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Review of Photo – Voltaic System Technology Tools

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Abstract— Photo-Voltaic System has improved in technology and high importance in last few years. In this review different technology tools has come into existence such as data logger, I-V Curve Tracer and Thermal Imaging Device, Hybrid2 PV software, RETScreen PV software, System Advisor Model PV Software, Easy Solar PV software App, HOMER Legacy PV software, SKELION software, EASY PV software, PVWATTS software and PVSYST Software. The different photovoltaic system technology tools are used to analyze different types of PV systems with different input parameters and a different layout of components. The output parameters in the form of energy produced and efficiency are estimated throughout a year. The economic evaluation and financial analysis of system components are also predicted through these technology tools. The system losses can be analyzed and load modulation can also be performed.

Keywords— _Photo-Voltaic System; Technology Tools; System Losses; Economic Evaluation;_

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I. INTRODUCTION

Photo- Voltaic technology can be simulated by different technology tools which take various input parameters and simulates in real time conditions giving different outputs for different load conditions. These can be used as monitoring tools for the design of PV systems which may be grid connected or a panel in remote area. An accurate evaluation of solar photovoltaic panels can be done to get desired energy output. Simulation of PV systems includes planning and sizing, analysis, monitoring and economic evaluation.

II. TECHNOLOGY TOOLS

A. PV System Technology Tools

A photovoltaic system basically consists of a solar panel, inverters, power conditioning elements, pyranometer, thermocouple, wind speed and wind direction sensor, and RTD air temperature detector, panel mount and system wiring. The other devices include AC distribution panel, data logger, I-V curve tracer and thermal imager. The solar panel is made up of either mono crystalline or poly crystalline material. The solar panel is mounted at an appropriate orientation with help of a supporting structure. The pyranometer measures amount of solar irradiance. The thermocouple is used to measure heat absorbed by the panels. The temperature detector measures temperature of solar cells. All these measuring devices are connected to data logger as shown in fig 1. Data logger is a device that displays all these values with accuracy and resolution. Fig 2 represents I-V curve tracer which displays the I-V curve. Thermal imaging devices are used to detect hotspots in the panel. These output devices measures real time values and can be compared with simulation results.

Fig.1. Data Logger

The brief description of photovoltaic software's which are in use all over the world is given below.
This software's are used for appropriate planning and to provide good operation of PV system along with proper cost analysis of equipment being used.

Fig. 2 I-V Curve Tracer and Thermal Imaging Device

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III. PV SYSTEM TOOLS FOR SIMULATION

A. *Hybrid2 PV Software*

A wide variety of hybrid power systems can be simulated using Hybrid2 PV software for long term performance results. This tool is used to predict the output for given input in data form of type of PV system, solar irradiation, wind speed, temperature and user needs. It is a probabilistic and time series computer model in which time step takes into account of wind speed and change in load. This software is best suited for analyzing a PV system with long term point of view. Economic evaluation can also be done for system components.

B. *RETScreen PV software*

RETScreen is an Excel-based clean energy project analysis software tool. This software is used to examine the potential of renewable energy,
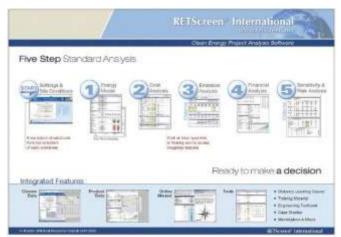

Fig. 3 Analysis of PV system using RETScreen Software

C. *System Advisor Model (SAM) PV Software*

The System Advisor Model (SAM) PV software is a free software which is performance oriented and supports analysis of different PV models. Some of the models are flat plate and concentrating PV systems, solar water heating systems, solar thermal systems and PV systems with battery storage. Analysis of different renewable energy sources can also be done such as wind power, geothermal power and biomass energy production. The analysis includes input parameters and cost assumptions for a project and output parameters in the form of tables and graphs. The financial analysis can be done based on performance results and energy output. The various financial models include residential, commercial and utility scale models.

D. *Easy Solar PV software App*

Easy Solar software is a professional app in smart phones which are user friendly and provide tools for simulation of photovoltaic systems. This software consists of tools which can provide correct azimuth angle and orientation of panel at specific location. With the help of cloud technology complete analysis of the PV system can be done using this app. Measurement of various input and output parameters can be done in a short period of time with accurate results. It is the

first app to design photovoltaic systems and for performing dimensioning, visualization and design of solar plants wherever you are using your smartphone.

Fig. 4 Results in SAM PV Software

Fig. 5 Easy Solar App

E. *HOMER Legacy PV Software*

HOMER Legacy PV software is a computer software that evaluates both grid connected PV systems as well as off grid systems for various applications that are remote, stand alone and distributed generation systems. This software provides optimization of system components taking into account of all uncertainties. A large number of technology options can be explored by using this software by providing technical specifications and cost details of the project. Different configurations can be simulated and sensitivity analysis can also be done using this software. This software can be applicable for small scale systems in villages as well as for large commercial systems.

F. **SKELION Software**

The SKELION software mainly focuses on designing and implementation of solar photovoltaic system and thermal components in a surface. It explores the possibilities of solar

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panel arrangement in the form of connection between solar cells in series and parallel and also includes shading analysis. This software is used to create own models at different locations and gives pictorial view in the form of 3D model view. It is used for designing of solar thermal and solar photovoltaic systems. This software can be used for reducing the cost of design in a short period of time.

G. EASY PV Software

EASY PV software is a software where any project can be created online for free. This tool can be used to estimate PV system performance and output at any instant. The input parameters include designing and type of roof, panel specifications, inverter type and isolator. The electrical specifications include wiring arrangement between components. The structural specifications include all the components to be electrically connected in desired way. The performance analysis gives the output results on simulation.

H. PVWATTS Software

PVWatts Calculator is an online calculator that estimates the energy production and cost of energy of a grid-connected photovoltaic (PV) system using solar resource data for locations throughout the world. It is an online software which can give cost and performance estimate of any site located in the world. It analyzes grid connected systems giving hourly values of the output. Physical parameters of PV system are taken as input values. The limitation of this software is that it works only for crystalline modules. The Results page displays monthly and annual average solar radiation in kilowatts per square meter per day and annual and monthly energy production in kilowatt-hours and the value of electricity generated by the system in dollars per month and dollars per year.

I. PVSYST Software

The characteristics of grid connected PV system can be analyzed using PVsyst software which predicts the energy production taking into account the amount of irradiance and shading effects. PVsyst software gives quick evaluation of potentials and possible constraints of a PV System. The PVsyst software provides full analysis of PV system, accurate System yield computed using detailed hourly simulation. Different simulation variants such as orientation i.e., tilt angle, azimuth angle, sizing of PV array, inverters with number of MPPT features and number of strings and modules can be performed and compared. Horizon analysis for different places can be analyzed. Additionally economic evaluation with real component pricing can be done. Carbon balance is calculated on the basis of life cycle emissions of components being used in photo voltaic system.

CONCLUSION

These Photo- Voltaic technology tools are useful for the simulation keeping all the conditions required. The economic evaluation and financial analysis of system components are to be followed. These software's are 3-D model of a PV system can also be created using these software's for better understanding. The simulation results of a PV system can be studied and analyzed efficiently by knowing the pros and cons

of the system parameters. The PV software's are tools for providing a better design and to get accurate evaluation of system parameters.

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