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Real Time Analysis of Solar Radiation Availability Using Solar Power Research Analyser at Kothagudem at a Latitude of 17.55^{o} and a Longitude of 80.64^{O}

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ABSTRACT

The electricity requirements of the world including India are increasing at alarming rate and power demand has been running ahead of supply. It is also now widely recognized that fossil fuels and other conventional resources presently being used for generation of electrical energy may not be either sufficient or suitable to keep pace with ever increasing demand of the electrical energy of the world.

The recent severe energy crisis has forced the world to develop new and alternative methods of power generation which could not be adopted so far due to various reasons. So, the non-conventional method of electrical generation of energy is produced

This paper elucidates about the REAL TIME ANALYSIS OF SOLAR RADIATION AVALIABILITY & POWER GENERATED USING SOLAR POWER RESEARCH ANALYSER. The idea is to present the Real Time values of Solar Radiation available at Kothagudem of Bhadradri Kothagudem District of Telangana State of India which normally records he Highest Temperature during the Summer seasons , particularly between 5th May to 5th June of every year at a latitude of 17.55^{O} AND A LONGITUDE OF 80.64^{O} .
Note: The experimental values presented here are the sole work carried out in the Solar Power Research Lab of the Dept. of EEE UCEKU Kothagudem.

KEY WORDS: SOLAR RADIATION, SOLAR POWER RESEARCH ANALYSER, SILICON CONVERTERS, DESIGN OF SOLAR PANNELS

INTRODUCTION

SOLAR RADIATION DATA:

Most of the solar radiation data received on the surface of the earth are measured by "solarimeter" which give readings for instantaneous rate throughout the day for total radiation on the horizontal surface, integrating the plot of rate of energy received per unit area per unit time over a whole day gives the langleys of the radiation received on the horizontal surface.

It should be plotted out that solar radiation flux is generally reported in Langleys per hour or per day.

1 Langley =1 Cal/cm^2

The unit 'Langley' have been adopted in honour of **Samuel Langley** who made the first measurement of the spectral distribution of the sun.

For instance, the total daily radiation received in Calcutta (latitude 20^{o} 32^{1} N) on the basis of yearly average is 680langleys (i.e., 680cal/cm^2/day).

The averaging is usually made over a month and tabulation showing the hourly variation of the global and diffuse radiation, the amount received per day and the Rajasthan and Gujarat receiving over 25100 KJ/m^2/day (i.e., 600cal/cm^2/day).

During the monsoon and winter months the daily solar radiation decreases to about 16700KJ/m^2/day(i.e., 400cal/cm^2/day).

The annual daily diffusion radiation received over the whole country is observed to about 7300KJ/m^2/day (i.e., 175cal/cm^2/day).

The minimum values of diffusion radiation , measured over many parts od the country during the November and December are between 3135-41800KJ/m^2/day(i.e., 75-100cal/cm^2/day), while maximum values measured over the whole country are about 12550KJ/m^2/day(i.e., 300cal/cm^2/day) specially in July in Gujarat

SOLAR POTENTIAL IN INDIA

The Eastern parts of Jammu & Kashmir and the Eastern part of Uttarakhand – in the chilly shadow of the Himalayas are the highest potential for solar energy generation in India.

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Traditionally energy that can be generated from sunlight solely on the basis of the amount of solar radiation incident in a particular place.

But a new study says other parameters like ambient temperatures, altitude, wind velocity and weather conditions tend to influence the energy generation to a great deal and therefore these factors must also be taken into account before selecting a place for settling up a solar plant.

The combination of high altitude and low ambient temperature plays a crucial role in the efficient performance of the photovoltaic (PV) modules while wind velocity is a deciding factor in the energy generation process from the view point of heat transfer.

"Therefore, What the developers really require for choosing the best place for locating a solar plant is a map of solar energy 'generation potential' and not just the solar radiation map".

The researchers have for the first time produced such a map for India by simulating the various conditions in a computer and have identified 286 locations with high energy generation potentials in different regions of the country.

A more detailed map prepared for three states has identified 266 locations in Gujarat, 231 in Andhra Pradesh and 165 in Telangana.

The researchers have computed the month-wise solar energy generation potential and also the total energy that could be generated for the whole year at each of these location.

Most of India has substantial solar energy potential ranging from 680,000-730,000KWH. Per acre of land except in Arunachal Pradesh and Eastern part of Assam that have that have the least potential.

The highest annual solar energy generation (750,000-800,000KWH per acre) potential has been identified in the eastern parts of Jammu and Kashmir and the eastern part of Uttarakhand.

"Although the incident solar radiation in these regions is low when compared to rest of the country, the energy generation potential is high due to the ideal combination of solar radiation, ambient temperature and wind velocity. In the case of Gujarat, most of the region has the potential to generate from 7000,000-730,000KWH of solar energy while the maximum (8000,000KWH) is limited to a small area in the district of Junagarh.

The annual solar energy generation map of Andhra Pradesh shows a variation from 670,000-740,0000KWH. The eastern part of Kurnool, the northern part of Kadapa, and major portions of ongole and Guntur districts have the least potential and the maximum energy potential (730,000-740,000KHW) is limited to the western part of Ananthapur district. In the newly formed Telengana state, the northern part of Adilabad and southern part of Mahaboobnagar districts have the least energy generation potential (670,000-690,000KWh) while Khammam and the western parts of Medak districts have the highest range (715,000—275,000KWH).

Real Time availability of solar radiation is what is absolutely required for any electrical engineer to design a suitable solar station to cater to the requirements of the load in that area. The seasonal conditions and the geographical status of the land area play a dominant role in deciding the technical usability of a solar power plant. The monthly or yearly average values of radiation availability do not completely speak of the plant use factor, it is the actual radiation data taken at regular intervals ranging from 10 minutes to 60 minutes is what really helps in designing a solar power plant

EXPERIMENTAL PROCEDURE AND VALUES

The Voltage, Current and Power available at PV module with varying radiation and temperatures are noted at regular intervals .

PV module is characterized by its I-V and P-V characteristics.

In I-V characteristic maximum current at zero voltage is the short circuit Current (Isc). Which can be measured by shorting PV module and maximum voltage at zero current is the open

AT 07:00 AM

Inclination (Degree)	Radiation (W/m^2)	Module Temperature (^0C)	V (Volts)	I (Amperes)	P (Watts)
0	30.2	30.3	0.4	0.01	0.004
10	42.05	30.3	0.7	0.03	0.021
20	51.1	30.3	0.87	0.035	0.03045
30	58.4	30.3	0.93	0.05	0.0465

Table.1

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Academic Science

AT 08:00 AM

Inclination (Degree)	Radiation (W/m^2)	Module Temperature (^0C)	V (Volts)	I (Amperes)	P (Watts)
0	72	32.1	1.53	0.061	0.09333
10	77.5	32.3	2.15	0.089	0.19135
20	84.73	32.3	2.48	0.13	0.3224
30	88.95	32.3	2.89	0.16	0.4624

Table.2

AT 09:00 AM

Inclination (Degree)	Radiation (W/m^2)	Module Temperature (^0C)	V (Volts)	I (Amperes)	P (Watts)
0	125.56	34.8	3.68	0.28	1.034
10	132.88	34.8	4.45	0.33	1.4685
20	140.22	34.8	5.47	0.42	2.2974
30	151.00	34.8	6.30	0.51	3.213

Table.3

AT 10:00 AM

Inclination (Degree)	Radiation (W/m^2)	Module Temperature (^0C)	V (Volts)	I (Amperes)	P (Watts)
0	298.51	39.7	17	0.69	11.73
10	335.6	39.7	17	0.77	13.09
20	342.6	40.89	18.2	0.81	14.742
30	354.8	40.89	18.3	0.84	15.372

Table.4

AT 11.27 AM

Inclination (Degree)	Radiation (W/m^2)	Module Temperature (^0C)	V (Volts)	I (Amperes)	P (Watts)
0	418.30	44.5	19.3	0.97	18.721
10	418.30	45.2	19.3	0.96	18.528
20	418.30	45.6	19.2	0.96	18.432
30	418.30	45.6	19.1	0.95	18.145

Table.5

AT 12.10 PM

Inclination (Degree)	Radiation (W/m^2)	Module Temperature (^0C)	V (Volts)	I (Amperes)	P (Watts)
0	452.4	46	24	1.04	24.96
10	452.4	46	24	1.04	24.96
20	452.4	46	24	1.04	24.96
30	452.4	46	24	1.04	24.96

Table.6

AT 01:30 PM

Inclination (Degree)	Radiation (W/m^2)	Module Temperature (^0C)	V (Volts)	I (Amperes)	P (Watts)
0	489	47	25.2	1.25	31.5
10	489	47	25.2	1.25	31.5
20	489	47	25.2	1.25	31.5
30	489	47	25.2	1.25	31.5

Table.7

AT 02:30 PM

Inclination (Degree)	Radiation (W/m^2)	Module Temperature (^0C)	V (Volts)	I (Amperes)	P (Watts)
0	528	48	28.3	1.56	44.148
10	528	48	28.3	1.56	44.148
20	528	48	28.2	1.51	42.582
30	528	48	28.2	1.51	42.582

Table.8

AT 03:26 pm

Inclination (Degree)	Radiation (W/m^2)	Module Temperature (^0C)	V (Volts)	I (Amperes)	P (Watts)
0	545.32	52	30.2	1.78	53.576
10	545.32	52	30.2	1.78	53.576
20	545.32	52	30.2	1.77	53.454
30	545.32	52	30.2	1.77	53.454

Table.9

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AT 04:30 PM

Inclination (Degree)	Radiation (W/m^2)	Module Temperature (^0C)	V (Volts)	I (Amperes)	P (Watts)
0	470	46	23.4	0.62	14.508
10	470	46	23.0	0.61	14.03
20	470	46	22.6	0.61	13.786
30	470	46	21.4	0.60	12.84

Table.10

AT 05:30 PM

Inclination (Degree)	Radiation (W/m^2)	Module Temperature (^0C)	V (Volts)	I (Amperes)	P (Watts)
0	380.8	34	5.4	0.42	2.268
10	380.5	33	5.34	0.41	2.1894
20	378.1	32	5.2	0.40	2.08
30	365.7	31.4	5.14	0.38	1.9532

Table.11

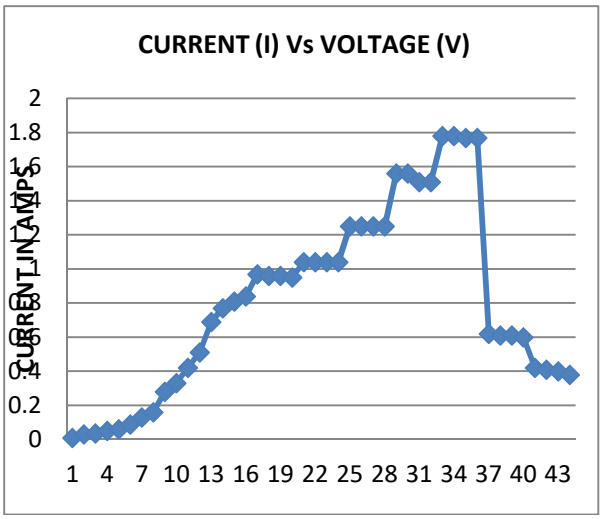

FIGURE 1. CURRENT vs VOLTAGE

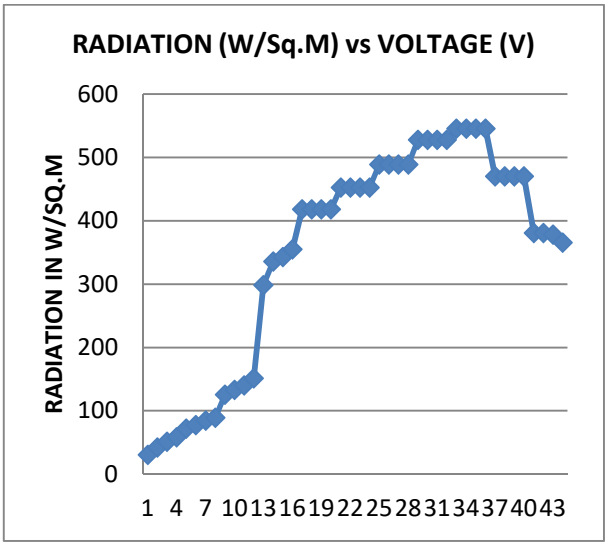

FIGURE 2 : RADIATION vs VOLTAGE

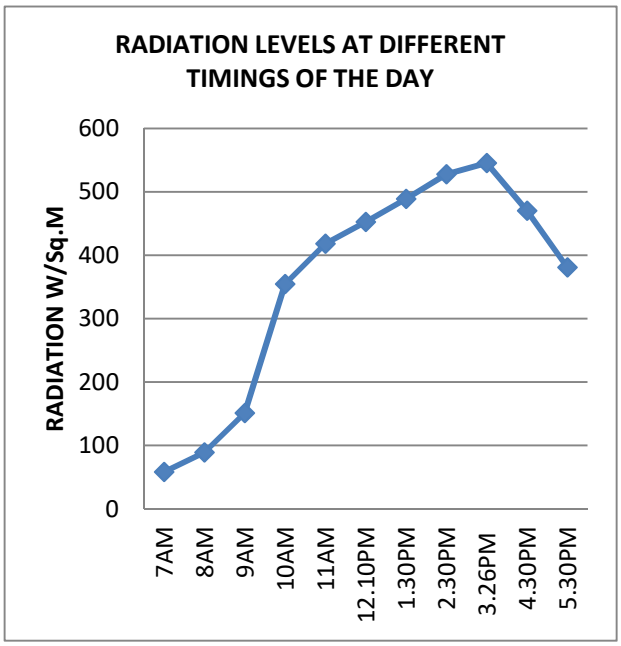

FIGURE 3: RADIATION LEVELS AT DIFFERENT TIMINGS OF A DAY

CONCLUSION:

This data measured live gives an idea of the solar radiation levels at Kothagudem at a Latitude of **17.55^O AND A LONGITUDE OF 80.64^O .**

The data Tabulated in each of the tables presented from Table.1 to Table.11 are an average of the Readings taken over a period from 05^{th} May till 5^{th} June 2016 which are normally the peak temperature periods of Kothagudem area.

The tabulated data and the graphical analysis presented helps in the design of proper solar plant that suits the given location. Pre Installation design of solar plants using the Real Time Data always helps in designing a Very Accurate Solar Panel. The Data also helps in Proper coordination of Thermal, Hydel; Wind with Solar Plants for optimal operation of different generating plants so that the overall cost of generation is Minimum.

Theoretical calculations using some formulae might give errors and the actual performance values of a component might deviate from the theoretical values .Therefore use of such research equipment will give a high degree of accuracy .This enables design of appropriate components based on requirement i.e., custom based components can be designed with high degree of accuracy.

The calculations and ratings of the solar panel required to cater the different requirements of the given electrical loads at different geographical locations will be presented in the next paper to follow. The help of a REAL TIME DATA EMULATOR will be taken to design the solar plants at different locations of the world which gives a high degree of accuracy in the design of solar panels.

Fig.4 SOLAR POWER RESEARCH ANALYSER SYSTEM

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