SHARP EYEZ®

SOLAR PHOTOVOLTAIC WATER PUMPING SYSTEMS

(2013-14)

I. INTRODUCTION

A solar photovoltaic (SPV) water pumping system consists of :

- PV array :
    - Capacity in the range of 200 Watt to 5 KWp .
    - Should be mounted on a suitable structure with a provision of tracking the sun
- Motor Pump Set (Surface or submersible) :
    - D.C. Motor Pump Set (with Brushes or Brush less D.C.)

      OR
    - A.C. Induction Motor Pump Set with a suitable Inverter
- Electronics :
    - Maximum Power Point Tracker (MPPT)
    - Controls / Protections.
- Interconnect Cables and "On-Off" switch.

II. PERFORMANCE SPECIFICATIONS AND REQUIREMENTS (DUTY CYCLE)

Solar PV Water Pumps with PV array capacity in the range of 200 Watt to 5 KWp could be installed on a suitable bore-well, open well, Water Reservoir, Water stream, etc.

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 :

For D.C. Motor Pump Set with Brushes or Brush Less D.C.(B.L.D.C.) :

(i) 100 liters of water per watt peak of PV array, from a Total Dynamic Head of 10 metres (Suction head, if applicable, minimum of 7 metres) and with the shut off head being at least 12 metres.

(ii) 55 liters of water per watt peak of PV array, from a Total Dynamic Head of 20 metres (Suction head, if applicable, up to a maximum of 7 metres) and with the shut off head being at least 25 metres.

(iii) 35 liters of water per watt peak of PV array, from a Total Dynamic Head of 30 metres and the shut off head being at least 45 metres.

(iv) 21 liters of water per watt peak of PV array, from a Total Dynamic Head of 50 metres and the shut off head being at least 70 metres.

(v) 14 liters of water per watt peak of PV array, from a Total Dynamic Head of 70 metres and the shut off head being at least 100 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 .

For A.C. Induction Motor Pump Set with a suitable Inverter :

(i) 90 liters of water per watt peak of PV array, from a Total Dynamic Head of 10 metres (Suction head, if applicable, minimum of 7 metres) and with the shut off head being at least 12 metres.

(ii) 50 liters of water per watt peak of PV array, from a Total Dynamic Head of 20 metres (Suction head, if applicable, up to a maximum of 7 metres) and with the shut off head being at least 25 metres.

(iii) 32 liters of water per watt peak of PV array, from a Total Dynamic Head of 30 metres and the shut off head being at least 45 metres.

(iv) 19 liters of water per watt peak of PV array, from a Total Dynamic Head of 50 metres and the shut off head being at least 70 metres.

(v) 13 liters of water per watt peak of PV array, from a Total Dynamic Head of 70 metres and the shut off head being at least 100 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 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 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:

1. Surface mounted motor pump-set
2. Submersible motor pump set
3. Floating motor pump set
4. 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 5 HP** and 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.

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

- Maximum Power Point Tracker (MPPT) should be included 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. PERFORMANCE SPECIFICATIONS AND WARRANTY

Solar PV Water Pumps with PV module capacity in the range of 200 Watt to 5 KWp may be installed on a suitable bore-well / open well / Water Reservoir / Water stream etc. Indicative Performance Specifications for the Shallow and Deep well SPV Water Pumping Systems are given in the Annexure.

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

i. Wherever the "Water table" or the level of water in the reservoir or the water source (e.g. Diggie) from which the water is to be pumped, is within 10 metres depth, 'Surface Motor Pump sets" should be preferred.

ii. 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.

iii. 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 of Shallow Well (Surface) Solar Pumping Systems

With D.C. Motor Pump Set with Brushes or Brush Less D.C.(B.L.D.C.)

Description	Model-I	Model-II	Model-III
PV array	900 Wp	1800 Wp	2700 Wp
Motor capacity	1 HP	2 HP	3 HP
Shut Off Dynamic Head	12 metres	15 metres	25metres
Module mounting structure	MS hot dipped galvanised, at least three times manual tracking facilities	MS hot dipped galvanised, at least three times manual tracking facilities	MS hot dipped galvanised, at least three times manual tracking facilities
Water Output*	90,000 litres per day from a total head of 10 metres	180,000 litres per day from a total head of 10 metres	148,000 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, 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. Suction head, if applicable, minimum 7 metres.
2. 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.
3. If submersible pumps are used in lieu of surface pumps, the water output must match that of the surface pumps as specified in this table.

Indicative Technical Specifications of Solar Deep well (submersible) Pumping Systems:

With D.C. Motor Pump Set with Brushes or Brush Less D.C.(B.L.D.C.)

Description	Model I	Model II	Model III	Model IV
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
Max. total dynamic head	45 Metres	45 metres	70 Metres	70 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
Water Output*	42,000 Litres per day from a total head of 30 mtrs	63,000 litres per day from a total head of 30 mtrs	63,000 litres per day from a total head of 50 mtrs	1,00,000 litres per day from a total head of 50 mtrs

* 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. If surface pumps are used in lieu of submersible pumps, the water output must match that of the submersible pumps as specified in this table.

ANNEXURE – II

Indicative Technical Specifications of Shallow Well (Surface) Solar Pumping Systems

With A.C. Induction Motor Pump Set and a suitable Inverter:

Description	Model-I	Model-II	Model-III
PV array	900 Wp	1800 Wp	2700 Wp
Motor capacity	1 HP	2 HP	3 HP
Shut Off Dynamic Head	12 metres	15 metres	25metres
Module mounting structure	MS hot dipped galvanised, at least three times manual tracking facilities	MS hot dipped galvanised, at least three times manual tracking facilities	MS hot dipped galvanised, at least three times manual tracking facilities
Water Output*	81,000 litres per day from a total head of 10 metres	162,000 litres per day from a total head of 10 metres	135,000 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, 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. Suction head, if applicable,should be minimum 7 metres.
2. 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.
3. If submersible pumps are used in lieu of surface pumps, the water output must match that of the surface pumps as specified in this table.

Indicative Technical Specifications of Solar Deep well (submersible) Pumping Systems:

With A.C. Induction Motor Pump Set and a suitable Inverter:

Description	Model I	Model II	Model III	Model IV
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
Max. total dynamic head	45 Metres	45 metres	70 Metres	70 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
Water Output*	38,000 Litres per day from a total head of 30 mtrs	57,000 litres per day from a total head of 30 mtrs	57,000 litres per day from a total head of 50 mtrs	91,000 litres per day from a total head of 50 mtrs

* 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. If surface pumps are used in lieu of submersible pumps, the water output must match that of the submersible pumps as specified in this table.