

**Ministry of New and Renewable Energy**  
**Jawaharlal Nehru National Solar Mission**  
**SOLAR PHOTOVOLTAIC WATER PUMPING SYSTEMS**  
**For Drinking Water Applications**

(2014-15)

**I. INTRODUCTION**

A Solar Photovoltaic (SPV) Water Pumping System consists of:

- PV Array :

PV Array Capacity should be Minimum 900Wp. **It should be mounted on a suitable structure with a provision of tracking the sun.**

- Motor Pump Set (Surface or submersible) :

It could be installed on a suitable bore-well, open well, Water Reservoir, Water stream, etc. It could be:

- D.C. Motor Pump Set (with Brush less D.C.)

OR

- A.C. Induction Motor Pump Set with a suitable Inverter

- Electronics :

- Maximum Power Point Tracker (MPPT)
- Inverter for A.C. Motors or appropriate Electronic Controller in case of B.L.D.C. Motor Pump set
- Electronic Protections.

- Interconnect Cables and

- “On-Off” switch.

## II. PERFORMANCE SPECIFICATIONS AND REQUIREMENTS

Under the “Average Daily Solar Radiation” condition of 7.15 KWh / sq.m. on the surface of PV array (i.e. coplanar with the PV Modules), the minimum water output from a Solar PV Water Pumping System, comprising B.L.D.C. or PMDC or A.C Motor and submersible pumps, at different “Total Dynamic Heads” should be as specified below :

- (i) Minimum 20000 liters of water per day from a Total Dynamic Head of 30 metres and the shut off head being at least 45 metres.
- (ii) Minimum 10000 liters of water per day from a Total Dynamic Head of 60 metres and the shut off head being at least 90 metres.
- (iii) Minimum 5000 liters of water per day from a Total Dynamic Head of 90 metres and the shut off head being at least 120 metres.

The actual duration of pumping of water on a particular day and the quantity of water pumped could vary depending on the solar intensity, location, season, etc. Indicative performance specifications for the Shallow and Deep well SPV Water Pumping Systems are given in the Annexure I.

## III. PV ARRAY

The SPV water pumping system should be operated with a PV array capacity of 900 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 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 14% 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.

- There should be a Name Plate fixed inside the module which will give:
  - a. Name of the Manufacturer or Distinctive Logo.
  - b. Model Number
  - c. Serial Number
  - d. Year of manufacture

#### IV **MOTOR PUMP-SET**

- The SPV water pumping systems may use any of the following types of motor pump sets:
  - a. Submersible motor pump set
  - b. Any other type of motor pump set after approval from Test Centers of the Ministry.
- The “Motor Pump Set” should have a of 1 hp and should have the following features:
  - The motor should be AC, PMDC or BLDC type.
  - Submersible pumps could be used according to the dynamic head of the site at which the pump is to be used.
- It is recommended that all parts of the pump and the motor of the submersible pumps should be made of stainless steel.
- The manufacturers of pumps should self certify that, the pump and all external parts of motor used in submersible pump which are in contact with water, are of stainless steel.
- 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.
- The delivery pipe (GI/HDPE), electric cables, floating assembly, civil work and other fittings required to install the Motor Pump set.

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

The PV modules should 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 should be hot dip galvanized iron with minimum 80 micron thickness.

To enhance the performance of SPV water pumping systems, manual or passive or auto tracking system **should** be used. For manual tracking, arrangement for seasonal tilt angle adjustment and three times manual tracking in a day should be provided.

## VI. **ELECTRONICS AND PROTECTIONS**

- Maximum Power Point Tracker (**MPPT**) **should** be included to optimally use the Solar panel and maximize the water discharge so as to achieve the desired water output.
- Inverter to operate an A.C. Motor
- Appropriate Electronic Controller in case of B.L.D.C.
- 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 use is to be provided. Sufficient length of cable should be provided for inter-connection of the PV array, Controller / Inverter and the motor pump set.

## VIII. **WARRANTY**

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.

The whole system including submersible/ surface pumps shall be warranted for 5 years. Required Spares for trouble free operation during the Warrantee period should be provided along with the system.

The pumps used for solar application should have a 5 years warranty and 10 years service life and therefore it is essential that the construction of the pump be made

using parts which have a much higher durability and do not need replacement or corrode for at least 5 years.

#### **IX. OPERATION AND MAINTENANCE MANUAL**

An Operation and Maintenance Manual, in English and the local language, should be provided with the solar PV pumping system. The Manual should have information about solar energy, photovoltaic, modules, DC/AC motor pump set, tracking system, mounting structures, electronics and switches. It should also have clear instructions about mounting of PV module, DO's and DONT's and on regular maintenance and Trouble Shooting of the pumping system. Name and address of the person or Centre to be contacted in case of failure or complaint should also be provided. A warranty card for the modules and the motor pump set should also be provided to the beneficiary.

#### **X. NOTES**

- The type of pump set used must match the total dynamic head requirement of the site (i.e. the location at which it is installed). Moreover, it should be appropriately tested and certified by the authorized test centres of the Ministry to meet the performance and water discharge norms specified in section II above.
- There should not be any compulsion to use only one or the other type of Motor-pump set. The beneficiary may select an appropriate Model (i. e. Capacity of PV Array and Type of Motor Pump Set) as per site requirement.

## ANNEXURE – I

### Indicative Technical Specifications

Description	Model III	Model IV	Model V
PV array	900 Wp	900 Wp	900 Wp
Motor pump set type	1hp Submersible B.L.D.C. or A.C with electronic controller/ inverter	1hp Submersible B.L.D.C. or A.C. with electronic controller/ inverter	1hp Submersible B.L.D.C. or A.C. with electronic controller/ inverter
Max. Shut off head	45 metres	90 Metres	120 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
Water Output*	20,000 litres per day from a total dynamic head of 30 mtrs	10,000 litres per day from a total dynamic head of 60 mtrs	5,000 litres per day from a total dyanamic head of 90 mtrs

\*Water output figures are on a clear sunny day under the “Average Daily Solar Radiation” condition of **7.15 KWh/ sq.m. on the surface of PV array (i.e. coplanar with the PV Modules)**.

Note: For higher or lower heads or in between various models; water output could be decided on prorates basis