

Ministry of New and Renewable Energy

SOLAR PHOTOVOLTAIC WATER PUMPING SYSTEMS

For MICRO PUMPING Applications

(2016-17)

I. INTRODUCTION:

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

- PV Array :

Capacity in the range of **200Wp to 500Wp**.

These ranges of Solar Photovoltaic (SPV) Water Pumping Systems are basically for "MICRO PUMPING" applications. However, these may also be used for "Drinking Water Applications wherever such capacities are required".

PV Array should be mounted on a suitable structure with a provision for manual tracking.

- 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 Brushes or Brush less D.C.)

OR

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

- Electronics :
 - Inverter for A.C. Motors (Appropriate Electronic Controller in case of B.L.D.C. motors)
 - Electronic Protections.
- Interconnect Cables and
- “On-Off” switch.

II. PERFORMANCE SPECIFICATIONS AND REQUIREMENTS

Solar PV Water Pumps with PV Panel capacity in the range of 200 Wp to 500 Wp may be installed on a suitable bore-well / open well / Water Reservoir / Water stream etc.

FOR 0.25 hp Motor Pump Set and 300 Wp Solar Panel:

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 at different “Total Dynamic Heads” should be as specified below:

- (i) Minimum 10, 000 liters of water per day from a Total Dynamic Head of 10 metres and the shut off head being at least 12 metres.
- (ii) Minimum 5, 000 liters of water per day from a Total Dynamic Head of 20 metres and the shut off head being at least 30 metres.
- (iii) Minimum 3000 liters of water per day from a Total Dynamic Head of 30 metres and the shut off head being at least 45 metres.

FOR 0.5 hp Motor Pump Set and 500 Wp Solar Panel:

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 at different “Total Dynamic Heads” should be as specified below :

- (i) Minimum 20, 000 liters of water per day from a Total Dynamic Head of 10 metres and the shut off head being at least 12 metres.
- (ii) Minimum 10, 000 liters of water per day from a Total Dynamic Head of 20 metres and the shut off head being at least 30 metres.
- (iii) Minimum 6000 liters of water per day from a Total Dynamic Head of 30 metres and the shut off head being at least 45 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 II.

III. PV ARRAY

The SPV water pumping system should be operated with a PV array capacity in the range of **200 Watts peak to 500 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 75 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 siliconsolar 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**
 - e. **Made in India (Subscribe in words)**

IV MOTOR PUMP-SET

- The SPV water pumping systems may use any of the following types of motor pump sets:
 - a. Surface mounted motor pump-set
 - b. Submersible motor pump set
 - c. Floating motor pump set
 - d. Pressure booster pumps
 - e. Any other type of motor pump set after approval from Test Centers of the Ministry.

- The “Motor Pump Set” should have a capacity in the range of **0.2 hp to 0.5 hp** **and** should have the following features:
 - The mono block DC/ AC centrifugal motor pump set with the impeller mounted directly on the motor shaft and with appropriate mechanical seals which ensures zero leakage.
 - The motor of the capacity ranging from 0.2 hp to 0.5 hp should be AC, DC or BLDC type. The suction and delivery head will depend on the site specific condition of the field.
 - Submersible pumps or Surface pumps could also 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 or suitable grade of plastic. The impellers and other internal parts can be of suitable grade of modified PPE resins (example Noryl) or Polycarbonate or equivalent.
 - 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 or suitable grade of plastic. The pumps used for solar application should have a 5 years warranty so 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.

- 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 suction/ delivery pipe (GI/HDPE), electric cables, floating assembly, civil work and other fittings required to install the Motor Pump set.

V. MOUNTING STRUCTURES.

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 **must** 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

- Inverter could be used, if required, to operate an A.C. Pump. The inverter must have IP 54 protection or must be housed in a cabinet having at least **IP54** protection.
- Controller for BLDC motor driven pumps, if required may be used. The controller must have **IP 54** protection or must be housed in a cabinet having at least IP 54 protection.
- 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.

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).
- 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.
- Solar Photovoltaic Water Pumping Systems should be tested and certified by an authorized test centre of the Ministry to meet the performance and water discharge norms specified in section II above.
- Variation in the modules wattage in the PV Array should be within + or - 3 % so as to minimize the mismatch losses in the PV Array.
- The capacity (i.e. overall wattage) of the PV Array submitted to the Test Centers should be within - 3% or + 5 % of the specified value. However, the capacity of the PV Array, supplied in the field could be more than the 5 % of the specified value (but not less than 3% of the specified value).

Indicative Technical Specifications of Solar ‘MICRO’ Pumping Systems:

	Model-I	Model-II	Model-III	Model-IV	Model-V	Model-VI
PV array	300 Wp	300 Wp	300 Wp	500 Wp	500 Wp	500 Wp
Motor capacity	0.25 hp	0.25 hp	0.25 hp	0.5 hp	0.5 hp	0.5 hp
Shut Off Dynamic Head	12 metres	30 metres	45 metres	12 metres	30 metres	45 metres
Water output *	10,000 litres per day from a total head of 10 metres	5,000 litres per day from a total head of 20 metres	3,000 litres per day from a total head of 30 metres	20,000 litres per day from a total head of 10 metres	10,000 litres per day from a total head of 20 metres	6,000 litres per day from a total head of 30 metres

* Water output figures are on a clear sunny day with three times tracking of SPV panel, 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)**.

Notes:

1. For higher or lower head / PV capacity, or in between various models; water output could be decided as per the clause II. (i.e. performance specifications and requirements) specified earlier.
2. In case of a surface pump, the suction head to be limited to **6 metres**.