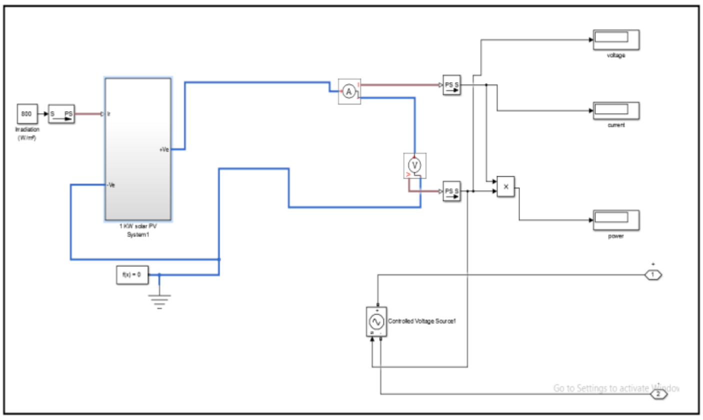

Fig-3: Solar PV subsystem model

Figure 3 shows the solar PV subsystem model in which solar irradiation and temperature adjusted also different company solar models available. In this case we were design 4.5 KW solar pv array system. In figure 3, there are different solar pv and vi characteristics for different solar irradiation is calibrated. That VI and PV characteristics are matches with standard characteristics define by manufacturer. Table 1 shows the parameter specification for 4.5 kw solar pv array system. There are 4 modules of 285 W connected in series in single strings. And such four strings are connected in parallel which generates 4.5 KW peak power at standard temperature condition STC condition

Table-1: Solar PV subsystem MATLAB simulink model parameter specification

Sr No	Name of block	Specification
1	PV Array	Parallel string = 4; Series connected modules per string = 4;; Maximum power = 285 W; Cell per module=72; Open circuit

		voltage (Voc) = 44; Short circuit current (Isc=5.7A; Voltage at maximum

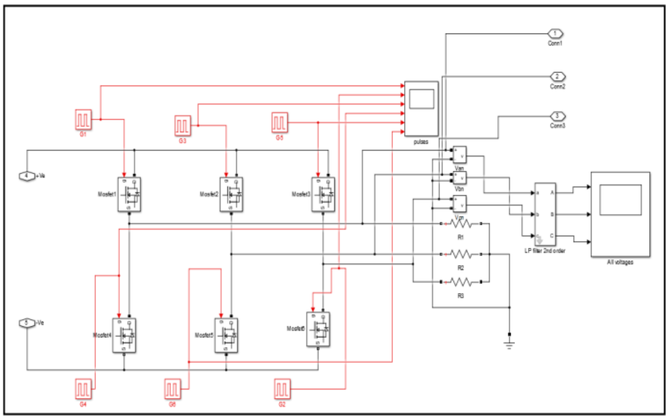

Fig-4: Inverter model subsystem

Figure 4 shows the six pulse MOSFET based three phase inverter subsystem model in which the firing pulses of inverter susbsyetm was controlled by 180 degree mode of operation. Figure 5 shows the three phase LC filter in which three phase supply generated from inverter output was purify by removing the third and fifth order harmonics content from inverter output supply. Then after LC filter we get sinusoidal output power which is then fed to the coupling transformer for fed to the power system and infinite bus of power system.

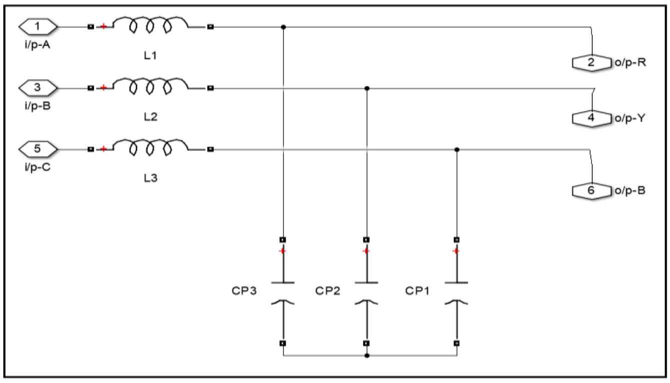

Fig-5: LC filter for harmonics reduction of inverter output

Figure 5 shows the LC filter for third and fifth harmonics generated after inverter DC to AC conversion process. In which parallel inductor and capacitor circuit connect at each three phases of inverter output. After LC filter pure sinusoidal output is generated which then fed to the three phase grid connected system. Figure 6 shows the coupling transformer which used for sharing of PV system generated power to power system and infinite bus for of grid system.

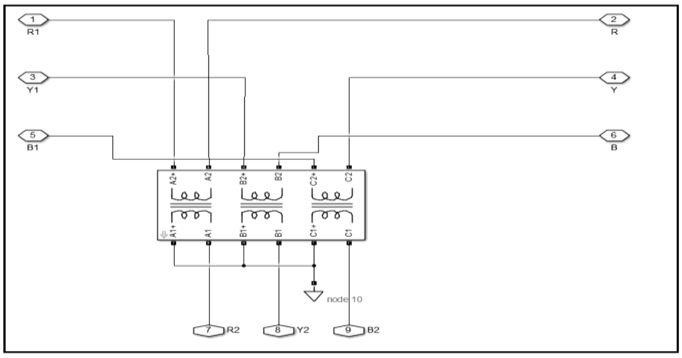

Fig.-6: Point of common coupling for coupling and synchronization of solar and grid system

Figure 7 shows the power system model which generates the 33 KV from generate side and which step down at 11 KV. That power system model act as small industrial power system of 11 KV system. That power system is connected with main power grid through common coupling point transformer. The primary and secondary side of common coupling transformer is 11/11 KV like isolating transformer. PCC transformer only connect in system for coupling of inverter, small power system and AC grid system coupling and synchronization at 11 KV, 50 Hz power supply with phase shift or phase difference in each phase.

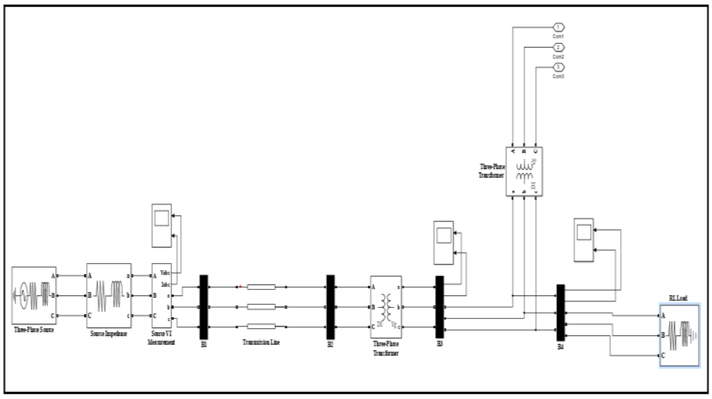

Fig-7: Power system model connected with solar PV system

4. MATLAB SIMULATION RESULT

Figure 8 shows the three phase voltage and current waveform which generated after three phase multi-level inverter system. In that waveform it is observed that the voltage and current have so many harmonics content presents but generated three phase supply is perfectly 120 degree apart from each other and having same magnitude.

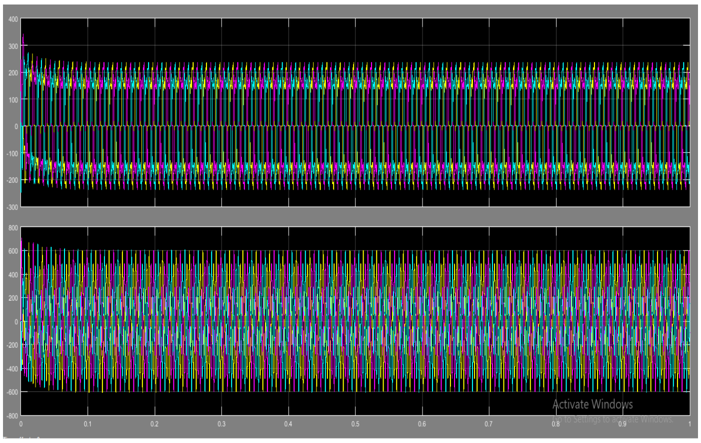

Fig-8: Bus bar 1 three phase voltage and current waveform after inverter output

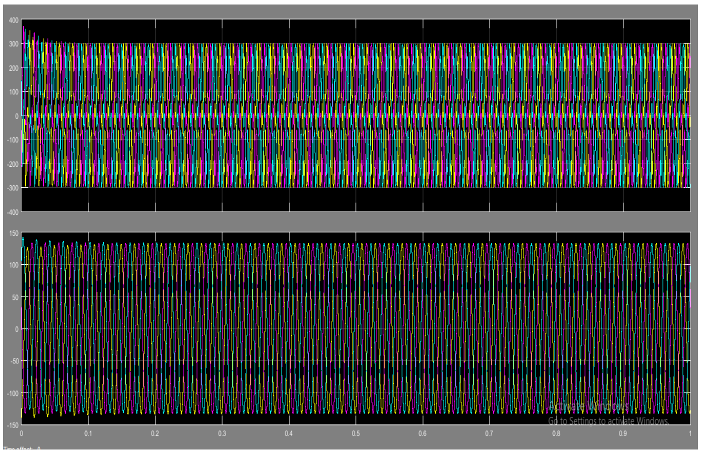

Fig-9: Bus bar 2 three phase voltage and current waveform after LC filter output

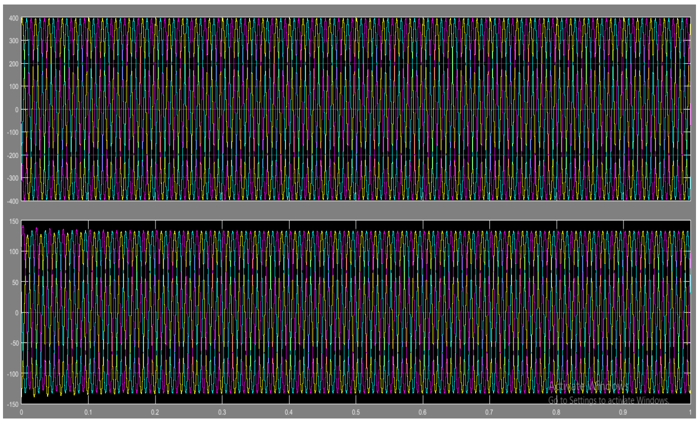

Fig-10: Bus bar 3 three phase voltage and current waveform after grid connected with solar output (at point of common coupling)

Figure 9 shows the three phase voltage and current waveform after LC filter subsystem in which it is observed that harmonics content present in three phase voltage was completely removed while some small harmonics content was present in three phase current waveform.

Figure 10 shows the three phase voltage and current waveform measured at point of common coupling transformer at which PV generated three supplies synchronized with ac grid and power system. It is observed that pure sinusoidal 11kv voltage was generated and synchronized with power system and grid system.

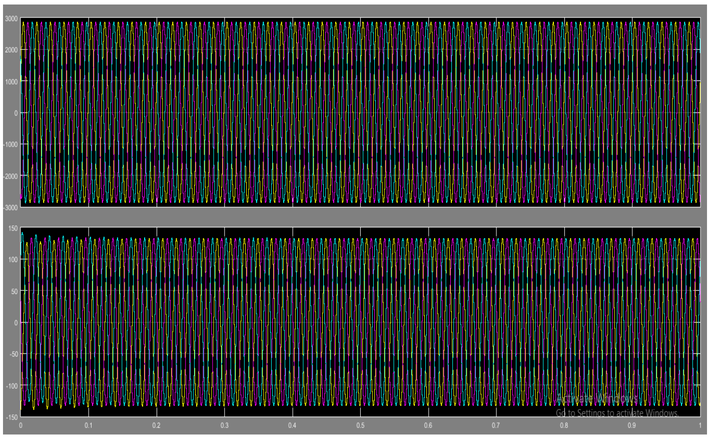

Fig-11: Bus bar 4 three phase voltage and current waveform at infinite bus system (at power system grid)

Figure 12 shows the three phase voltage and current waveform at infinite bus bar that is grid of power system. It is observed that proposed inverter system exactly synchronized the three phase system with infinite grid system.

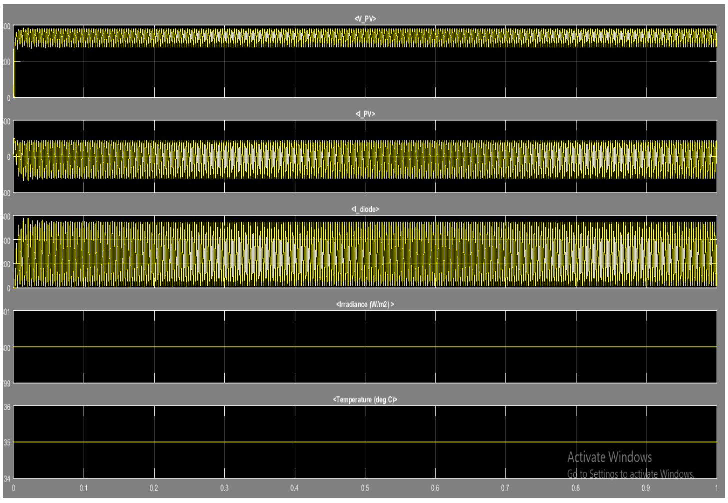

Fig-12: Solar PV system output DC voltage and current waveform for constant irradiation and temperature condition

5. CONCLUSION

This paper present, the grid connected solar pv system model in which 180 degree conduction mode inverter used for generation of AC three phase electricity from solar pv system. The complete project idea was simulated in MATLAB simulink. MATLAB Simulink result shows that the generated AC three phase power successfully fed to three phase system using inverter and point of common coupling transformer. From simulation results it clear that using 180 degree mode inverter and PCC transformer, system is synchronized with AC grid at constant 11KV, 50 Hz supply specification.

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