

# Grid Tied One Megawatt Solar Photovoltaic Power Plant at Bhopal: A Feasibility Study

**M.Tech Scholar Lalit Kumar  
Goel**

School of Energy and Environment  
Management, Rajiv Gandhi Proudlyogiki  
Vishwavidyalaya, Bhopal, MP, India.

**Prof (Dr) Mukesh Pandey**

Head of the Department, School of  
Energy and Environment Management,  
Rajiv Gandhi Proudlyogiki  
Vishwavidyalaya, Bhopal, MP, India.

**Associate Prof. Dr Anurag Gour**

School of Energy and Environment  
Management, Rajiv Gandhi Proudlyogiki  
Vishwavidyalaya, Bhopal, MP, India.

**Abstract -** With about 300 clear and sunny days in a year, the calculated solar energy incidence on India's land area is about 5000 trillion KWh per year. India is densely populated and has been blessed with high solar insolation; it is a best combination for harnessing solar power. The way India is tapping the solar energy, the country is already a leader in solar power generation. In the solar energy sector, large projects have been proposed, and a 34,000 km<sup>2</sup> area of the Western Desert has been earmarked for solar power projects, sufficient to generate 500 GW to 2,000 GW. Ministry of New and Renewable Energy(MNRE) has released the Jawaharlal Nehru National Solar Mission (JNNSM) Phase 2 Draft Policy, our Government is planning to install 10GW of Solar Power, and of this planning, 4 GW is under the central govt scheme and the remaining 6GW under state govt schemes.

**Keywords -** Green energy, solar, grid, load balancing, solar power plant.

## I. OBJECTIVE

To perform feasibility study of installing a grid tied one megawatt solar power plant in Bhopal, Madhya Pradesh with the help of available documents and information received from the owner of the plant and site visits.

## II. INTRODUCTION

Solar energy is a sustainable, renewable and predictable form of energy. Solar energy is environment friendly and no pollution is created in the process of generating electricity. Also, the solar panels do not require maintenance as they do not have wearable parts and thus can last very long. Various technologies, such as silicon PV (Crystalline Silicon and Nano Crystalline), thin film solar cells (Amorphous Silicon, Cadmium Telluride, Gallium Arsenide and Copper Indium Gallium Deselenide) and concentrated PV (multifunction cells), are used to produce PV cells. Of these technologies, researchers have found that multicrystalline outputs and monocrystalline cells have the highest output range (between 12 and 17%).

The Government of Madhya Pradesh has taken note of the growing recognition for impact of climate changes at the local, national and global levels and taking lead, this government is preparing the vast potential of solar energy. The state is endowed with around 300 days of clear sun and offers good sites with potential of more than 5.5 KWh/sq m/day for installation of solar based

projects. Bhopal, the capital town of the state is among the first 20 cities selected in first round of smart cities challenge under Government of India's Smart Cities Mission (SCM) to implement the Smart City Proposal (SCP). According to which, at least 10% of the electricity consumption must be from renewable resources. The research paper is prepared based on the grid tied one megawatt solar power plant installed in Bhopal in one of the departments under Ministry of Defence. The researcher was instructed to restrict the name of the location where the solar plant is functioning.

## III. FEASIBILITY OF GRID CONNECTED ONE MEGA WATT SOLAR POWER PLANT

Departments of Ministry of Defense are major consumers of electricity. The growing demand and perpetual shortage of electricity compelled the forces to explore economical options of electricity availability. The factors enlisted under are primary requirement to set up a grid connected 1 MW solar power plants and are hereby elaborated with respect to the 'Gandhi agar Hill Plant (GHP)'.

### 1. Size of the plant in terms of megawatt:

The foremost step is to estimate the load or energy of the target place, such estimate is crucial to the entire process as it determines the amount of power and energy the solar power plant is required to

produce on daily basis and its variation from season to season in the location.

If more modules are installed, the system works better. If fewer modules are used, the system may not work at all time during cloudy periods. As stated above the average RMD is 950 KVA, this plant of one megawatt is fully capable of meeting the day time requirement of the power supply.

## 2. Availability of capital:

The Government of India was promoting the scheme so the availability of funds was available post audit and scrutiny of the vendors and source of purchase of the equipment. MNRE had issued guidelines with respect to the rates prevailing in the market of the solar power generation accessories. Moreover, the work would commence with the uploading of the Request for Proposal (RFP) on the open portal of the tender of the Central Government. The work will be awarded to the L1 (Lowest) bidder after ratifying the Technical bids and negotiations over the Commercial bids.

## 3. Selection of the land:

Bhopal occupies the geographically central position in the country. The site can absorb more solar radiation for the entire year as power generated by solar plant completely depends up on sun's insolation. Roughly it was estimated that 4.5 acres of land will suffice for the scheme, however, up to 8 acres is available, and the basic data of the land is as under:

Latitude	23.28°
Longitude	77.35°
Altitude(Mean sea Level)	450m
Climatic conditions:	
(a) Annual rainfall(mm)	1050
(b)Temperature	10° – 44°

## 4. Vicinity of tall structures or trees (Shadow Assessment):

Unused area is to be assessed for incidence of shadows through the year to determine the extent of shade-free area available for installing a solar PV plant. One row of panels can cast a shadow on the row behind them; as further we move away from the equator, the longer the shadow that is cast and the amount of room required between rows of panels. Shadows affect the PV plants in two ways:

### 4.1 Output:

when the shadow falls on a PV panel it reduces the output from the plant.

### 4.2 Panel Damages:

when the shadow falls on part of a panel, that portion of the panel turns from a conductor into a resistance and starts heating up. That portion of the panel will eventually burn out and the entire panel will have to be replaced. This is not covered in warranty. It is critical to monitor the shadow pattern of the trees or tall structures

in the vicinity of the panels. The shadow can be of building, hoardings, mobile phone towers, pillars and wires between them.

## 4.3 Solar energy potential (Insolation Availability):

Measurement of the solar radiation is direct or indirect. Direct methods are those involving the use of devices such as 'Pyrhelio meters and 'Pyranometers' at radiation stations. Indirect method use satellite data, the number of sunshine hours or extrapolation to arrive at values for radiation at a place. Geographically, Bhopal is located near Tropic of Cancer, it means that city receives substantially high amount of annual direct normal solar radiation and high number of sunshine hours. Bhopal is endowed with almost 300 days of clear sun and offers good site with potential of more than 5.5 kwh/sq mtr/day. Table of insolation in Bhopal is as under:

- Annual Average Direct Normal Irradiance: 5.61 kwh/m<sup>2</sup>/day.
- Annual Average Global Horizontal Irradiance: 5.67 kwh/m<sup>2</sup>/day.

## 5. Operational and Maintenance cost of the plant:

This comprises of routine maintenance, security of the plant and minor part replacement to ensure maximum generation from the plant. This operational and maintenance cost is taken as the 10% annually of the cost of the installation of the photovoltaic power plant. This task is performed by the qualified installers or service technicians who are conversant with PV components and their safety procedure. They carry out the following:

- Carrying out visual inspections.
- Conducting verification of the PV system operations.
- Taking corrective actions.
- Cleaning of the solar cells on a timely basis.
- Service of HT side equipment annually.
- Testing and upkeep of circuits.

## 5. Calculation of the per unit cost of power from solar power plant:

Utilizing solar energy is definitely free, clean, safe, abundant, renewable but the high initial investment, higher cost per unit of electricity, long-term payback and poor conversion efficiency are some major drawbacks that have held back this ideal energy source. Two reasons contribute to high cost of the plant; one is the need to use large amounts of expensive semiconductor material and the low conversion efficiency. The challenge is to reduce the total costs of a PV system to bring down the per unit cost.

## IV. CONCLUSION

Energy produced from renewable energy sources like solar energy is getting popular as the energy produced is green energy and there are no greenhouse gas emissions. At the same time the energy produced from a raw

material is free. The operating and maintenance costs for PV panels are negotiable, compared to the costs of other renewable energy systems. There is a high possibility of obtaining benefits from on-grid solar systems when the consumption is less so that surplus electricity can be sold to the local electricity supply. It is clear that the Grid connected solar PV system can provide some relief towards future energy demands. The results showed promise for solar development in the country.

## REFERENCES

- [1]. A report on Performance of Solar Power Plants in India, by, Central Electricity Regulatory Commission, 2011.
- [2]. A report on Jawaharlal Nehru National Solar Mission towards Building Solar India.
- [3]. [www.mnre.gov.in](http://www.mnre.gov.in), [www.mpnred.com](http://www.mpnred.com), [www.itsmysun.com/madhyapradesh](http://www.itsmysun.com/madhyapradesh)
- [4]. [www.mprenewable.nic.in](http://www.mprenewable.nic.in), [www.bijlibachao.com](http://www.bijlibachao.com) , [www.pveducation.org](http://www.pveducation.org)
- [5]. A student guide Energy from the Sun by National Energy Education Development project, 2017-18.
- [6]. A paper on Effect of Temperature and Irradiance on Solar Module Performance by Dr P Sobha Rani et al, Apr 2018.
- [7]. A study on Grid Connected PV system by Mrs J Sreedevi et al, 2016.
- [8]. Madhya Pradesh Solar Policy 2012.
- [9]. Tariff Order for Solar Energy Based Power Generation in Madhya Pradesh, Aug 2016.
- [10]. A paper on Analysis of 2 MW solar power plant in Madhya Pradesh by Mr Ankit Barasiya et al, Jan 2016, e-ISSN: 2395-0056.
- [11]. A paper on An Analysis of One MW Photovoltaic Solar Power Plant Design by Ms Hemakshi Bhoje et al, Vol 3, issue 1, Jan 2014.