Detailed Project Report (DPR) of 5 MW Solar Grid-Connected Power Plant

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Contents

Main Features of the Project

⇒ **Project promoter:-** **xxxxxx**
⇒ **Project location:-** Village, Tehsil
⇒ **State :-** Madhya Pradesh
⇒ **Proposed technology:-** Si-Poly Technology
⇒ **Technology Supplier (PV Modules):-** Waree Si-Poly Module
⇒ **Technology Supplier (Power Condition units) :-** Power Electronics
⇒ **Design consultant:-** enincon LLP
⇒ **Plant capacity:-** 5 MW
⇒ **PV Module Type-** Si Poly modules
⇒ **PV Modules Required (area):-** 35892 m²
⇒ **Total Area Required: -** 101171 m2
⇒ **Annual global solar radiation :–** 1976 kWh/m²
⇒ **Annual average temperature :–** 25.18 C
⇒ **Annual Gross Output :-** 7896505 kWh
⇒ **Miscellaneous PV array losses :-** 1 %
⇒ **Miscellaneous power conditioning losses :-** 1 %
⇒ **Expected CUF :-** 19 %
⇒ **Project implementation period:-** 14 months
⇒ **Estimated project cost :-** Rs xxxx lakhs
⇒ **Project IRR :-** %
⇒ **Design Optimization Software used:-** RETScreen, METEONORM, PVSYST V5.72
⇒ **Site selection:-** Site identified and suitability confirmed
⇒ **Financial closure:-** On approval of the project, promoters will approach banks

Site Assessment

Abc Village (24.xx" North and 79.xx"East) is located in xx tahsil of xx district of Madhya Pradesh. xx located at 24.12 N and 79.59 E with an average elevation of 352 meters. It is surrounded by rocky, sandy and five salt ranges. It has well road and rail connectivity from abc. xxxx is planning to install a solar energy based grid connected power project in xx, Madhya Pradesh under the Madhya Pradesh Solar Policy. The identified technology is solar Si-Poly; while the capacity of proposed power plant is 5 MW. Enincon LLP has been selected by the company as project consultants and for preparation of detailed project report (DPR) of the proposed plant.

Exhibit 01 : Site images for Site Assessment

GRAPHIC

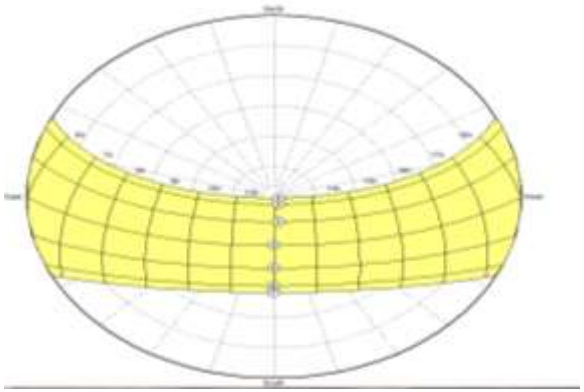
Source: enincon

Solar radiation over Village x,Madhya Pradesh

The proposed project site is situated in the x Village,x district of the Madhya Pradesh State in India.The distance from the district headquarters xx to the site is 31 km (by road) towards the north. The nearest meteorological station for solar data is in xx. The solar data collected in this station is available in the “Solar Radiation Handbook 2008”, published by the Ministry of New and Renewable Energy (MNRE) and in the “Handbook of Solar Radiation”, compiled by Anna Mani. In this exercise, solar data for “Global solar irradiance "is taken from NASA-SSE, Meteonorm and the “Solar Radiation Handbook 2008. Global solar irradiance for the proposed site, xx from PVsyst5.74 software.

Exhibit 02 : *Stereographic Sun-path Diagram for xxxx ,Madhya Pradesh*

ILLUSTRATIVE



Source: enincon, PV syst 5.74

Exhibit 03 : *Orthographic Sun-path Diagram for xxxx ,Pradesh*

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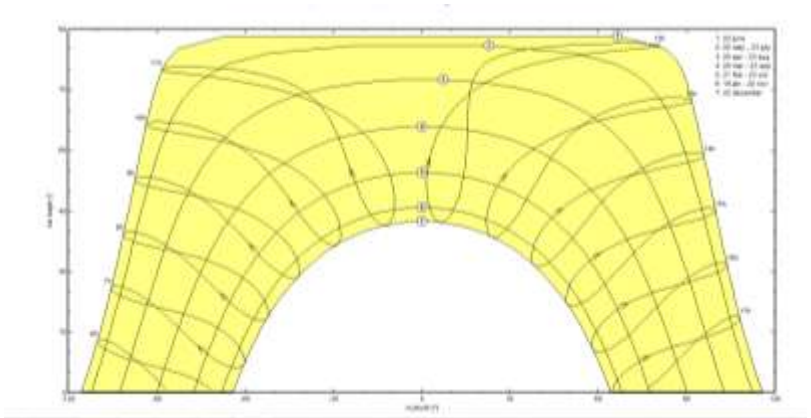

Source: enincon, PV syst 5.74

Monthly average daily values (average, maximum, minimum) of climatic parameters for site

TABULAR

Month	Air temperature	Relative humidity	Daily solar radiation - horizontal	Atmospheric pressure	Wind speed	Earth temperature
	°C	%	kWh/m²/d	kPa	m/s	°C
January	17.3	46.7%	4.23	97.7	2.7	19.1
February	20.7	41.2%	5.09	97.5	2.8	23.6
March	26.6	31.1%	5.92	97.2	2.9	30.9
April	31.9	24.5%	6.60	96.8	3.1	37.6
May	34.1	32.0%	6.51	96.4	3.3	39.6
June	31.6	55.2%	5.45	96.1	3.3	34.6
July	27.9	76.3%	4.32	96.2	2.9	29.2
August	26.6	81.5%	3.93	96.4	2.5	27.2
September	26.3	73.6%	4.51	96.7	2.4	27.2
October	25.4	50.9%	5.04	97.2	2.0	27.0
November	21.9	40.0%	4.51	97.6	2.1	23.3
December	17.9	45.4%	4.00	97.8	2.3	19.1
Annual	25.7	49.9%	5.01	96.9	2.7	28.2
Measured at (m)					10.0	0.0

Exhibit 04 : Estimation of Annual Electrical Output

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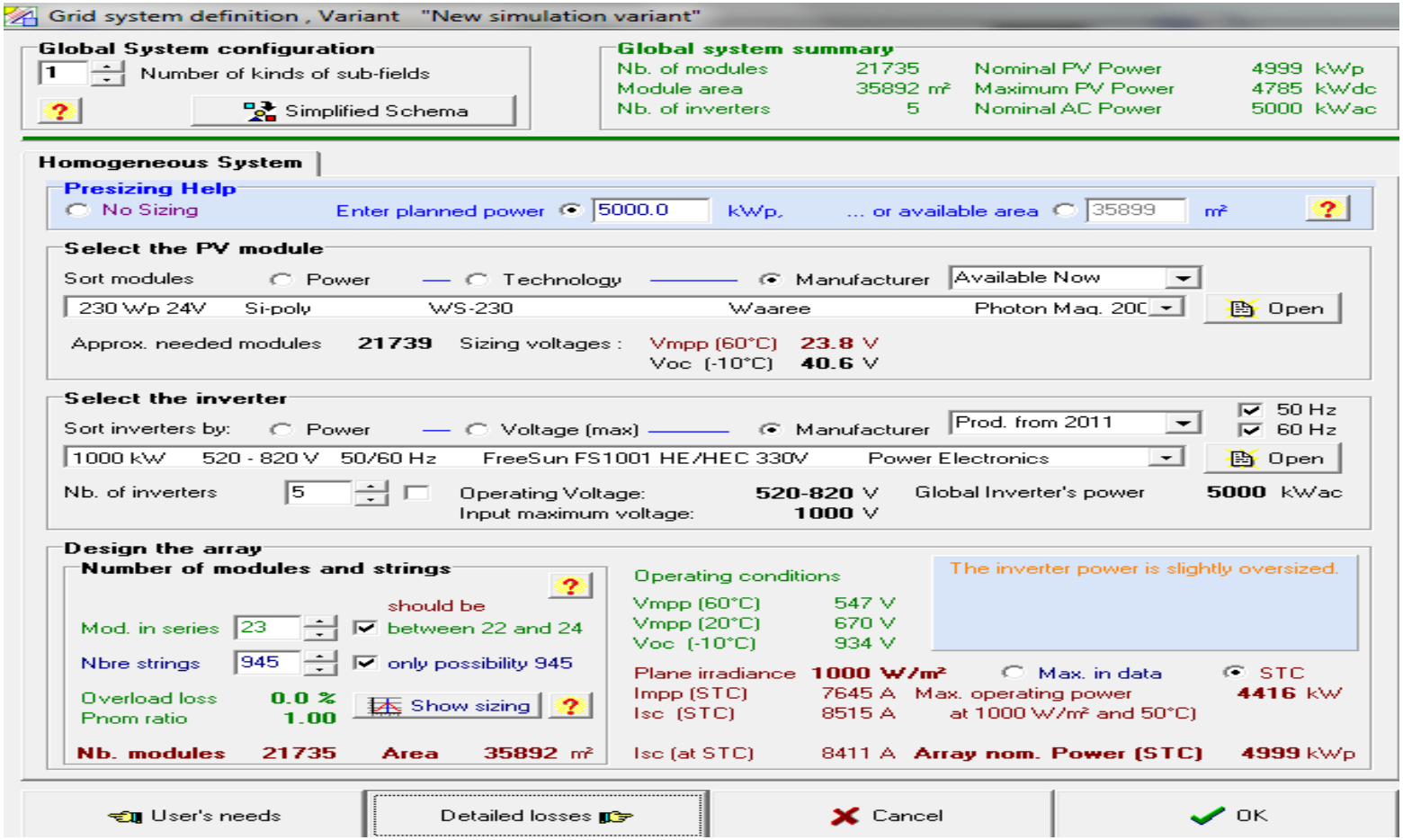

Source: enincon, PV syst 5.74

Exhibit 05 : Project report from Pvsyst V5.74

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Grid-Connected System: Simulation parameters

Project :	**Grid-Connected Project at kanti ,Madhya Pradesh**				
Geographical Site	**Kanti ,Madhya Pradesh**			**Country**	**India**
Situation	Latitude	24.1°N		Longitude	79.6°E
Time defined as	Legal Time	Time zone UT+6		Altitude	352 m
	Albedo	0.20			
Meteo data :	kanti madhya pradesh, Synthetic Hourly data				
Simulation variant :	**New simulation variant**				
	Simulation date	07/09/14 23h04			
Simulation parameters					
Collector Plane Orientation	Tilt	24°		Azimuth	0°
Horizon	Free Horizon				
Near Shadings	No Shadings				
PV Array Characteristics					
PV module	Si-poly	Model	**WS-230**		
		Manufacturer	Waaree		
Number of PV modules		In series	23 modules	In parallel	945 strings
Total number of PV modules		Nb. modules	21735	Unit Nom. Power	230 Wp
Array global power		Nominal (STC)	**4999 kWp**	At operating cond.	4416 kWp (50°C)
Array operating characteristics (50°C)		U mpp	578 V	I mpp	7645 A
Total area		Module area	**35892 m²**		
Inverter		Model	**FreeSun FS1001 HE/HEC 330V**		
		Manufacturer	Power Electronics		
Characteristics		Operating Voltage	520-820 V	Unit Nom. Power	1000 kW AC
Inverter pack		Number of Inverter	5 units	Total Power	5000 kW AC
PV Array loss factors					
Thermal Loss factor		Uc (const)	20.0 W/m²K	Uv (wind)	0.0 W/m²K / m/s
=> Nominal Oper. Coll. Temp. (G=800 W/m², Tamb=20°C, Wind=1 m/s.)				NOCT	56 °C
Wiring Ohmic Loss		Global array res.	1.3 mOhm	Loss Fraction	1.5 % at STC
Module Quality Loss				Loss Fraction	3.0 %
Module Mismatch Losses				Loss Fraction	2.0 % at MPP
Incidence effect, ASHRAE parametrization		IAM =	1 - bo (1/cos i - 1)	bo Parameter	0.05
User's needs :	Unlimited load (grid)				

Source: enincon, PV syst 5.74

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Grid-Connected System: Main results

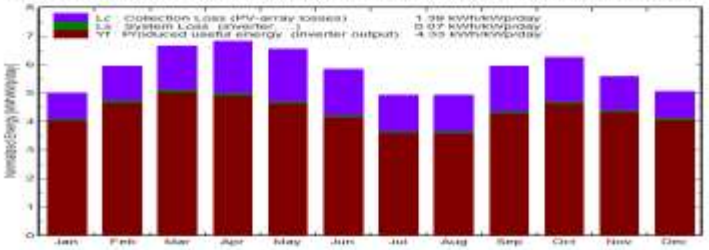
Project : Grid-Connected Project at kanti ,Madhya Pradesh
Simulation variant : New simulation variant

Main system parameters	System type	**Grid-Connected**			
PV Field Orientation	tilt	24°	azimuth	0°	
PV modules	Model	WS-230	Pnom	230 Wp	
PV Array	Nb. of modules	21735	Pnom total	**4999 kWp**	
Inverter	Model	FreeSun FS1001 HE/HEC 3300V	Pnom	1000 kW ac	
Inverter pack	Nb. of units	5.0	Pnom total	**5000 kW ac**	
User's needs	Unlimited load (grid)				

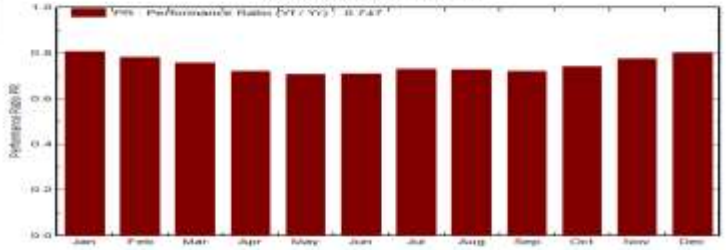
Main simulation results
System Production

Produced Energy	**7896505 kWh/year**	Specific prod.	1580 kWh/kWp/year
Performance Ratio PR	74.7 %		

Normalized productions (per installed kWp): Nominal power 4999 kWp



Performance Ratio PR



New simulation variant
Balances and main results

	GlobHor kWh/m²	T Amb °C	GlobInc kWh/m²	GlobEff kWh/m²	EArray kWh	E_Grid kWh	EffArrR %	EffSysR %
January	118.0	14.70	155.0	150.7	636031	625415	11.43	11.24
February	137.0	17.30	166.8	162.4	664185	653022	11.10	10.91
March	168.0	22.70	206.6	201.0	795143	782291	10.72	10.55
April	207.0	28.80	204.6	198.6	760843	737680	10.22	10.04
May	222.0	32.50	203.0	196.7	731628	718413	10.04	9.86
June	197.0	32.90	175.1	169.0	633246	622059	10.08	9.90
July	167.0	30.30	152.8	147.5	567936	558170	10.36	10.18
August	160.0	29.80	153.1	148.0	567048	557038	10.32	10.13
September	171.0	29.50	170.6	173.7	655598	644063	10.22	10.04
October	165.0	26.20	193.8	188.8	730732	718804	10.50	10.33
November	129.0	20.90	167.5	163.0	661100	650585	10.99	10.82
December	116.0	18.00	158.9	152.6	838821	629084	11.38	11.17
Year	1978.0	25.18	2114.0	2062.0	8033309	7896505	10.59	10.41

Legends:
GlobHor Horizontal global irradiation
T Amb Ambient Temperature
GlobInc Global incident in coll. plane
GlobEff Effective Global, corr. for IAM and shadings
EArray Effective energy at the output of the array
E_Grid Energy injected into grid
EffArrR Effic. Eout array / rough area
EffSysR Effic. Eout system / rough area

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Grid-Connected System: Loss diagram

Project : **Grid-Connected Project at kanti ,Madhya Pradesh**
Simulation variant : **New simulation variant**

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Inverter pack	Nb. of units	5.0	Pnom total	**5000 kW ac**	
User's needs	Unlimited load (grid)				

Loss diagram over the whole year

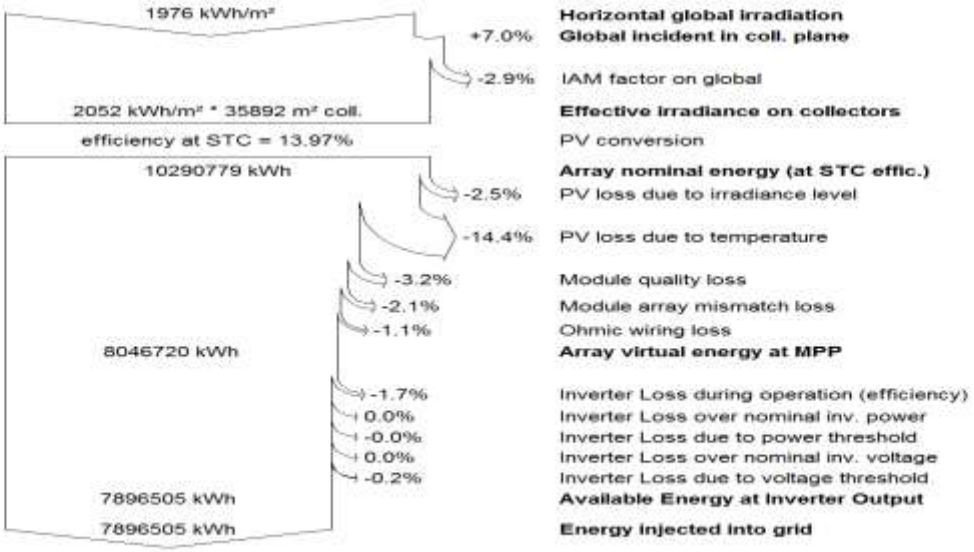

Exhibit 06 : Financial aspect of Project

TABULAR

SR.No.	PARAMETER	UNIT	VALUE
1	IRR	%	Xxxxx
2	IRR EQUITY	%	Xxxxxx
3	DSCR	%	Xxxxxx
4	PAYBACK PERIOD	YEAR	Xxxxxx
5	LEVELISED TARIFF	Kwh/Rs.	xxxxxx

Source: enincon, PV syst 5.74

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