

Solar Water Pumping System Design & Features



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Solar water pumping system by National Engineers is a practical and affordable solution designed to mitigate the water shortage problem faced by the agricultural sector of Pakistan. Due to excessive load shedding and constantly rising cost of fuel, extraction of water through tube wells has become extremely difficult for farmers. NE's solar powered systems aim to provide an affordable alternative to both individual farmers and enterprises.

NE's solar water pumping system employs DC powered pumps instead of the conventional AC powered pumps. DC pumps require considerably lower power and provide greater efficiency. Since there are no batteries installed, the system only operates during daylight hours and the water pumped out is stored in a storage tank. The storage tank is insulated with a geo-membrane which practically eliminates loss of water through seepage. This method ensures constant availability of water which can later be extracted from the tank as per the farm's requirement.

NE's solar water pumping system has the following components:

a) DC Powered Pump

The solar water pump used is manufactured by a Chinese company, 'SinoStar' based on the specifications of renowned German solar water pumps manufacturer, 'Lorentz'. The pump, model # PS-1200 is a submersible pump with a 4" Helical Rotor (HR) or Centrifugal Pump Unit. Power rating for this pump is 1000 W. It can provide a maximum lift up to 240 m with a maximum flow rate of 21 m³/hr. The PS 1200 has the following components:

- i. Controller PS 1200: Controls the pump system and monitors operating states
- ii. Motor ECDRIVE 1200HR/C: Brushless DC Motor
- iii. Pump End
- iv. Helical Rotor (HR) Pump

The technical specifications are summarized in the table below.

solar generator	vertical lift	5 m 16 ft	10 m 33 ft	15 m 50 ft	20 m 65 ft	30 m 100 ft	40 m 133 ft	50 m 165 ft	60 m 200 ft	70 m 230 ft															
	array mounting	fixed	tracked	fixed	tracked	fixed	tracked	fixed	tracked	fixed	tracked	fixed	tracked	fixed	tracked	fixed	tracked								
flow rate [m³/day]																									
1000 W ₀	irradiation kWh/ m ² /day	7.5	145	205	84	125	66	100	43	60	34	48	23	30	21	29	17	25	14	20					
		6.0	130	185	73	105	55	78	34	45	27	36	22	28	18	25	14	21	12	17					
	4.5	103	140	47	65	39	51	26	33	23	31	20	25	15	20	12	16	10	14						
	pump type	C-SJ12-3			C-SJ8-5				C-SJ5-8*				HR-14				HR-10								
	peak flow rate [l/min]	310			180				160				100				90		52		39		38		30
wire size/max. length	4mm ² /40m #10/170ft										4mm ² /70m #10/300ft														



Figure 1: PS-1200 Submersible Pump

b) Solar Modules

The solar modules used in the system will be obtained from Chinese manufacturer, ‘ET Solar’. Details and technical specifications are given below:

Model type	ET-P648175	ET-P648170	ET-P648165	ET-P648160	ET-P648155
Peak power (Pmax)	175W	170W	165W	160W	155W
Cell type	156mm x 156mm				
Number of cells	48 cells in series				
Weight	15.6 kg (34.45 lbs)				
Dimensions	1324x992x50mm (52.13x39.06x1.97 inch)				
Cell Efficiency	15.44%	15.00%	14.59%	14.12%	13.67%
Module Efficiency	13.38%	13.00%	12.62%	12.24%	11.80%
Maximum power voltage (Vmp)	23.20V	23.00V	23.00V	23.00V	23.00V
Maximum power current (Imp)	7.54A	7.39A	7.17A	6.95A	6.73A
Open circuit voltage (Voc)	29.04V	29.00V	29.00V	29.00V	29.00V
Short circuit current (Isc)	8.10A	8.10A	7.90A	7.80A	7.60A
Power Tolerance	-1 to +3%				
Maximum system voltage	DC 1000V (VDE)				
Temp. Coeff. of Isc (TK Isc)	0.065 %/°C				
Temp. Coeff. of Voc (TK Voc)	-0.346 %/°C				
Temp. Coeff. of Pmax (TK Pmax)	-0.46 %/°C				
Normal Operating Cell Temperature	45.3±2°C				
Series fuse rating (A)	12A				
Number of bypass diode	3				
Max Load	2400Pascals (50lb/ft ²)				

Figure 2: ET Solar Modules

c) Storage Tank

Since the flow rate of this system may not meet the daily water requirement of the farm, therefore a storage tank needs to be incorporated in order to ensure supply of water as and when needed. The method for determining the size and dimensions of the storage tank is determined based on the crop and watering pattern.

d) Mounting Structure and Wiring

Installation of solar modules requires an aluminum mounting structure and wiring for supply of power from the panels to the pump.

The pump delivers peak flow rate when the water lift is between 0-5 meters. For this reason a borehole needs to be drilled to within 5 meters of the water table. The installation of the pump will be at the bottom of the borehole. The figure below demonstrates the positioning of the components in the system.

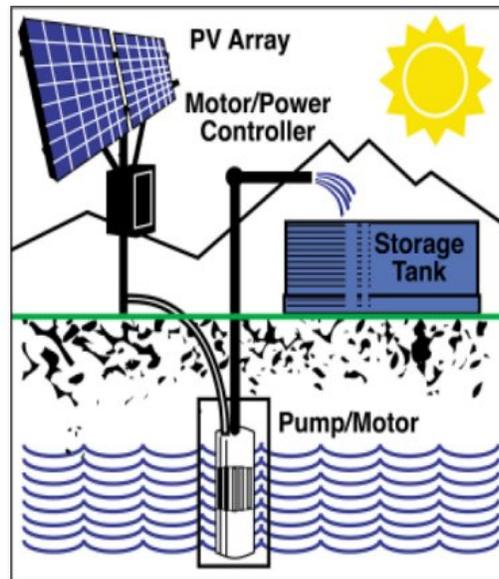


Figure 4: Solar Water Pumping System Design

Basic features and benefits of the system:

- The system pumps out 100,000 Litres of water per day (Assuming 6 hours of available sunlight) at 5 meters lift.
- System productivity increases in summers when water requirement is usually greater.
- Life of 20 years hedges future costs and uncertainties.
- Requires minimal service and maintenance
- Breakeven against conventional diesel pumps as low as three years
- Powered by clean, renewable energy
- The PS-1200 pump can be replaced with PS-1800 (1800 Wp) to achieve higher flow rates, however, this raises the cost of the system.
- Breakeven for solar pumps is reached within 3.5 years after which it is virtually free while the cost of diesel and grid electricity is constantly on the rise.

