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A REVIEW ON OPTIMAL POWER CONTROL OF GRID CONNECTED PHOTO VOLTAIC RESOURCES

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***Abstract*—The increasing in electricity demand, fast depletion of fossil fuel and the growing towards renewable energy resources, the integration of Distributed Energy Resources (DERs) such as solar Photovoltaic (PV) generation in the utility grid is high popularity in the present years. Most Distribution generation resources are connected to the utility grid or micro grids with the help of power electronics interface. They are ability of producing both active and reactive power with the proper control of the inverter interface. It is also used to controlled constant value of voltage at the DC-link voltage. The control technique works very well under the variations of temperature and irradiance for supplying power with different power factors into the grid.. Various case studies are presented to validate the proposed methods. The simulation results prove the effectiveness of the proposed control methods.**

Keywords: voltage source inverter, mppt.

1. INTRODUCTION

In the case of photovoltaic sources, an inverter of some capacity will always be associated with the connection to the utility grid to transform the DC power supplied by the PV array to an AC output that can be connected to the utility system. When reactive power compensation in distribution systems is considered, almost exclusively, In the case of inductive loading and compensation with capacitor banks is observed. New technique, such as Static Var Compensator (SVC), Static synchronous compensator (STATCOM), etc. are predominately used in high voltage transmission systems.

STATIC VAR COMPENSATOR: static VAR compensator is a set of electrical devices for providing reactive power on high-voltage transmission networks. SVCs are part of the Flexible AC transmission system devices, regulating voltage, power factor, harmonics and stabilizing the system.

STATIC SYNCHRONOUSCOMPENSATOR:

It is also known as a static synchronous condenser, is a regulating device used on alternating current electricity transmission networks. It is based on a power electronics voltage-source converter and act as a source or sink of reactive AC power to an electricity network.

However,in recent years, several contributions where usage of grid-connected Photovoltaic (PV) system inverters for reactive power generation (i.e., compensation) in distribution systems was proposed.

Total operating costs of a grid-connected micro grid of PV system is considered. Hence, a simple control technique for a PV system connected with the grid is presented in this paper. The Voltage Source Inverter (VSI) at the grid side is controlled to maintain the constant value of voltage at the DC-link voltage and supply a reactive and active power with different power factors to the grid. Simulation results reveal the control technique fulfills very well with variations in the temperature, irradiance incident in PV array.

II. CHARACTERISTIC OF PHOTOVOLTAIC GENERATION

A grid connected PV system converts sunlight into ac electricity. The main purpose of the system is to reduce the electrical energy importance from the electric utility. The dc output current of the PV array Ipv is converted into ac and injected into the grid via an inverter. The controller of this inverter includes all the main control and protection functions. Solar irradiance is the radiant power incident per unit area on a surface. It is usually expressed in W/m^2.

The effect of irradiance and cell temperature on Ipv-Vpv characteristic curve is shown in Figure 2 and Figure 3 respectively. Figure 2 shows that the maximum power output varies almost linearly with the irradiance. Figure 3 shows that the maximum output power from the array decreases as the temperature increases

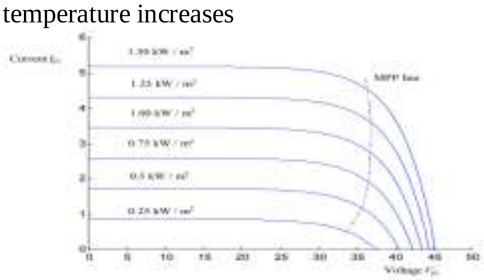

Fig:2- Effect of irradiance on the I-V characteristic at constant cell temperature

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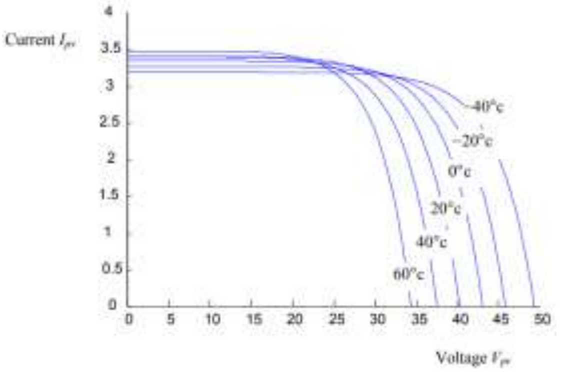

Fig:3- Effect of temperature on the I-V characteristic at constant irradiance

For grid-connected PV systems applications, it is necessary to have an interface between the PV array and the grid to regulate the PV voltage thus to obtain the maximum power of the PV array and to inject sinusoidal current to the grid at a different power factors. The configurations From efficiency and reliability point of view Single-stage PV systems have been reported by researchers using many circuits topologies and different control approaches to managing the active and reactive power of grid-connected PV systems with MPPT. Depending on the range of the electric power, PV systems are classified as three phase or single-phase systems.

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For low power application of about few kilowatts, single phase PV systems are required to operate at unity Power factor (PF) with maximum power point tracking. The power generated by the PV system has to supply the grid or local loads and the grid when the PV system output power is greater than the load demand. The active power flow direction; on the grid side, depends on the power generated by the PV system or on the power required by load.

III. VOLTAGE SOURCE INVETER:

A three phase VSI has been utilized as a power electronic interface between the DC-link voltage and the grid at the grid side. The control of the VSI is responsible for supplying power into the grid with different power factors (lagging, unity, and leading) to the grid. 220V and 50Hz are considered the magnitude of the RMS phase voltage of the grid and its frequency, respectively. To implement the control of the VSI, the voltages Vab, Vbc and the currents Ia, Ib at the grid side should be sensed and changed from stationary reference (abc) to the rotating reference (dq). Change of variables from the abc frame to qd0 frame is used in electric machine analysis because it eliminates the time-varying inductances in the voltage equations.

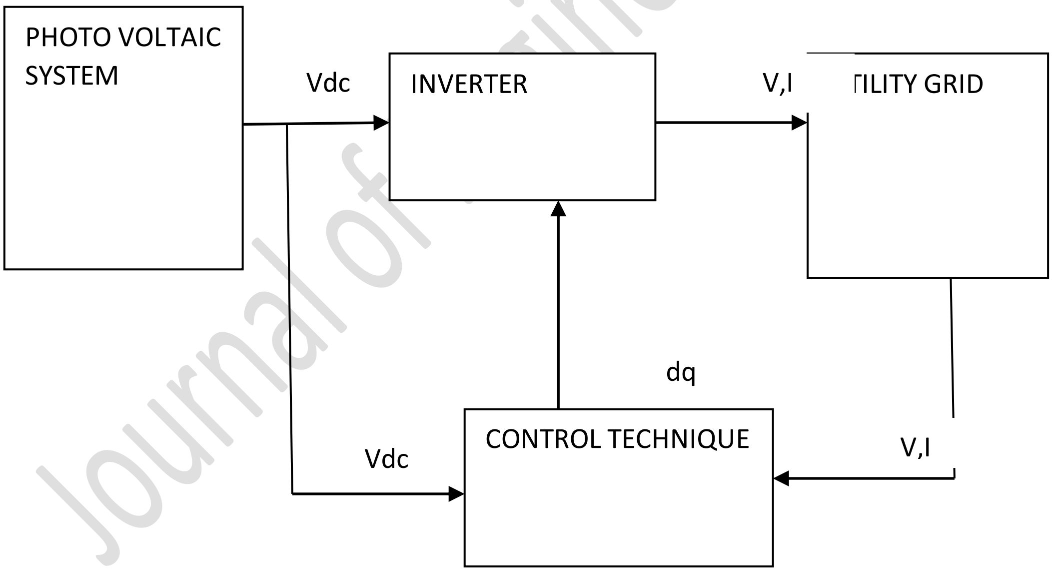

Fig:4- block diagram of pv system connected to grid with control technique

The Park's transformation is used widely in grid-connected inverter because the control variables become DC values, thus the design of the controller Fig.4 shows the control strategy of the VSI to attain the voltage value at the DC-link voltage at a constant value and to supply active and reactive power with different power factors (lagging, unity, and leading) into the grid. The output of the used PI controller is id*, multiplied this value by 1.5 vd to get the active power value. Also to supply a reactive power into the grid with specified power factor,the active power value should multiplied by tancos-1(p.f). To get iq*, the reactive power value should divide to 1.5vd So, after calculating id*and iq*, the power can be supplied into the grid with different power factors (lagging, leading, and unity) according to the chosen power factor.

$P=1.5*Vi_d$

$Q=1.5*Vi_q$

(The proposed controller should ensure that the d-axis inverter output current (t) tracks the d-axis reference current $I(t)$, which novel trajectory is obtained online from the voltage dynamics of the DC link capacitor, and that the q-axis current Iq tracks the q-axis reference current $Iqref$ obtained from the load requirement.

Therefore, the objective of the control scheme is to design the control signals $d_d(t)$ and $d_q(t)$ such that $I_d(t) \rightarrow Idref(t)$ and $Iq(t) \rightarrow Iqref(t)$ as $t \rightarrow \infty$, thus controlling the active &reactive power of the system to keep the unity power factor on the grid side.

Moreover, the PV system must operate at a maximum power point while maintaining the other objectives. To achieve MPP operation, the control law must also ensure that $(t) \rightarrow V(t)$ as $t \rightarrow \infty$, where $Vref(t)$ is the reference voltage obtained.

First, to evaluate the performance of the control scheme under various atmospheric conditions, a constant temperature of $25oC$ was set and the irradiance was changed in steps from 0 to 600 to 800, to 1000 and finally back to 800 $W\ m2 \,/$ at t= 0, 0.2, 0.4, and 0.6 seconds respectively. the steady state and dynamics response of the PV power to variations of the irradiance after that the active and reactive power injected into the grid for different values of irradiance. It can be concluded that the reactive power supplied to the grid is zero, as it was desired. Further calculate the phase-voltage and the phase-current of the grid. Then finally that the grid voltage and current with leading, unity and lagging power factors, respectively.

IV.CONCLUSION

The Matlab/simulink program has been used to model and simulate the PV energy system connected with the grid with the suggested control method. The simulation model of the complete system is working under diverse operating conditions such a variations in temperature, radiation, and supplying powers with different power factors into the grid. A simple control technique is used to achieve the power at grid with different power factors form solar system. The MATLAB simulink is used to achieve this analysis through simulation results.

From the analysis, the voltage value at the DC-link voltage has been attained at constant value, and supplying an active and reactive power with different power factors (lagging, unity, and leading) into the grid have been achieved through the control of the Voltage Source Inverter (VSI) at the grid side..

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