

**Ministry of New and Renewable Energy**  
**Jawaharlal Nehru National Solar Mission**  
**Technical Specifications**  
**for**  
**SOLAR PHOTOVOLTAIC WATER PUMPING SYSTEMS**

**I. DEFINITION**

A solar photovoltaic (**SPV**) water pumping system consists of a PV array, a DC/AC surface mounted/ submersible/ floating motor pump set, electronics, if any, interconnect cables and an “On-Off” switch. PV Array is mounted on a suitable structure with a provision of tracking. Electronics could include Maximum Power Point Tracker (MPPT), Inverter and Controls/Protections. Storage batteries will not constitute a part of the SPV Water Pumping System.

Components and parts used in the SPV water pumping system including the PV modules, pumps, metallic structures, cables, junction box, switch, etc. should conform to the BIS/ IEC/ international specifications, wherever such specifications are available and applicable.

**II. PERFORMANCE SPECIFICATIONS AND REQUIREMENTS (DUTY CYCLE)**

The Solar PV Water Pumping System should provide a minimum of 85 liters of water per watt peak of PV array used per day under average daily solar radiation conditions of 5.5 KWh/sq.m. on a horizontal surface, from a total head of 10 metres (Suction head up to a maximum of 7 metres).

For Deep Well Pumps, the water discharge should be a minimum of 28 liters of water per watt peak of PV array capacity used per day from a total head of 30 metres. In case of High Head, Deep Well Pumps, the water discharge should be a minimum of 17 liters of water per watt peak of PV array capacity used per day from a total head of 50 metres.

Use of a tracking system to enhance the availability of solar radiation to lift desired quantity of water is desirable. It should be specified whether the minimum water output is achieved directly or through tracking of PV Array. The actual duration of pumping of water on a particular day and the quantity of water pumped could vary depending on the location, season, etc.

**PV ARRAY**

The SPV water pumping system should be operated with a PV array capacity in the range of 200 Watts peak to 5000 Watts peak, measured under Standard Test Conditions (STC).

Sufficient number of modules in series and parallel could be used to obtain the required PV array power output. The power output of individual PV modules used in the PV array, under STC, should be a minimum of 74 Watts peak, with adequate provision for measurement tolerances. Use of PV modules with higher power output is preferred.

Indigenously produced PV module (s) containing mono/ multi crystalline silicon solar cells with following features should be used in the PV array for the SPV Water Pumping systems:

- Modules supplied with the SPV water pumping systems should have certificate as per IEC 61215 specifications or equivalent National or International/ Standards.
- Modules must qualify to IEC 61730 Part I and II for safety qualification testing.
- The efficiency of the PV modules should be minimum 13% and fill factor should be more than 70%.
- The terminal box on the module should have a provision for “Opening” for replacing the cable, if required.
- Each PV module must use a RF identification tag (RFID), which must contain the following information:
  - (i) Name of the manufacturer of PV Module
  - (ii) Model or Type Number
  - (iii) Serial Number
  - (iv) Month and year of the manufacture
  - (v) I-V curve for the module
  - (vi) Peak Wattage of the module at 16.4 volts
  - (vii)  $I_m$ ,  $V_m$  and FF for the module
  - (viii) Unique Serial No and Model No of the module

Until March 2013, the RFID can be inside or outside the module laminate, but must be able to withstand harsh environmental conditions. **However from 1<sup>st</sup> April 2013 onwards; RFID shall be mandatorily placed inside the module laminate**

**A distinctive serial number starting with NSM will be engraved on the frame of the module or screen printed on the tedlar sheet of the module.**

### **III. MOTOR PUMP-SET**

Following types of motor pump sets could be used in the SPV water pumping systems:

- I. Surface mounted DC motor pump-set
- II. Submersible DC motor pump set
- III. Submersible AC motor pump set
- IV. Floating DC motor pump set
- V. Any other type of motor pump set after approval from Test Centers of the Ministry.

The “Motor Pump Set” should have the following features:

- The mono block DC/ AC centrifugal motor pump set has its driving unit and impeller mounted on a common shaft, thereby giving it a perfect alignment. The pump should be provided with specially developed mechanical seals which ensure zero leakage.
- The motor is of 1-5 HP having spring loaded carbon brushes in case of D.C. Motor Pump Sets. The suction and delivery head will depend on the site specific condition of the field.
- Submersible pumps could also be used according to the technical need of the particular case. .
- The suction/ delivery pipe (GI/HDPE), electric cables, floating assembly, civil work and other fittings required to install the system.
- The following details should be marked indelibly on the motor pump set
  - (a) Name of the Manufacturer or Distinctive Logo.
  - (b) Model Number.
  - (c) Serial Number.

## **V. MOUNTING STRUCTURES and TRACKING SYSTEM**

To enhance the performance of SPV water pumping systems, it is desirable to use a tracking system. Manual, passive and auto tracking are permitted. The PV modules will be mounted on metallic structures of adequate strength and appropriate design, which can withstand load of modules and high wind velocities up to 150 km per hour. The support structure used in the pumping system will be hot dip galvanized iron (G.I).

Facilities to be provided in the structure:

- Seasonal tilt angle adjustment and
- Three times manual tracking in a day

The G.I. structures for mounting the Solar panels could be so designed, that these can be manually/ auto adjusted for optimal tilt throughout the year. A simple provision is to be provided so that the panel can be manually adjusted three times a day (East-South-West) to face the sun optimally. This adjustment could be done in the early morning, noon time and afternoon to increase the total input solar radiation on the solar panel surface substantially. This provision helps the motor pump set to start early in the morning and function efficiently till late in the afternoon, thereby increasing the total output of the pumping system.

The “Mounting Structure” should have the following features:

- The modules support structure shall be mild steel, hot dipped galvanized (120 micron) iron for holding the PV modules. The size of angle iron should not be less than 50x50x5 mm.

- Each panel frame structure shall be so fabricated as to be grouted on ground or roof on its legs. It will withstand severe cyclone/ storm with the speed of 150 Km/Hr.
- Each panel frame structure shall have provision to adjust its angle of inclination to the horizontal between 10 to 40 degrees with a step of 10 degree, so that the inclination can be adjusted at the specified tilt angle whenever required.
- Each panel frame shall be complete with a weatherproof junction box as per the relevant BIS specifications, where the module terminals shall be interconnected and output taken.
- All nuts and bolts should be made of very good quality and should be corrosion resistant.
- The structure should be designed to allow easy replacement of any module.
- The array structure shall be so designed that it will occupy minimum space without sacrificing the output from the SPV panels.

## **VI. ELECTRONICS AND PROTECTIONS**

- Use of Maximum Power Point Tracker (MPPT) is encouraged to optimally use the Solar panel and maximize the water discharge.
- Inverter could be used, if required, to operate an A.C. Pump.
- Adequate protections should be incorporated against dry operation of motor pump set, lightning, hails and storms. Full protection against open circuit, accidental short circuit and reverse polarity should be provided.

## **VII. ON/OFF SWITCH**

A good reliable switch suitable for DC / AC use is to be provided with the motor pump set. Sufficient length of cable should be provided for inter-connection between the PV array and the motor pump set.

## **VIII. O/M MANUAL**

An Operation and Maintenance Manual, in English and the local language, should be provided with the solar PV pumping system.

The following minimum details must be provided in the Manual:

- (a) About photovoltaics
- (b) About solar pump
- (c) About PV module
- (d) About motor pump set
- (e) About tracking system
- (f) Clear instructions about mounting of PV module.
- (g) About electronics used in AC motor pump sets, if any

- (h) DO's and DONT's,
- (i) Clear instructions on regular maintenance and Trouble Shooting of the pumping system.
- (j) Name & address of the person or Centre to be contacted in case of failure or complaint.

## **IX. INDICATIVE TECHNICAL SPECIFICATIONS**

### **General Information:**

The information given here under is indicative only and the designer must satisfy himself regarding quantity and quality wise supply of Solar Modules / panel, Solar Photovoltaic (SPV) Pump, and GI support structure as well as all aspects of commissioning of solar infrastructural facility.

The scope of work includes supply, installation & commissioning **of Solar PV Water Pumps** on bore-well of minimum 4" diameter (to be provided by the user) at various sites as per the technical specification mentioned below. The whole system including submersible/ surface pumps shall be **warranted for 5 years**, The PV Modules must be warranted for output wattage, which should not be less than 90% at the end of 10 years and 80% at the end of 25 years.

## TECHNICAL SPECIFICATIONS OF SOLAR SHALLOW WELL PUMPING SYSTEM

Description	Model-I	Model-II	Model-III
Solar PV array	900 Wp	1800 Wp	2700 Wp
Motor pump set type	Centrifugal DC monoblock	Centrifugal DC monoblock	Centrifugal DC monoblock
Motor capacity	1 HP	2 HP	3 HP
Operating voltage	60 V DC (nominal)	60 V DC (nominal)	90 V DC (nominal)
Max. Suction Head	7 metres	7 metres	7 metres
Max. total dynamic head	10 metres	15 metres	25 metres
Module mounting structure	MS hot dipped galvanised, three times manual tracking facilities	MS hot dipped galvanised, three times manual tracking facilities	MS hot dipped galvanised, three times manual tracking facilities
Required shadow free area	30 sq. Metres	75 sq. Metres	120 sq. Metres
Water Output *	77,000 litres per day from a total head of 10 metres	154,000 litres per day from a total head of 10 metres	115,000 litres per day from a total head of 20 metres

\*. Water output figures are on a clear sunny day with three times tracking of SPV panel when solar radiation on horizontal surface is: 5.5 KWH/sq.m/day

## TECHNICAL SPECIFICATIONS OF SOLAR DEEPWELL PUMPING SYSTEM

Description	Model I	Model II	Model III	Model IV
Solar PV array	1200 Wp	1800 Wp	3000 Wp	4800 Wp
Motor pump set type	Submersible with electronic controller	Submersible with electronic controller	Submersible with electronic controller	Submersible with electronic controller
Motor capacity	1 HP	1 HP / 2 HP	3 HP	4.6 HP
Max. total dynamic head	70 Metres	70 metres	120 Metres	160 Metres
Module mounting structure	MS hot dipped galvanised, three times manual tracking facilities	MS hot dipped galvanised, three times manual tracking facilities	MS hot dipped galvanised, three times manual tracking facilities	MS hot dipped galvanised, three times manual tracking facilities
Required shadow free area	45 Sq. Metres	75 sq. Metres	120 sq. Metres	200 sq. Metres
Water Output *	34,000 Litres per day from a total head of 30 metres	51,000 litres per day from a total head of 30 metres	51,000 litres per day from a total head of 50 metres	82,000 litres per day from a total head of 50 metres

\*. Water output figures are on a clear sunny day with three times tracking of SPV panel when solar radiation on horizontal surface is: 5.5 KWH/sq.m/day

### **Details of Solar Pump Models and configuration to be provided\***

S. No	SPV Array Wp (900/ 1200/ 1800/ 2700/ 3000/ 4800)	Proposed No of SPV modules with Wp& Make	Motor-Pump set Model & Make	Type of Motor-Pump set DC/ AC	Type of Motor-Pump set Surface/ Submersible	Motor-Pump set HP	Total Dynamic Head (M)	Water Output** (Ltrs./ day)

\* Head v/s discharge characteristic curves along with details of Motor-pump set should be provided with this document.

\*\*. Water output figures are on a clear sunny day with three times tracking of SPV panel when solar radiation on horizontal surface is: 5.5 KWH/sq.m/day.