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ENERGY GENRATION FOR ON GRID SOLAR PV PLANT USING PV SYST

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ABSTRACT

Today, energy conservation, as well as the use of renewable resources has become imperative. Because of this, the need for methods that are both highly efficient and low in energy consumption has greatly increased.

One of the best options for the development of renewable energy such as solar power is the flattening of conventional electricity models and solar systems provisioning. The virtual modeling and simulation tool of the grid connected photovoltaic system is one of the most important aspects to assess the real time behavior. With the help of PV system planning software, prospective analysis and evaluation of the grid-connected photovoltaic system is carried out. This paper is aimed to study the design and evaluation of an 80 kWp solar system at the Ace Engineering college as the proposed location. A prospective modeling of the grid connected 80 kWp Solar PV system is developed based on Solar PV cells and sticks model.

In this some preliminary design, the economic assumptions and the simulation result has been dealt in this paper. PVsyst is used to simulate every minute the performance (levelized cost of energy, LCOE) of a ground mounted solar system. Solar modules used in the simulation encompass the various power losses that appear in series-connected solar modules, such as the temperature losses, the internal network losses, the shading effects, the mismatch effects, etc. In the design phase, several performance properties such as system levelized cost of energy (LCOE), the average production and the maintenance cost of the system are evaluated. For the 80 kWp system, simulation of 125MWh/yr indicate that the average production of 112.8 ccs/h with an average gross production of 115.5 MWh performance ratio of 71.74%.

Keywords: Renewable Energy , Photovoltaic system, Solar panels, PVSYST.

I. INTRODUCTION

Among several renewable energy sources, energy generation from photovoltaic (PV) effects is the most important and sustainable method because solar radiant energy is abundant and easily accessible around the world. Solar energy is widely available and free to use during the day, even though the sun is blocked. Recently, photovoltaic systems have been recognized as leaders in renewable power generation as they can generate direct current without serious environmental impact or pollution. A PV module is the basic power conversion unit in a PV power generation system. The performance characteristics of PV modules depend on solar radiation, cell temperature, and PV module output voltage. Because PV modules exhibit nonlinear electrical characteristics, the design and simulation of this system requires reliable PV modeling. With the expectation of energy security and sustainable development to reduce the generation deficiency in the province this has made essential to utilize the potential of renewable energy resources. Installing a grid-connected 100 kWp photovoltaic system might be a step forward in increasing energy generation in the province.

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A. **System Design and Objective:**

The objective of this study is to design a PV system suited for the needs of the user and exploring possible PV system solutions which includes

- Collecting and evaluating meteorological data for the site to determine the available solar resource and environmental conditions.
- Evaluating available ground surfaces regarding the suitability of installing a PV system.
- Designing and simulating several possible PV systems while considering limitations and restrictions
- Evaluating the economical feasibility of the PV systems designed.

II. METHODOLOGY

A. Simulation Software: PVsyst:

PVsyst was selected as the simulation software, because it is a powerful tool for studying, sizing and analyzing data of a PV system. It contains databases of both meteorological data and PV system components from several manufacturers. For this study version 6.77 evaluation mode is used. Figure 1 shows an outline of the different steps in performing a PV system design and simulation in PVsyst

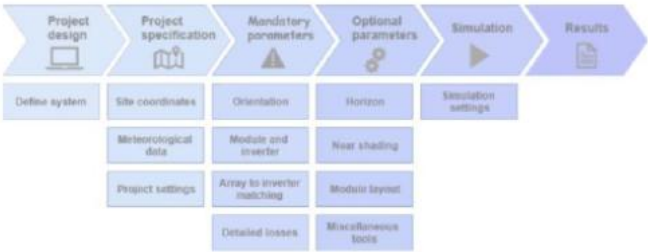

Fig. 1. Project design steps in PVsyst

B. Site Assessment.

Fig. 2.Site Location

During the site assessment, available area for installation, orientation and dimensions, near shading objects, and electricity consumption pattern were investigated. The proposed site is located at Ibabao, Aloran, Misamis Occidental. The geographical location is listed in Table 1. These coordinates were used for all weather data and site specific data throughout the study.

TABLE 1. GEOPGRAH ICAL LOCATION

Latitude	Longitude	Altitude	Time zone
17.44	78.72	468	UTC+5.5

C. Meteorological data:

Meteorological data The meteorological datafile can be chosen from one of the databases included in PVsyst, which are NASA-SSE and Meteonorm 7.1, imported from another database that PVsyst supports or created based on measured data from e.g. weather stations. The required parameters in the meteorological file are horizontal global irradiance and ambient temperature. Horizontal diffuse irradiance and wind velocity are optional parameters, but the result will be more accurate if they are included. Since the simulation in PVsyst is operated at hourly intervals, hourly meteorological data are required to perform a simulation. For the meteorological data sources only containing monthly data, synthetic hourly data are constructed from the monthly values

TABLE 2. MONTHLY METEO DATA

Month	Horizontal global radiation (kWh/m²)	Horizontal diffuse irradiation (kWh/m²)	Temp. (°C)	Wind Velocity (m/s)
January	132.1	68.3	26.0	1.20
February	143.1	67.2	26.0	1.3
March	195.9	69.0	26.8	1.31
April	179.2	77.8	27.3	1.19
May	171.2	87.3	27.6	1.19
June	155.4	74.2	26.6	1.09
July	166.5	73.1	26.9	1.09
August	169.3	83.6	27.1	1.19
September	160.8	76.1	26.5	1.19
October	158.1	77.3	26.7	1.19
November	151.0	62.7	26.3	1.10
December	155.0	58.4	26.5	1.19
Year	**1937.6**	**875.0**	**26.7**	**1.2**

a. Meteonorm7.1 (1989-2015), Sat=100%

D. Selection of module and inverter:

Selecting a module to use may be challenging as there are numerous modules available in sizes, power, types, prices and efficiency from multiple manufacturers. It is important to make sure that the module complies with IEC standards for module design and quality and investigate the module warranty. Another factor to consider is which modules are available in the country and which modules installers are familiar with. Based on the OhmHome summary recommendation of solar modules available on the market today, Canadian Solar (CS) was listed as one of the top preferred module brand as of 2017 [4]. The CS6U - 330P solar module was distinguished having substantial efficiency in CS6U Series with 18.85% efficiency per cells area. The modules have to be oriented in landscape configuration to avoid the effect of parallel shading on the module cells.

When selecting the inverter, consideration should be made of the size of the system, cost, flexibility of the system, partial shading, number of sub-strings or strings and their orientation. Care should be taken to ensure that only modules with the same orientation, angle and shading conditions are connected together in strings. The selected string inverter for the design was chosen based on recommendation from Clean Energy Reviews [5]. The most used inverter brand for PV systems in the 11 - 99 kWp range is SMA [6]. The SMA Sunny Tripower 10000TLEE inverter was used in all ground mounted simulations.

Input side (DC PV Field)	
Minimum MPP Voltage	300 V
Maximum MPP Voltage	590 V
Absolute max. PV Voltage	600 V
Output side (AC Grid)	
Triphased	50/60 Hz
Grid Voltage	202 V
Nominal AC Power	10.0 kW
Maximum Efficiency	97.80%

TABLE 3. SMA SUNNY TRIPOWER 10000TLEE INVERTER

E. Module orientation and inter-row spacing:

The field type of a ground mounted PV system can be chosen as either a fixed tilted plane or unlimited sheds in PVsyst. A shed in PVsyst is a row of modules. When using a fixed t ilted plane, the module rows are constructed in the near shading scene. Both mutual shading and near shading items are therefore accounted for. A fixed tilted plane is used and unlimited sheds is defined on near shadings optional parameters to specify module layout. The energy production will be optimized for a yearly irradiation yield. When choosing the tilt angle and azimuth angle for a ground mounted PV system, the inter-row spacing must be considered together with the orientation. An optimization between tilt angle, azimuth angle, area utilization and maximum energy production is ideal when choosing the inter-row spacing. In this design, the optimization by respect to yearly irradiation yield and the condition of no mutual shading from 7am to 4pm was used based on the solar paths at specified site as shown on Fig. 5. Through orientation optimization by PVsyst, an azimuth angle of 0° and a tilt angle of 15° were considered.

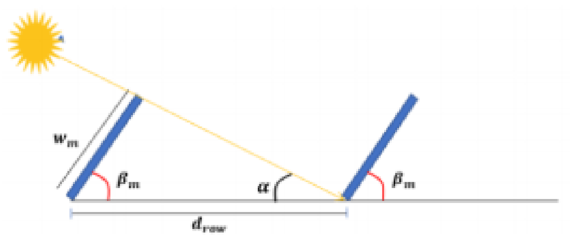

Fig. 3. Inter-row spacing for a ground mounted PV system

F. System Designs:

The sizing ratio between the nominal PV array power at STC and the nominal AC inverter power is called the Pnom ratio, and describes the capacity utilization of the inverter.

where Pnom array is the nominal PV array power at Standard Test Condition (STC) [W] and Pinv AC is the nominal AC inverter power [W].

If Pnom ratio is 1 the systems DC and AC capacity matches, if Pnom ratio is lower than 1 the inverter is oversized and if Pnom ratio is larger than 1 the inverter is undersized. The AC nominal power is the power that the inverter can continuously feed into the grid without cutting out at an ambient temperature of 25◦C [7]. The nominal power of inverters can be within ± 20% of the PV array power at STC, depending on the inverter and module technology, and the environmental conditions [7]. This gives the following power range for optimizing the performance

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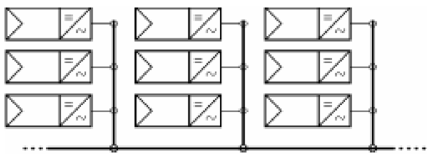
Planned Power	100 kWp
Number of Inverters	10
Global Inverter's Power	100 kWac
Module in Series	10
Number of Strings	30
Number of Modules	300
Area	583 m²
Array Nom. Power (STC)	99.0 kWp
Pnom Ratio	0.99

TABLE 4. ARRAY DESIGN

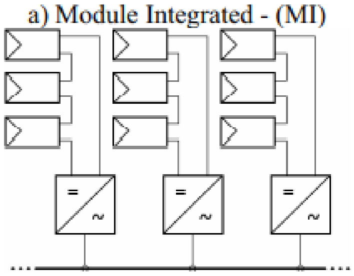
III. ON GRID

The main components of a grid-connected PV system include a series-parallel connection arrangement of the available PV modules (solar panels), usually referred as "photovoltaic generator or solar field", and a DC-AC power processing architecture in charge to extract and properly transfer the maximum available power present at the PV generator to the grid.

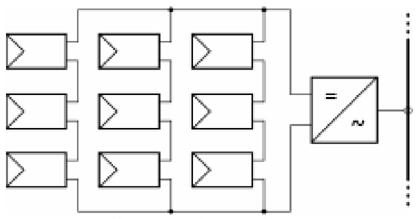
In this sense the maximum available power is extracted by means of power processors controlled by maximum power point tracking (MPPT) algorithms, and is injected into the grid through a DC-AC output current conversion at unity power factor.



a) Module Integrated - (MI)



b) Module Oriented - (MO)



c) Plant Oriented - (PO)

The extensive research over the last two decades has led to different configurations of grid-connected PV systems in terms of PV generators and power processing architectures which are oriented either to maximize the power extraction or to optimize the cost and the design of the power processors [1]. The prevailing configurations in grid-connected PV systems design namely, Module Integrated (MI), Module-Oriented (MO) and Plant Oriented (PO) are depicted.

Fig 4. ON GRID SYSTEM

IV. RESULTS AND DISCUSSION

DATA SHEET FOR THE (80 kW) SOLAR POWER PLANT FOR THE YEAR (2020) IN ACE ENGINEERING COLLEGE

A. Pvsyst-Simulation report

General parameters

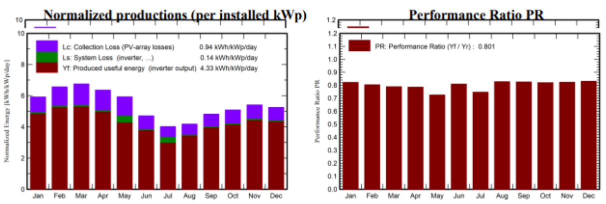
Grid-Connected System	**No 3D scene defined, no shadings**	
PV Field Orientation		
Orientation	**Sheds configuration**	**Models used**
Fixed plane	No 3D scene defined	Transposition Perez
Tilt/Azimuth 20 / 0 °		Diffuse Perez, Meteonorm
		Circumsolar separate
Horizon	**Near Shadings**	**User's needs**
Free Horizon	No Shadings	Unlimited load (grid)

PV Array Characteristics

PV module		**Inverter**	
Manufacturer	Generic	Manufacturer	Generic
Model	Eldora VSP.72.315.03.04	Model	Solar Inverter M30A_230
(Original PVsyst database)		(Original PVsyst database)	
Unit Nom. Power	315 Wp	Unit Nom. Power	30.0 kWac
Number of PV modules	160 units	Number of inverters	4 * MPPT 33% 1.3 unit
Nominal (STC)	50.4 kWp	Total power	40.0 kWac
Modules	8 Strings x 20 In series	Operating voltage	200-900 V
At operating cond. (50°C)		Max. power (=>35°C)	33.0 kWac
Pmpp	45.2 kWp	Pnom ratio (DC:AC)	1.26
U mpp	669 V		
I mpp	68 A		

System Production

Produced Energy	79.74 MWh/year	Specific production	1582 kWh/kWp/year
		Performance Ratio PR	80.07 %



Balances and main results

	GlobHor kWh/m²	DiffHor kWh/m²	T_Amb °C	GlobInc kWh/m²	GlobEff kWh/m²	EArray MWh	E_Grid MWh	PR ratio
January	149.9	51.16	23.43	183.7	179.5	7.770	7.620	0.823
February	159.1	52.28	26.35	184.1	179.9	7.614	7.467	0.805
March	196.5	68.79	29.80	209.6	204.7	8.503	8.339	0.789
April	193.6	79.80	32.04	190.9	185.8	7.709	7.562	0.786
May	198.6	89.08	33.62	184.0	178.3	7.434	6.733	0.726
June	155.5	82.06	29.34	141.4	136.5	5.882	5.773	0.810
July	135.3	86.05	27.51	124.8	120.2	5.290	4.700	0.747
August	135.4	83.29	26.47	129.6	125.3	5.519	5.414	0.829
September	142.5	85.36	26.39	144.7	140.3	6.140	6.025	0.826
October	144.3	72.73	26.42	157.8	154.0	6.651	6.522	0.820
November	137.4	56.82	24.28	162.6	158.9	6.885	6.754	0.824
December	132.8	55.73	23.08	162.9	159.1	6.960	6.829	0.832
Year	1881.1	863.16	27.40	1975.9	1922.5	82.357	79.739	0.801

Fig. 5. Data Sheet Produced Energy

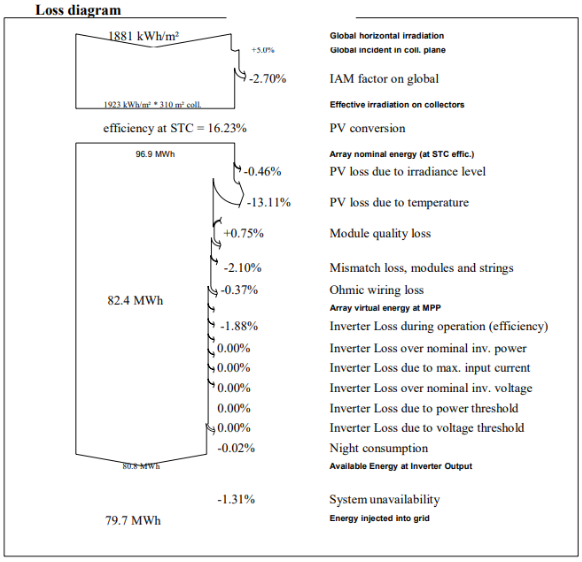


Fig. 6. Loss diagram

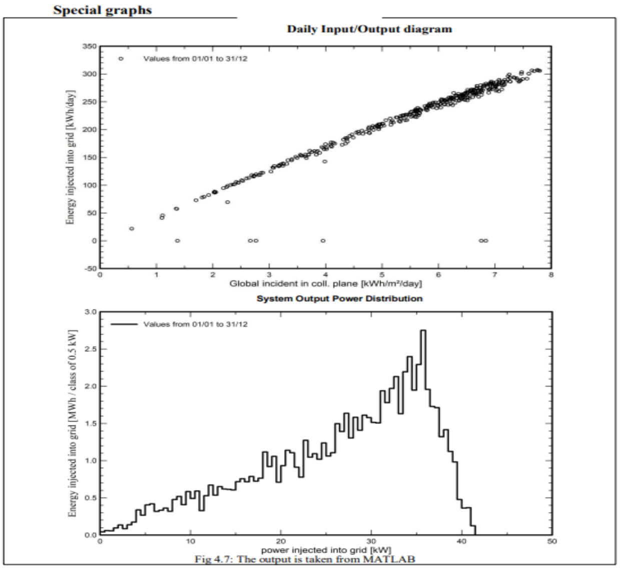


Fig. 8. Daily Input/output Diagram

V. CONCLUSION

As the world is quickly moving towards renewable energy ,solar rooftop has been a key part. As it is efficient and also cost effective .Today , even people are concerned towards the climate change issues and are now trying to address this issue by moving towards renewable energy .As home comes first personal step to solve the issue .people are trying to install solar rooftops. Even the central has introduced policy for grid connected solar rooftop programme-which reserves finance assistance for the residential sector. Here ,the supply and demand side complexities are also addressed and there will be uninterrupted power supply. Even the state government is formulating regulations that encourage solar rooftop adoption. Most of the houses in our near future will be having installed solar panels. There is so much potential energy to be gained from using solar energy. If you are looking to move towards greener and safer environment, this is by far the easiest, simpliest and most inexpensive

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