A Review of Various Power Quality Issues in Solar Power System Connected Grid

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Abstract— Solar is the major source to generate the electricity. To meet the energy has been utilised more than non-renewable energy. The renewable energy such as solar, wind, hydro and geothermal. The renewable energy are more abundant and it is environment friendly. The demand of electric power is huge and it is expected to increase in future. [1]The grid connected power system consists of PV panel, power conditioning unit and inverter solar panel grid connected system feeds solar panel energy directly to the loads without battery storage. [2]Power quality issues that occur between grids end to distribution side in. In this paper, solar energy, various power quality issues and the methods to overcome them have been discussed and using Matlab Simulink the power quality issues are improved.

Key words: Power Quality, PV Panel, Matlab

I. INTRODUCTION

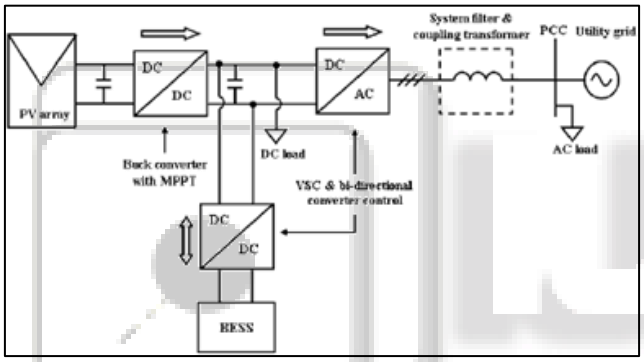


Fig.1.1.Block diagram of Grid connected solar system

Production of electricity from renewable energy has proved to be the best alternative for fuel. Solar energy is a form of renewable energy source. It is the energy obtained from the sun. It involves harnessing the sun's energy to produce electricity. This can be used to perform various activities such as cooking, heating, etc. The use of solar energy is considered as safe and clean. The operation of power systems is enhanced due to the improved voltage profile and reduced maintenance costs. As of now, photo voltaic cells are allowed to inject all the power produced into the grid. But in the near future, additional rules will be imparted due to the fluctuating nature of the output power of PV cells since they can negatively impact the system. As of March 2012, the grid interactive power generation from RES is 24914 MW.

Power quality may be defined as the variation in supplied power from the estimated power being minimum. [3]There are various issues related to power quality,some of the major causes of these are load equipments and components such as converters, UPS, television sets,[4]

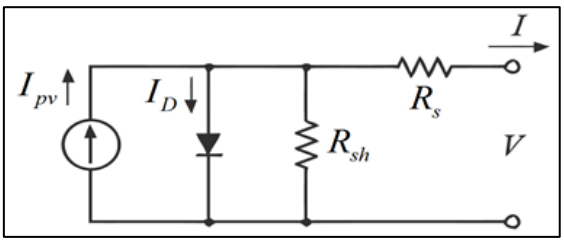


Fig.1.2.Solar Panel Equivalent circuit

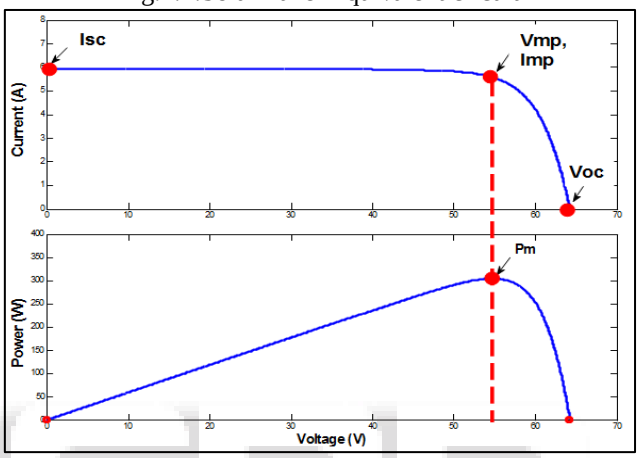


Fig.1.3.Characterictics of Solar Cell

$$I_d = I_0 \left[exp\left(\frac{V_d}{V_T}\right) - 1 \right]$$

$$V_T = \frac{KT}{q} \times nI \times n_{cell}$$

The major power quality issues in power systems are:[5]

II. SHORT DURATION VARIATIONS:

1) Voltage sag: it is a phenomenon by which the voltage level falls below the rated (RMS) value. This lasts for less than a minute.
2) Voltage swell: It is a phenomenon by which the voltage level rises above the rated value. This lasts for less than a minute.
3) Momentary interruptions: The absence of voltage in a system for less than a minute.

III. LONG DURATION VARIATIONS:

Long duration variations are similar to short duration variations. They consist of: over voltage, under voltage and sustained interruption.

1) Over voltage: it is a phenomenon by which the voltage level rises above the RMS value and this lasts for more than a minute. Whenever the load changes in the grid connected this voltage may issue into certain value this may lead to various changes into solar side.
2) Under voltage: it is a phenomenon by which the voltage level falls below the RMS value and it lasts for more than a minute.Due to the irradiance of the sunlight the output of the solar cells decreases,this will cause the under voltage in the soalr panel .

3) Sustained interruption: it is similar to momentary interruptions. The only difference is that this lasts for more than a minute. sometimes the load get settle down will not be in proper schedule one that may lead to interruption of the solar supply voltage.

Apart from these issues, there are a few other issues as well. These include:

- Voltage flicker
- Notching
- Inter-harmonics
- Voltage fluctuations

Several devices are used to overcome such power quality issues. Some of these are:

- DSTATCOM: It is a type of static compensator that is used for power factor correction, current harmonic filtering and also for load balancing.
- DVR: It stands for 'dynamic voltage regulator' and is used to protect sensitive loads from supply side disturbances.
- DigSilent is a power factor simulation software. Using this, the voltage fluctuations and also flickering were reduced.
- iv. By using the active filtering method, the harmonics can be reduced and voltage regulation can also be achieved.
- v. SAPF: It stands for 'shunt active power filter' and compensates the current harmonics by injecting equal but opposite harmonic currents into the grid.
- vi. STATCOM: various power quality problems are reduced. It consists of four inverter legs and a grid connected voltage source inverter.
- vii. DC bus voltage control and UPF at the grid side is achieved using synchronous reference frame theory(SRF).

IV. SIMULATION BLOCK DIAGRAM OF SOLAR PLANT IN MATLAB

SPECIFICATION OF THE GRID-CONNECTED SOLAR POWER PLANT

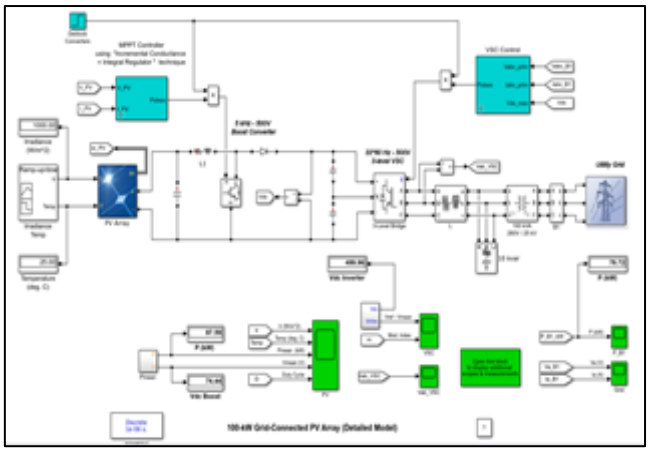
ELECTRICAL DATA

Electrical characteristics	300wp
Nominal Maximum Power (P_{max})	300w
Optimum operating voltage (V_{mp})	37V
Optimum operating current (I_{mp})	8.11A
Open circuit voltage (V_{oc})	44.4V
Short Circuit current (I_{sc})	8.71A
Module efficiency	15.63%
Operating Temperature	- 40 to +85 deg C
Maximum system voltage	1000V
Maximum series fuse rating	15Amps
Power tolerance	+3%
Application Classification	Class A

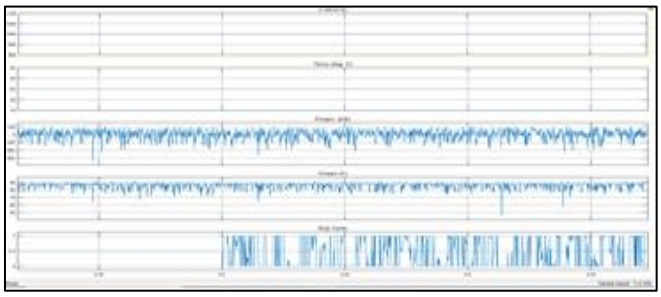
The above parameter are at Standard Test Condition (STC) i.e irradiance 1000w/m^2, A.M-1.5 & cell temperature.

A. Temperature Characteristic Specification

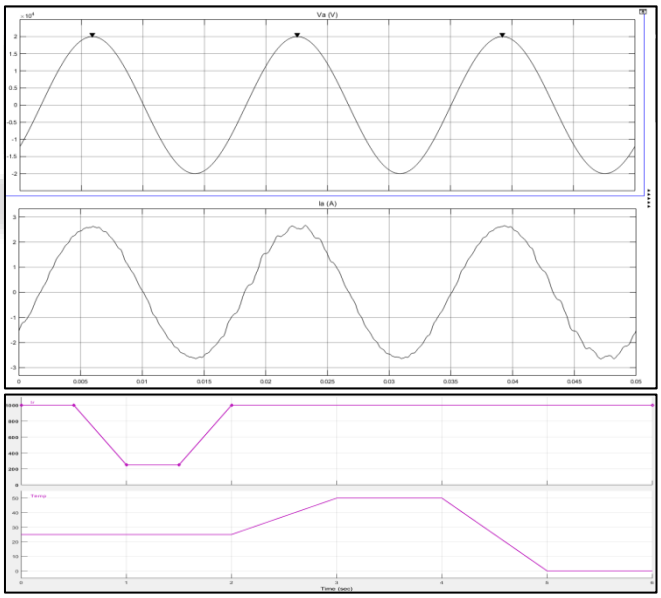
Temperature Coefficient (P_{max})	-0.42%K
Temperature Coefficient (V_{oc})	-0.35%K
Temperature Coefficient(I_{sc})	-0.06%K



V. SIMULATION OUTPUT



VOLTAGE WAVE FORM



CURRENT WAVE FORM

VI. DISCUSSION OF SIMULATION AND RESULTS

A 100 KW solar power plant designed and the power generated using the MPPT technic ,power boosted through the boost converter 5Khz -500V 3 Level VSC. the power transmitted to the utility grid with improvement of the various power quality issues and the results are shown in the matlab Simulink software.

VII. CONCLUSION

In this paper, discussed the various power quality issues and simulated the output for the solar power plant . In this work we have taken the small solar power generation and plotted the graph the given parameters and electrical datas. This will

give the information regarding how the power quality issues are reduced by using the Mat lab Simulink. The Simulation of the solar plant shown in the diagram .Further this work extend into with the other technique and increasing the capacity of the plant.

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