2/2/2020

1 MW Solar Power Project - Proposal

Prepared By:
PRATAP CHANDRA NANDA

Contents

1. Introduction

Power is imperative to our modern daily life, because of its use in nearly everything. Looking at the current pace of increase in global population, thus increasing demand and depletion of current major source of electricity production i.e. coal, increasing our power base to cover the demand is therefore necessary. Apart from this, research, improvement and developments in new innovations (for example electric vehicles) have also increased the demand. Thus, innovating into a different source of production is the need of the hour. A significant renewable energy source (RES), which is abundantly available is the Sun. Generation of electricity has exponentially increased since last decade and this is because of the technological achievements, that has significantly decreased the cost of PV modules. Also, expenses related with PV systems can be reduced by setting up even bigger farms which is the benefit of economies of scale.

India has a tremendous potential for solar power generation since about 60% of the complete land region gets yearly average of Global insolation over 5 kWh/m^2/day. Being a densely populated country with above 1.3 billion population, all having their own priorities with land, residential, private works etc., availability of land for solar power project or be it any renewable energy source project is of serious concern in many parts. Recent statistics has highlighted the availability of infertile or unculturable land in numerous states like Rajasthan, Gujarat, Andhra Pradesh, Maharashtra, Karnataka, Tamil Nadu, Uttar Pradesh, Madhya Pradesh and Bihar. It is also seen that the per capita power utilization is recorded to be the most elevated in Western India trailed by Southern and Northern districts. The majority of the recognized solar hotspots are available in these areas, and subsequently solar power generation could decrease the losses due to transmission and distribution in these areas. The power quality can be maintained above the optimal level.

As per the latest report published by Ministry of New & Renewable Energy (MNRE - Solar R&D Division), total solar potential in India was close to 750 GWp in the year 2015. Odisha state is having a solar potential of 26 GWp.

2. Power Scenario in Odisha

The power supply circumstance in Odisha is presently going through a critical stage. The hydro reservoirs in the State which are the foundation of the power supply framework in Odisha are in depleted condition. The thermal power stations are not ready to deliver the maximum capacity because of various factors like non-availability of coal etc. Odisha, once upon a time, was energy surplus state and there was no shortfall in any event, even throughout the summers in the State. However, the position has changed radically over the period of time due to increase in demand, and no significant addition of any new generating units. In summer months, the hydro reservoirs commonly become dry and because of monsoon failure, the hydro power accessibility has gone down. Adding to this, because of the non-availability of coal, thermal power plants are unable to generate power to their full potential.

3. Site Selection

The proposed site is near Titilagarh in Bolangir district. It is situated in the western region of Odisha, in India. Odisha. It lies at 20.3°N 83.15°E. It has an average elevation of 215 metres (705 feet). The district has an area of 5,165 km², and a population of 1,648,997 (2011 census).

3.1.Climate Condition

This city has a tropical climate. When compared with winter, the summers have much more rainfall. This city is claimed to be the hottest city in Odisha. As per IMD data, in Titlagarh, the average annual temperature is 27.1 °C. Precipitation is about 1349 mm per year. The temperatures are highest in May, at around 45°C. At 20.7 °C on average, January is the coldest month of the year. Droughts are quite common in the district.

3.2.Soil and Land

Majority of the land includes red sandy soils and red loamy soils. The characteristic features of red soils are light texture, porous and friable structure, absence of lime Kankar and free carbonates and soluble salts in a small quantity. The terrain is levelled and is perfect for mounting civil structures. Soil quality is moderate and light weighed. The moisture content is low to medium level during pre-monsoon and medium during post monsoon. In normal the soil is somewhat dusty on the upper most layer everywhere throughout the year.

3.3.Wind Dynamics

In the chosen site, the wind flow is moderate and it will be same throughout the year and the effect of wind is very less because the site where the 1MW plant to be installed is far away from sea.

3.4.Substation

The power generated from the Solar PV Project is proposed to be evacuated through the nearest 33/11 kV Titilagarh Sub-station-cum-Switching Station. This is around 10 kilometres from the project site. Thus, the transmission and distribution losses will be less, which also reduces the cost of cable and wire to be used in the project.

3.5.Connectivity and Availability of Labour

The proposed site for 1MW PV plant installation is located nearer to the district headquarter of Bolangir, which is 60 km far and the road way transport is quite developed and it is very feasible for the transportation of the solar power plant equipment without any kind of transport delay. there is surplus man power available for the civil work and installation of the plant nearer to the selected area so there will be less chances of obstacles or time delay in the progress of setting up solar power plant in Titilagarh.

3.6.Site Solar Radiation

As per National Renewable Energy Laboratory (NREL), the Average Global Horizontal Irradiance 5.51 kWh/m2/day

4. Project Dynamics

Choosing the right solar module support method involves understanding a variability of natural/environmental factors, for example, soil conditions, geographic area, and local wind velocities. Other significant variables that should be considered incorporate soil mechanics, for example, combination, porousness and drainage, bearing limit, horizontal earth pressure, slope, as well as wind statistics to decide potential forces or loads that the solar module installation will be dependent upon, in view of PV panel size, weight, geographic orientation, tilt angle and so on. Every one of these variables should be deliberately considered for every single PV module installation, so as to limit the downtime while in operation. In this way, Capacity Utilisation Factor (CUF) of the plant can be increased above 95%.

The energy produced can be used in agriculture in the state, since major occupation is agriculture. The ever-increasing demand can be met by the plant. The project's direct beneficiaries are: (a) distribution utilities (DISCOMs); (b) customers who receive reliable, clean electricity; (c) society will benefit from system-wide positive externalities of:

(i) avoiding local coal-fired power plant emissions and greenhouse gas (GHG) emissions and
(ii) improving resource use

5. Project Finance

The finance is based on below assumptions:

Location	Titilagarh, Odisha
Project Size (in MW)	1
Number of Sun days	365
Per day Output (Units-kWh)	5000-7000
Total Annual Output (generation in MWh)	1800 to 2500
Generation depreciation factor (up to 10 years)	0.40%
Generation depreciation factor (above 10 years)	0.75%
Depreciation as per IT Act – WDV	15%
Salvage Value of PV Modules (%-age of initial cost)	60%
Salvage Value of Inverters and transformers (%-age of initial cost)	20%
Salvage Value of Civil Structures and wires and cables (%-age of initial cost)	2%
Construction period (in days)	180
Project Construction Start Date	Jul-20
Project Construction End Date	Dec-20
Land per MW Plant (in acres)	5
Cost of Land per acre	₹ 5,00,000
Tax Rate	30%
Tax Holidays (in years)	10
Power Tariff per kWh	₹ 7.00
Project Period of Operations (in years)	25

The total initial investment on the 1MW solar power plant project is estimated to be 7.55 Cr, out of which 80% is fulfilled with long term loan from banks. The project is proposed to run for 25 years. The project financial statement (P&L, Balance Sheet and Cash Flow) is as attached with this project. The power generation output is assumed to be depreciating at a rate of 0.4% in the first 10 years, followed by at a rate of 0.75% after 10 years of operations. The Internal rate of return (IRR) of the project scenario is 9.65 percent and Net Present Value (NPV) is estimated to be Rs 1.81 Cr over the 25-year life of the project. The net DSCR of the project came to be at an average of 1.39. The indicators make the project viable from all perspective.

6. Formulae used in Financial Analysis

NPV – NPV Function of excel

IRR – IRR Function of excel

Payback period =

(year prior full recovery of initial investment) + $\frac{Amount\ of\ initial\ investement\ that\ is\ unrecovered}{Total\ cash\ flow\ generated\ during\ the\ year}$

Debt Service Coverage Ratio (DSCR Ratio)

I) Gross DSCR = $\frac{Total\ Source\ of\ cash}{Total\ obligation}$

$= \frac{PAT + Depreciation + Interest}{Loan\ Principal + Loan\ Interest}$

II) Net DSCR = $\frac{PAT + Depreciation}{Loan\ Principal}$

7. Reference

MNRE - mnre.gov.in

IMD - https://mausam.imd.gov.in/

Census - https://www.census2011.co.in/data/subdistrict/3152-titlagarh-balangir-orissa.html