"CASE STUDY ON 100 KW SOLAR POWER PLANT IN SVIT COLLEGE OF ENGG,NASHIK"

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ABSTRACT

The objective of this project work is to analyze the performance of a 100kw capacity solar panel installed in sir visveswarya institute of technology College of Engineering. Use of electricity is increasing day by day. The electricity finds its application in all the domains. Converting solar energy into electrical energy is one of the best ways to reduce fossil fuel consumption. Owing to the cost and efficiency of the solar cells, it is not used in most of the electrical applications. By detailed analysis of plant we could determine the various performance aspects and make or recommends changes accordingly to improve the efficiency and utilization of plant optimally.

The project includes the comparison of the current electricity bill with the bill before installation of solar panel system and conducting detailed analysis to understand Energy consumption (kWh). The third phase includes the study of the direct and indirect advantages of installing a solar panel in this institution for e.g. bill savings, tax savings and power being supplied back to the grid.

Keywords-: , Pv cell,Array,Solar panel,string,insolation,Performance ratio

1. INTRODUCTION

The solar power generating system supplied by Tata Power Solar is trouble-free, long-lasting and cost effective power solution. Non-availability of grid power, Unpredictable power cuts, rising power bills and maintenance worries are history. As a result of proven technology, they are highly efficient and maintenance free. With just a onetime investment, Solar Power Packs send your non-availability of grid power, unpredictable power cuts & rising electricity bill worries packing. What's more, they are eco-friendly too!

Solar PV modules produce DC electricity. They may be used in single-module and multiple-module systems to meet the current or voltage requirements of a wide range of applications with its nominal power, it's well-suited to utility grid systems and traditional applications of photovoltaic such as Telecommunications, grid connect and standalone systems.

Inverter does the function of converting DC energy produced by Solar modules to AC energy along with many other supporting operations required for proper functioning of solar power system & export power to Grid.

AC Distribution board is used to connect the output of inverter at one common point and Output of ACDB to be connected to Existing LT Panel at site. ACDB is also used to monitor the output parameters at on

Considering the good potential of Solar Power and also the trust given by the Central & State Government in utilizing the abundant Solar Power in the State of Maharashtra for Power generation, SIR VISVESVARAYA INSTITUTE OF TECHNOLOGY is proposing to set upto 100KW Roof Top Solar PV based Power Plant in Maharashtra state.

The Plant and equipment facilities will be designed to comply with all applicable stipulations / guidelines of statutory authorities such as State and Central Pollution Control Boards, Electrical Inspectorate.

This report highlights the details of the proposed Power generation scheme, site facilities, features of the main plant, electrical systems evacuation of generated power, environmental and safety aspects, distribution mechanism, Cost estimation, risk mitigation plan and Project viability. It also highlights the complete schedule for the project implementation.

PROJECT STAGES

1. SYSTEM COMMISSIONING STUDY
2. PERFORMANCE ANALYSIS
3. INNOVATIVE CHANGES (RECOMMENDATIONS)
4. ELECTRICITY BILL COMPARESION
5. DETERMINE DIRECT AND INDIRECT ADVANTAGES

1. SYSTEM COMMISSIONING STUDY

PROJECT SUMMARY

PROJECT: Design, manufacture, Supply, installation and commissioning of 100 KW Solar Photovoltaic Grid Connect systems

1.	Name of the Company	TATA SOLAR POWER SYSTEMS LIMITED #78, ELECTRONICS CITY BANGLORE-560100,INDIA
2.	Proposed Project Location	S V I T NASHIK ROOFTOP
3.	Power Plant capacity	100KW
4.	Technology	Solar Photovoltaic
5.	System type	Grid connect Solar PV system
6.	Type of Module proposed	Multi Crystalline
7.	Type of Inverter proposed	Grid tie centre Inverter
8.	Total Inverter capacity	3 units each 30kw
9.	Single panel output	255W

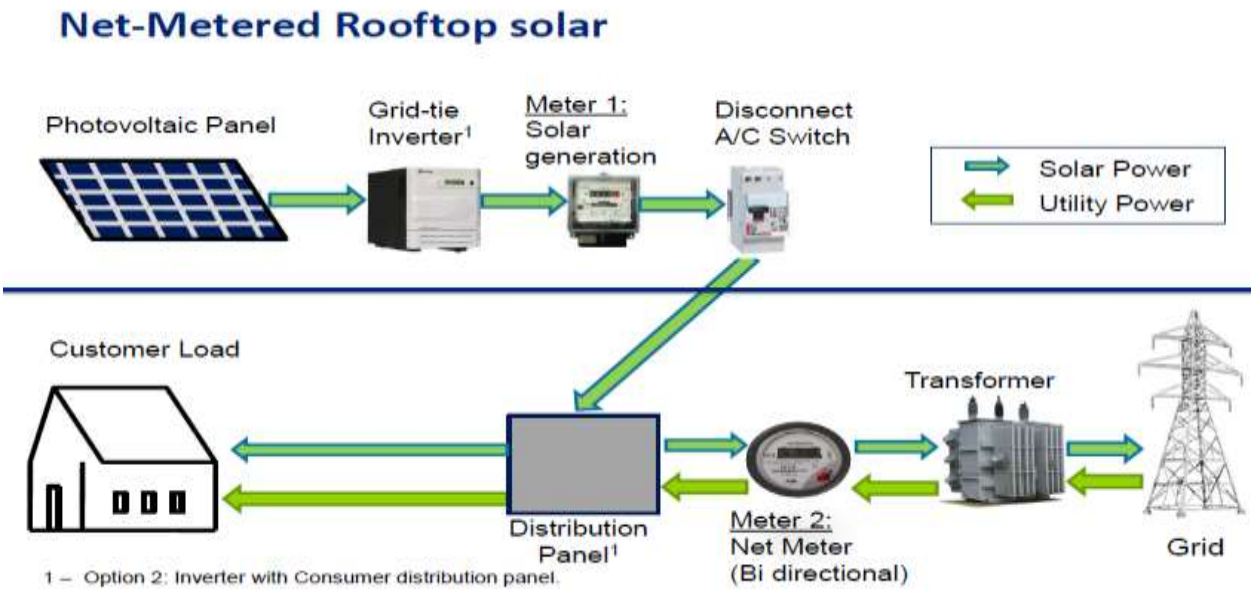
MODEL-

- Total plant divided in two part

- 68kw plant-
  : 267 module
  : two 30kw inverter
  : Tilt angle 15 degree

- 32kw plant-
  : 127 module
  : One 30kw inverter
  : Tilt angle 15 degree

BLOCKDIAGRAM



LIST OF COMPONENTS

Sr.No.	Description	Qty	Unit
1	250Wp Solar Module Mono	200	Nos.
2	String Inverter 11KW	5	Nos.
3	PV Junction Box	10	Nos.
4	Module Mounting Structure	For 50KWp	Sets
5	DC Cable 1C x 4Sq.mm	1000	Mtrs.
6	AC Cable 4 C of 6sqmm armour Cu cable	25	Mtrs.
7	AC Cable 4C of 70sqmm armour Alu cable	100	Mtrs.
8	DC earthing kit	1	Set
9	Lightning Arrestor	1	Set

2 PERFORMANCE ANALYSIS

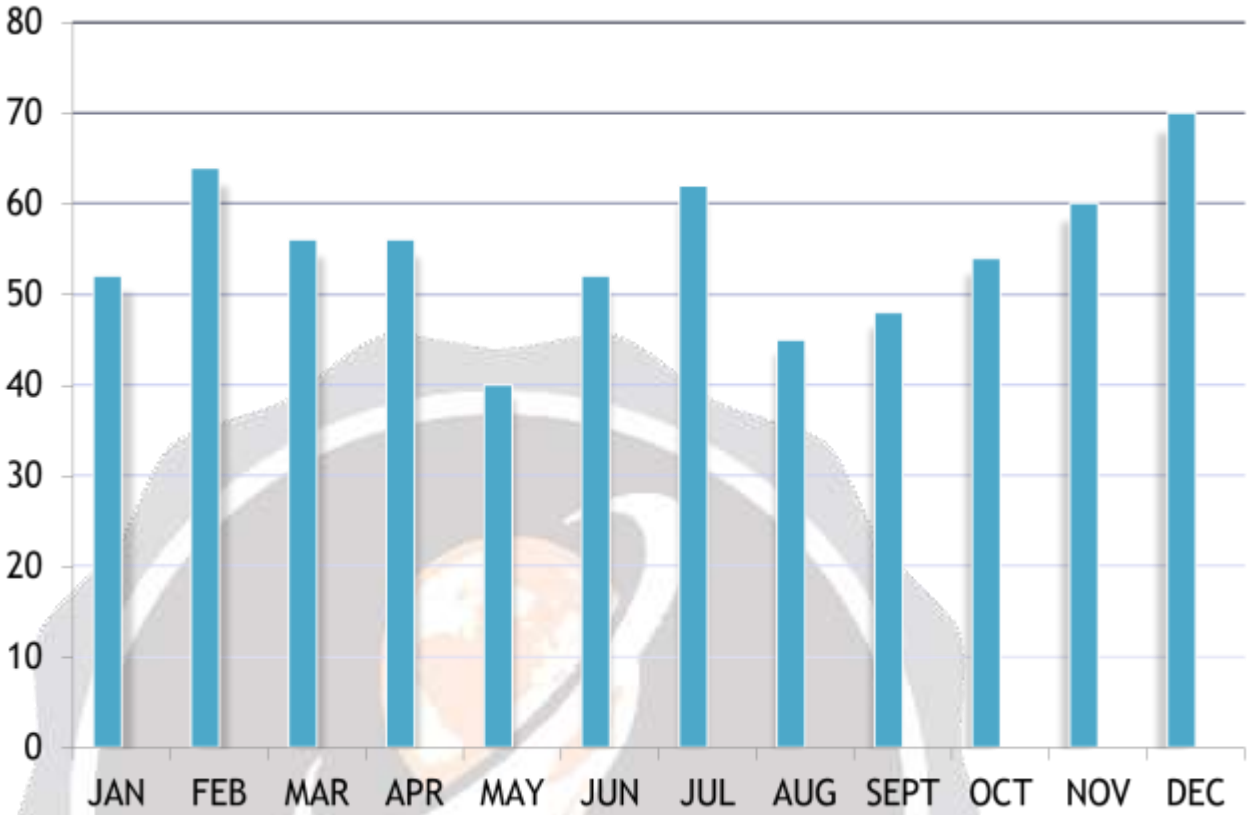
Capacity utilisation factor = Energy measured in (kwh) / (365*24*installed capacity)

Performance ratio = Energy measured in (kwh) / (Generated energy *Active area* module efficiency)

Performance statistics of year 2016

Sr.no.	Month	Measured Energy (MWH)	PR (IN %)	CUF(IN %)
1	JAN	3.37	52	0.38
2	FEB	4.159	64	0.47
3	MAR	3.63	56	0.41
4	APR	3.63	56	0.41
5	MAY	2.59	40	0.29
6	JUNE	3.31	51	0.37
7	JULLY	4.02	62	0.45
8	AUG	2.92	45	0.33
9	SEPT	3.119	48	0.35
10	OCT	3.5	55	0.40
11	NOV	3.89	60	0.44
12	DEC	4.54	70	0.51
	TOTAL	3.55	54.91	0.36

PERFORMANCE GRAPH



KEY FINDINGS

- **Proper distance between inverter and panel**

  The distance between panel erected and the inverter is proper which reduces high dc power losses in cable. Shorter the cable length less is the power losses so inverter to panel distance is kept small.

- **Proper selection of module technology**

  Efficiency and performance of plant also depends upon the module technology selected. The selected technology is PHOTOOVOLTAIC which is cost effective and efficient.

- **Less optimisation due to fixed tilt angle**

  The plant commissioned is at fixed tilt angle 15 degree so we cannot optimise plant at its full efficiency. This we can see in performance analysis.

- **Inverter down time should consider**

  As this plant is grid connected due various power quality aspects inverter trips too frequently which increases the down time of plant results in poor optimization.

- **Operating tempreture should consider**

  Regardless of other seasons in summer the operating tempreture of PV cells crosses the critical operating tempreture which will reduces the efficiency of plant due to semiconductor loss.

- **Storage system unavailable**

  The plant grid connected so plant is only useful in day time .In night campus needs to depend on MSEB supply as there is no storage system.

- **Improper spacing between modules- effect of shadow**

  The plant erected does not meet the specific distance a measurement so there is shadow effect occurs on panel. So afternoon 2 hours energy generation affected by this shadow effect

INNOVATIVE CHANGES (RECOMMENDATIONS)

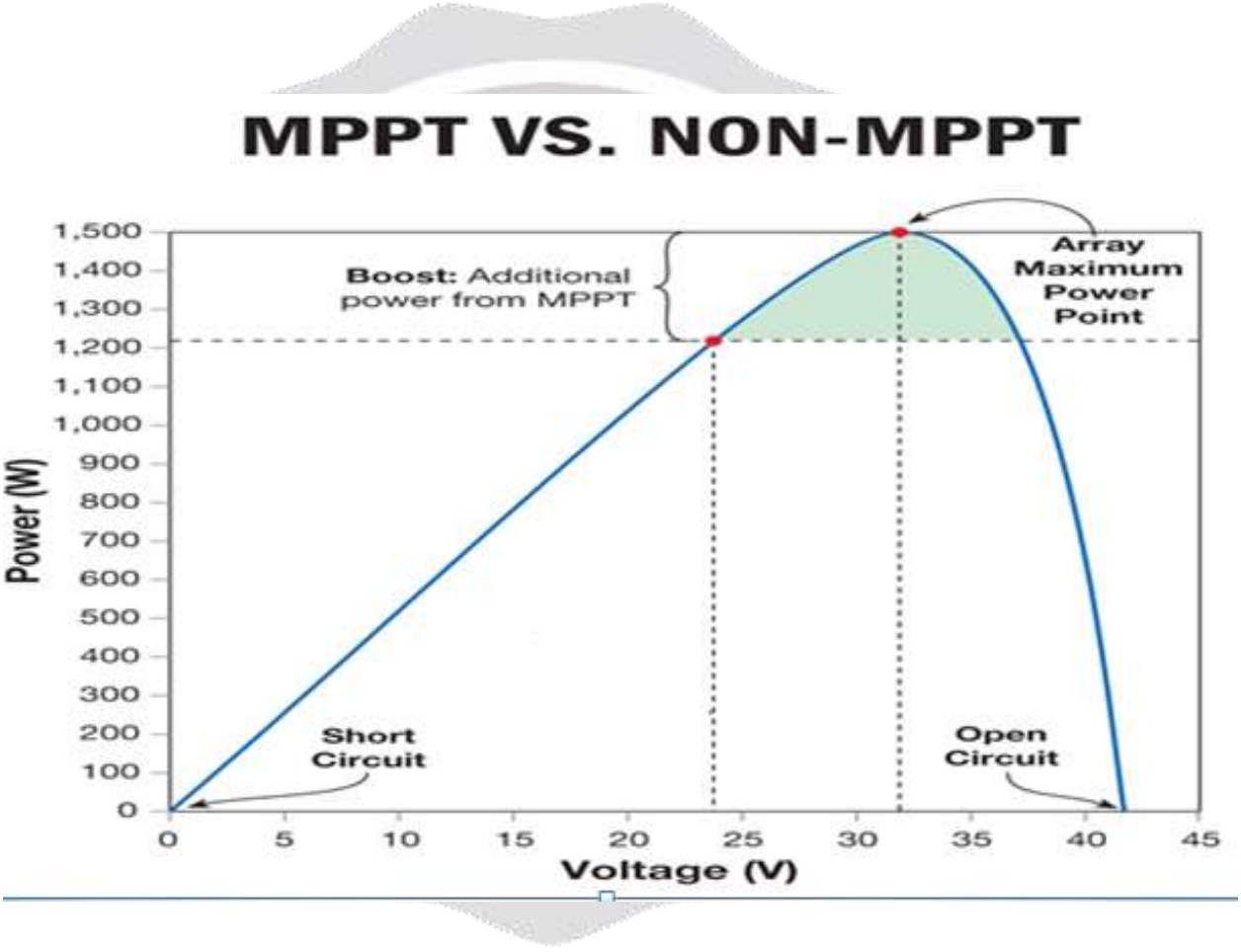
1. Use of maximum power point tracking
2. SPWM Technique for inverter.
3. Proper distance between solar panel
4. Storage system

1. Use of maximum power point tracking:

By using the maximum power point tracking the efficiency of plant will be increase ,table shows the actual effect of MPPT on solar power plant. For this proof we studied one MPPT project and we took actual one day readings for our reference as below.

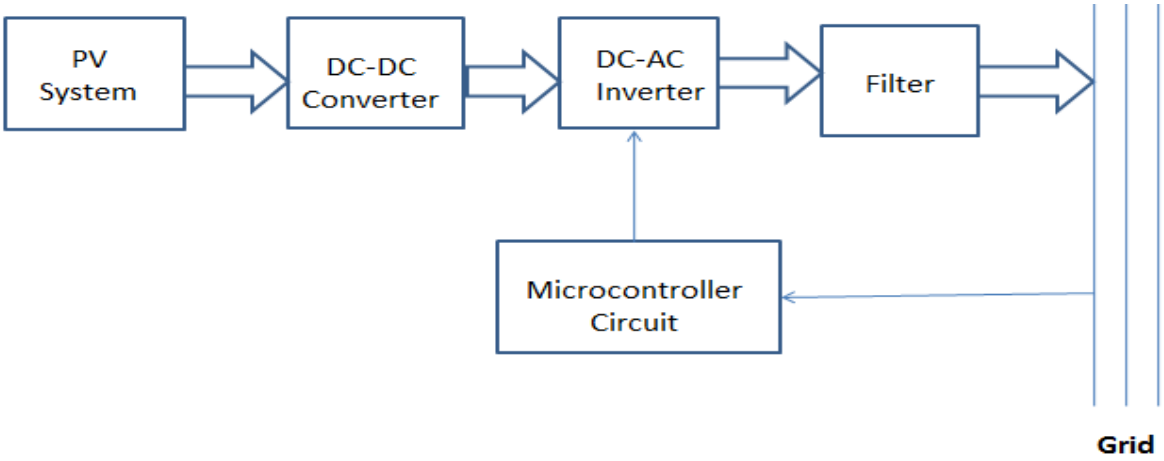
SR. NO	TIME	STATIC READING(WATT)	MPPT.READING (WATT)
1	9.30	6.33	7.5
2	10.00	8.6	11.33
3	10.30	8.72	11.34
4	11.00	8.69	10.3
5	11.30	8.49	11.10
6	12.00	8.11	10.20
7	12.30	9.30	11.80
8	1.00	9.05	11.45
9	1.30	9.00	10.95

10	2.00	8.75	10.70
11	2.30	8.6	10.56
12	3.00	8.6	10.41
13	3.30	7.10	9.65
14	4.00	7.49	9.10
15	4.30	6.50	7.44
16	5.00	6.75	7.49
	AVERAGE	8.13 W	10.1444W



So the readings shows by maximum power point tracking **24.77 %** of efficiency increases. So this could be the most economical solution for better performance of plant.

2 SPWM Technique for inverter



The block diagram shows advanced technique for inverter which is used for grid connected solar power plants. During detailed analysis we came to find inverter down time for most of the periods which decreases overall plant efficiency. Due to this solution following objectives are fulfilled.

To design and implement switching strategy for inverter application which are simple, reliable, low cost and high efficiency.

To design gate pulse switching of grid tie inverter with SPWM and microcontroller.

So this can be implemented at our project site due to following crucial advantages

I. Increases efficiency of inverter.
II. Output parameters synchronises with grid properly.
III. Pure sinusoidal output.
IV. Reduced THD.(total harmonic distortion).
V. Real time control without change hardware.

3 RECOMMISSIONING OF PV MODULES

The plant erected does not meet the specific distance a measurement so there is shadow effect occurs on panel. So afternoon 2 hours energy generation affected by this shadow effect. This problem could be overcome by only one solution that is recommissioning of PV modules. Almost 30% part of solar cell is affected by this shadow effect 2 hours daily. Hence we suggest repeat errection of PV modules according to specific measurements.

4 STORAGE SYSTEM

The whole 100 kw solar power plant is grid connected hence we could use this generated energy only in day time. For remaining hours of day campus still needs MSEB Supply for required electricity consumptions. Hence main objective of project can't be fulfilled i.e. independency from MSEB SUPPLY.

Hence we propose one change in current system

The large one model (68kw) should remain as grid connected .

And make small unit (32 kw) as stand by

So does second unit will store sufficient amount of energy in day time which can be used at night hours of campus energy demands. The storage system can be of conventional battery type or can employ new innovative systems such as flywheels, super capacitors etc.

ELECTRICITY BILL COMPARISON

Before the installation of solar power plant average monthly electricity bill of campus will be 3 lakhs per month, after the installation of solar power plant monthly electricity bill will be decrease

AVERAGE SAVING PER MONTH = BILL BEFORE INSTALLATION –BILL AFTER INSTALLATION

Energy bill of last six month as shown in table

SR .NO	MONTH	UNIT IN KWH	COST IN RS
1	July	16132	173088
2	August	18080	190593
3	September	20527	187731
4	October	23153	207535
5	November	20600	195932
6	December	18787	179620
	Average	19546.5	190000

Average saving per month = 300000 – 190000

= 110000 RS

DIRECT AND INDIRECT ADVANTAGES

1 Clean and eco-friendly energy
2 Negligible maintainance
3 Optimum use of solar energy
4 Efficient use of rooftop
5 Improves performance of plant
6 Cost saving
7 Return period decreases
8 Energy independency

ACKNOWLEDGEMENT

Whenever I am standing on most difficult step of the dream of our life, I often remember the great Almighty God for his blessing and kind help. And they always help us in tracking off the problems by some mean in our lifetime.

I feel great pleasure to present the seminar on **"SOLAR POWER PLANT".** Foremost, I would like to show our heartfelt indebtedness to my Guide **Prof.K.P.VARADE** whose valuable guidance has helped us to make this seminar a reality.

I would like to convey my sincere gratitude to the **H.O.D. Prof Mr.N.B. SHAIKH** and all staff members of **ELECTRICAL DEPARTMENT** for their support and valuable help which they have always provided me.

CONCLUSION

- Efficiency of plant can be improved by above proposed techniques about 15 to 30 percentage.
- Thus the college campus can look forward towards full independency from MSEB supply.
- While implementing the improvement techniques capital cost increases but return period is significantly decreases which is indirectly beneficial.
- Although it good earning potential to college by giving extra energy to grid through net metering by increasing current energy generation.

REFRENCES

[1] TATA SOLAR POWER SYSTEMS User mannuals

[2] TrishanEsram and Patrick L.Chapman, "Comparison of Photovoltaic Array Maximum Power Point Tracking Techniques,"IEEE Transactions on Energy Conversion, Vol. 22, No. 2, June 2007.

[3] Hung-I Hsieh, Jen-Hao Hsieh, et al., "A Study of High-Frequency Photovoltaic Pulse Charger for Lead-Acid Battery Guided by PI-INC MPPT".

[4] K.H. Hussein, I. Muta, T. Hoshino and M. Osakada, "Maximum photovoltaic power tracking:an algorithm for rapidly changing atmospheric conditions,"IEEEploc.-Gener. Transmission and Distribution, Vol. 142, No. 1 , Jan. 1955.

[5] C.Thulasiyammal and S Sutha, "An Efficient Method of MPPT Tracking System of a Solar Powered Uninterruptible Power Supply Application," 1st International Conference on Electrical Energy Systems, 2011.

[6] NoppadolKhaehintung and PhaophakSirisuk, "Application of Maximum Power Point Tracker with Self-organizing Fuzzy Logic Controller for Solarpowered Traffic Lights," IEEE, 2007.