UNBALANCED DISTRIBUTION NETWORKS WITH PHOTOVOLTAIC GENERATION

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Abstract – *In this paper an unbalanced distribution network with grid interactive solar photovoltaic system of is designed. The proposed system takes DC power input employing a MPPT controller from solar photovoltaic module. Maximum power point tracking may be a mechanism used for obtaining optimum power from PV cell in varying intensity of sunlight. Solar Photovoltaic systems acting as a distributed generation, the DC energy obtained is fed through the power-conditioning unit inverter to the grid. The proposed model are going to be developed using MATLAB/Simulink to get the results for the active, reactive, and apparent powers that are supplied to the electrical grid.*

Key Words: Photovoltaic (PV), Distributed generation (DG), Reactive Power (Q), Active Power (P) and Maximum Power Point Tracker (MPPT)

1.INTRODUCTION

Electric utilities have centralized electricity generation and distributing satisfied customers demand by through an in depth transmission and distribution lines. If demand increases beyond a particular level, generation, transmission and distribution capacities are often unable to supply the required amount of energy becoming mandatory new investments. The delivery of electrical energy is required where DGs are strategically placed near consumption points. DG can improve voltage profile of the feeder, load curve and reducing the extend of charge of feeders and transformers, if the primary source of energy is renewable we will avoid the emission of polluters.

Economic benefits to the energy company reduction of risks due to fossil fuel market uncertainties also include reduction in electric loses, decrease of energy cost production, bigger capacity of generation. Renewable sources such as small hydroelectric centrals, biomass, wind energy generation and photovoltaic systems include the subsequent benefits. The merits of use of photovoltaic systems as a Distributed Generation are energetic potential, decrease of the present price of the photovoltaic system components, freed from polluting emissions, high reliability, multi functional features of the building elements and high efficiency of the PV system connected to the facility grid. The most application supported on international data of the PV has been the connected to the electrical grid in developed countries. The bulk of inverters are CSI operating with a unity power factor that is used to connect the PV to the electrical power system.

2. OPERATION PRINCIPLES OF PROPOSED SYSTEM

The proposed system with fixed PV is connected to the inverter comprises of setting the facility angle in accordance with photovoltaic system completing the control of the voltage Vc of the DC bus capacitor. The variation of the generated energy changes with insolation level and provides more or less active power to the electrical grid.

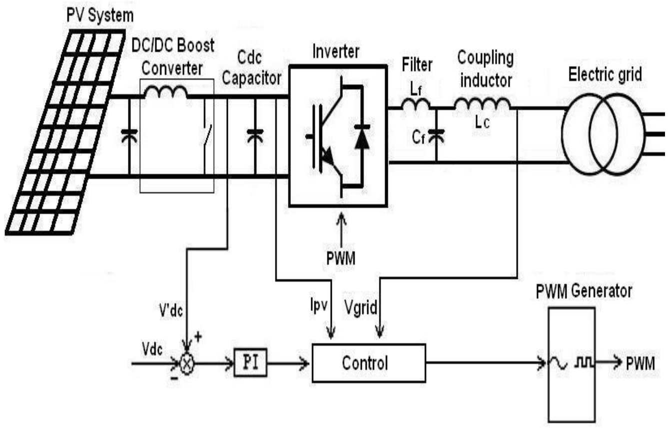

Figure 1 Power system and control of the PV connected to the electrical grid

Figure 1 shows the power system and control of the PV connected to the electrical grid and it are often seen that the components of currents I_p and I_q so as to regulate the flow of the active and reactive powers of the inverter. Voltage V_i *is* provided in its terminals and currents I_p and I_q are set in suitable values, components are often alternated by working properly with the inverter for the specified compensation. The proposed system includes Photovoltaic, DC/DC boost converter, DC side capacitor -C_{dc}, full bridge inverter with PWM switching frequency *fs* control, filter- L_f and C_f, coupling inductor of the side AC –LC filter, voltage and current sensors.

Figure 1 shows the measured variables of the inverter circuit structure of this techniques includes voltage DC of the capacitor, voltage of the electrical grid and therefore the current of the PV. The maximum power point tracking (MPPT) for the PV array outputs are often realized by the boost circuit.

The closed-loop system operation of the DC link voltage is depends on the output power of the PV array is variable with the temperature of the cells and therefore insolation level. The output active current of the inverter are often obtained by comparing error between the measured DC link voltages V_{dc} and therefore reference DC link voltage V_{dc}. Let the measured voltage be the positive input and reference DC link voltage be the negative input. When the measured DC value is above than the reference DC value, the error is positive and therefore the inverter produces the active power. When the measured DC value is less than the reference DC value, the inverter decreases or stops delivering the active power. The power of the inverter is decided by the maximum active power provided by the PV. As shown if figure 2 so as to specific value of active power, by the nominal apparent power the reactive power provided or absorbed by the inverter is restricted.

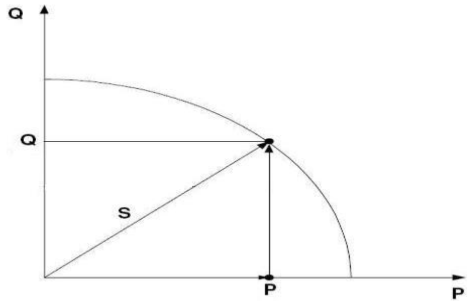

Figure 2. Operational modes of the inverter

For inverter operation if P>0 supplying active power, P<0 Absorbing active power, Q>0 supplying reactive power, Q<0 Absorbing active power as shown in figure 2.

3. SIMULATIONS AND RESULTS

The software MATLAB was used in the simulations to obtain the results for the active, reactive, and apparent powers that are supplied to the electric grid. The inverter is used to supply active power from a DC source to the grid as shown in figure 3.

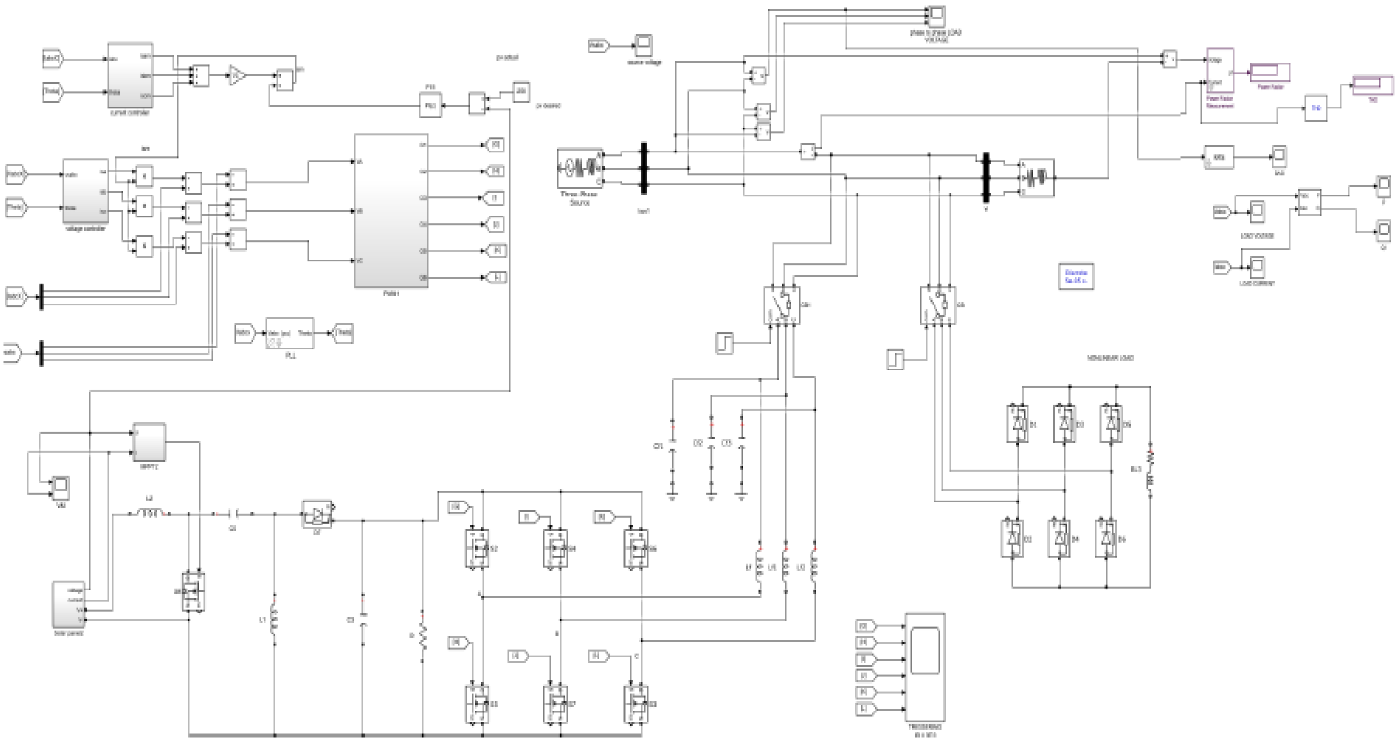

Figure 3 Proposed Simulation Circuit for supplying active power

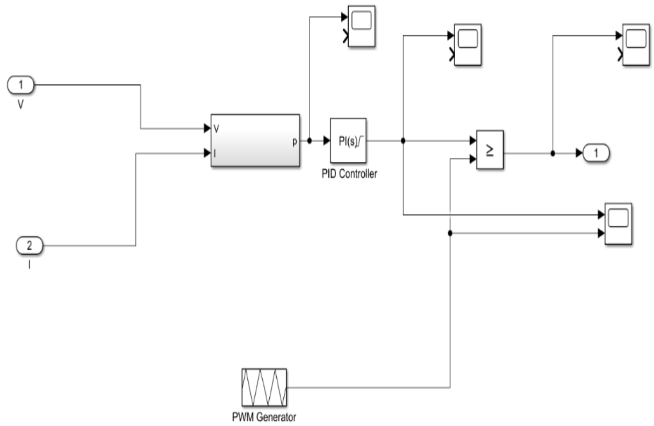

Figure 4 MPPT Controller

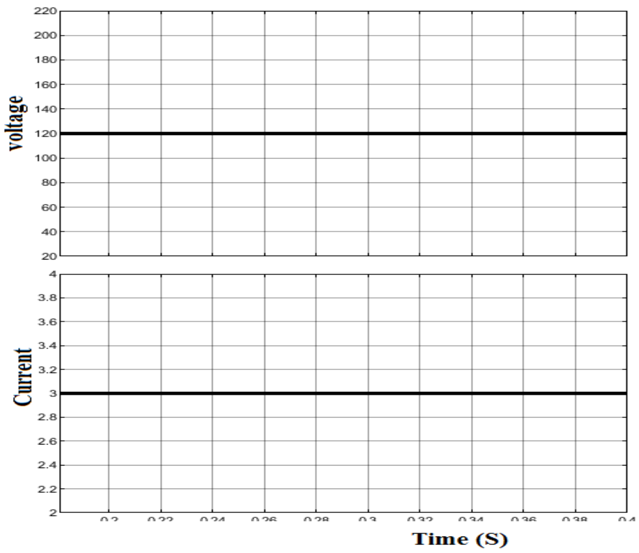

Figure 5 Solar Input voltage and current

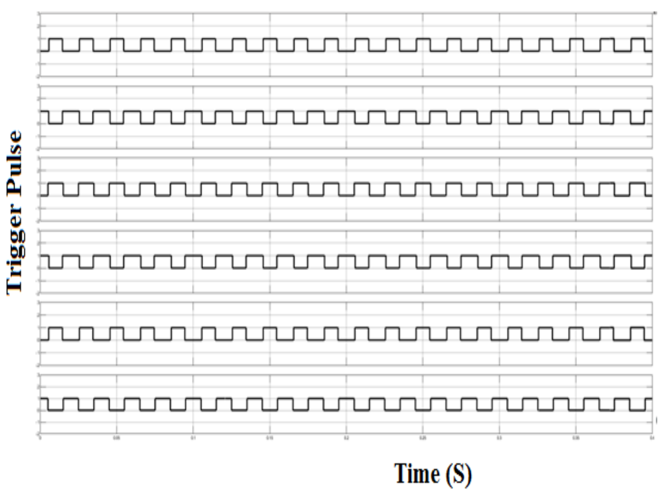

Figure 6 Trigger pulse

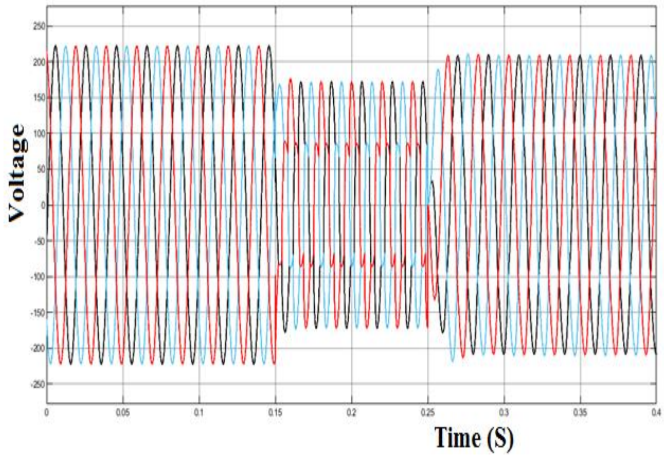

Figure 7 Three Phase Source voltage

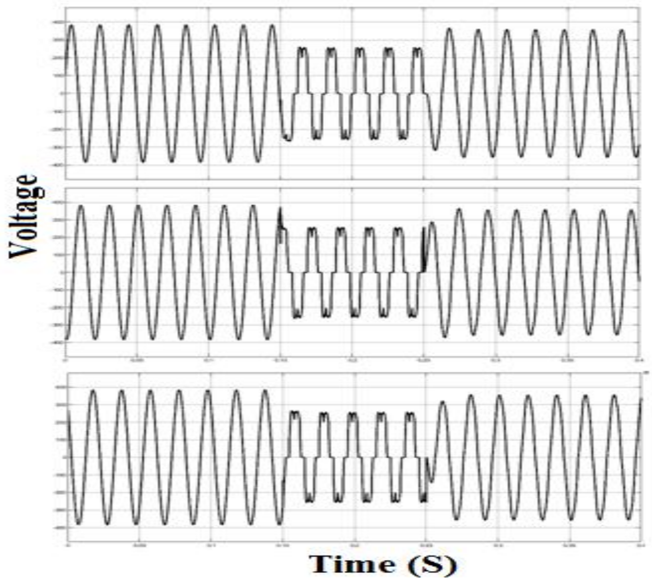

Figure 8 Phase to Phase load voltage(single phase)

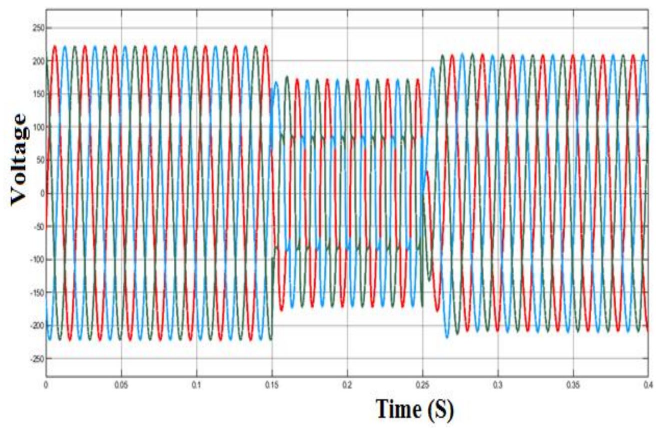

Figure 9 Three Phase Load voltage with MPPT

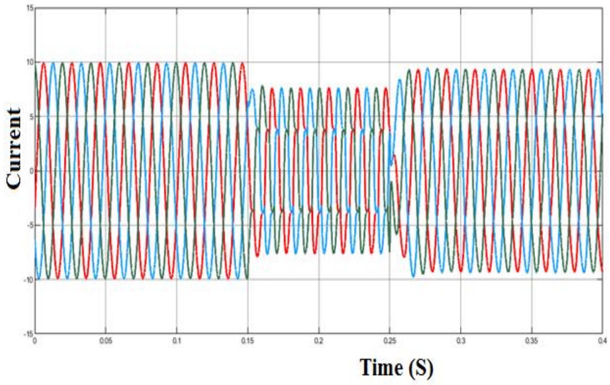

Figure 10 Three Phase Load Current with MPPT

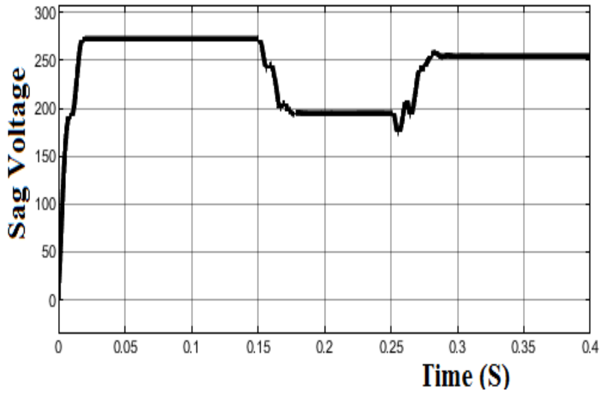

Figure 11 Sag Voltage with MPPT

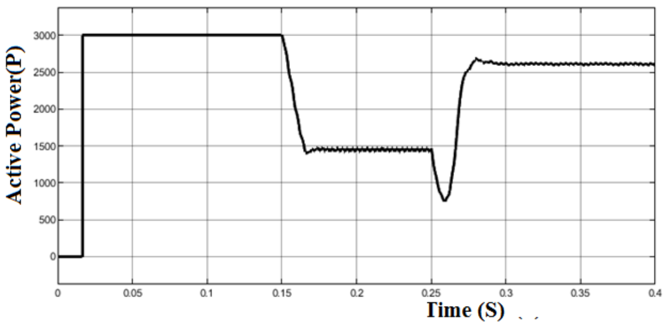

Figure 12 Active Power with MPPT

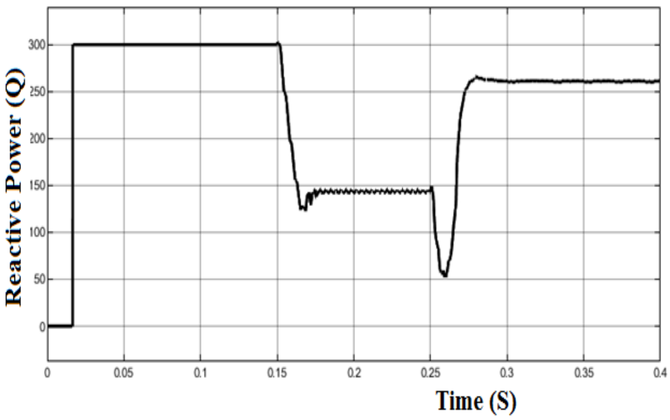

Figure 13 Reactive Power with MPPT

4. CONCLUSION

In this paper an unbalanced distribution network with grid interactive solar photovoltaic system of is designed and simulated using MATLAB/simulink. Simulation results have shown that the system developed to regulate the active and reactive powers supplied. The utilization of the proposed system become possible to work a photovoltaic system in supplying both active and reactive power in accordance with availability of solar radiation and necessities of the electrical grid and becomes quite suitable to enhance the transient and dynamic stability of a influence electric system.

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BIOGRAPHIES

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