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Solar Photovoltaic Option for Meeting Power Demand at Pondicherry Engineering College

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ABSTRACT: The depletion of fossil fuel resources on a worldwide basis has necessitated an urgent search for alternative energy sources to meet up the present day demands. Solar energy is clean, inexhaustible and environment-friendly potential resource among renewable energy options. But neither a standalone solar photovoltaic system nor a wind energy system can provide a continuous supply of energy due to seasonal and periodic variations. Therefore, in order to satisfy the load demand, grid connected energy systems are now being implemented that combine solar and conventional conversion units. Solar photovoltaic option for meeting power demand at Pondicherry engineering college is fully theoretical based project. The main objective of this project are Meteorological data for the site ,Load forecasting at Pondicherry engineering college, Component selection ,Design layout of solar photovoltaic plant ,Testing and analysis of system design by using PVSYST software .Finally obtained electricity consumption by load forecasting technique can be validated by using PVSYST software.

KEYWORDS: *grid connected, solar photovoltaic system, Meteorological data for the site, load forecasting, design layout, testing and analysis using PVSYST software*

I.INTRODUCTION

Energy plays a pivotal role in our daily activities. The degree of development and civilization of a country is measured by the amount of utilization of energy by human beings. Energy demand is increasing day by day due to increase in population, urbanization and industrialization. The world's fossil fuel viz., coal, petroleum and natural gas will thus deplete in few hundred years. The rate of energy consumption increasing, supply is depleting resulting in inflation and energy shortage. This is called energy crisis. Hence alternative or renewable sources of energy have to be developed to meet future energy requirement.

1.2 WE PREFER GRID CONNECTED PV SYSTEM

Because as day by day the demand of electricity is increased and that much demand cannot be meeting up by the conventional power plants. And also these plants create pollution. So if we go for the renewable energy it will be better but throughout the year the generation of all renewable energy power plants. Grid tied PV system is more reliable than other PV system. No use of battery reduces its capital cost so we go for the grid connected topology. If generated solar energy is integrated to the conventional grid, it can supply the demand from morning to afternoon (total 6 hours mainly in sunny days) that is the particular time range when the SPV system can fed to grid. As no battery backup is there, that means the utility will continue supply to the rest of the time period. Grid-connected systems have demonstrated an advantage in natural disasters by providing emergency power capabilities when utility power was interrupted. Although PV power is generally more expensive than utility-provided power, the use of grid connected systems is increasing.

II. METHODOLOGY OF THIS PROJECT

The methodologies of the projects are as follows

- Meteorological Data for the site
- Load calculation at Pondicherry engineering college
- Selection of components System sizing and specification

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- Design layout of solar photovoltaic plant
- Testing and analysis of system design by using **pvsyst software**

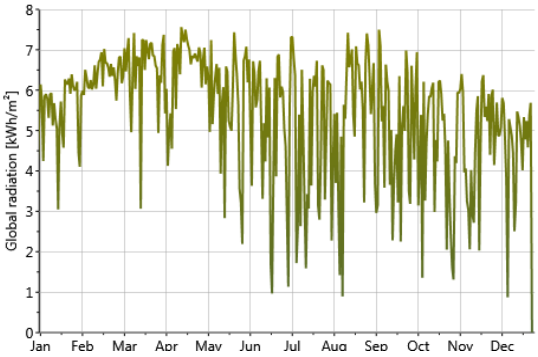
2.1 METEOROLOGICAL DATA FOR PONDICHERRY ENGINEERING COLLEGE

Meteorological data includes solar radiation, sunshine hours, temperature of air and wind velocity for the sites. Pondicherry engineering college campus is situated at Pillaichavady which is about 12 km from the railway station and bus-stand in Pondicherry town. It is about 160 km south of Chennai (Madras) on the shores of Bay of Bengal and spread over 240 acres (0.9712 sq.KM). Located at latitude of 12°00′47.74″N and longitude of 79°51′13.78″E. This activity shall assess solar resource attractiveness of the proposed site. This shall include assessment of parameters like Global Horizontal Solar Radiation, Diffused Horizontal Solar Radiation, Direct Normal Solar Radiation, Wind Speed/Direction and Air Temperature. To estimate the meteorological data for the site by using METEONORM software.

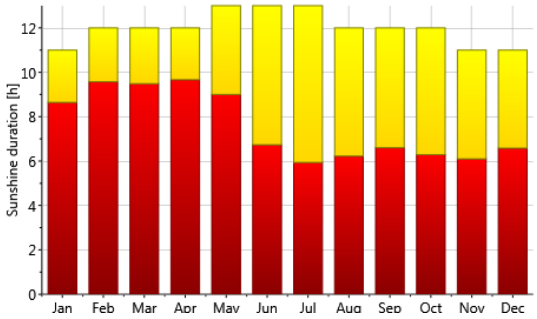
III. METEONORM SOFTWARE

Meteonorm is a comprehensive meteorological reference. It gives you access to meteorological data for solar applications, system design and a wide range of other applications for any location in the world. The sophisticated interpolation models inside meteonorm allow a reliable calculation of solar radiation, temperature and additional parameters at any site in the world. By using Meteonorm software to predict the global solar radiation, diffuse solar radiation, beam radiation, ambient temperature and wind velocity at Pondicherry engineering college based on these years from 2000-2009.

DAILY GLOBAL SOLAR RADIATION CHART AT PONDICHERRY ENGINEERING COLLEGE



SUNSHINE DURATION CHART AT PONDICHERRY ENGINEERING COLLEGE



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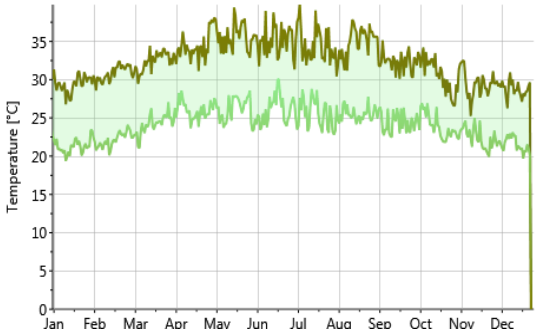
DAILY TEMPERATURE CHART AT PONDICHERRY ENGINEERING COLLEGE



METEOROLOGICAL DATA TABLE FOR PONDICHERRY ENGINEERING COLLEGE

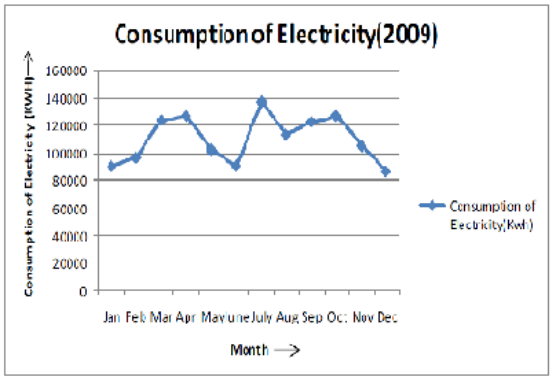
Months	Global solar radiation (kWh/m²/month)	diffuse solar radiation (kWh/m²/month)	solar beam radiation (kWh/m²/month)	Temperature (deg.celcius)	wind velocity (m/s)
January	168	55	182	25.1	2.2
February	170	56	170	26.8	2.2
March	201	75	178	29	2.8
April	193	76	159	31.4	3.3
May	177	87	124	33.5	3.2
June	157	89	91	32.9	3.7
July	163	89	75	31.2	3.2
August	158	92	89	30.5	2.9
September	152	84	94	30.1	2.4
October	149	80	97	28.8	2.1
November	128	65	95	26.7	2.1
December	145	64	128	25.6	2.2

From the meteorological data the average global radiation per day is 5.32 kWh/m^2, average temperature 29.3deg.celcius and average wind velocity is 2.69m/s. Thus the Pondicherry engineering college is suitable for installing solar photovoltaic system.

2.2 LOAD CALCULATION AT PONDICHERRY ENGINEERING COLLEGE

In this project, load calculation can be done by using forecasting technique.Forecasting is the establishment of future expectations by the analysis of past data, or the formation of opinions. Load forecasting can be done based on the past years electricity consumed at Pondicherry engineering college.

ELECTRICITY CONSUMPTION GRAPH FOR PONDICHERRY ENGINEERING COLLEGE (2009)



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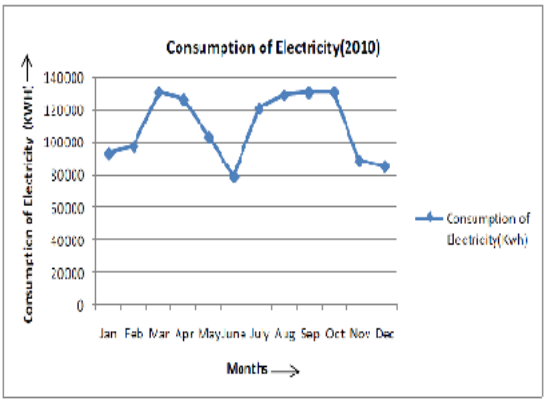
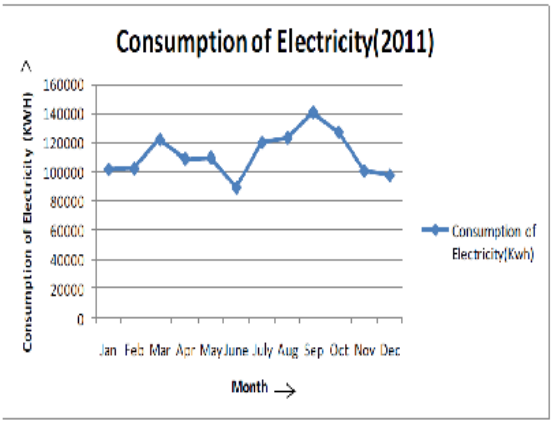
ELECTRICITY CONSUMPTION GRAPH FOR PONDICHERRY ENGINEERING COLLEGE 2010)



ELECTRICITY CONSUMPTION GRAPH FOR PONDICHERRY ENGINEERING COLLEGE (2011)



IV. LOAD FORECASTING

Regression forecasting technique

In regression forecasting technique, by considering last three years electricity consumption at Pondicherry engineering college. We can predict the electricity consumption in year 2020.

In this forecasting technique
Formula for finding electricity consumption is
Y=A+Bx
Where Y= electricity consumption
X= years
A= $(\sum Y)/n$
B= $(\sum XY) / (\sum X^2)$
Based on the consumption of electricity in last three years (2009, 2010, and 2011).
We get the equation
Y=1280021+10435(X)
By substituting x values, we get electricity consumption graph in the year of 2020.

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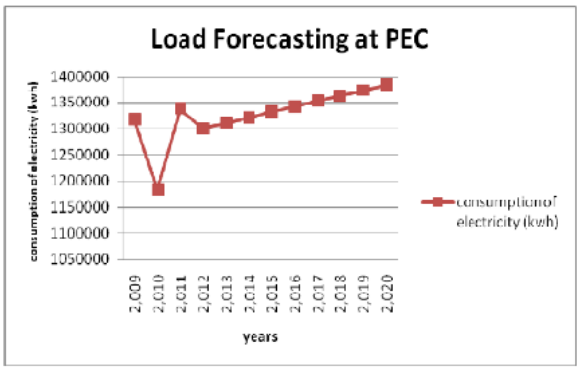

From the load forecasting graph , we predict the electricity consumption in 2020 is 1384371 kWh. Therefore average electricity consumption per day is 160kW. While design a solar photovoltaic system, choosing a maximum electricity consumption data.hence solar phovoltaic system can be design in rated of 250 kW.

V.SELECTION OF COMPONENTS

The basic Grid Connected PV system design has the following components:

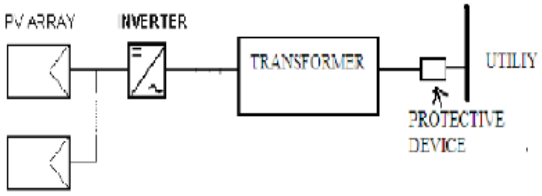

Fig. 1. Block diagram Grid Connected System

P V ARRAY: A number of PV panels connected in series and/or in parallel giving a DC output out of the incident irradiance. Orientation and tilt of these panels are important design parameters, as well as shading from surrounding obstructions.

INVERTER: A power converter that 'inverts' the DC power from the panels into AC power. The characteristics of the output signal should match the voltage, frequency and power quality limits in the supply network.

T R A N S F O R M E R : A transformer can boost up the ac output voltage fro m inverter when needed. Otherwise transformer less design is also acceptable.

L O A D : Stands for the network connected appliances that are fed from the inverter, or, alternatively, from the grid.

M E T E R S : They account for the energy being drawn from or fed into the local supply network.

P R O T E C T I V E DEVICES: Some protective devices is also installed, like under voltage relay, circuit breakers etc for resisting power flow from utility to SPV system.

O T H E R DEVICES: Other devices like dc-dc boost converter, ac filter can also be used for better performance.

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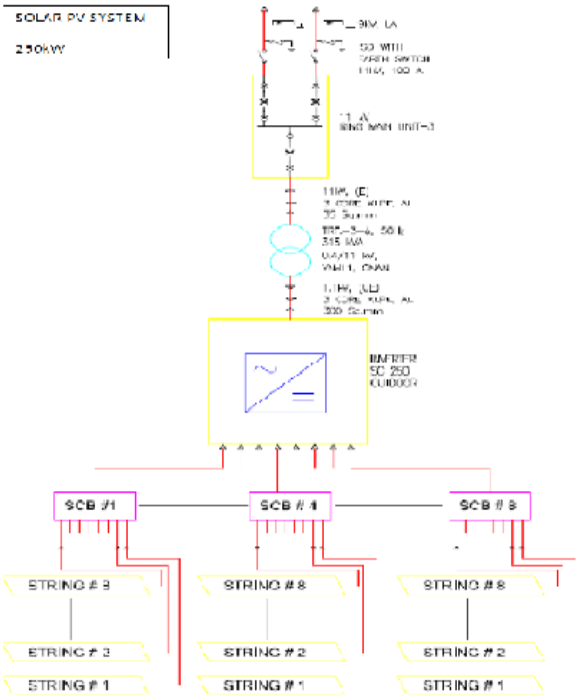
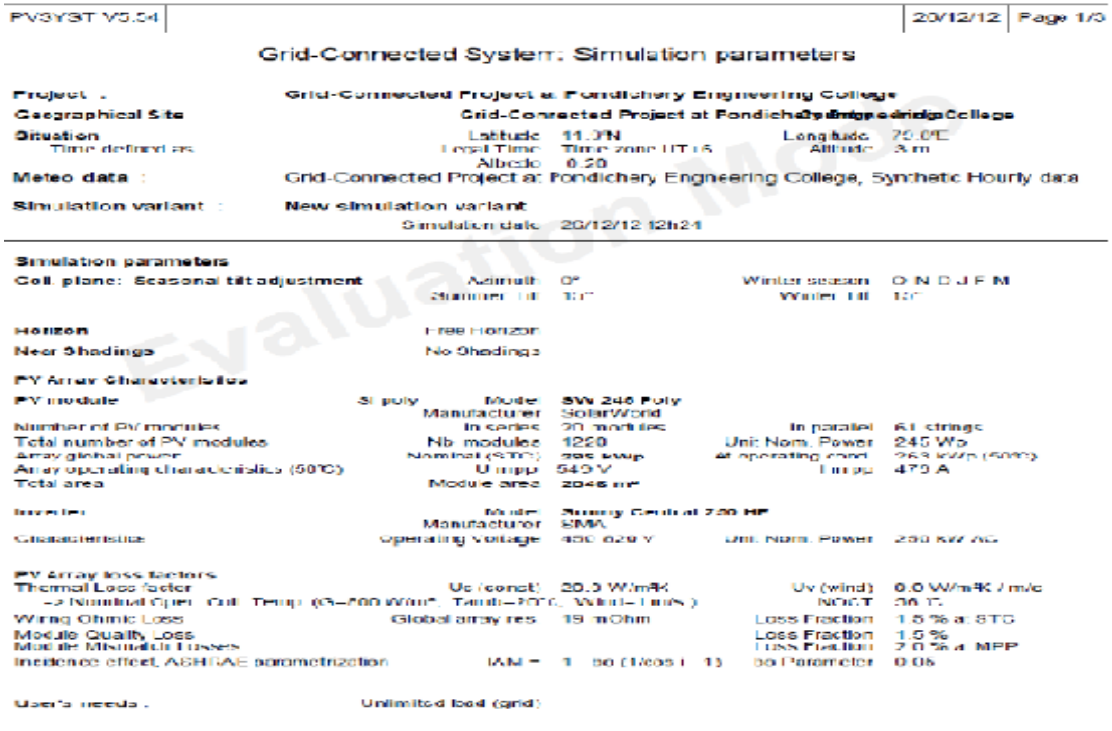
VI. DESIGN LAYOUT OF SOLAR PHOTOVOLTAIC GRID CONNECTED SYSTEM



2.6 PV SYST SOFTWARE RESULT



PVSYST V5.54 | 20/12/12 | Page 1/3

Grid-Connected System: Simulation parameters

Project : Grid-Connected Project at Pondicherry Engineering College

Geographical Site: Grid-Connected Project at Pondicherry Engineering College

Situation: Latitude 11.9N, Longitude 79.8E; Time defined as: Legal Time, Time zone UT+5, Altitude 3 m; Albedo 0.20

Meteo data : Grid-Connected Project at Pondicherry Engineering College, Synthetic Hourly data

Simulation variant : New simulation variant; Simulation date: 20/12/12 12h24

Simulation parameters

Coll. plane: Seasonal tilt adjustment: Azimuth 0°, Winter season O N D J F M

Horizon: Free Horizon

Near Shadings: No Shadings

PV Array Characteristics

PV module: Si poly, Model SW 245 Poly, Manufacturer SolarWorld

Number of PV modules: In series 20 modules, In parallel 61 strings

Total number of PV modules: Nb. modules 1220, Unit Nom. Power 245 Wp

Array global power: Nominal (STC) 299 kWp, At operating cond. 263 kWp (50°C)

Array operating characteristics (50°C): U mpp 540 V, I mpp 479 A

Total area: Module area 2046 m²

Inverter: Model Sunny Central 230 HE, Manufacturer SMA

Characteristics: Operating Voltage 450-820 V, Unit Nom. Power 250 kW AC

PV Array loss factors

Thermal Loss factor: Uc (const) 20.0 W/m²K, Uv (wind) 0.0 W/m²K / m/s; Nominal Oper. Coll. Temp (G=800 W/m², Tamb=20°C, Wind=1 m/s) NOCT 39 °C

Wiring Ohmic Loss: Global array res. 19 mOhm, Loss Fraction 1.5 % at STC

Module Quality Loss: Loss Fraction 1.5 %

Module Mismatch Losses: Loss Fraction 2.0 % at MPP

Incidence effect, ASHRAE parametrization: IAM = 1 - bo (1/cos i - 1), bo Parameter 0.05

User's needs : Unlimited load (grid)

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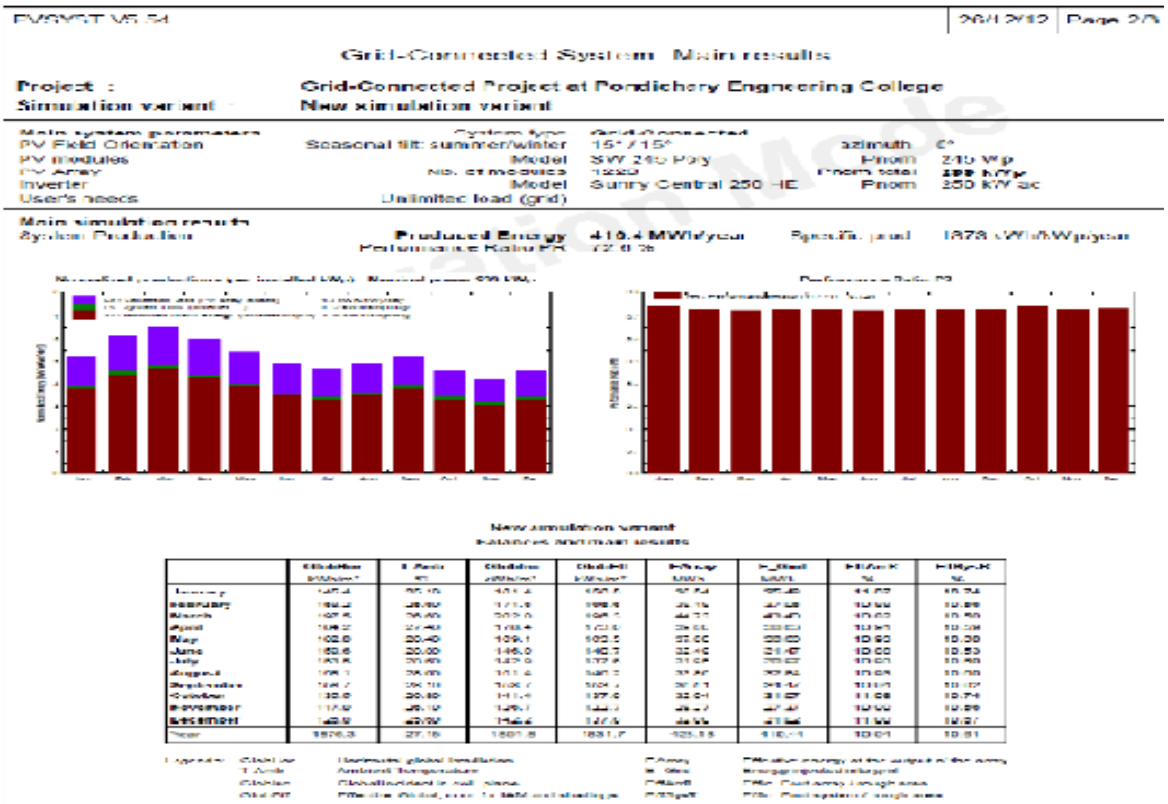

VII. RESULTS AND CONCLUSION

As per energy forecasting technique, average electricity consumption per month in Pondicherry engineering college is 115364kWh.Obtained electricity consumption by solar photovoltaic grid connected system based on pv syst software is 142361kWh per month. Thus solar photovoltaic design can be validated.

REFERENCES

[1] Wang Jianqiang & L i J i n g x i n , " Design and Experience of G r i d -connecting Photovoltaic Power System", IEEE International Conference on Sustainable Energy Technology, Page(s): 607 - 610, 2008.

[2] Evert Nieuwlaar & Erik Alsema, "Environmental aspects of PV power systems",Report on the IEA PVPS Task1 Workshop, 25-27 June 1997, Utrecht The Netherlands. Report no. 97072, December 1997.

[3] Brig.M.R.Narayaoan, D.V.Gupta, R.C.Gupta & R.S.Gupta, "Design, Development and Installation of 100 kW utility grids connected solar PV plants for rural application- indian experiences".IEEE first world conference on photovoltaic energy conversion. Volume: 1. Page(s): 1073 – 1076, 1994.

[4] R. Ramkumar & J . E. Bigger, "photovoltaic systems "proceedings of IEEE.Volume: 81, Page(s): 365 – 377, 1993.

[5]Evert Nieuwlaar & Erik Alsema, "Environmental aspects of PV power systems",Report on the IEA PVPS Task1 Workshop, 25-27 June 1997, Utrecht The Netherlands. Report no. 97072, December 1997.