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SUN TRACKING SOLAR PHOTOVOLTAIC SYSTEM: PERFORMANCE ANALYSIS ON SIMULINK PLATFORM

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Abstract: ***This paper presents the concept of tracking system which was implemented on Simulink platform. The variation in current and voltage for static and tracking SPV power plant are shown in this paper. The comparative study at different positioning of panel (static power plant) is also shown in this paper. All the model like sun tracking model, static SPV model, LDR sensor model, DC motor model also shown in the paper. The result in this paper presented, is to analyses the results with respect to static power plant. The tiltaion angles are 300, 600, and 900 static power plants. The simulation results and the effect of tiltation angle are also presented in this paper. In the concluding remark, the improved efficiency due to tracking technique is shown.***
Keywords: Simulink Model, Static PV System, Solar tracking system, Photovoltaic.

I. INTRODUCTION

Every nation is concentrating on renewable energy sources because it is nonpolluting source of electrical energy. The solar photovoltaic cells are playing vital role for converting light energy to electrical energy. When the light rays falls on the silicon solar cells. The outermost orbital electron will free. The flow of electron in the load connected circuit will continues as the light falls on the panel surface. Means generation of electron depends on the amount of light energy. It has been presented in various paper about the effect of light intensity on solar cells. The irradiance value is directly proportional to the current generated by solar cell. As the irradiance value increases the output current also increases but the voltage value decreases as the temperature of solar cells increases. Thereby the production of power generated via SPV power plant is greater in the month of November as compared to June. As the output current depends on sun light intensity therefore sun tracker plays, vital role for improvement of SPV efficiency. There are many papers presented by the authors some are explained active sun tracking system, while some authors presented the passive tracking system, but most of the authors suggested active tracking system because it is easy to maintain and provide accurate tracking of sun position. Also the construction cost of active tracking system is low. In Active tracking system electromechanical system are used. Electromechanical word implies electrical and mechanical system. Mechanical system means gear system, steel structure and bearing. Under electrical system come motor, control circuit and LDR sensor. AdarshAdeppa, et. al discussed in his paper about developed sun tracking system but in this system author used microcontroller and LDR sensor for tracking the sun position author used servo motor [1]. Alberto Dolara.et.al, [2] explained the different techniques for the improvement of solar power plant efficiency. In the research paper many authors giving the concluding remark that improved efficiency of the sun tracking system is 41% while implementing the dual axis tracking concept [3-12].This paper presents the results obtained from SIMULINK based model. The comparative results are also shown in the result section.

II. REQUIREMENT OF SUN TRACKER

The trajectory of sun with respect to the earth is depicted in figure 1. The sun rotates from east to west per day while the variation in the position of the sun towards the elevated direction is 47^0 during the whole year.

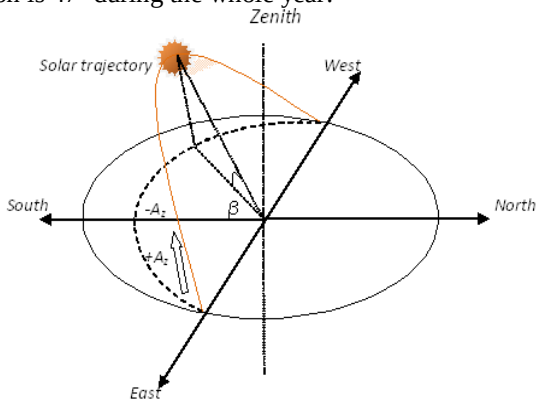

Figure 1: The SUN Trajectory

Figure-2 shows the variation in current due to irradiance value variation. Because the current produced by solar cell is directly proportional to the irradiance value.

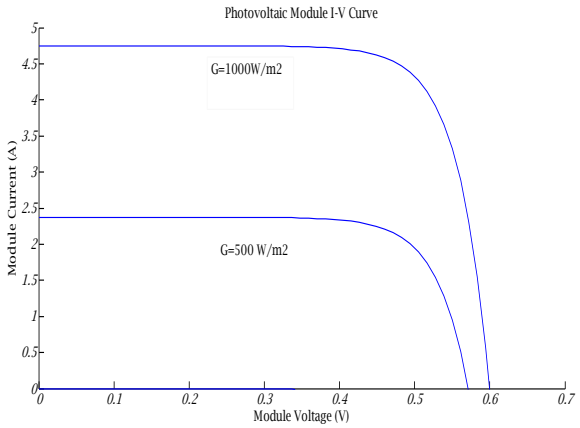

Figure 2: Variation in current vs. Voltage at different irradiance value.

Form the above figures it can be observed that sun tracker plays vital role for the improvement of output power generated by solar cells.

III. SIMULINK MODEL

For the investigation of improved efficiency by implementing the sun tracking concept, the SIMULINK model is designed for the SPV power plant without tracking system and with tracking concept. The irradiance data and temperature data were recorded on dated 13-08-2019. As shown in figure 3 and 4.

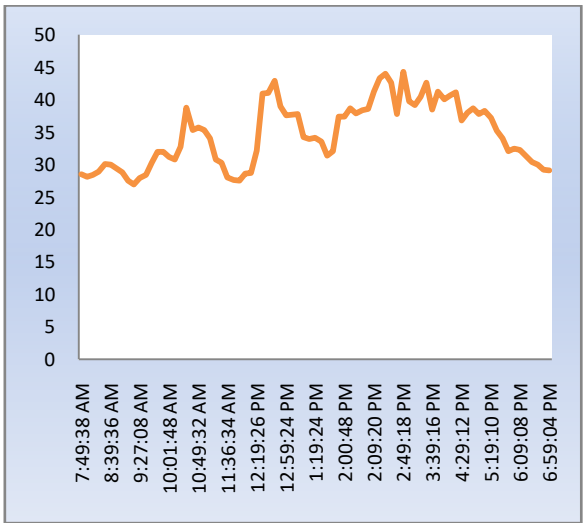

Figure 3: Temperature Recorded on date: 13-08-2019.

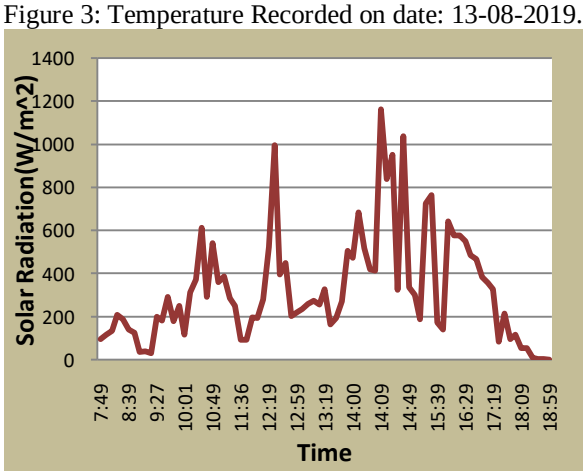

Figure 4: Solar Irradiance Recorded on 13-08-2019

PV System without Tracker:

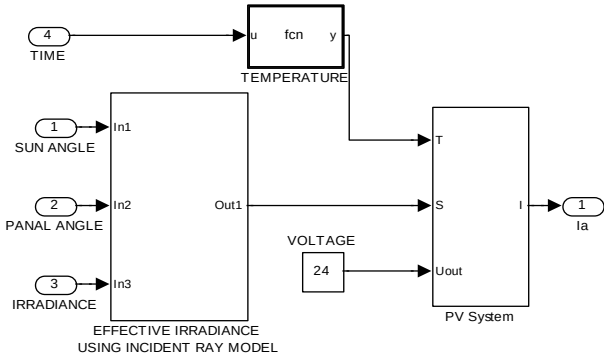

Figure 5: SIMULINK Model for Static PV System

Tracking PV System:

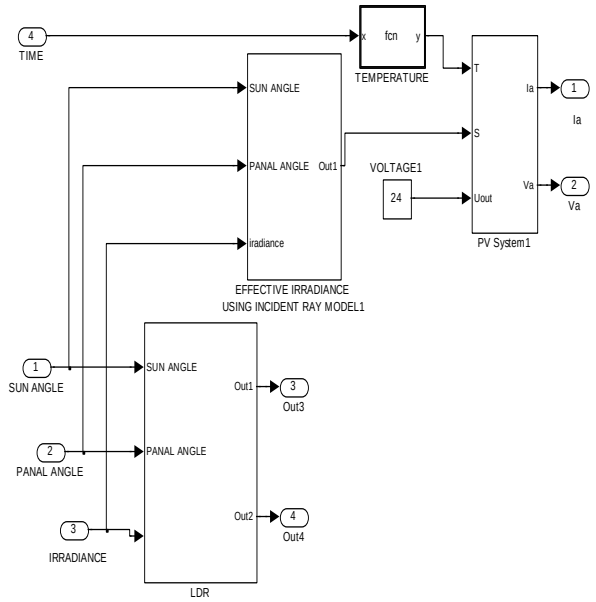

Figure 6: Tracking PV System Model

Figure 5 shows the Simulink model of the solar photo voltaic power plant, which represents the static solar photovoltaic power plant. Figure 6 represents the Simulink model for the solar power plant with tracking system.

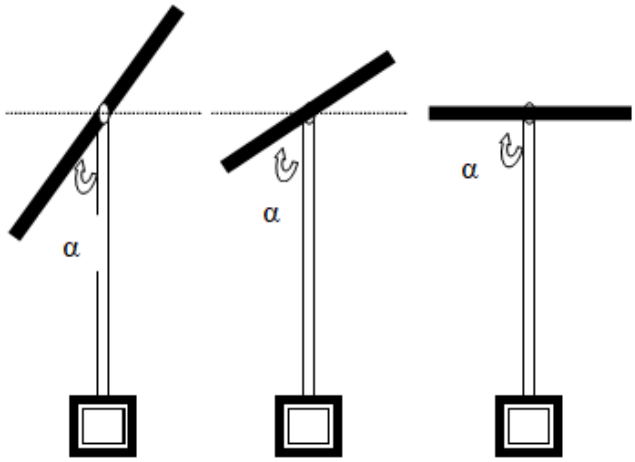

Figure 7: Static panel mounted at different angle.

Figure 7 shows the different position of static panels while SPV panel mounted on sun tracker rotated from east to west direction. Static panels are tilted at different angle. where α angle is the angle calculated from horizontal position. In first figure of fig-7 $\alpha=30^0$, in second figure its value is 60^0 while in third figure the value of $\alpha=90^0$.When the panel was fixed at 90 degree it will give maximum current and efficiency. Simulation result shows the variation of current at different angle (30°, 60° and 90°). Tracking Panel current was not affected due to variation in the Sun Angle.

IV. SIMULATION RESULTS

The results are getting from simulation results shown in figure 8. The bold green color line shown in this figure

represents the variation in current data with respect to time. These current values are getting from Simulink model of the SPV panel mounted on sun tracker. While the current value calculated, getting from the fix panel is shown in thin green color line when static panel is tilted at the angle 90^0. The current with respect to time depicted here in blue line is the data coming from the Simulink model of static panel when it is tilted at angle 60^0 and when the fix panel is tilted at angle 30^0 is the value of current with respect to time is presented in red color line.

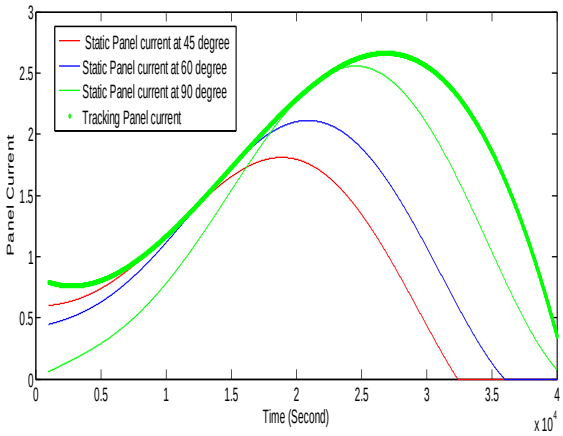

Figure 8: Simulation Result of SPV Power Plant

Here in the simulation results it can be seen that the efficiency of solar photo voltaic power plant with tracking system is greater than the static power plant. It doesn't matter the SPV panels are mounted at any tiltation angle.

V. CONCLUSION

The results shown above represent the importance of sun tracking system. When panels are mounted at 30^0tiltationangle, the energy getting from SPV system with tracking system is maximum while the power getting from static SPV system is lesser.

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