IJIREEICE

ISSN (Online) 2321-2004
ISSN (Print) 2321-5526

International Journal of Innovative Research in
Electrical, Electronics, Instrumentation and Control Engineering

Vol. 7, Issue 10, October 2019

Photovoltaic Panels Literature Reconsideration Using P&O Maximum Power Point Technique in Solar Panel Installation

Kuldeep Singh Rathode[1], Santosh Kr Sharma[2], Hemant Kumar Nagar[3]

Department of Electrical Engineering, Rajasthan Technical University, Kota, India[1,2,3]

Abstract: This preeminent PV technology work on contagious photons of light & exploits them to generate free electrons. Electricity generation is done by these free electrons. The solar PV cell or power panels are the main & effective technology for solar power generation. This is a semi converter device that converts the solar rays into useful electrical energy (power). This paper also deals with the power generation process with the several outputs like P-V characteristics at different irradiance level, DC voltage provided by the boost converter using P&O maximum power point technique.

Keywords: Types of Solar Panels, Solar Power System, Boost Converter, P&O MPPT, Vikram Solar Project

I. INTRODUCTION

This paper mainly deals with the basic explanation of cells, PV module, array and various genre of PV cell which further consist Mono Crystalline Panels, Polycrystalline panels, Amorphous panels, Tandem panels. This paper also explains the solar panel installation employing boost converter with efficient control strategies using Perturbation and Observation (P&O) Algorithm for obtaining maximum output power. Here in this paper a discussion is done over the solar panel efficiency in laboratory and in practical life. This paper also considering the "Vikram Solar project" located at Manchitya, Bap, Rajasthan as a case study.

II. DETAILING ABOUT SOLAR PANELS AND VARIOUS GENRE OF PV CELL

2.1 Cell: - Energy transfer through proton-electron is done in this unit.

2.2 Panel or module: -Amalgamation of many cells. This panel referred all the calculation of main energy characteristic of the system.

2.3 Array: - Amalgamation of varied panels. Three elements are used collected to produce a photovoltaic cell which is shown in the fig.1 given below.

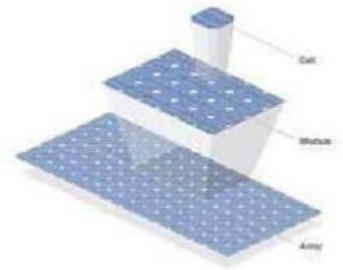


Fig 1 Three elements are used to produce solar panel.

2.4 Various genre of PV cell: -

Solar panels are basically dependent on semiconductor material used & methodology of production. Dependency of panels on the material & manufacturing process: -

The availability of different types of solar affiliated on manufacturing process & material used in it.

There are several of types of solar panels available in market are following: -

(i) Mono Crystalline Panels

Silicon bar sections are crystallized perfectly in one piece. These panels exhibit low efficiency i.e 24.7 in labs & 16% for commercial use.

IJIREEICE

ISSN (Online) 2321-2004
ISSN (Print) 2321-5526

International Journal of Innovative Research in
Electrical, Electronics, Instrumentation and Control Engineering

Vol. 7, Issue 10, October 2019

(ii) Polycrystalline panels

This panel manufacturing resembles the previous one but with different process of silicon crystallization. The pieces of silicon bar formed polycrystalline panels in disordered crystals form. These panels are visually recognizable because of granulated surface. These panels show 19.8% in laboratory and 14% in commercial modules. This panels are Lower efficient then mono crystalline. It is also lower cost than mono crystalline panels.

(iii) Amorphous panels

Amorphous panels have significant thickness, employing silicon structure on distinct semiconductor materials thinner and adaptable panel can be obtained. Irregular surfaces adaption can also be allowed in some special cases. These thin film PV modules classified according to material employed called amorphous PV solar panels.

a. Amorphous silicon (TFS): -These panels also construct by silicon but virtue differently from previous examples. Crystal structure of material is not required small electronic devices (watch, calculators) and some small portable panels are common example of this panels. Its working efficiency in the laboratory is 13% and for commercial modules of 8%, while cadmium telluride having 13% efficiency in laboratory and 8% in commercial modules. Gallium arsenide is considered most efficient material virtue 20% of efficiency for commercial panels.

(iv) Tandem panels

They are perfect blend of two distinguish semiconductor materials. Absorption of electromagnetic spectrum of solar radiation is done by each semiconductor type material and the blends of two or three different material employed to gather more electromagnetic spectrum. This panels having maximum efficiency of 35%.

III. PV SOURCES

Functions and operations of a PV panel: -photovoltaic effect occur when solar radiation incidences in semiconductor material (having known characteristic and internal construction) is the basic working principle of solar panels. The photons give away their energy to electrons during solar radiation exposure to semiconductor materials. Breaking of potential barrier of PN junction and pass through semiconductor material generating an electrical power (current), Voltage and power is achieved by different combination of these solar cells. Power generated by solar panel is straightway associated to peak power output which represents maximum power generation through panel in full sunlight. Angle of inclination and tilt of the panels on the roof is additional features to understand PV panels installation. 30 degree from the horizontal is best angle for solar panel installation. However, the temperature of the panel is relevant in other region and the main considerable reason for reduction of overall efficiency of the solar panel system when temperature is relatively high. Fig 2 shows the Chart Detailing of the optimum angle shown below.

Chart Detailing of the optimum angle shown below

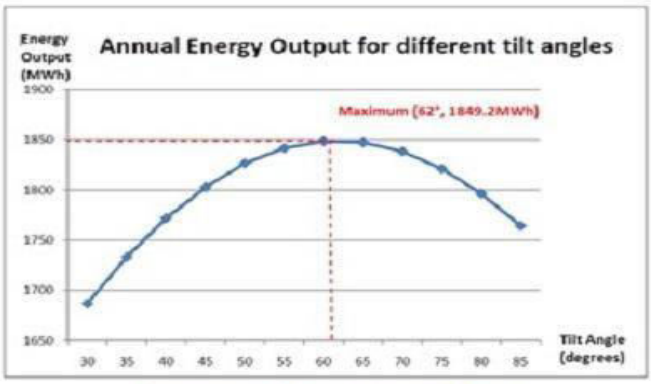


Figure 1. Graph of Energy Output vs. Tilt Angle

Fig 2 shows the Chart Detailing of the optimum angle

IV. SOLAR POWER SYSTEM

After considering the solar panels we further move our attention to the working phenomenon of Solar panel system this system usually consist boost converter and P&O MPPT technique to obtain maximum output from the specific installed Solar power generation system. Fig 3 shows the Simulation model of PV array with MPPT and boost converter.

Maximum power point tracking:-Maximum power point tracking generally assigns as MPPT, it is an electronic system which performs the PV panels in such a manner which allows that allows the panels to generate the power which is

IJIREEICE

ISSN (Online) 2321-2004
ISSN (Print) 2321-5526

International Journal of Innovative Research in
Electrical, Electronics, Instrumentation and Control Engineering

Vol. 7, Issue 10, October 2019

capable of MPPT which is not a mechanical tracking system that "physically moves" the modules to make them point more precisely toward the sun.

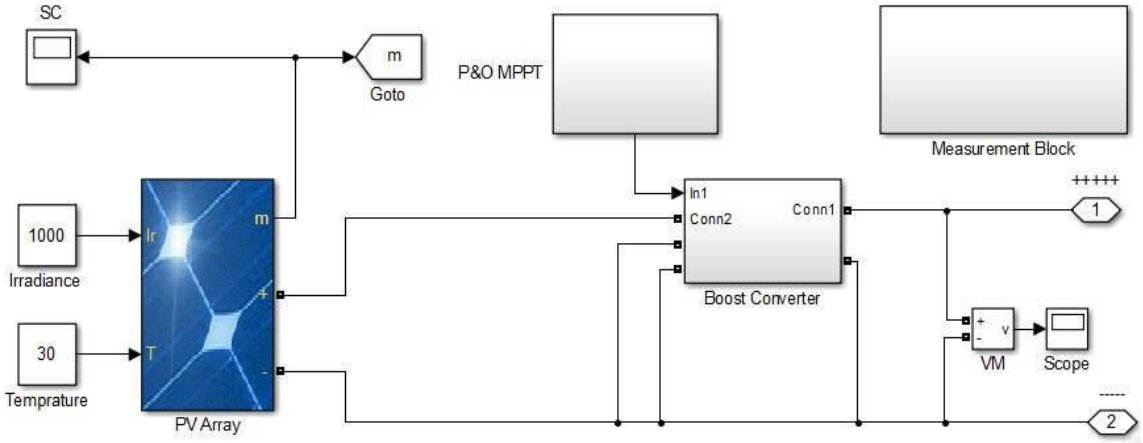


Fig 3 Simulation model of PV array with MPPT and boost converter

The conventional solar array can convert only 35-40 percent of total incident solar radiation into electricity. To enhance the performance of solar panel we use maximum power point tracking techniques are used. MPPT controller is a controlling device which tracks the locus of maximum power point of the PV panel. In order to track maximum power from a PV panel, MPPT methods are employed to control DC converters under variable weather conditions. To operate the array at its maximum power point despite the DC converter is constantly controlled. Grid integrated inverters normally use MPPT so the inverter can operate near the MPP and keep the output efficiency as high as possible.

The basic principle of the MPPT algorithms is the use of $\Delta P/\Delta V = 0$ to find the array output MPP. The algorithm measures both ΔP and ΔV to find the array's momentary operating region. By doing this, the MPPT algorithm ensures that the PV system performs at the MPP of the array at all the time. An easy way to comply with the conference paper formatting requirements is to use this document as a template and simply type your text into it.

V. DISTINCT MPPT TECHNIQUE

There is a no. different technique used for maximum power point tracking. Some popular techniques are given below:

(1) Fraction short circuit current
(2) Fuzzy logic
(3) Fractional open circuit voltage
(4) Incremental conductance
(5) Neural Network, etc.
(6) Perturb and observe

The selection of the technique basically depends on the complexity and time involve in the tracking of MPP, cost and the ease of implementation. In this thesis work, perturb and observe method is applied as a MPPT algorithm.

4.2 Perturbation and observation (P&O) Algorithm

Perturb & Observe is the easy method, this is the generally applied method of MPPT. This technique has one sensing device which sensor the voltage. This device sensor the voltage of PV module and so the economic cost of implementation is reduced and easy to implement. To observe the change transfer, the algorithm rapidly adjusts the electrical performing point by measuring the performing voltage of PV array.

The Fig.4 above shows the flowchart for the Perturb and Observe algorithm. The inputs to the algorithm are current and voltage of the PV array. As seen from the flowchart the instantaneous voltage; V(k) and current; I(k); are measured by the algorithm and the instantaneous power; P(k); is calculated by multiplying them. The calculated power is then compared with the last calculated power; P(k-l). The system is constantly perturbed by the algorithm if the variation in operational point is positive; or else the direction of perturbation is swapped. It can be seen from the flowchart that if both the change in voltage and change in power is positive or negative then the duty cycle is decreased by a factor of Δd in order to produce the successive cycle of perturbation and to force the performing point to movement towards the maximum power point. Similarly; if change in the voltage is positive and the power change is negative or contrariwise then duty cycle is increased by a factor of Δp for the next cycle of perturbation.

IJIREEICE

ISSN (Online) 2321-2004
ISSN (Print) 2321-5526

International Journal of Innovative Research in
Electrical, Electronics, Instrumentation and Control Engineering

Vol. 7, Issue 10, October 2019

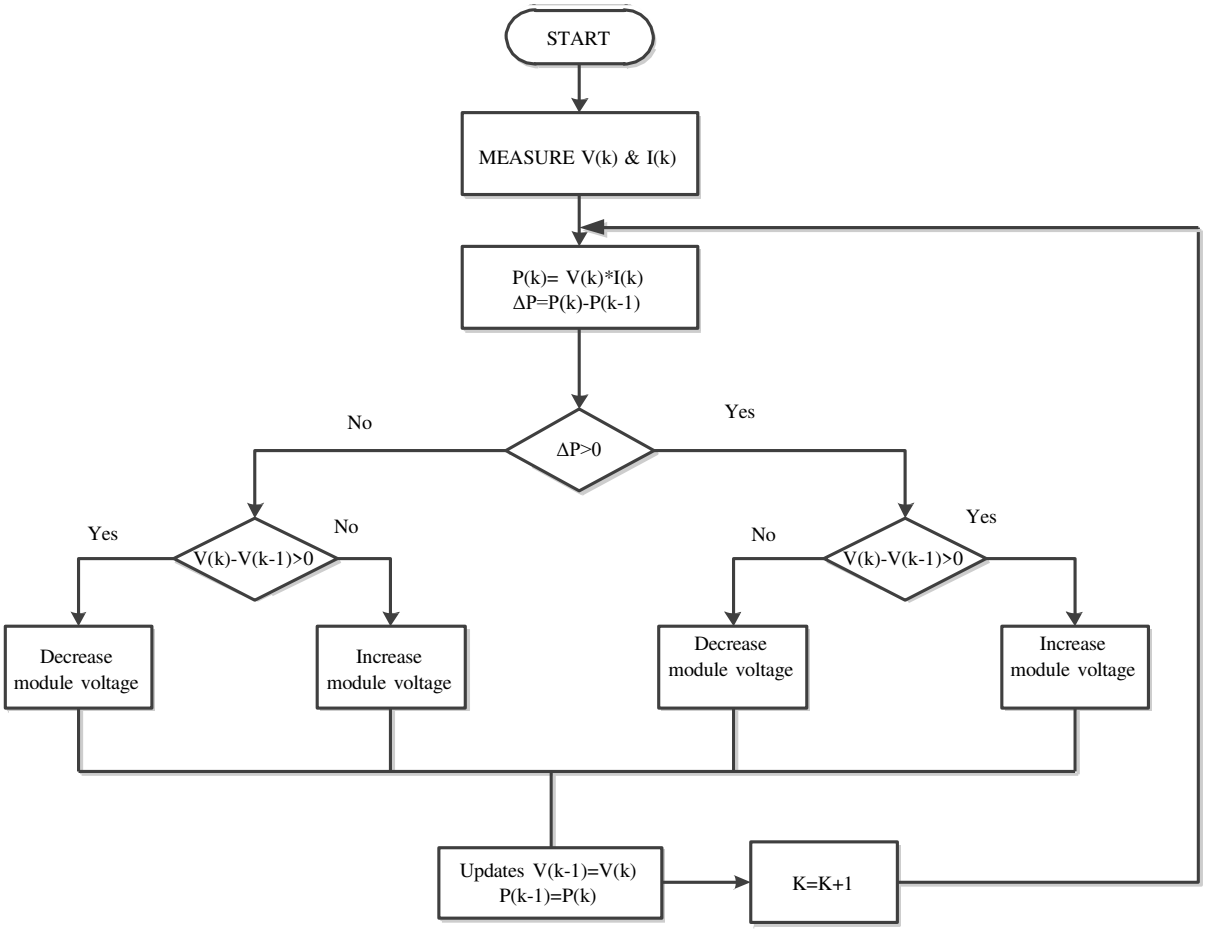


Fig. 4 Flow chart of P&O technique.

If $\frac{dP}{dV} > 0$: The PV array has achieved a performing point near to the MPP.

If $\frac{dP}{dV} < 0$: the PV array has achieved a performing point further away from the MPP.

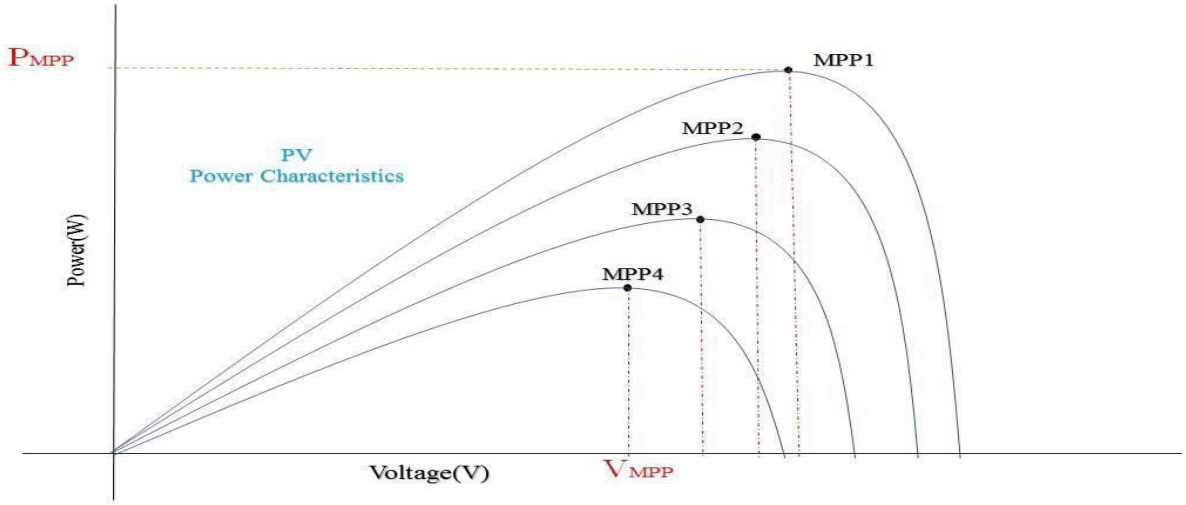


Fig 5 Perturb and observe algorithm.

The direction of changing the voltage or current is kept same if the calculated power increases with perturbation until the power begins to fall. From the Fig. 5 shown below it can be seen that when operating on the left side of the maximum power point; on increasing the voltage the power increases while when operating on the right side it decreases the power.

IJIREEICE

ISSN (Online) 2321-2004
ISSN (Print) 2321-5526

International Journal of Innovative Research in
Electrical, Electronics, Instrumentation and Control Engineering

Vol. 7, Issue 10, October 2019

Owner	**Jakson Power Pvt. Ltd., Lexicon Vanijya Pvt. Ltd., Symphony Vyapar Pvt. Ltd.**
Project	4x10 MW
Location	Manchitya, Bap, Rajasthan
Module Type	Polycrystalline - 215-250Wp
Connection Type	On Grid
Installer	Vikram Solar Limited

Technical Specifications

Rated System Power	4 X 10 MW
Number of Modules	183.120
Space Coverage	217 Acres
Inverter	Solar Grid Connected Inverter: 60 nos
Coordinates	Latitude:27˚29'00.15"N;Longitude: 72˚19'16.12"E
Annual Energy Yield	76,994,679 kWh
Number of Avg. Homes Powered	10,000
CO2 Savings Per Annum (Aprox.)	61,595,743.2 kgs/yr

Similarly; when operating on the left side of maximum power point, by decreasing the voltage the power decreases while when operating on the right side it increases the power. Hence; the successive perturbation is kept in identical same direction if an increase in the power is there in order to reach the maximum power point but if there is a decrease in the power; the next perturbation shall be reversed. The advantages of the Perturb and observe algorithm are easy structure, minimum required parameters and simple implementation.
The power change is measured by changing the perturbation and If the change is positive, then the MPPT has turned the performing point of the PV array closer to the MPP. Thus, the voltage is still continued perturbed in the same direction. If the change on the other hand is negative, the operating point has become minimum optimal and the direction of perturbation must be switch

Incentives: - Some networking subsidies are provided for the in PV system installation as detailed & explained in some literature and many circular times to time. Installing hefty no. of solar panels had renewable obligations.

VI. A Project & Service of Solar power facility for NVVN, Rajasthan a Case Study. Solar power facility for NVVN, Rajasthan 40 MW capacity Solar PV Power Plant Date of Commissioning - 26.02.2013

Fig 6 Shows the panels installation at Vikram Solar Limited Manchitya, Bap, Rajasthan

6.1 Background: -40 mw solar power plant set up was installed by Vikram Solar in BAP tehsil of Jodhpur in Rajasthan state in India. 74$ US million is expected and granted amount for the project installation. A Indian program namely Jawahar Lal Nehru national solar mission (JNNSM) initiated by Indian government which aims to install 20 GW of PV capacity by 2022. Vikram solar installed 40 MW solar facilities successfully with an investment of over 4 Billion $.
6.2 Objective: -The states rising power demand is the primary objective of the solar power plant installation. This power system installation creates good job opportunity and new income avenues with a perfect solution to frequent undesirable power cut.
6.3 Challenge: - Installation of such solar power system for NVVN Rajasthan was difficult to achieve as these agreements specified that installed solar PV model were completely made in India. Such large and massive quantities of

IJIREEICE

ISSN (Online) 2321-2004
ISSN (Print) 2321-5526

International Journal of Innovative Research in
Electrical, Electronics, Instrumentation and Control Engineering

Vol. 7, Issue 10, October 2019

PV module manufacturing and delivery in such short span of time were challenging but achieved successfully. Moreover, the transmission line row was another major hurdle. The company faced some other problems like the local farmer protest for their crop production as it was a season of harvesting 'Gawar' (a local seasonal crop). It was hard to convince the entire resident along with agriculturist about the benefit of installation of this project as the company needs to precede the construction without affecting the crop productivity.
The time of installation of the project is decided to be in winter which had a lot of seasonable festivals and all the locals were all in the festive mood so it was hard to arrange local laborers at the time for completion of the project.

VII. RESULT

Here the figure 6 shows the PV system VI & PV characteristics and Fig 7 shows the Output at various Irradiations while fig 8 shows the Output at various Temperature PV and IV characteristic of the PV array at specified system parameters. The modeling of the charging stations is done employing the equation (1) to equation (6).
The inputs of the system are temp 25°C and 800W/m2.

The output PV and IV graph of the system at 25°C and 800W/m2 are shown below

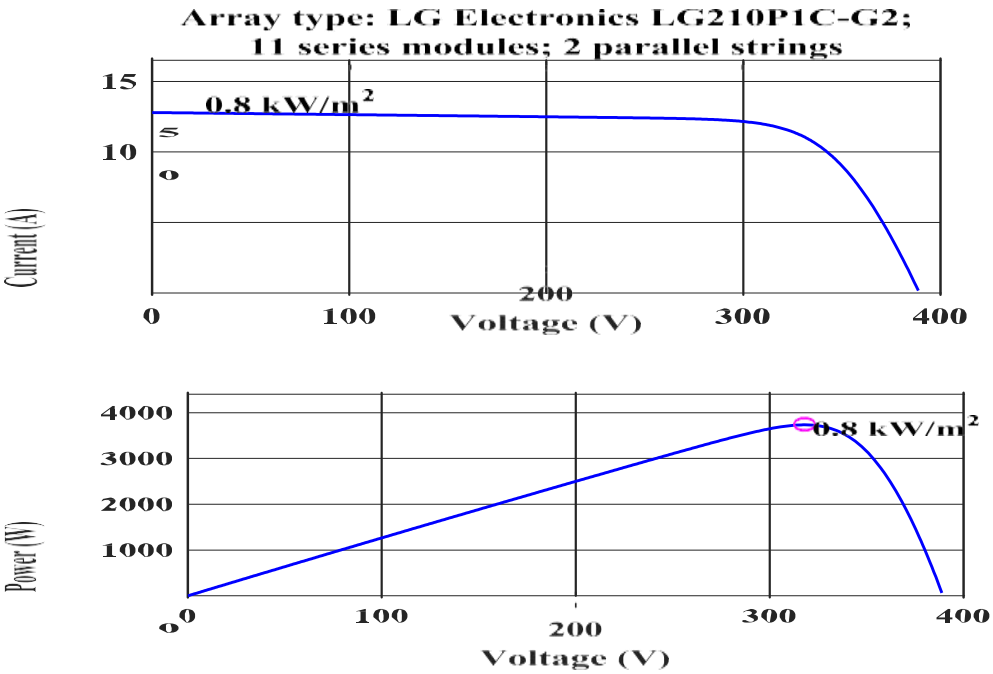
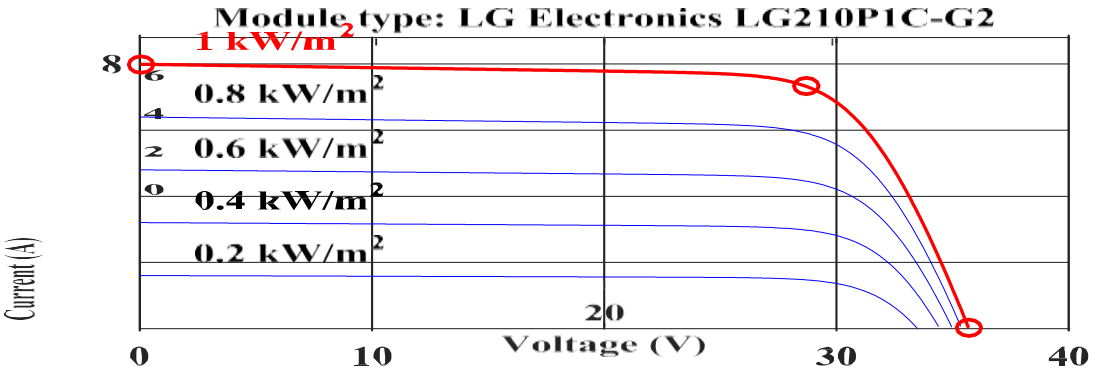


Fig 6 Characteristics of PV System (a) I-V curve (b) P-V curve

Output at various Irradiations



IJIREEICE

ISSN (Online) 2321-2004
ISSN (Print) 2321-5526

International Journal of Innovative Research in
Electrical, Electronics, Instrumentation and Control Engineering

Vol. 7, Issue 10, October 2019

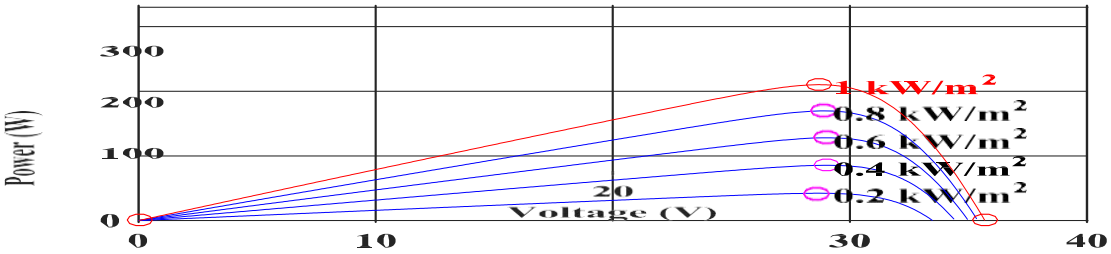


Fig 7 Output at various irradiations 200, 400, 600, 800, 1000

Output at various Temperature

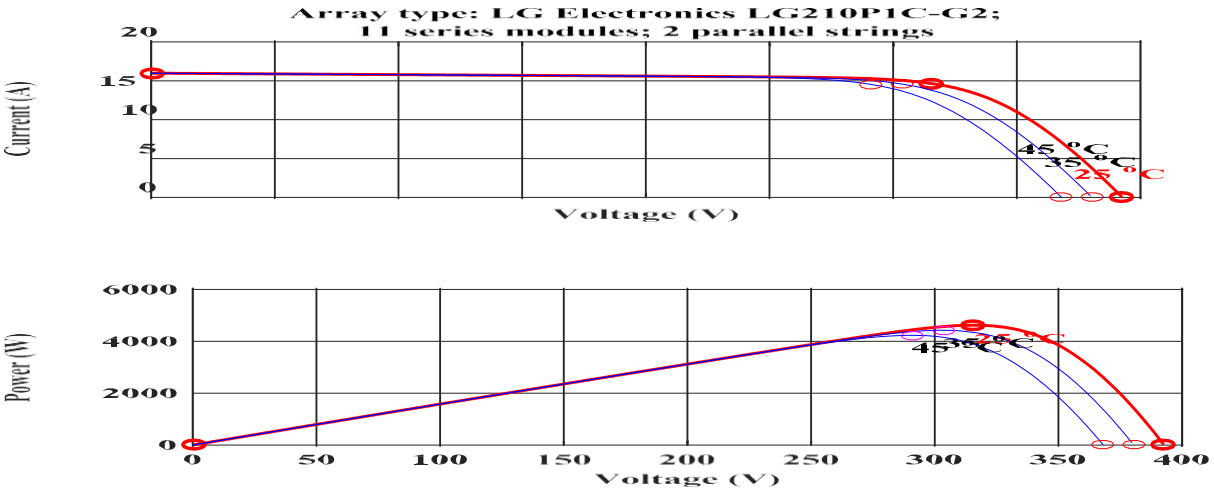


Fig 8 Output at various temperatures 25, 35, 450 C

Table-3 Characteristic Data Sheet of the Lg210p1c-G2 Pv-Array At 25°C And 800w/M^2 Are

Electrical Characteristics	**Values**	
Maximum Power (P_{max})	210.08	**W**
Voltage at P_{max} (Vmp)	28.7	**V**
Current at P_{max} (Imp)	7.32	**Am**
Open-circuit voltage (Voc)	35.7	**V**
Short-circuit current (Isc)	7.99	**Am**
(KI) Temperature coefficient of Isc	-0.001	**%/d**
(KV) Temperature coefficient of Voc	-0.311	**%/d**
NOCT		

Installation of 40 MW solar project is successfully executed on time with all required and relevant IS standards guideline provided by CEIG, Discom and electricity board.

NTPC vidyut vyapar nigam (NVVN) is the main customer of the generated electricity by the solar plant under a power purchase agreement.

VIII. CONCLUSION

Solar energy generation through solar PV cells coined as green power production with least environment pollution and no pollution to other habitats of earth. Different countries government provide worthy promotional scheme with ultimate solutions for zero pollution power generation.

DOI 10.17148/IJIREEICE.2019.71003

IJIREEICE

ISSN (Online) 2321-2004
ISSN (Print) 2321-5526

International Journal of Innovative Research in
Electrical, Electronics, Instrumentation and Control Engineering

Vol. 7, Issue 10, October 2019

REFERENCES

[1]. Rahman, M. M., M. Hasanuzzaman, and N. A. Rahim, Effects of various parameters on PV-module power and efficiency." *Energy Conversion and Management* 103 (2015): 348-358.
[2]. Ding, K., Bian, X., Liu, H. and Peng, T., 2012, A MATLAB-simulink-based PV module model and its application under conditions of non-uniform irradiance. *IEEE Transactions on Energy Conversion*, *27*(4), pp.864-872
[3]. Mahmoud, Y., Xiao, W. and Zeineldin, H.H., 2012, A simple approach to modeling and simulation of photovoltaic modules. *IEEE transactions on Sustainable Energy*, *3*(1), pp.185-186
[4]. Babu, B.C. & Gurjar, S., 2014, A novel simplified 2-diode model of photovoltaic (PV) module. IEEE journal of photovoltaics, 4(4), pp.1156- 1161.
[5]. Illanes, R., De Francisco, A., Núñez, F., De Blas, M., García, A. and Torres, J.L., 2014, Dynamic simulation and modeling of stand-alone PV systems by using state equations and numerical integration methods. *Applied energy*, *135*, pp.440-449.
[6]. Soon, J.J., Low, K.S. and Goh, S.T., 2014, June. Multi-dimension diode photovoltaic (PV) model for different PV cell technologies. In *Industrial Electronics (ISIE), 2014 IEEE 23rd International Symposium on* (pp. 2496-2501). IEEE.
[7]. Altas, I.H. and Sharaf, A.M., 2007, May. A photovoltaic array simulation model for matlab-simulink GUI environment. In Clean Electrical Power, 2007. ICCEP'07. International Conference on (pp. 341-345). IEEE.
[8]. Mahmoud, Y., Xiao, W. and Zeineldin, H.H., 2012, A simple approach to modeling and simulation of photovoltaic modules. IEEE transactions on Sustainable Energy, 3(1), pp.185-186.
[9]. Sahu, P., Verma, D. and Nema, S., 2016, December. Physical design and modeling of boost converter for maximum power point tracking in solar PV systems. In Electrical Power and Energy Systems (ICEPES), International Conference on (pp. 10-15). IEEE