ANALYSIS OF 2MW SOLAR POWER PLANT IN MADHYA PRADESH

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Abstract - ***Renewable energy is projected to meet a significant portion of the future needs in India. With solar energy being abundantly available in most part of the country, grid connected solar power plants are assuming increasing importance. Energy fed into grid by a solar power plant depends upon seasonal variation of the solar resources, system losses, and losses due to condition of the grid. This paper presents performance analysis of solar power plant installed in Madhya Pradesh. Daily and seasonal variation in the solar power plant output are shown using monitored data, the SPV generation in relation to load duration curve of substation is observed . Since the cost of electricity generated from solar is still expensive and also the power from renewable resources including solar is infirm power, large scale development of renewable resources did not take place and distribution utilities are also least interested to purchase power from renewable sources. This paper provides an overview of technical, economic and policy aspects of solar energy development. The performances of power plant are compared with PV systems installed worldwide and found comparable. The result presented provide insight to the long term performance of solar power plant under actual operating condition in Madhya Pradesh*** .

Key Words : *SPV, economic climate, policy, PV.*

1. INTRODUCTION

Conventional energy sources like coal, oil, natural gas, etc., are limited in quantity, and if these continue to be depleted at the present rate, these will be exhausted in the coming decades. Energy demand is resulting in the creation of fossil fuel based power plants leading to substantial green house gas emissions having an adverse impact on energy resource to mankind.

The cost of solar energy have been falling rapidly and are entering new areas of competitiveness. Solar Photo Voltaic Electricity (SPV) are becoming competitive against conventional electricity generation in tropical countries. Rooftop SPV in tropical countries can compete with high retail electricity prices. Solar Power installations worldwide are growing rapidly with nearly 18-20 Giga Watt (GW) expected to be installed in 2012. Solar energy offers a clean, climate-friendly, abundant and inexhaustible

1.1 Global Solar Scenario

The Global solar market is expected to have an installed capacity of 227 Gigawatts (GW) by 2016. Global solar installations, meanwhile, are expected to reach 46.8 GW per annum in 2016, up from 19.8 GW in 2011, with a Compounded Annual Growth Rate (CAGR) of 18.7 percent during the same period.

1.2 Solar Energy In India

India has high solar insolation. India being a tropical country receives adequate solar radiation for 300 days, amounting to 3,000 hours of sunshine equivalent to over 5,000 trillion kWh. The Government of India unveiled a plan to produce 22 GW of solar power by 2020 under the Jawaharlal Nehru National Solar Mission (JNNSM). Solar Energy is undergoing a silent revolution in India.

Why Madhya Pradesh?

- Madhya Pradesh is one of the largest power consuming States in India with a peak demand of nearly 8 GW and a peak deficit of close to 10 per cent.
- Is a neighbor to both Rajasthan and Gujarat — States with the highest solar irradiation and the largest areas of arid lands. Offers good sites having potential of more than 5.5 to 5.8kWh/sq m for installation of solar based power projects.

- The State's RPO demand for solar power is expected to rise to 400 MW by 2016
- As per MPERC regulations 2008, RPO has been specified as 2% for cogeneration and other sources for FY-2010 -11 and 2011 -12.
- Purchase of electricity from solar projects to form part of 2% subject to any amendments/ regulations of MPERC

10-year exemption in electricity fee, four per cent subsidy by the state government in the wheeling charges, banking of generated power and exemption as per rules in VAT and entry tax, among others

2. LITERATURE SURVEVY

There are different solar collector systems used for Solar Electric Power and Generation (S.E.P.G), the commonly used one is concentrator collector and Flat-plate Collector due to its low cost design, easy installation and effectiveness in cloudy day. In order to improve the efficiency of Flat-plate Collector, selective coating on the appropriate surface would be such that it absorbs maximum Solar Radiations with minimum emission of long Wave Length Radiations. Their optical, structural and electrical characteristics were studied to find out improvement in heat absorption.

3. METHODOLOGY

The solar panels have been used in parallel with a storage battery normally rated at 12 volts be efficiency of system is quite stable and reliable. So this system can be used to power any conventional electrical application. The measurement of Solar Electric Power in the form of A.C, D.C. volt, current and Power efficiency (η) of the system by using inverter (regulated voltage) when solar panels are connected in parallel combination at different temperature with time of the day. The results of solar cells connected in parallel show that only short circuit current and maximum power output are added up. This is because the current is added in parallel circuits and voltage remains constant. The changes in fall factors and efficiencies are only because of changes in solar intensities i.e. by connecting the solar cell modules in parallel, efficiency is not added up.

Solar collectors are described by their efficiency parameters:

Zero-loss efficiency: n0

1st order heat loss coefficient: a1,

2nd order heat loss coefficient: a2,

Using these parameters, the collector efficiency can be expressed as:

$$n = n0 - a1*(Tm-Ta)/G - a2*(Tm-Ta)^2 /G \quad (1)$$

and hence the power:

$$P = A*(n0*G - a1*(Tm-Ta) - a2*(Tm-Ta)^2) \quad (2)$$

where:

G = solar irradiation W/m²

Ta = ambient air temperature

Tm = collector mean temperature

A = collector area (corresponding to the efficiency parameters)

3.1Current-Voltage Measurements: Current-voltage (I-V) relationships that measure the electrical characteristics of photovoltaic devices are depicted by what we call "I-V curves."These I-V curves are obtained by exposing the cell to a constant level of light, while maintaining a constant cell temperature, varying the resistance of the load, and measuring the current that is produced. On an I-V plot, the vertical axis refers to current and the horizontal axis refers to voltage. The actual I-V curve typically passes through two significant points:

- The **open-circuit voltage (V_{oc})** is the voltage across the positive and negative terminals under open-circuit conditions, and the current is zero, which corresponds to a load resistance of infinity.
- The **short-circuit current (I_{sc})** is the current produced when the positive and negative terminals of the cell are short-circuited, and the voltage between the terminals is zero, which corresponds to a load resistance of zero.

The photovoltaic cell may be operated over a wide range of voltages and currents. By varying the load resistance from zero (a short circuit) to infinity (an open circuit), we can determine the highest efficiency as the point where the cell delivers maximum power. Remember that power is the product of voltage times current. Therefore, on the I-V curve, the maximum-power point (P_m) occurs where the product of current times voltage is a maximum. . The higher the fill factor's percentage or match, the "squarer" the curve. The conversion efficiency of a solar cell is the percentage of the solar energy shining on a photovoltaic device that is converted into electrical energy, or electricity. No power is produced at the short-circuit current with no voltage, or at open-circuit voltage with no current. So we expect to find maximum power generated somewhere between these two points. Maximum power is generated at only one place on the power curve, at about the "*knee*" of the curve. This point represents the maximum efficiency of the solar device in converting sunlight into electricity. A parameter known as fill factor measures the "*squareness*" of the I-V curve and describes the degree to which the voltage at the maximum power point (V_{mp}) matches V_{oc} and that the current at the maximum power point (I_{mp}) matches I_{sc} Improving this conversion efficiency is a key goal of much research and helps to make photovoltaic technologies cost competitive with more traditional sources of energy. The efficiency of solar cells is affected by a variety of factors, which are discussed in the next section.

4.FACTORS AFFECTING CONVERSION EFFICIENCY

Much of the energy from sunlight reaching a photovoltaic cell is lost before it can be converted into electricity. But certain characteristics of solar cell materials limit a cell's efficiency. Some characteristics are fixed, but others can be improved by selecting appropriate materials and carefully designing the cell.

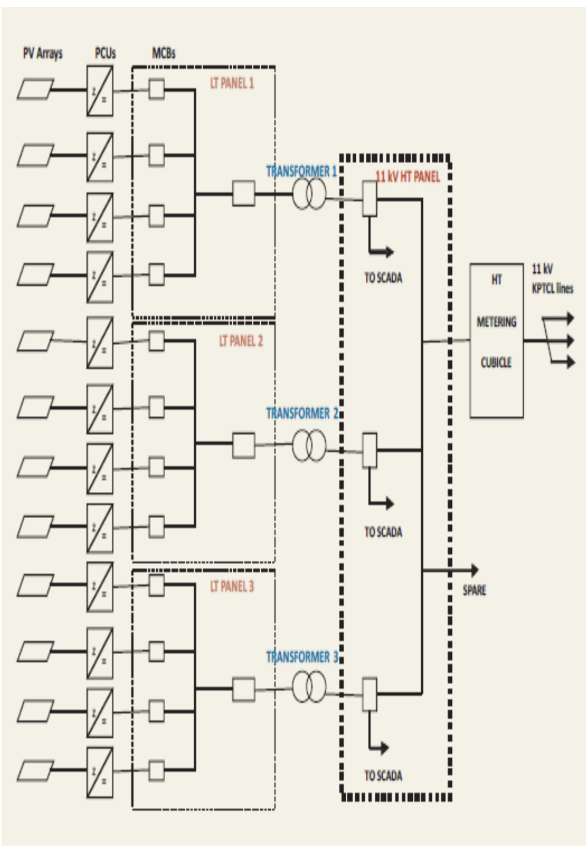

Fig -1. Solar power plant

International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 03 Issue: 01 | Jan-2016 www.irjet.net p-ISSN: 2395-0072

Table-1: Inverters reading

MARCH			
DATE	INVERTER.1 unit in(KWH)	INVETER.2 unit in(KWH	INVERTER.3 unit in(KWH)
1	1981	1906	3715
2	1480	1398	3668
3	658	578	3623
4	525	454	3597
5	581	499	3344
6	2039	2061	3506
7	2258	2242	3443
8	1103	973	3333
9	2214	2263	3211
10	2364	2233	3289
11	2517	2403	2715
12	2092	1933	2725
13	2479	2235	2606
Total	65369	61134	84921

JUN			
DATE	INVERTER.1 unit in(KWH)	INVETER.2 unit in(KWH	INVERTER.3 unit in(KWH)
1	2337	2211	2341
2	1765	1602	1783
3	2106	1958	2102
4	2718	2472	2729
5	2567	2352	2629
6	2547	1782	2580
7	742	800	810
8	1835	1678	1911
9	1595	1413	1666
10	2367	2154	2413
11	892	846	958
12	2166	2048	2181
13	2287	2212	2312
Total	53823	49530	54447

International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 03 Issue: 01 | Jan-2016 www.irjet.net p-ISSN: 2395-0072

Table-3: Panel specification

PANEL SPECIFICATION	
Plate	Canadian solar plate
Type	Mono crystalline
Rating	245Watt
Open circuit voltage	37Volt
Short circuitcurrent	8A
Variation	0.1 -8A
Type	Central inverter
INVERTER SPECIFICATION	
Rating	510Kwatt
Maximum voltage	1000Volt
Current	800A
Temp range	-20 – 50^{0}C

5. RESULT ANALYSIS:

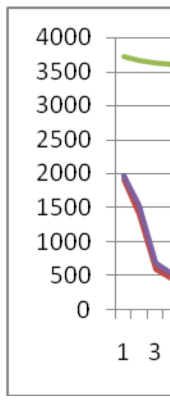

Chart - 1. . Inverter output march

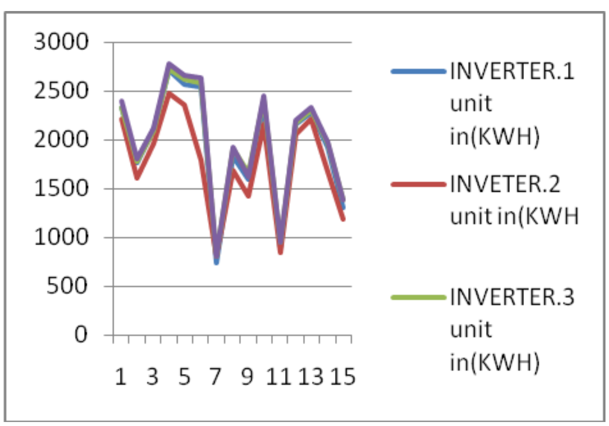

Chart - 2. Inverter output june

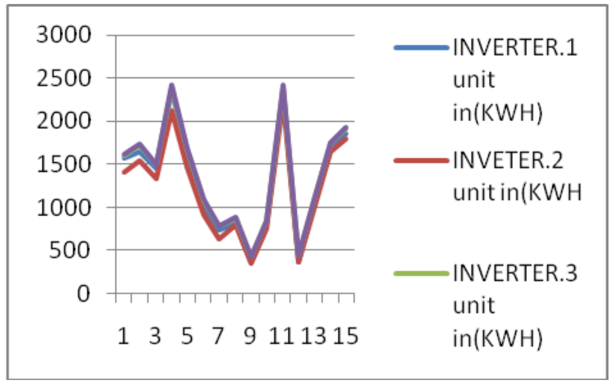

Chart - 3. Inverter output august

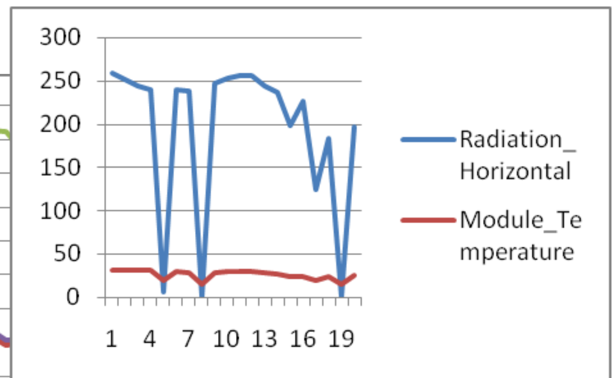

Chart - 4. Horizontal radiation Vs module temperature

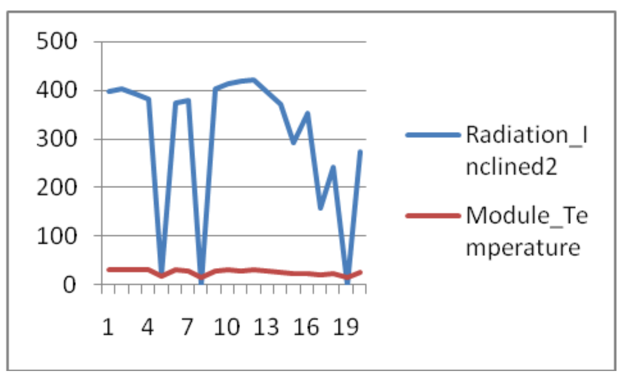

Chart - 5. Inclined radiation Vs module temperature

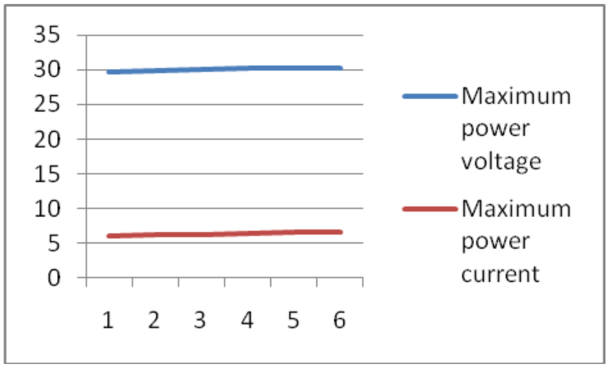

Chart - 6. Maximum voltage Vs maximum curren

6. CONCLUSIONS

Physically, solar energy constitutes the most abundant renewable energy resource available and, in most regions of the world, its theoretical potential is far in excess of the current total primary energy supply in those regions. The market for technologies to harness solar energy has seen dramatic expansion over the past decade – in particular the expansion of the market for grid-connected distributed PV systems and solar hot water systems have been remarkable. Solar energy technologies could help address energy access to rural and remote communities help improve long-term energy security and help greenhouse gas mitigation. The positive effects of low temperatures on solar panel power production in colder climates can be countered by clouds and snow that decrease solar panel efficiency. While there is little to be done about cloudy skies, several steps can be taken to help reduce snow accumulation on solar panels. The energy production efficiency of solar panels drops when the panel reaches hot temperatures. Photovoltaic solar panel power production works most efficiently in cold temperatures Cold, sunny environments provide optimal operating conditions for solar panels.

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