



DETAILED PROJECT REPORT
ON
SUPPLY, INSTALLATION AND COMMISSIONING
OF
SOLAR PHOTO VOLTAIC POWER PACKS 1 KWP
FOR
MADHYA PRADESH FOREST DEPARTMENT
BHOPAL



SUBMITTED BY

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1. EXECUTIVE SUMMARY

The demand of electricity has increased a lot in last decade and even after putting all out efforts in increasing the production of electricity it has been realized that by only doing in this way the increasing demand can not be met by conventional energy sources. One of the ways of bridging this gap in energy demand and supply is by putting Renewable Energy Power Plants in rural/semi urban areas, which will assist the utility grid in providing independent power to a dedicated load. This will reduce the load on the conventional power systems and results in saving of precious fossil fuels.

Looking above in mind, Madhya Pradesh Forest Department has decided to put up 1 Kwp Roof top SPV Power Packs at 113 nos. remote Forest Range offices in Madhya Pradesh for providing uninterrupted power to communication equipments (computers and wireless system).

The purpose of putting SPV Power Plant is to provide uninterrupted power to dedicated loads such as computers, fans, CFL's and other essential loads. The installation of SPV Power Packs at Forest Range offices will not only serve the purpose of smooth operation of communication equipments but will also save conventional energy and fossil fuels thereby more conventional energy will be available for other applications. The proposed solar pv power packs will be procured by calling tenders as is required under the GoMP rules and regulations.

The estimated cost of the project is Rs 380 Lacs only. The subsidy component is Rs 125 Lacs, while State of MP will bear 255 lacs.

2. INTRODUCTION

Energy from the Sun not only sustains life on earth but is also the source of almost all forms of energy used by man. Fossil fuels such as coal and oil represent solar energy that was received on earth millions of years ago and converted into other forms. Renewable sources of energy such as wind, hydropower, biomass and ocean energy are also indirect forms of solar energy.

Solar energy, experienced by us as heat and light, can be used in a number of ways and for many applications. The two Principal routes and technologies of solar energy utilisation are:

- (i) **The thermal route** using the heat for heating, cooling, drying, water purification and power generation;
- (ii) **The photovoltaic route** which converts the light into electricity which can then be used for a variety of purposes such as lighting, pumping, communications and refrigeration etc.

Energy from Sun has many features, which make it an attractive option such as its widespread distribution, pollution-free nature and virtually inexhaustible supply. India receives solar energy equivalent to over 5,000 trillion KWh / year which is far more than the total energy consumption of the country. The daily average solar energy incident varies from 4 - 7 KWh / m² depending upon the location. There are around 250 - 300 Sunny days in most parts of the country. If 1% of the total land area is used to generate electricity from this radiation at a net efficiency of only 1%, it will be possible to produce about 300,000 MW of power.

The potential of the solar energy in meeting the growing energy needs of the country was recognised in mid 70s. Research and development efforts in both solar thermal and photovoltaic routes were initiated. Several applications were developed and demonstrated during the 80s. These efforts received an impetus with the establishment of Ministry of New & Renewable Energy Sources (MNRE). The Ministry's programmes helped in R&D, demonstration, commercialisation and utilisation activities in respect of a wide variety of renewable energy technologies. The

programmes are implemented through a network of state level agencies, industrial, research and academic organisations and non-governmental bodies.

India has one of the world's largest programmes in solar energy. A sizeable research and technology base, a growing manufacturing capability and a countrywide infrastructure for the distribution and after-sales service of solar energy products have emerged. Solar energy is beginning to be used for a large number of applications. Nevertheless, the achievements so far add up to only a tiny fraction of what is possible. The efforts initiated during the last few years by MNRE to restructure the programmes and giving them a market orientation are contributing significantly in accelerating the utilisation of solar energy commercially in the country.

3. OBJECTIVES

Madhya Pradesh, the largest state of the country is endowed with rich and diverse forest resources. Lying between lat. 21° 04'N and long. 74° 02' and 82° 49'E, it is a reservoir of biodiversity. The geographical area of the state is 308, 144 km² (118, 975,sq mi) which constitutes 9.38% of the land area of the country. The forest area of the state is 95,221 km² (36,765 sq mi) constituting 31% of the geographical area of the state and 12.44% of the forest area of the country.

Madhya Pradesh Forest Department (MPFD) is a very big organization manned by a twenty five thousand strong force that is responsible for the management and conservation of this large area of forests. MPFD needs to reach to the remotest of those interiors of the state that no other department would probably need to. This can not be possible without quick communication. In today's ever changing scenario and ever increasing pressures on the forest eco-systems and wildlife, quick dissemination of information is mandatory for an efficient forest management strategy.

MPFD is not only one of the few forest departments of the country that have put modern Information Technology to extensive use in its forest management planning, implementation and monitoring but is probably a pioneer in the use of many of these technologies for better eco-system management. But there have lots of road blocks in the optimum utilization of these technologies and availability of power has probably been the biggest deterrent.

Many of the Forest Range offices (a Forest Range happens to be the key administrative unit in forestry parlance) are situated in extreme remote interiors and communication even in this WEB-age can be extremely frustrating and painful – just because of unavailability of power. Gen-sets with heavy diesel bills ad a long list of negative externalities have so far been the only solution, if that can be termed as a solution.

In this context, Solar Photo Voltaic (SPV) standalone (SPPs) appear to be a tailor made solution to make available regular power to these remotely situated forest Range offices. This proposal puts out a plan to put roof top SPVs on 100 of the remotest of these Forest Range offices and to utilize the so generated electricity for the IT facilitated communication network that incorporates use of the Web, GPS and MIS supported by an online live database.

Besides providing electricity to Range Offices, MPFD envisages that every remote location where the Range Offices exist, a kiosk will be created which will provide wide ranging web based services to the villagers. The kiosks will be managed by the respective Range Offices and can be accessed by all for fixed time duration to be decided by the villagers, Gram Sabha or Panchayats.

It is proposed to set up 100 nos. Solar PV Standalone type Power Packs 1 KWp at M.P. Forest Range offices spread all over Madhya Pradesh.

The power from the PV plant is natural and reliable power source. Further the quantum and availability of sunlight in M.P. is excellent to prompt the implementation of such a project

The success of such projects has already been established, as number of projects has been installed and working satisfactorily.

Ministry of New & Renewable Energy Sources, Govt of India has launched a scheme " Implementation of Solar Photovoltaic (SPV) Programme during FY 2009-10 " in order to:

- 1) To promote the use of SPV systems for lighting and various other applications in the country
- 2) To create awareness & demonstrate effective and innovative use of SPV Systems
- 3) To save diesel for power generation
- 4) To reduce burden on conventional electricity

Solar PV Power Packs 1 KWP Power Plant are proposed with an objective to attain following benefits:

- Providing uninterrupted power to the Wireless sets, light points and computer for better communication.
- Saving of precious fossil fuels.
- Noiseless, pollution free and Eco-friendly power.
- Saving of revenue.
- Can work as a demonstration project for further expansion of PV technology all over the country.

4. SITE DETAILS

The proposed 1 Kwp Solar Pv Power Packs shall be installed at following locations:

Remote M.P. Forest Range Offices spread all over M.P. - 113 sites

S.N.	Name of District	Name of Division	Ranges	
			S.N.	Name
1	Mandla	D.F.O. (P) MANDLA	1	Anjaniya
		D.F.O.(East) MANDLA(T)	2	Bichhiya
		D.F.O.(East) MANDLA(T)	3	Motinala
		D.F.O.(East) MANDLA(T)	4	Mawai
		D.F.O.(East) MANDLA(T)	5	Jagmandal
		D.F.O.(East) MANDLA(T)	6	Mohgaon
		D.F.O.(East) MANDLA(T)	7	Ghughri
		D.F.O.(West) MANDLA(T)	8	Mandla
		D.F.O.(West) MANDLA(T)	9	Maharajpur
		D.F.O.(West) MANDLA(T)	10	Tikariya
		D.F.O.(West) MANDLA(T)	11	Bamhani
		D.F.O.(West) MANDLA(T)	12	Kalpi
		D.F.O.(West) MANDLA(T)	13	Barela
		D.F.O.(West) MANDLA(T)	14	WM
		D.F.O.(West) MANDLA(T)	15	Beejadandi
		D.F.O.(West) MANDLA(T)	16	Niwas
		DY. DIRECTOR BUFFER ZONE KANHA TIGER RESERVE	17	Sijhora
		DY. DIRECTOR BUFFER ZONE KANHA TIGER RESERVE	18	Samnapur
		DY. DIRECTOR BUFFER ZONE KANHA TIGER RESERVE	19	Khapa
		DY. DIRECTOR BUFFER ZONE KANHA TIGER RESERVE	20	Khatia
		DY. DIRECTOR BUFFER ZONE KANHA TIGER RESERVE	21	Garhi
		DY. DIRECTOR KANHA TIGER RESERVE	22	Kisli
		DY. DIRECTOR KANHA TIGER RESERVE	23	Kanha
		DY. DIRECTOR KANHA TIGER RESERVE	24	Phen Sanctuary
		DY. DIRECTOR KANHA TIGER RESERVE	25	Mukki
		DY. DIRECTOR KANHA TIGER RESERVE	26	Supkhar
		DY. DIRECTOR KANHA TIGER RESERVE	27	Bhaisanghat
2	Dindori	DFO (T) DINDORI	28	Shahpur (T)
		DFO (T) DINDORI	29	Shahpura (T)
		DFO (T) DINDORI	30	Mehandwani (T)
		DFO (T) DINDORI	31	Dindori (T)

		DFO (T) DINDORI	32	Amarpur (T)
		DFO (T) DINDORI	33	Bajag (T)
		DFO (T) DINDORI	34	Karanjia (T)
3	Shahdol	D.F.O. (NORTH) SHAHDOL	35	Beohari
		D.F.O. (NORTH) SHAHDOL	36	Godawal
		D.F.O. (NORTH) SHAHDOL	37	Amjhor
		D.F.O. (NORTH) SHAHDOL	38	Jaisinghnagar
		D.F.O., (SOUTH) SHAHDOL	39	Jaitpur
		D.F.O., (SOUTH) SHAHDOL	40	Keshwahi
		D.F.O., (SOUTH) SHAHDOL	41	Burhar
		D.F.O., (SOUTH) SHAHDOL	42	Shahdol
		D.F.O., (SOUTH) SHAHDOL	43	Gohparu
		D.F.O., (SOUTH) SHAHDOL	44	Khannoudhi
4	Umaria	DFO UMARIA	45	Ghunghunti
		DFO UMARIA	46	Manpur
		DFO UMARIA	47	Dhamokhar
		DFO UMARIA	48	Chandia
		DFO UMARIA	49	Umaria
		DFO UMARIA	50	Nourozabad
		DFO UMARIA	51	Panpath
		Director, Bandhavgarh National Project, Umaria	52	Panpatha
		Director, Bandhavgarh National Project, Umaria	53	Khitauli
		Director, Bandhavgarh National Project, Umaria	54	Magdhi
		Director, Bandhavgarh National Project, Umaria	55	Kallwah
		Director, Bandhavgarh National Project, Umaria	56	Tala
		Director, Bandhavgarh National Project, Umaria	57	Pataur
5	Anuppur	D.F.O. ANUPPUR (T)	58	Rajendragram
		D.F.O. ANUPPUR (T)	59	Amarkantak
		D.F.O. ANUPPUR (T)	60	Ahircawa
		D.F.O. ANUPPUR (T)	62	Anuppur
		D.F.O. ANUPPUR (T)	63	Jaithari
		D.F.O. ANUPPUR (T)	64	Kotma
		D.F.O. ANUPPUR (T)	65	Bijuri
6	Sidhi	D.F.O.(WEST) Sidhi.	69	Majhauri
		D.F.O.(WEST) Sidhi.	70	Churhat
		D.F.O.(WEST) Sidhi.	71	Sidhi
		D.F.O.(WEST) Sidhi.	72	Bahari
		D.F.O.(WEST) Sidhi.	73	Madwas
		D.F.O.(WEST) Sidhi.	74	Mohan
		D.F.O.(East Sidhi) Singrauli.	75	Jiyavan
		D.F.O.(East Sidhi) Singrauli.	76	Karthua
		D.F.O.(East Sidhi) Singrauli.	77	Chitrangi
		D.F.O.(East Sidhi) Singrauli.	78	Bargawan
		D.F.O.(East Sidhi) Singrauli.	79	Sarai
		D.F.O.(East Sidhi) Singrauli.	81	Gorbi
D.F.O.(East Sidhi) Singrauli.	82	Mada		

		D.F.O. (East Sidhi) Singrauli.	83	Waidhan
		Director, Sanjay National Park, Sidhi.	84	Son Gharial
		Director, Sanjay National Park, Sidhi.	86	Pondi
		Director, Sanjay National Park, Sidhi.	87	Bastua
		Director, Sanjay National Park, Sidhi.	88	Dubari
8	Rewa	D.F.O. REWA	89	Rewa
		D.F.O. REWA	90	Semaria
		D.F.O. REWA	91	Sirmour
		D.F.O. REWA	92	Atraila
		D.F.O. REWA	93	Dabhoura
		D.F.O. REWA	94	Mauganj
		D.F.O. REWA	95	Chakghat
		D.F.O. REWA	96	Hanumana
		D.F.O. REWA	97	Traning School Govind Garh
9	Satna	DFO SATNA	98	Satna
		DFO SATNA	99	Unchehara
		DFO SATNA	100	Maihar
		DFO SATNA	101	Amarpatan
		DFO SATNA	102	Mukundpur
		DFO SATNA	103	Nagod
		DFO SATNA	104	Singhpur
		DFO SATNA	105	Baroundha
		DFO SATNA	106	Majhgawan
DFO SATNA	107	Chitrakoot		
10	Katni	DFO, KATNI (T)	108	Katani
		DFO, KATNI (T)	109	Badwara
		DFO, KATNI (T)	110	Vijayraghav Garh
		DFO, KATNI (T)	111	Rithi
		DFO, KATNI (T)	112	Bahoriband
		DFO, KATNI (T)	113	Dheemarkhed a

5. TECHNICAL DETAILS & SYSTEM SPECIFICATIONS

A. System Description and Definitions

Forest Range Office Load Estimate:

A typical Forest Range Office that is enabled to use IT needs on a minimum basis the following – a Computer, two wireless radio, at least three lights apart from at least one fan. This put out the following load requirements on a daily basis:

Electrical Item	Nos	Load (W)	Hours	Powr Consumption (WH)
Wireless Radio (20 W)	2	40	12	480
Fans (70 W)	1	70	6	420
Misc Lights (10 W)	3	30	6	180
Computer (150 W)	1	150	10	1500
Total	-	440	-	2580

A.1 SPV MODULES:

Type and Quality

The total Solar PV Array Capacity shall be 1 kWp. Crystalline type solar modules of desired nominal voltage or peak power rating which meet specifications are considered appropriate for inclusion in this offer. Modules will be procured by MPFD with a warranty that:

Fabrication is in compliance with the standards approved by MNRE.

70/75/125/140/150 Wp or any other capacity modules shall be used.

Offered module shall have a power output warranty for 10 years.

Solar cells / modules used have a proven record for the performance in actual field conditions of many states.

The modules used shall have following specifications under STC:

Make : As registered with MNRE

Type : 70W36/75W36/125W36/140W72/150W72

Peak Power Output : 70/75/125/140/150 Watts

Maximum Current : 4.11/4.41/7.35/4.11/4.41 A DC

Maximum Voltage : 17/17/17/34/34 VDC

Type of Cell used : Crystalline Silicon

A.2 MECHANICAL COMPONENTS

ARRAY SUPPORT STRUCTURE

Modules shall be mounted on a non corrosive support structure suitable for site conditions. The inclination angle of the array support structure shall be in accordance with the latitude of the place of installation. No provision for adjusting inclination angle is required.

Complete set of engineering drawings for the array support structure proposed are enclosed.

There shall be mild steel frame structures (Hot dipped, Galvanized) for holding the PV modules to form the PV panels

Each panel frame structure shall be so fabricated as to be grouted using cement concrete

foundation.

Each panel frame shall be complete with a weather proof junction box as per the relevant ISI specifications, where the module terminals shall be interconnected and output taken.

The panel frame structure be capable of with standing a wind load of 150 km per hour, after grouting and installation.

A.3 Power Conditioner Unit (PCU)

The power conditioning unit will convert dc power produced by spv array into ac power. The capacity of PCU shall be 1 KVA.

ELECTRICAL

INVERTER	
Max. No. of Series panels	1 or 2 nos.
Nominal Battery voltage	24 volts
AC out put voltage	230 volt, 50 Hz
Maximum out put capacity	1 KVA
Peak out put capacity	Up to 150% of maximum current for 15 seconds
Out put wave shape	Sine wave
THD	< 5 %
Max current ripple	4% peak to peak
No load power consumption	2.5 % of O/p rating
Efficiency at 30 degree centigrade	Up to a maximum of 85%

SOLAR CHARGE REGULATOR	
Maximum capacity	1 kW

ENVIRONMENTAL	
Cooling	Temperature controlled fan forced cooling
Ambient temperature range	0 deg to 55 deg
Ambient humidity range	5% to 90% condensing

Construction

The inverter shall be supplied in IP 30 outdoor enclosure.

Protections:

Following protections shall be provided:

- Short Circuit
- Battery deep discharge/overcharge
- Overload
- Battery reverse polarity
- Input surge voltage

A.4 Battery Bank:

A battery bank of 24 Volt, 300 Ah capacity shall be provided with the power plant..

Suitable no. of acid proof storage racks shall be supplied to accommodate the cells.

Specifications:

Type	:	Tubular Lead Acid type
Capacity	:	24V, 300 AH at C/10 rate
Container	:	Made of hard rubber
Total no. of cells	:	12 nos. connected in series
Self Discharge	:	less than 4% per month
Ampere hour eff.	:	96%
Watt hour eff	:	81%
Max. depth of Discharge	:	80%
Cycle life at MDOD:		more than 1200 nos.

A.5 Junction Boxes

A array junction boxes shall be provided in PV array field for termination of connections from various pv modules.

Features:

Made of FRP

Dust and vermin proof

Suitable MOV's shall be provided for high voltage surge

Copper bus bars of suitable rating

A.6 Cables

Cabling will be carried out as per IE rules.

Cable Marking: All cables/wires shall be marked with good quality ferule for Cable identification.

Cable Ends: All connections shall be made through suitable cable lugs/tags crimped properly and

with the use of cable glands.

All cables shall be:

- Multistrand , annealed high conductivity copper/aluminium conductor
- Overall PVC insulation for UV protection
- Armoured cables for under ground laying
- All cables shall conform to BIS standards

A.7 Civil Work

Civil work shall include work related with foundation for installation of module mounting structures.

B. Bill of Material

The bill of material for 1 Kwp SPV Power Plant is as under:

S. No.	Description of item	Unit	Quantity
1.	Solar PV Modules70/75/125/140/150 Wp	Set	1 Kwp
2.	Mounting Structure	Set	01 Set
3.	Power Conditioning Unit (1 KVA)	Nos.	01 no.
4.	Array Junction Box	No.	01 no.
5.	Wires and Cables	Set	As per site requirement
6.	Battery Bank (24 V, 300 AH)	Set	01 set

C. Project Duration

The complete work of supply, installation and commissioning shall be in a period of 6 months once the sanction is granted.

6. FINANCIAL ASPECTS

Project Cost

The cost per system including of supply, installation, commissioning and 5 year maintenance is Rs 3, 50,000.00

Subsidy from MNRE @ Rs 125 per wp : Rs1, 25,000.00 per system

Net cost to M.P. Forest Department : Rs2, 25,000.00 per system

Net cost of the project for 113 locations: Rs3, 79, 25,000.00

Net cost to M.P. Forest Department : Rs2, 54, 25, 000.00

Net Subsidy on 113 Systems : Rs1, 25, 00,000.00