Modeling Simulation & Performance Assessment of Different Manufacturing Technology and Effect of Partial Shading in Grid Connected Solar PV System at Jaipur

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Abstract— **The renewable energy area has a capability to provide solutions for enduring power problem facing by developing nations. Various renewable energy resources are used to conquer the power scarcity in India. In recent years, power generation has increased dramatically, but the industry is promising for domestic organisations, distribution networks and transmission networks, and the financial situation is slow and influential. India has 450,000 KW of hydro power, has an installed wind power capacity of 230,000 KW, but has almost no great level for renewable power. Solar energy has a bigger part of the government's extension strategies. The demonstration of solar PV Systems is highly desirable for geography and structure. For effective and efficient structured we need forecasting and designing tools like PVSYST software. It is a common tool to optimize and plan the design and installation of independent photovoltaic solar systems connected to the grid. The motive of this work is to developed mathematical model for diode equivalent Photovoltaic system in MATLAB software and analysed the characteristics. Model of 100 KW peak is developed and simulated with different manufacturing technologies in PVSYST software. Load forecasting and yield simulation is done in PVSYST software. In this paper, the various characteristics of photovoltaic arrays under partial shielding conditions are discussed, and a model for selecting the characteristic regions of the array is proposed to track the global maximum power point.**

Keywords-Loss Analysis, PV-Syst, Grid Connected System, Yield.

I. INTRODUCTION

In recent years, such as solar, wind, hydrogen, biomass and other renewable energy sources has been of concern due to the increasing global warming environment to achieve. In this case, the photovoltaic (PV) solar systems in the introduction of large, because a residential area of government subsidies. In addition to the PV output power at night to stop the dramatic changes in the intensity of the sun radiation and air temperature. In a standalone configuration, the photovoltaic power generation system is the most suitable as a clean energy source, the battery can be used to store coordination at night use. For many applications, the electric car's power PV modules are increasingly common.

India has abundant solar energy. The energy resources available for domestic electricity generation and industrial use. Reduce costs, improve efficiency and performance of photovoltaic panels over a wide temperature range better of recent developments in photovoltaic technology. The field has been in place for nearly two decades, the widespread use of interactive PV systems to the utility grid of remarkable growth from independence.There are many advantages of the solar system some of which include distribution and transmission capacity relief, peak load shaving, the high cost of transmission and distribution (T & D) system upgrade postponed. Despite these benefits mentioned, photovoltaic grid interconnection, which must take into account that it is a lot of technical problems to be resolved before a reliable source of supply.Solar photovoltaic arrays (PV system), which in turn is the series to do a lot of the most interconnected photovoltaic modules. By a single power module generated is small enough for commercial use, so modules are connected in series are arranged in parallel to form an array of power to the load. In connection module array is similar to the module cells.Again by the power of a single module is not sufficient to meet the power needs of most practical purposes. From the PV array using an inverter converting DC power into AC power and outputs it to the motor, lighting loads and other loads. Modules are connected in series to get more of the rated voltage, and then in parallel to meet the current specification, as shown in Figure 1.1.

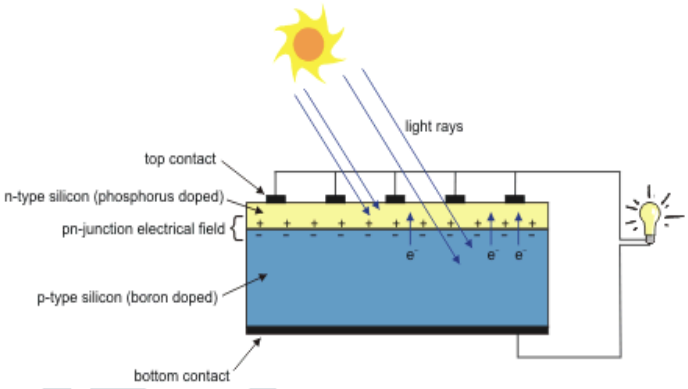

Fig. 1.1. Structure of a PV Cell

Fig. 1.2. Different PV Modules

Represented by a small solar cell or a thin semiconductor wafer, electrical characteristics different from the Shockley diode equation layer made of a p-n junction. Thus, a simple equivalent circuit of the solar cell are connected in parallel with a diode current source. A photovoltaic array (PV system) which in turn are interconnected in series or in parallel of several modules of the PV cells.

Grid connected PV system is a system when grid is connected to PV system and also called utility-interactive systems. In this type of system consist of PV array and inverter. Utility-

interactive systems deal with AC. Grid connected system deals with very high power applications, so is tough to store this much of power in battery. Solar cell is made by two types of semiconductor materials one is N-type semiconductor and other is P-type semiconductor material for generation of electricity but Solar cell is manufacturing by different materials.

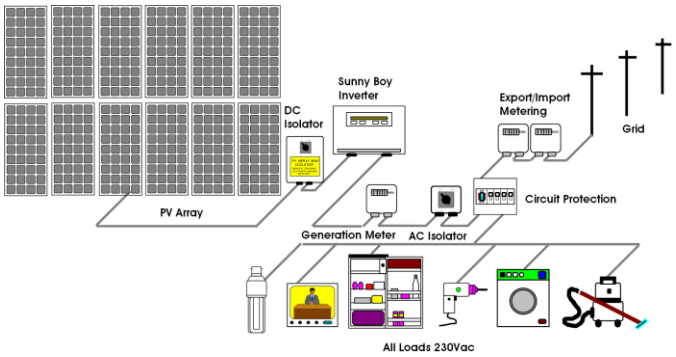

Figure 1.3 Grid Connected Solar PV System

The inverter is used to convert the direct current (DC) generated by the solar panel into a load of alternating current (AC). Today, many investors on the market are based on battery connections and network systems. Investors need to determine the magnitude of the expected power level to be processed and are compatible with the conditions on the network side. Other components include JS mounting systems, wiring, switches, disconnectors and system monitors.

II. SYSTEM DESIGN

To utilize PVSYST and concentrate the presentation capability of photovoltaic and solar thermal systems, light information and exact worldwide temperatures are basic. In PVSYST, both breeze speed and diffuse radiation are discretionary.

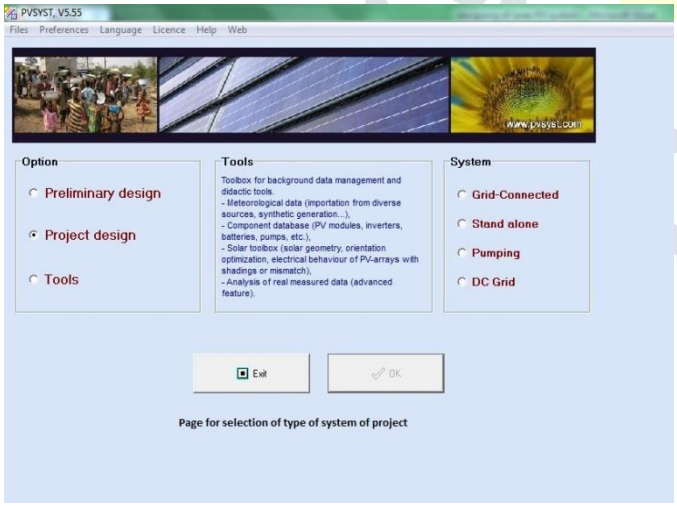

Figure 1.4 Grid Connected Solar PV System Using PV syst

PVSYST utilizes the irradiance information imported in PVSYST to make sporadic markers utilizing imported practical climate information. Except if generally expressed, the data in this part is the PVSYST Contextual Help Manual. The format and simulation of system associated solar PV systems was expanded utilizing the accompanying informational indexes.

Meteological Data-Meteonorm programming gives month to month climate information to each point on the planet. They additionally utilize a stochastic model to give time sensitive information dependent on manufactured age. In the event that there is a station in a given scene, Meteonorm will utilize introduction between the three stations. Satellite information from five geostationary satellites was utilized as an enhancement when soil information was poor. 8 km level resolution. Soil estimation vulnerability ranges from 1% to 10% (Meteonorm results [46]) and satellite information ranges from 3% to 4% (low scope). For earthbound insertion, the vulnerability is 1% over a separation of 2 km, 6% to 100 km, and 8% for separations more noteworthy than 2000 km. Even diffuse light was determined utilizing the Perez model to isolate the worldwide radiation shaft and the diffuse part. Performance and economics of solar photovoltaic system depends on the location and geographical parameters module. Given research addresses the efficient mathematical modelling and design simulation of grid connected solar photovoltaic system. After mathematical modelling we have addressed the problem of design and installation of Grid connected and standalone solar photovoltaic system.

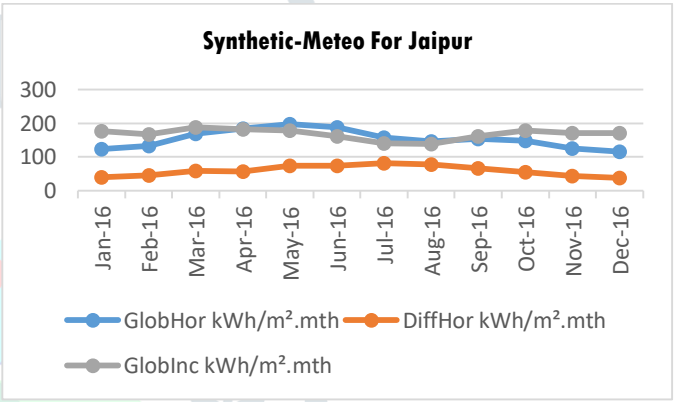

Figure 1.5 . Meteorological Data-Jaipur

Choice of Solar Panel-In PV systems, the preset depends on region or power. Contingent upon the size, the board is chosen dependent on the appraised power and working voltage.

Choice of Inverter-In PV syst the choice of inverter is done as per the choice of pv panel.The rating of invereter should coordinate with the details of board.

Direction and Horizon-In the proposed work contemplate, we have recreated a 1 MWp fixed tilt system that has been chosen for fixed tilted straight shading. Photovoltaic systems have been built up in Jaipur (26.9124°N, 75.7873°E and 431m), Kolkata (22.57260 N, 88.36390 E and 9 m) and Chennai (13.0827°N, 80.2707°E and 6.7 m) with scope and elevation Height and height. Once more, it is likewise produced for different spots. The time zone is chosen by the Indian Standard Time (IST). In the following area, the stepwise coordination of the scientific equal model for a given grid-associated system in PV Syst is talked about.

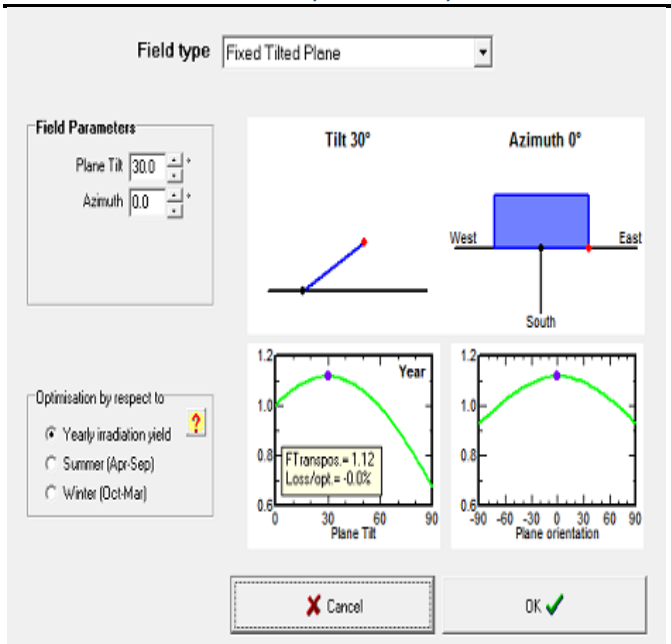

Figure 1.6 . Orientation and Horizon finalization of PV module

III. PARTIAL SHADING CONDITION

Partial shading is the case of poor performance of photovoltaic cells, panels or arrays, or provides low power, instability and complex IV and PV characteristics.In most cases, partial shadowing occurs when some of the PV cells on the panel or array block direct sunlight. Studies have shown that most shadows are caused by the angle of inclination of surrounding trees, clouds, buildings/houses, bird droppings, dust/leaves, water and solar panels/arrays. The full shadow will also bring similar problems to the PV system, but there is no discussion like partial shadows. Trees, nearby buildings and clouds are the main reasons for partial shadows.

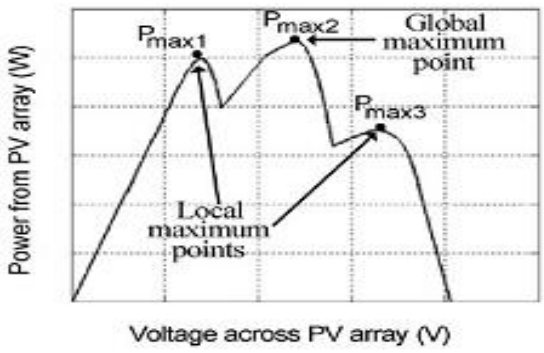

Figure 1.7. Power-voltage Characteristics of PV Array Under Partial Shading condition

Other causes (not shown) can also affect the performance of the PV system, including varying temperatures, weather conditions and sunshine levels. The P-V characteristics shown can represent an array under normal conditions. The P-V curve has multiple peaks, so it has multiple maximum power points (MPP), in this case three. There is only one global MPP and two local MPPs, of which the global MPP has the highest MPP value within the P-V curve. MPP needs to be researched and analyzed to verify possible outputs and to locate MPPs throughout the system under specific conditions. For this reason, the MPPT algorithm must be applied to the system to help track the MPP under all conditions, which will result in increased output and increased efficiency.

IV. SIMULATION & RESULTS

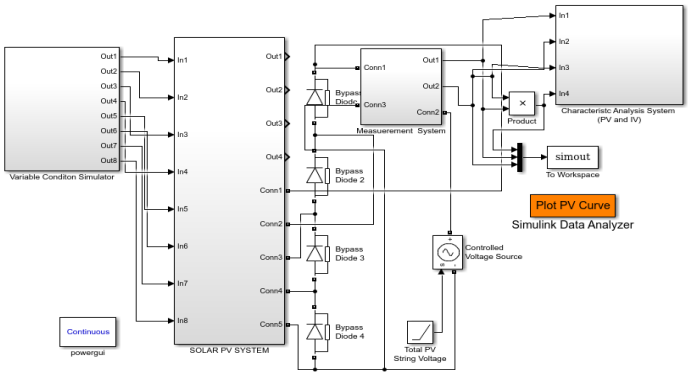

Figure 1.8. Mathmeatical Model of Partial Shading Condition in Solar PV System

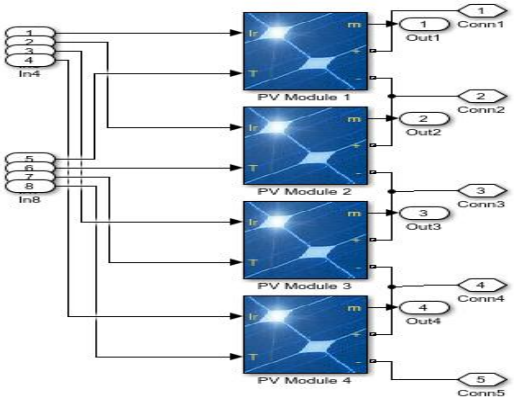

Figure 1.8. Connection of PV String

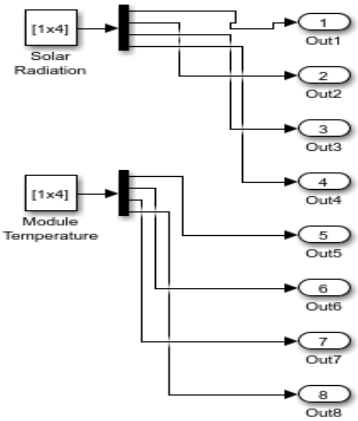

Figure 1.9. Connection of Variable Irradiance and Variable temperature in PV String

A more general partially shaded PV string with n different irradi- ance values of G1,…,Gn,, G1 > G2 > … > Gn, is divided into n sub- strings and their PV module numbers of their substrings are, respectively, N1,…,Nn. Based on the simulation results presented in this section, several useful rules for a partially shaded PV string in general case are unveiled as the followings:

(i) The overall V–I curve takes the shape of an ascending-multiple-step terrace field and V–P curve has mul- tiple peaks, where the numbers of MPPs and

step terrace field are exactly equal to the number of the irradiance levels in the PV string.

(ii) The left-side MPP on the V–P curve is only dependent on sub- string1 consisted of full sun PV modules and independent on the other substrings consisted of full shaded PV modules, which are bypassed.

(iii) At right-side MPP on the V–P curve, all modules in the string make contribution to power generation, which is dominated by the irradiance value Gn received in substring n, since the current value of Impn at the MPPn is proportionally to Gn.

(iv) The location of MPPi is determined by Gi and N1, …, Ni, since substring1 up to substring i make contribution to power generation, the current Impi at the MPPi is proportionally to Gi and the other substrings from i +1 to n are bypassed.

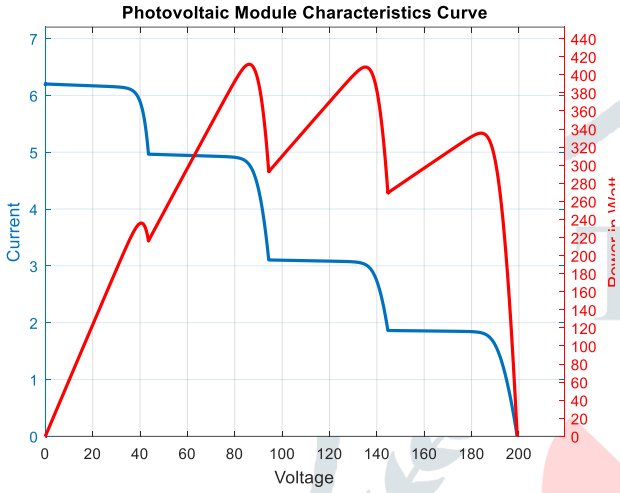

Figure 1.10. P-V & I-V Characteristics of PV Array Under Partial Shading condition

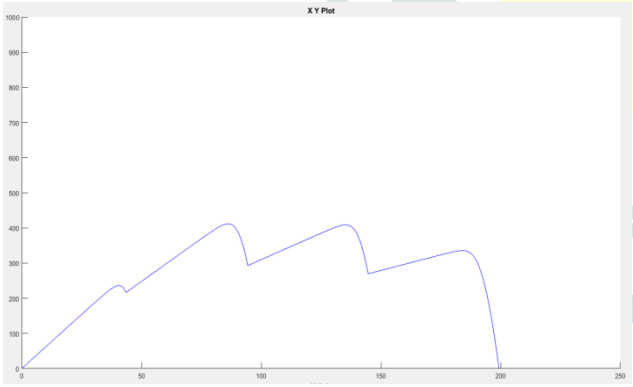

Figure 1.11. P-V Characteristics of PV Array Under Partial Shading condition

Given a PV array consisting of N PV modules are arranged into Np PV module strings connected in parallel, each string with Ns PV modules in series, where N= Ns × Np. It is required to obtain the entire V–I and V–P characteristics curves for one to learn and under- stand the behaviour of a PV array in a complex scenario conclusion

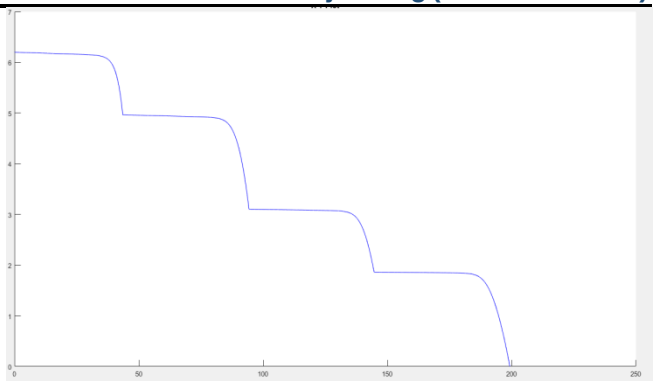

Figure 1.12. I-V Characteristics of PV Array Under Partial Shading condition

We have reproduced scientific likeness introduced control plant in PV-SYST by orchestrating engineered meteo document for Jaipur. Following stages associated with modeling mathematic likeness solar board, inverter and direction. Design of introduced control plant was done in PV-SYST which is broadly utilized business instrument for design and establishment of solar photovoltaic system. The well ordered procedure of designing numerical modeling and programming design of our photovoltaic plant is being depicted here as follows.The illumination information were gotten from NASA-SSE satellite information, discharge 6 just as Metronome satellite discharge. The got Irradiation information established estimations of artificially created hourly estimations of surrounding temperature, diffused, shaft and worldwide light of Jaipur for range of one year as plotted in Fig. 3.1. These information were spared in PV-Syst for making new topographical site.[5.2] Using producer datasheet of ELDORA-300, equal numerical model of solar board has been acquired in PV-Syst client characterized library. These models were utilized in making 100 kWp system for proposed photovoltaic power plant.Using maker datasheet of Sunny Tri control 25000TL, comparable numerical model of inverter has been designed in PV-SYST client characterized library. These inverters were utilized in making 100 kWp system for proposed photovoltaic power plant. This procedure can be comprehended by investigation of Fig. 3.1. which is preview of system design device of PV-SYST made for proposed system.

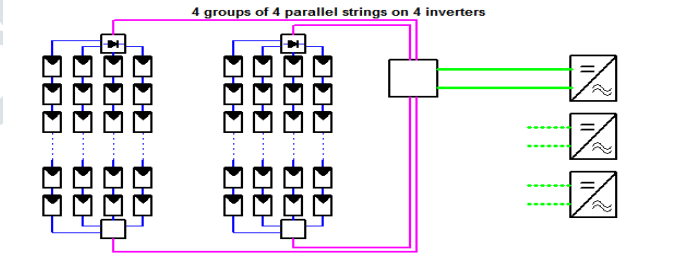

Fig. 1.13 Inteconnection of Inverters in String Topology

There are 4 inverters every one of 25 kW so as to acknowledge proportionate mathermatical model of the introduced system.Figure 3.4 clarifies the interconnection of inverters and panels in string topology which is at long last associated with grid so as to interface with the two-sided net meter.

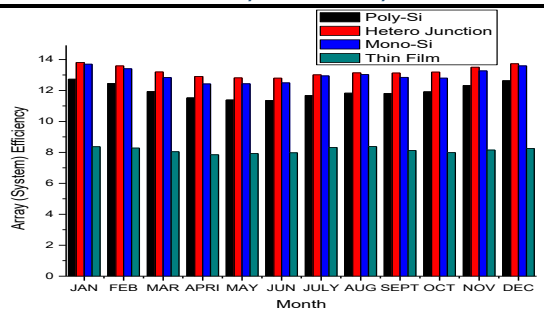

Figure 1.14 . Simulation of Module Efficiency for 100 Kwp System

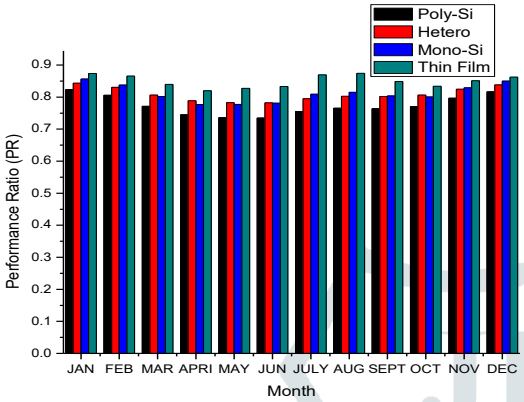

Figure 1.15 . Simulation of Performance Ratio

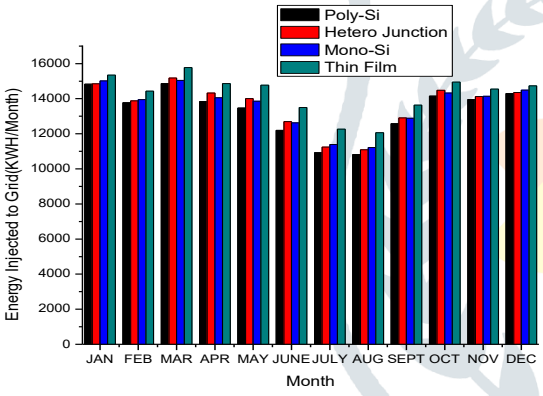

Figure 1.16. Simulation of Energy Injected to Grid

Using PV syst estimated estimations of montly yield is determined as far as kWh/Month. We have additionally reproduced anticipated estimation of created control by Solar PV plant for each of the four assembling technologyon the premise of kWh/day. The yearly reference and last yield has been recreated utilizing the pvsyst programming introduced by the system. The yield maps have been described as standardized porosity and essential outcomes. The reference units and the last yield are communicated in hours per day.We have mimicked for complete yearly dependent on month to month premise. Plot of simulation are clarified in figure 6.8 and figure 6.9 individually. For the proficient use of solar energy, it is basic to actualize effective numerical model, design and establishment process just as guaging methods for arranging and dependability. Simulated values of performance assessment, yield forecasting and loss forecasting for 100 kWp grid connected solar photovoltaic system with respect to four different manufacturing technology have been obtained, The results obtained from forecasting simulation have been explained in table. We can analyze that the performance ratio of thin film technology based system was highest as comapred to other comparative technology. Whereas in terms of injected energy to grid the performance of heterojunction system was superior.

Table 1.1. Results for Mono Si and Poly Si

Name of Parameters	Mono-Si	Poly-Si
PR	0.8116	0.773692
Reference Yield	5.513917	5.513917
Final Yield	4.474167	4.26875
Energy Output for Inverter (KWH)	176570.3	159697

Table 1.2. Results for Hetero Junction and Thin Film

Name of Parameters	Hetero Junction	Thin-Film
PR	0.808492	0.849925
Reference Yield	5.513917	5.513917
Final Yield	4.459917	4.680833
Energy Output for Inverter (KWH)	176741.5	170877

V. CONCLUSION

This paper first introduces the partial shading condition analysis tools like MATLAB and PV-Syst for analyzng partial shading condition. This paper focus on the characteristic of photovoltaic system. A mathematcal model has been examined using MATLAB to access the effect of variable irradiance and variable temperature on PV and IV characteristic of solar photovoltiac system.This analysis is useful in studying partial shading condition effect on tracking maximum power point in such scenario. This analysis will help in application of MPPT algorithm in partial shading scenatio for efficiency improvement objective.In our examination work completed we have tended to these issues and effectively built up every one of the issue with the assistance of applicable programming. Modeling and simulaion of 100 Kwp Solar PV system was carried in PV Syst and it was observed that in high temperature region having optimum summer months. The performance of thin film modules are superior as compared to other technologies. The performance of heterojunction system is also optimum and less effected by temperature dependent losses. Mono Si and Poly Si system are affected by temperature dependent losses in significant amount.

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