LABVIEW BASED SIMULATOR FOR SOLAR POWER PLANTS

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Abstract- Installation of medium scale roof top ON-Grid solar photovoltaic plants are ideally suited for the educational Institutions & small industries, as they are functioning in day time where in there is sufficient solar isolation. The ON-Grid SPV system is interfaced with two sources: EB Grid and Generators. During normal operation EB and SPV system will supply the power to loads. If power generated exceeds the load then the excess power is fed to EB grid. When there is interruption in EB supply, the Generator would be switched ON to meet the load demand. This leads to two problems: 1) Since the solar power is varying it is not possible to achieve good overall efficiency (solar+ generator + loads) 2) if the generation exceeds the load the excess power is fed to the generator which in turn damage the bearings and prime mover. Thus we need real time simulators to predetermine the efficiency of our solar system. In this project we proposed the LabVIEW based solar simulator so that the all the problems of the solar panel can be predetermined with respect to our load parameters. By providing the parameters of solar cell, irradiation pattern, inverter design and our load demand values the simulator will show the resultant response of the solar system. In this phase we designed the entire solar panel design and MPPT model and simulated it against the irradiation pattern. The result shows that the variation of the solar output with respect to the change in irradiation pattern.

1. INTRODUCTION

This project is about real time simulator for solar power plants using labview design. Here I used MPPT maximum power point tracking method. MPPT will receive the maximum power from the solar panel for various irradiation pattern. For example we required a 12 V supply and we are receiving the 15V and 5 A power from solar . The MPPT will convert this 75W soalr power to 12V and 6.25 A power supply so that the more load can be connected. The current value will be increase after the MPPT. In this project we proposed the LabVIEW based solar simulator so that the all the problems of the solar panel can be predetermined with respect to our load parameters. By providing the parameters of solar cell, irradiation pattern, inverter design and our load demand values the simulator will show the resultant response of the solar system. In this phase we designed the entire solar panel design and MPPT model and simulated it against the irradiation pattern. The result shows that the variation of the solar output with respect to the change in irradiation pattern.

II. SOLAR PANEL MODELING

A solar cell is an electronic device which directly converts sunlight into electricity. Light shining on the solar cell produces both a current and a voltage to generate electric power. This process requires firstly, a material in which the absorption of light raises an electron to a higher energy state, and secondly, the movement of this higher energy electron from the solar cell into an external circuit. The electron then dissipates its energy in the external circuit and returns to the solar cell. A variety of materials and processes can potentially satisfy the requirements for photovoltaic energy conversion, but in practice nearly all photovoltaic energy conversion uses semiconductor materials in the form of a *p-n* junction.

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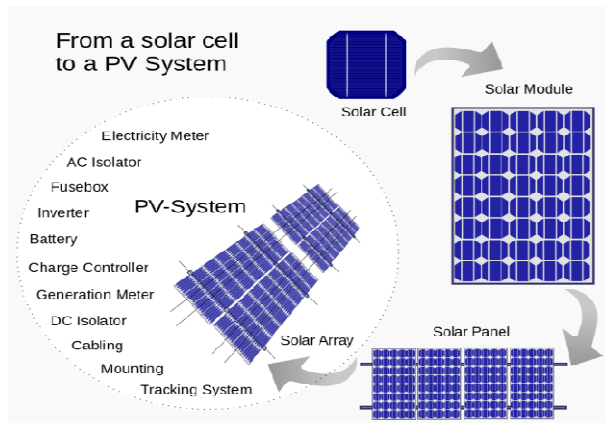
The Photovoltaic cell consist of PN junction that when exposed to light releases electrons. The solar cell can be modeled as a current source parallel with a forward biased diode. The diode current Id is varies with the junction voltage V_d and the cell reverse saturation current Io.
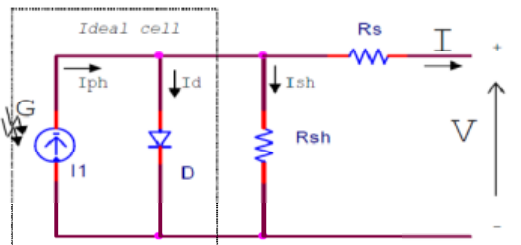
The current being sent through a diode is

$$I_d = I_o(e^{\frac{V_{dq}}{AKTc}} - 1)$$

When the terminal of solar cell are opening circuited the photo current generated by the current source is fully flow through the diode and Rsh. So maximum voltage Voc is produced across the terminal. When considering the case that the terminal of the photovoltaic cell is short circuited the photocurrent I_{ph} is flow through the short circuited terminal. Christo Ananth et al.[5] discussed about principles of Electronic Devices which forms the basis of the project. So the voltage across the terminal becomes zero and current I become I_{ph}. So the short circuited current I_{sc} is equal to I_{ph}. Then we can write current I,

$$I = I_{sc} - I_o(e^{\frac{IR_S + V}{AkTc}} - 1) - (\frac{IR_S + V}{R_{sh}})$$

I_{sc} is depend on weather conditions-ambient temperature

$$I_{sc} = \frac{G}{1000}[I_{scr} + K_i(T_c - T_r)]$$

The cell reverse saturation current I_o becomes,

$$I_o = I_{or}((\frac{T_c}{T_r})^{\frac{3}{A}} \exp(\frac{qE_G}{KA}(\frac{1}{T_r} - \frac{1}{T_c})))$$

Then we can calculate the open circuit voltage, V_{oc} as

$$V_{oc} = \ln(\frac{I_{sc}}{I_o} + 1)(\frac{AKT_c}{q})$$

The cell temperature is,

$$T_c = \frac{NOCT - 20}{0.8}G + T_a$$

III. IMPLEMENTATION

Here I used Maximum Power Point Tracking method (MPPT). MPPT will receive the maximum power from the solar panel for various irradiation pattern. For example we required a 12 V supply and we are receiving the 15V and 5 A power from solar . The MPPT will convert this 75W soalr power to 12V and 6.25 A power supply

The design procedure of power is shown in solar panel modeling. This design is implemented in labview software. The solar panel is designed in labview and simulated with the irradiation levels accquired from SECI (Soalr Energy Coporation of India) database . The parameters of solar panel which is taken for study are : open circuit Voltage , current, power, efficiency and maximum power tracking current values.

The first step to design the short circuit current (I_{sc}) and open circuit voltage (V_{oc}) using labview software, then the irradiation pattern of solar panel is given to input of current and voltage design then click run to see the output. After getting current and voltage waveform to check the power analysis.

The output power is given to input of MPPT. MPPT will receive the maximum power from the soalr panel by increasing or decreasing the current value and keeping the required voltage level constant. The current value will be increase after the MPPT. The separate current and voltage waveform is taken before MPPT and after MPPT. The result

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shows that the variation of the solar output with respect to the change in irradiation pattern.

IV. SIMULAITON RESUTLS AND ANALYSIS

The solar panel is designed in labview and simulated with the irradiation levels accquired from SECI (Soalr Energy Coporation of India) database . The parameters of solar panel which is taken for study are : open circuit Voltage , cuurent, power, efficiency   and maximum power tracking current values
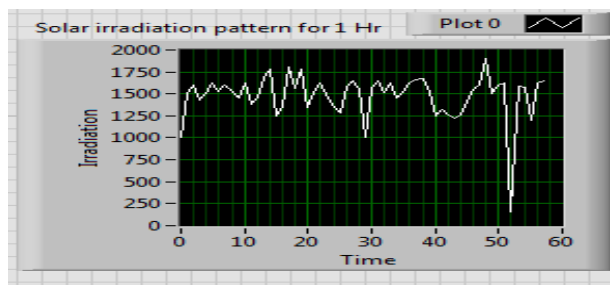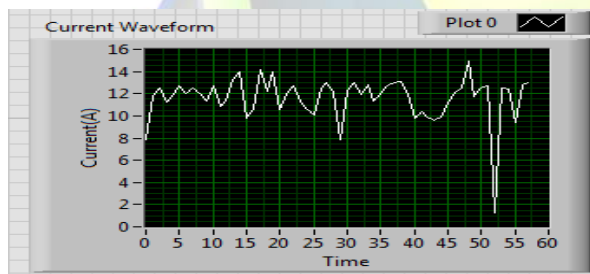

Fig 5.1 Irradiation pattern for one hour

Fig 5.2 Simulated Current output values

Figure 5.1 shows the pattern of the irradiation level abtained from the SECI (Solar Energy Corpiraiton of India) website .Figure 5.2 to 5.3 shows the current , voltage and power values of the solar panel with respect to the irradiation level. Since it a open circuit voalge and current values the output followes the same of pattern of the irradiation.
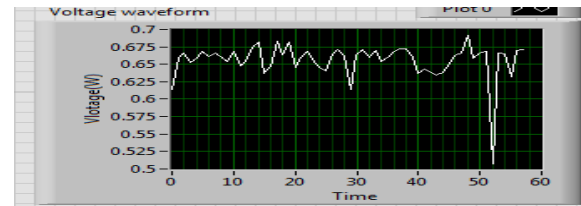

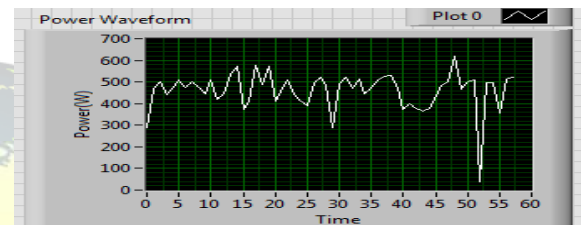Fig 5.3 Simualted open circuit voltage of single PV Cell

Fig 5.4 Simualted Power output for panel with 60 Cells in series

MPPT will receive the maximum power form the soalr panel by increasing or decreasing the current value and keeping the required voltage level constant . For example we required a 12 V supply and we are receiving the 15V and 5 A power from solar . The MPPT will convert this 75W soalr power to 12V and 6.25 A power supply so that the more load can be connected. Figure 5.5 Shows the ouput of the maximum power tracking system. Comparing the Fig 5.2   and 5.5 it is justified that   the current value is increased after the MPPT.
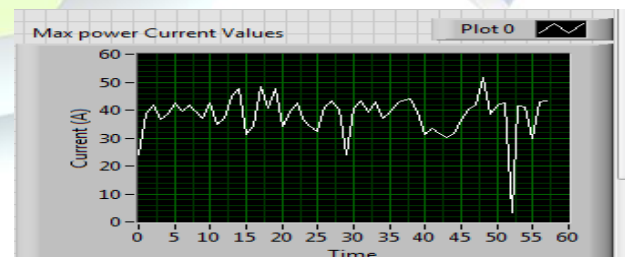

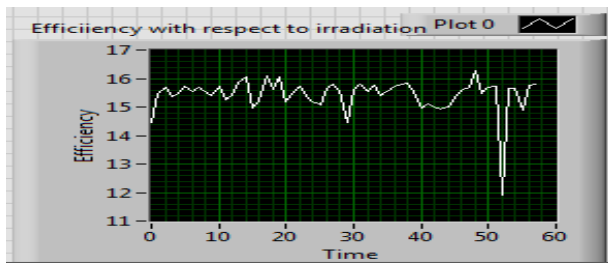Fig 5.5 Simulated output of the MPPT current values

Fig 5.6: Power Conversion effiency of Soalr Panels

Figure 5.6 describes the conversion efficieny of the solar panels and from the values we can justify the solar conversion efficiency is below 15% .
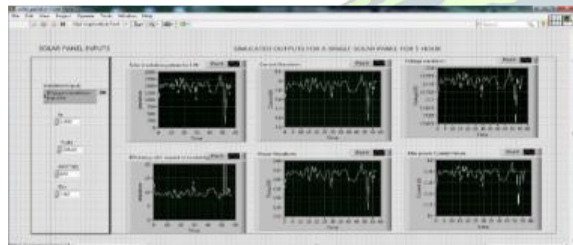

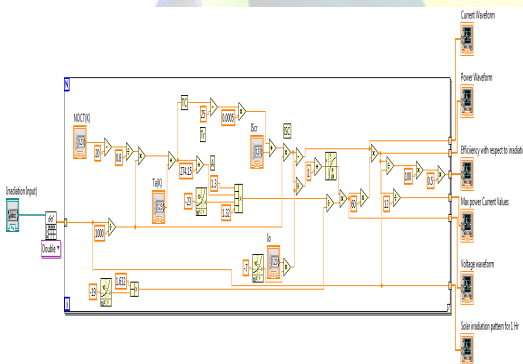Fig 5.7: The complete front Panel design of the LabVIEW solar model

Fig 5.8: Block diagram model of the Solar Panel

CONCLUSION

From the above results we concluded that the simulator designed is suitable for pre installation design. The parameters obtained are current, open circuit voltage, power and conversion efficiency of solar panel. The panel output is simulated with panel parameters (constants) obtained from the XH250P database. The solar irradiation patterns are taken from Solar Energy Corporation of India

(SECI). We modeled the above system for a single solar panel and this can be easily extended to complete solar power plant. By this output and load demand values we can easily simulate our pre installation design. This can be done comparing the instantaneous load power and generated power values. We also modeled and simulated the MPPT design. The results clearly shows that because of MPPT the diving capacity of the solar panel gets increased.

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