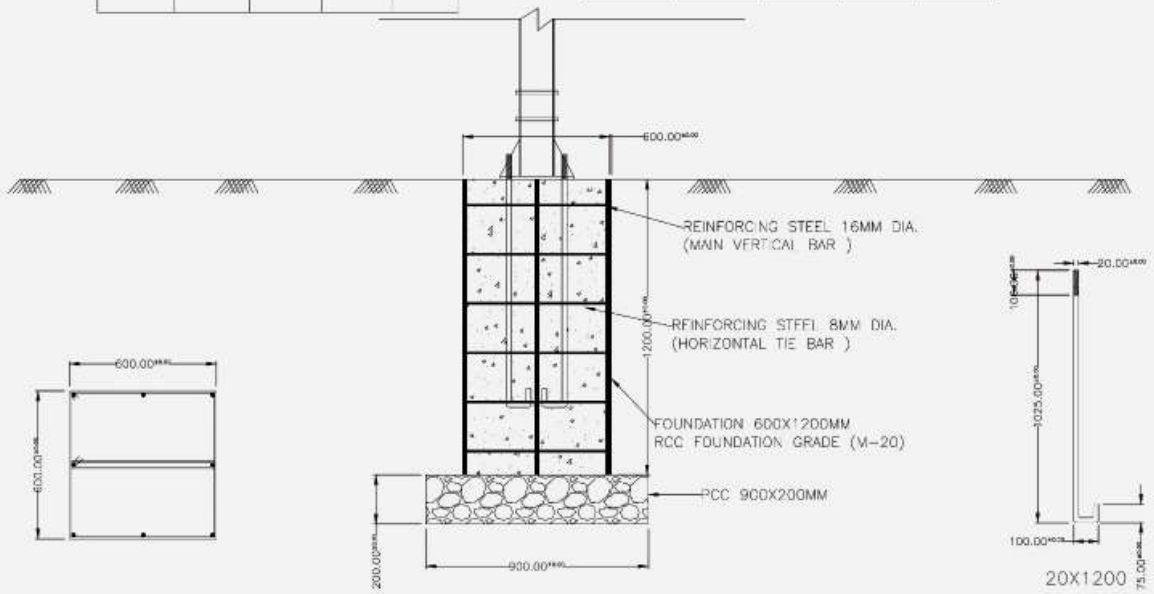
FOUNDATION DESIGN FOR 8 MMS

BOM				
TMT BAR	LENGTH	WEIGHT	QUANTITY	TOTAL WEIGHT
16 MM	1300 MM	2.05 KG	8 PCS	16.4 KG
8 MM	2400 MM	0.950 KG	6 PCS	5.7 KG
8 MM	1250 MM	0.500 KG	6 PCS	3 KG

BOM				
BLOCK	WIDTH	LENGTH	HEIGHT	VOLUME
RCC COLUMN	0.600 M	0.600 M	1.20 M	0.432 CU.M
PCC	0.900 M	0.900 M	0.200 M	0.162 CU.M



Note:-All dimensions are critical & in mm. Please maintain the dimensions. Welding dimension should be maintained 5 mm.

ANNEXURE – B

Indicative Technical Specifications of Shallow Well (Surface) Solar Pumping Systems with D.C. Motor Pump Set with Brushes or Brushless D.C. (B.L.D.C.)

Description	Model-I	Model-II	Model-III	Model-IV	Model-V	Model-VI	Model-VII	Model-VIII	Model-IX	Model-X	Model-XI	Model-XII	Model-XIII
PV array (Wp)	900	1800	2700	2700	4800	4800	4800	6750	6750	6750	9000	9000	9000
Motor Pump-set capacity (HP)	1	2	3	3	5	5	5	7.5	7.5	7.5	10	10	10
Shut Off Dynamic Head (meters)	12	12	12	25	12	25	45	12	25	45	12	25	45
Water output * (Liters per day)	99000 (from a total head of 10 meters)	198000 (from a total head of 10 meters)	297000 (from a total head of 10 meters)	148500 (from a total head of 20 meters)	528000 (from a total head of 10 meters)	264000 (from a total head of 20 meters)	182400 (from a total head of 30 meters)	742500 (from a total head of 10 meters)	371250 (from a total head of 20 meters)	256500 (from a total head of 30 meters)	990000 (from a total head of 10 meters)	495000 (from a total head of 20 meters)	342000 (from a total head of 30 meters)

* 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 meters.
2. For higher or lower head / PV capacity, or in between various models; water output could be decided as per the clause 4 (i.e. Performance 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.

ANNEXURE – B
(Continue)

Indicative Technical Specifications of Solar Deep well (submersible) Pumping Systems with D.C. Motor Pump Set with Brushes or Brushless D.C. (B.L.D.C.)

Description	Model-I	Model-II	Model-III	Model-IV	Model-V	Model-VI	Model-VII	Model-VIII	Model-IX	Model-X	Model-XI	Model-XII	Model-XIII	Model-XIV
PV array (Wp)	1200	1800	3000	3000	3000	4800	4800	4800	6750	6750	6750	9000	9000	9000
Motor Pump-set capacity (HP)	1	2	3	3	3	5	5	5	7.5	7.5	7.5	10	10	10
Shut Off Dynamic Head (meters)	45	45	45	70	100	70	100	150	70	100	150	70	100	150
Water output * (Liters per day)	45600 (from a total head of 30 meters)	68400 (from a total head of 30 meters)	114000 (from a total head of 30 meters)	69000 (from a total head of 50 meters)	45000 (from a total head of 70 meters)	110400 (from a total head of 50 meters)	72000 (from a total head of 70 meters)	50400 (from a total head of 100 meters)	155250 (from a total head of 50 meters)	101250 (from a total head of 70 meters)	70875 (from a total head of 100 meters)	207000 (from a total head of 50 meters)	135000 (from a total head of 70 meters)	94500 (from a total head of 100 meters)

* 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 4 (i.e. Performance 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 – C

Indicative Technical Specifications of Shallow Well (Surface) Solar Pumping Systems with A.C. Induction Motor Pump Set

Description	Model-I	Model-II	Model-III	Model-IV	Model-V	Model-VI	Model-VII	Model-VIII	Model-IX	Model-X	Model-XI	Model-XII	Model-XIII
PV array (Wp)	900	1800	2700	2700	4800	4800	4800	6750	6750	6750	9000	9000	9000
Motor Pump-set capacity (HP)	1	2	3	3	5	5	5	7.5	7.5	7.5	10	10	10
Shut Off Dynamic Head (meters)	12	12	12	25	12	25	45	12	25	45	12	25	45
Water output * (Liters per day)	89100 (from a total head of 10 meters)	178200 (from a total head of 10 meters)	267300 (from a total head of 10 meters)	132300 (from a total head of 20 meters)	475200 (from a total head of 10 meters)	235200 (from a total head of 20 meters)	168000 (from a total head of 30 meters)	641025 (from a total head of 10 meters)	330750 (from a total head of 20 meters)	236250 (from a total head of 30 meters)	890000 (from a total head of 10 meters)	441000 (from a total head of 20 meters)	324000 (from a total head of 30 meters)

* 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 meters.
2. For higher or lower head / PV capacity, or in between various models; water output could be decided as per the clause 4. (i.e. Performance 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.

ANNEXURE – C
(Continue)

Indicative Technical Specifications of Solar Deep well (submersible) Pumping Systems with A.C. Induction Motor Pump Set

Description	Model-I	Model-II	Model-III	Model-IV	Model-V	Model-VI	Model-VII	Model-VIII	Model-IX	Model-X	Model-XI	Model-XII	Model-XIII	Model-XIV
PV array (Wp)	1200	1800	3000	3000	3000	4800	4800	4800	6750	6750	6750	9000	9000	9000
Motor Pump-set capacity (HP)	1	2	3	3	3	5	5	5	7.5	7.5	7.5	10	10	10
Shut Off Dynamic Head (meters)	45	45	45	70	100	70	100	150	70	100	150	70	100	150
Water output * (Liters per day)	42000 (from a total head of 30 meters)	63000 (from a total head of 30 meters)	105000 (from a total head of 30 meters)	63000 (from a total head of 50 meters)	42000 (from a total head of 70 meters)	100800 (from a total head of 50 meters)	67200 (from a total head of 70 meters)	43200 (from a total head of 100 meters)	141750 (from a total head of 50 meters)	94500 (from a total head of 70 meters)	60750 (from a total head of 100 meters)	189000 (from a total head of 50 meters)	126000 (from a total head of 70 meters)	81000 (from a total head of 100 meters)

* 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).

Guidelines on
Testing Procedure for Solar Photovoltaic Water Pumping System

1 SCOPE

These Guidelines lays down basis for testing set up and testing procedures for Solar Photovoltaic (SPV) water pumping system. The SPV water pumping system covered are centrifugal pumps of all types up to 1-10 HP capacity.

2 REFERENCE STANDARDS

The Indian and IEC Standards listed at Annex A contain provisions which, through reference in this text, constitute provision of this standard. Latest editions of the indicated standards should be considered.

3 DEFINITION OF SYSTEMS AND PARAMETERS

3.1 Systems

3.1.1 *Stand-Alone Solar PV Water Pumping System*

A Solar PV Water Pumping System in stand-alone operation is neither connected to the grid nor to battery bank and is comprised mainly of the following components and equipment:

PV Modules, cabling, controller, motor pump-set and hydraulic piping. Combination of all these components shall be unique. Any change in combination will be treated as different model of pumping system.

3.1.2 *Motor-Pump Set*

The Motor-pump set consists of the pump (centrifugal pump) and the driving motor.

3.1.3 *Controller*

The controller converts the DC power (DC voltage & Current) of the PV array into a high or low DC voltage power, or converts this DC power into single -phase or multi-phase alternating-current power (voltage or alternating current) suitably for driving the motor of Motor-pump set.

NOTE — The Controller may also include equipment for MPPT, monitoring, metering and for protection purposes.

3.2 Parameters

Following parameter shall be referred during testing of SPV pumping system:

Table 1 – Parameters		
Parameter	**Symbol**	**Unit**
(1)	**(2)**	**(3)**
Array voltage (DC)	V_a	V
Array current (DC)	I_a	A
Array open circuit voltage (DC)	V_{oc}	V
Array short circuit current (DC)	I_{sc}	A
Array maximum power point voltage(DC)	V_{mpp}	V
Array maximum power point current (DC)	I_{mpp}	A
Pressure as measured	p	kg/cm^2
Flow rate	Q	Lps /Lpm /m^3h
Motor voltage DC or AC	V_m	V
Motor current DC or AC	I_m	A
Motor voltage (multi-phase AC)	V_{rms}	V
Motor current (multi-phase AC)	I_{rms}	A
Power factor	$cosØ$	-
AC frequency (or DC switching frequency)	F	Hz
Motor speed	N	min^{-1}
Radiation	E_e	W/m^2
Temperature	T	^oC

4 TEST SET UP

4.1 Test Set-Up

Illustration(s) of test set-ups are shown in Figure 1 & Figure 2, and a block diagram of required test set-up is shown in Figure 3. All test set-ups shall conform to applicable model test set-ups referred above and the water level in the sump well, locations of throttle valve, flow meter and pressure gauge/sensor connections as indicated in the test set-up(s) shall conform to Figure 1, Figure 2 & Figure 3 accordingly.

4.2 Precautions for Test Setup:

Before initiating testing of SPV pump the following precautions must be followed:

a) In case of direct coupled pump-set, proper alignment of input pipe, output pipe and the sensors shall be ensured.

b) Air tightness in suction line shall be ensured and the general layout of the system pipe work

should be designed to avoid airlocks.

c) The offset pipe of suction line shall either be horizontal or inclined upward towards the pump and shall never be inclined downward towards the pump to avoid air trapping.

d) For the delivery head, a pressure gauge/sensor shall be connected to the delivery line with tapping as shown in Figures 1 or 2 or 3. The tapping shall be flush with the inside of the pipe and shall have its axis at right angles to the direction of flow. The pipe set up between the pump outlet and the pressure sensor should be the same diameter as the manufacturer's outlet fitting. Sensor/gauge may be connected to the tapping point through a flexible hose.

e) Preferably, Digital Pressure sensor/gauges of suitable range need to be used for the measurement of head. Care shall be taken to eliminate any leaks in the connecting pipes and to avoid the trapping of air in the connecting pipe or hose.

f) It is assumed that over the normal operating range of the pump the pressure drop due to frictional losses between the pump outlet and the pressure sensor will be negligible and the kinetic energy component of the water at the pump outlet will be small compared to the increase in potential energy due to the increased pressure across the pump.

g) For instantaneous performance testing, pressure can be sustained by means of a simple gate valve in which a backpressure is sustained by restricting the flow. An automatic control valve(s) may be used to sustain a constant upstream pressure. Pressure may also be sustained by means of a pre-pressurized air chamber operating with a pressure maintaining valve at the outlet. A real water column may also be used.

h) A good quality digital flow meter with electrical output linearly proportional to flow rate shall be connected at the other end of the delivery pipe. The distance between the auto control valve and flow meter shell be minimum 1.5 meters to ensure laminar flow of water.

i) After flow meter the end of the discharge pipe should be beneath the water surface to prevent splashing. This could cause a mixed water / air bubbles fluid entering the pump inlet and affecting its proper operation. If so then a vertical baffle or a similar arrangement shall be inserted in the tank between the pump intake and the return pipe such that water does not make any splash and avoid any bubbles when spread to the bottom of tank to reach the input pump. In this way any small bubbles will be excluded, as they will remain near the surface. Alternatively a large pipe can be placed around the pump with its top breaking the surface and an arch cut in its base to allow water entry.

4.3 Priming Arrangement

A non-return valve/ foot valve shall be used in suction line, further it may also require suction pipe need to be filled with water for priming purpose in case of surface pumps.

4.4 PV Module Array Structures:

For testing the SPV pump using the actual solar array, outdoor PV array structures with different module mounting capacity (4,6,8,10, etc.) should be used. The modules are mounted on the structures with tracking facility to optimize irradiance, power output and accordingly, the total quantity of water pumped in a day.

4.5 Sun Simulator PV Module Tester:

To estimate the wattage of the PV modules under STC, a high precession (at least class AAA as per IEC 60904-9) sun simulator module tester is required in the pump testing lab. Alternatively,

all PV modules should have STC testing certificate from an NABL accredited test laboratory and the date of testing should not be later than a year. In the STC testing, if the module is found degraded, the degraded data should be used.

4.6 Simulator (Electrical) Testing

Ideally, the SPV pump should be tested as per the site conditions where it is designed to operate. The details of outdoor testing are discussed in the next sessions. However, for testing under simulated conditions, a programmable Solar PV (SPV) array simulator capable of simulating a given solar PV array configuration (i.e. the number of modules, the type and the series / parallel combination), site radiation and temperature conditions shall be required for laboratory. Measurement equipment with acceptable accuracy and precision shall be used for detection and data logging of the parameters listed in Table 2.

Table 2 – Core Parameters to be Measured and Recorded

Parameter	Symbol	Unit	Measurement Uncertainty
(1)	(2)	(3)	(4)
SPV Array voltage	*Va*	V	≤1 percent
SPV Array current	*Ia*	A	≤1 percent
Pressure/head as measured	*p*	Kg/cm^2	≤2 percent
Flow rate	*Q*	lps	≤2 percent
Solar irradiance	E_e	W/m^2	≤2 percent

4.7 Sump Well (Hydraulic Testing)

For the performance testing of SPV pumps a sump well with sensors for sensing, monitoring and recording of pump parameters will be required. The details of the resources required are given below:

a) Water tank / sump of required dimensions,
b) PV Modules, Controller, Motor-pump set, and Other Accessories (Test Sample)
c) Pressure transducer with data logging system
d) Flow Meter with data logging system
e) Suction pipe(s) (if applicable)
f) Discharge pipe(s)
g) Pyranometers and Temperature sensors with data logging system
h) Auto control valves
i) SPV array Simulator(s) for simulation of module arrays for testing
j) SPV array for realistic testing
k) Structure for mounting modules for realistic condition testing
l) AAA class Sun simulator for testing of modules performance at STC

Refer to the block diagram at Figure 3.

4.8 Constant Head Requirement

Dynamic head variation during test shall be within limit as specified in column 2 of table 3 and the allowable variation in arithmetic average (from start of flow point to end of flow point refer figure 5) of dynamic head shall be within value specified in column 3 of table 3. Any data with head variation during the test beyond the limit specified in column 2 of table 3 shall be treated as garbage data and shall not considered in calculations of daily water output.

Table 3– Allowable variation in arithmetic average of dynamic head		
Required Dynamic head in (meters)	Allowable variation in dynamic head during test	Allowable variation in arithmetic average of dynamic head
(1)	**(2)**	**(3)**
10	± 15 % = ± 1.5 meter	± 0.5 meter
20	± 10 % = ± 2 meter	± 0.5 meter
30	± 10 % = ± 3 meter	± 0.7 meter
50	± 8 % = ± 4 meter	± 0.8 meter
70	± 7 % = ± 4.9 meter	± 0.8 meter
100	± 7 % = ± 7 meter	± 1 meter

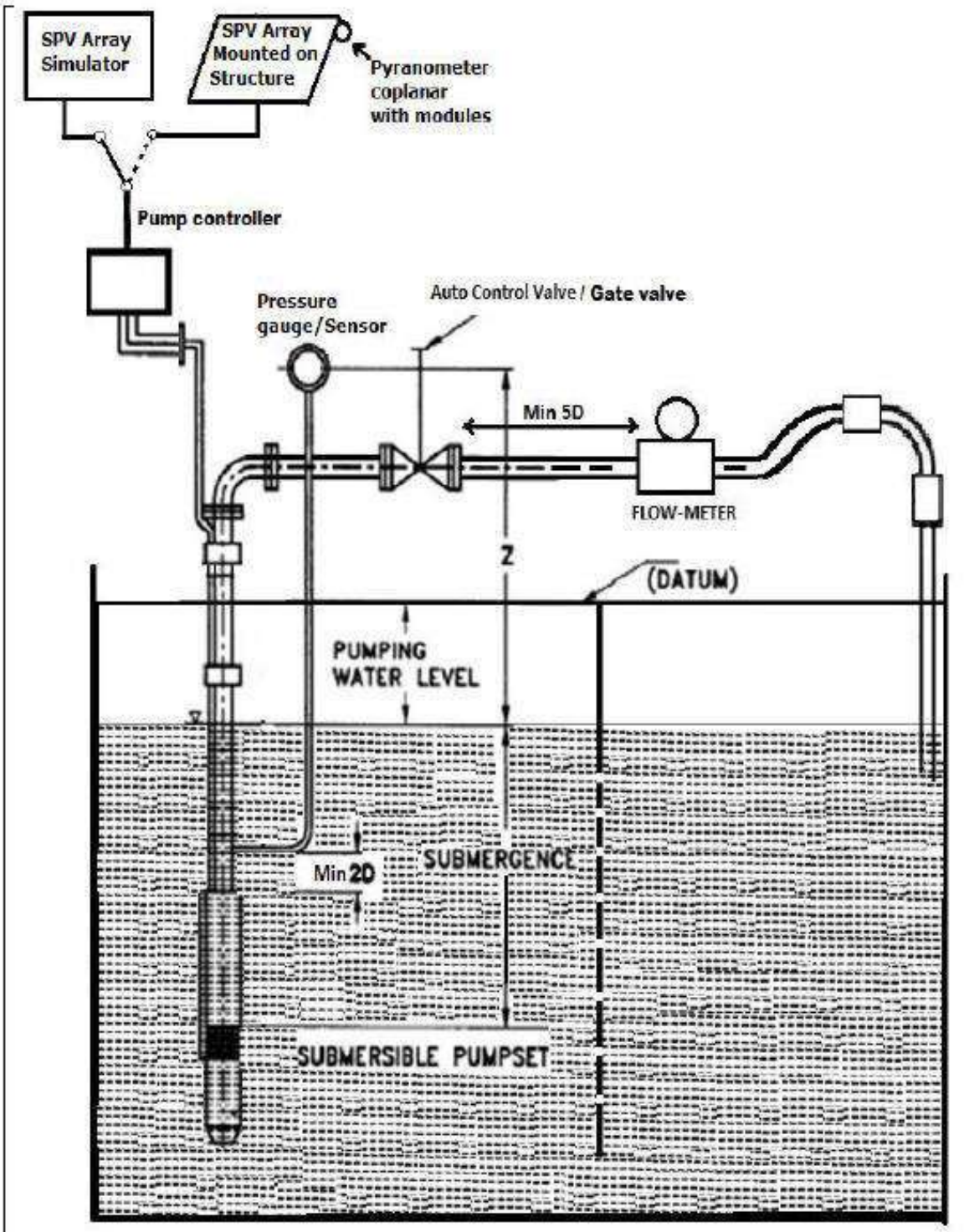


FIGURE 1– TYPICAL TEST SET-UP FOR SUBMERSIBLE SPV WATER PUMP-SET

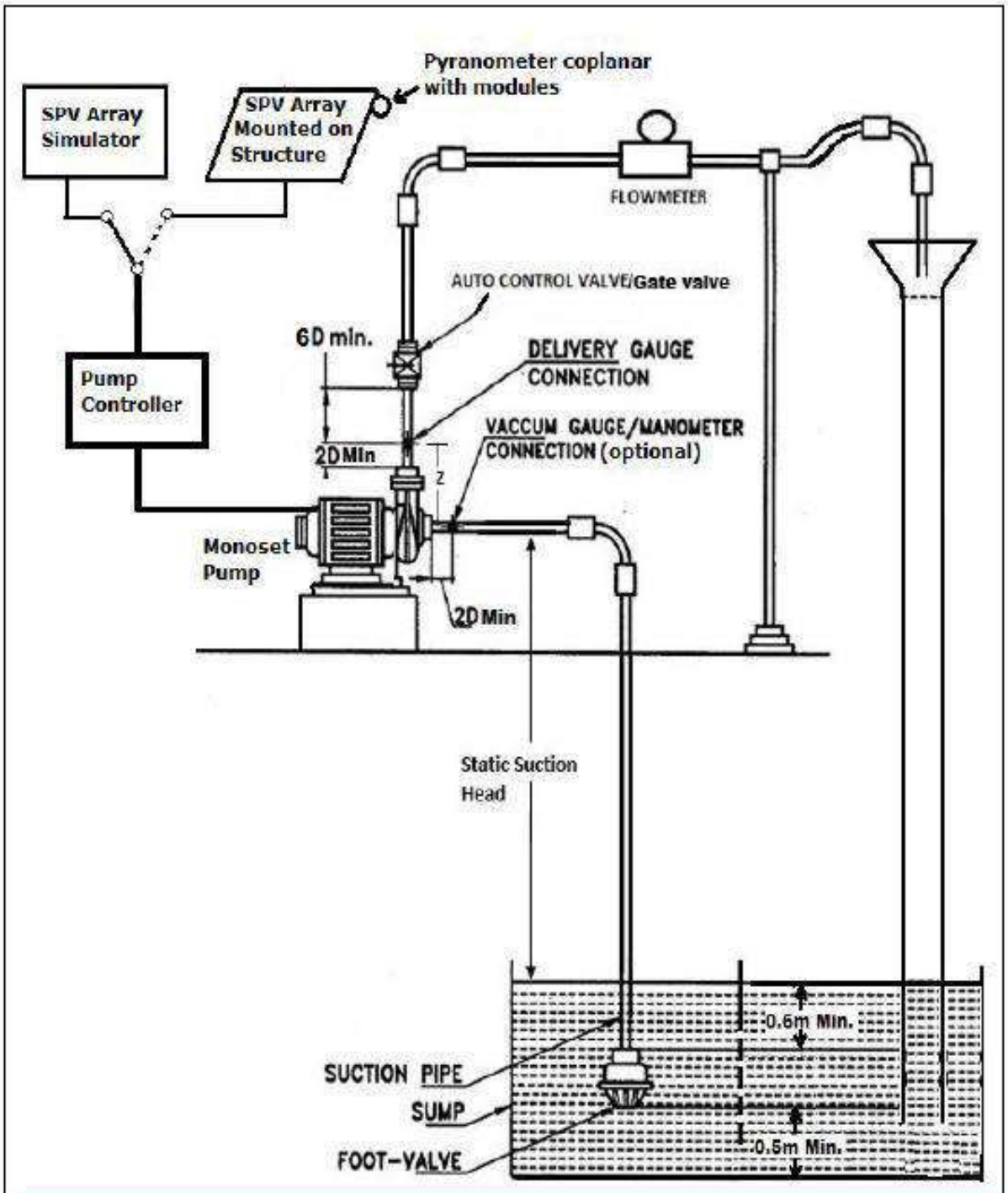


FIGURE 2 – TYPICAL TEST SET-UP FOR SPV SURFACE/MONO-BLOCK WATER PUMP SET

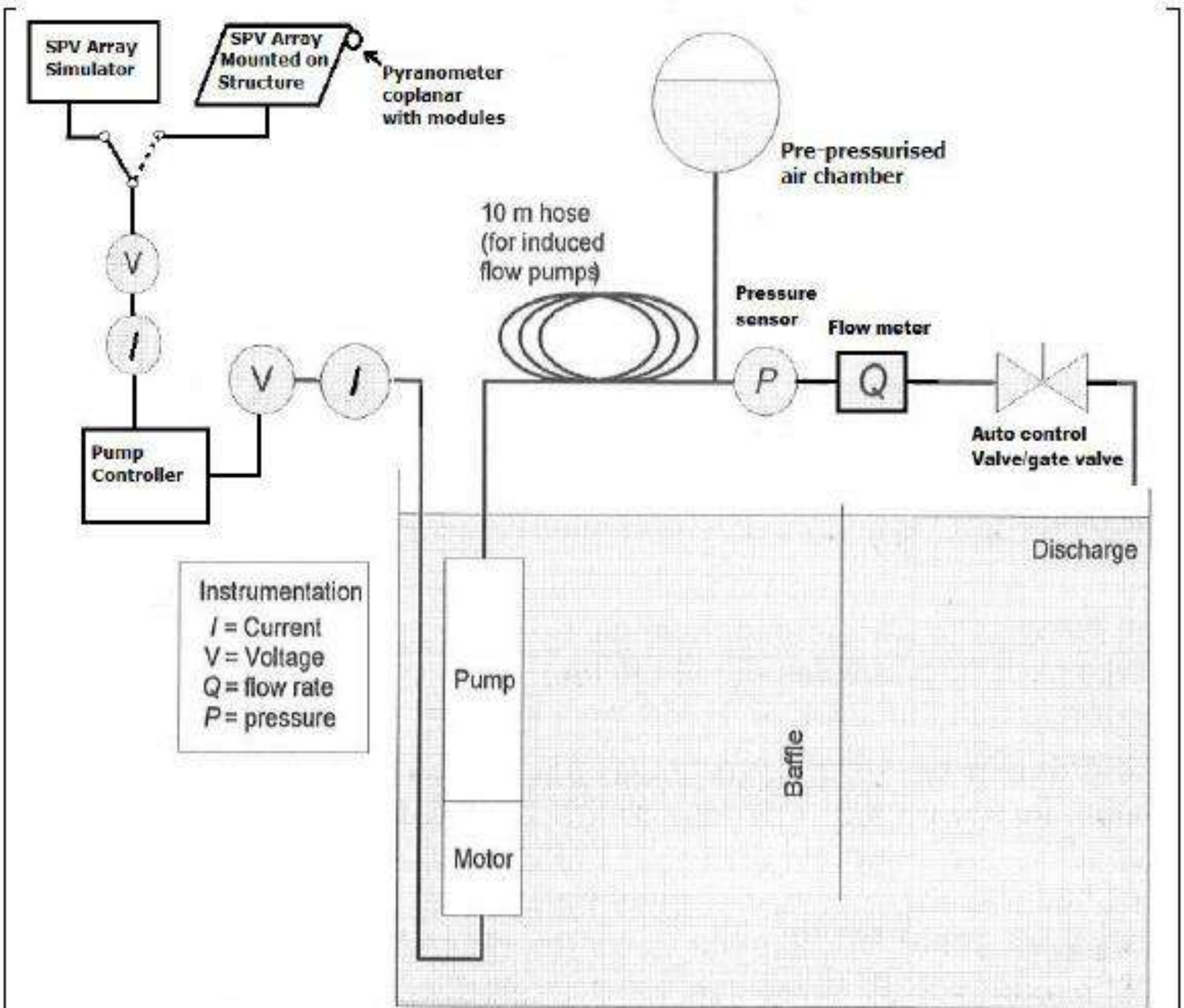


FIGURE 3 – BLOCK DIAGRAM OF TEST SETUP FOR SUBMERSIBLE PUMP-SET

5.0 Test Procedure for Performance Evaluation of SPV Pumping System:

There are three major profiles to be completed for comprehensive certification and qualification of a sample SPV water pump as per this standard. Two steps correspond to two simulation profiles, Hot & Cold. The third step corresponds to actual outdoor conditions testing using natural sun radiation. The SPV water pump sample should attain or exceed the qualification bench marks set by MNRE for the specified model & design, in all the three profiles. Before executing the three profiles testing, it is necessary to conduct the following protections test on the sample:

1. Dry running: System must shut down within one minute/manufacturer specification in dry running condition (when water level goes below pump inlet).
2. Open circuit: System should not operate if any phase become open circuited, the controller shall be tripped within one minute/manufacturer specified time.
3. Short circuit: System should not operate if any two or all three phase short circuited.
4. Reverse polarity: System should not malfunction if polarity of input power is reverse.

The performance testing of SPV Pumping System for the three procedures are discussed in following sections:

5.1 Simulator Methods:

Simulation methods are the easiest and fastest way of estimating SPV pump performance. However, in these methods actual PV array is not used, instead a PV array simulator is used. Here, a Programmable SPV array simulator capable of generating power output equal to actual SPV array under the given radiation and temperature conditions for given SPV array configuration (i.e. the number of modules, the type and the series / parallel combination) will be used. Although any radiation & temperature can be created, for the purpose of testing, two conditions one Hot summer day conditions (hot profile) and the other Winter day conditions (cold profile) shall be used.

Hot & Cold Profiles:

The typical Hot & Cold day profiles are shown Figure 4. These profiles of full day Solar irradiance and temperature shall be loaded in PV array simulator, sequentially one after the other. The simulator output is connected to the motor & pump through the pump controller and the profiles are run on real time basis. The performance parameters as given in table 2 are collected every minute for the entire duration of run time (per day). The total water output and output in liters /watt STC/ day can be estimated at desired constant head / dynamic head for complete duration of profiles.

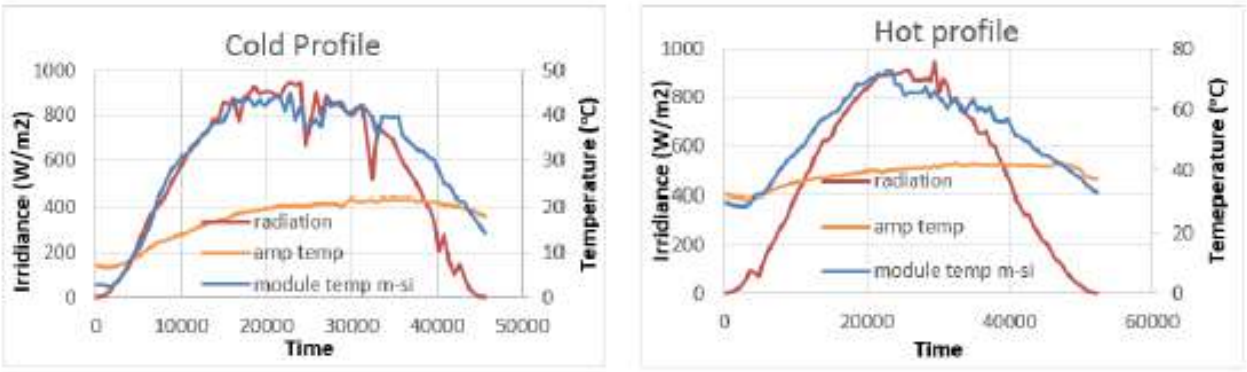


FIGURE 4 – TYPICAL SOLAR RADIATION HOT AND COLD PROFILE

Note: Per second data for hot and cold profile may be downloaded from MNRE/NISE website

5.2 Outdoor Condition using sun radiation:

To operate the motor-pump set using actual PV array, an array as per the Motor-pump set HP capacity to be designed. The STC wattage of all the PV modules is measured first, as per IEC 60904-1/ IS 12762-1 or clause number 11.6 of IEC 61215/ clause number 10.6 IS1 4286. . The modules will then be installed on the structures, both in series and parallel combinations, as required, are connected and designed PV module array is created. The array output is connected to Motor & Pump through pump controller. Then using a PV Array tester measure the PV array output and different radiation intensities starting 100W/ m^2 up to 1000 W/m^2 (if possible), if 1000W/ m^2 is not reached, calculate maximum power output at the maximum sun radiation that can be achieved (say 900 or 800w/ m^2). Always measure & record the instantaneous water flow rate at each of the radiation levels, against the PV array output power. A Table listing three parameters sun radiation, array Wattage output and water flow rate at each power output to be recorded. This data is most useful and will be used is subsequent calculations. This data can also be compared with data supplied by manufacturer.

Per day water output test to be performed at desired constant dynamic head for complete day from dawn to dusk (sunrise to sunset). Irradiance shall be measured at coplanar to modules. Tracking may be done manually or automatically. Total flow shall be corrected at reference Average Daily Solar Radiation of 7.15 kWh/m^2 on the surface of SPV array (i.e. coplanar with the SPV Modules). Results of the SPV pumping system obtained under outdoor condition shall be compared with data supplied by the applicant and also from the results obtained through simulator testing to assess the performance of the system.

NOTE:-

- Handle PV modules carefully during installation.
- PV modules to be free from dirt (sand, bird droppings etc.,) during test.
- Install PV modules in shadow free access controlled area.
- Tracking shall be minimum three time in a day for maximum performance
- Pyrono-meter should be mounted co-planer with SPV modules.

Recoding, measurement & logging of flow for the period of hot profile, cold Profile and Realistic condition need to be done.

5.3 Remote Monitoring System Verification

Provision for remote monitoring of the installed pumps must be made in the controllers through an integral arrangement and it should be capable of providing live status/parameters through online portal.

6 MEASUREMENTS AND APPARATUS

6.1 Solar Radiation Measurement

Solar radiation at coplanar with Module surface shall be measured using pyranometer. Response time of pyranometer should not be more than 15 seconds. Interval between two readings should not be more than one minute for the calculation of average daily solar radiation.

6.2 Measurement of Head

6.2.1 *Delivery Head*

Digital pressure gauge/sensor shall be used, also a data logging system must be used for calculation of average head through day. Interval between two readings should not be more than one minutes for the calculation of average head. Accuracy for pressure sensor shall be within ± 0.5 percent.

6.2.2 *Suction Head*

Suction head shall be kept constant by mean of vertical distance from sump water level to centre of pump impeller. Correction in head shall be applied as per atmospheric pressure at the testing place.

Distance measuring scale or laser based sensors may also be used for suction head measurement. For reference a vacuum gauge/absolute pressure gauge/manometer may also be used, if used, then shall be of suitable range for measuring suction head and delivery heads. Instead of mounting gauges directly on the pipes, they may be placed on separate stand.

6.3 Measurement of Rate of Flow

A good quality Magnetic flow-meter is desirable for flow measurement, data logging system must be used for calculation of cumulative water volume throughout the day. The maximum flow rate of flowmeters should be at least 1.5 times the maximum flow rate of pumps. Instrument can be selected as per 3.2 of IS 11346. Interval between two readings should not be more than one minutes for the calculation of cumulative flow. Accuracy for flowmeters shall be within ± 0.5 percent.

7 CALIBRATION OF APPARATUS

All measuring instruments are to be calibrated periodically as per requirement.

8 STEP-WISE TEST PROCEDURE

8.1 Per Day Water Flow Test of Submersible Pumps

a) Install the Pump-set as per Figure 1.

b) Connect Pump-set with controller as per manufacturer instruction

c) Use Solar PV Array Simulator Or actual output from SPV array, for testing of pump-set at given profile.

d) Connect controller with PV array Simulator or with actual SPV array output as per requirement of profile

e) Input STC performance data of each module in the array, into simulator and invoke the desired profile and run the same.

f) For realistic condition test, make array by mounting all SPV modules on structure(s) by connecting modules in series or parallel as per requirement.

g) Start controller after connecting it with array or array simulator.

h) Use head control valve or pre-pressurize tank to keep constant desired dynamic head.

j) Record parameters as given in table 2 recording interval shall be ≤ 1 minute.

8.2 Per Day Water Flow Test of Surface Pumps

a) Install pumps as per Figure 2

b) Maintain height to get desirable static suction head as per requirement

c) Install of foot valve or non-return valve as per manufacturer instructions;

and d) Follow steps (b) to (j) of para No. 8.1

9 OBSERVATIONS

The following observations of complete day profile shall be recorded in a test record

sheet. These observations shall be used to derive pump characteristics:

a) Instantaneous Solar irradiation (W/m^2), pyranometer reading
b) Delivery gauge/sensor readings
c) Suction gauge/sensor readings / Distance between water level to impeller eye, (if applicable)
d) Gauge distance correction factor, Z
e) Calculate cumulative daily solar radiation coplanar with solar modules (kWh/m^2), f) Calculate total water discharge in a day at desirable constant head (Liters per Day) g) Water output per day per watts peak (Liters/Wp)

10 COMPUTATION OF TEST READINGS

10.1 Computation of Total Head for Surface (Mono-set) Pumps

Total Head $H = H_{SSL} + H_d + Z + ((V_{ds}^2 – V^2) / 2g)$

H_{SSL} = Total Static suction Lift in meters of water column (measured by calibrated measuring tape or any distance measuring sensors)

H_d = Delivery gauge/sensor reading in meters of water column

Z = Gauge distance correction factor for delivery gauge centre and inlet pipe centre in meters (refer figure 3). If the delivery gauge centre is below the inlet pipe centre, Z is subtracted from the delivery gauge reading and if the delivery gauge centre is above inlet pipe centre, Z is added to the delivery gauge reading; the gauge distance correction factor shall never be applied to the suction vacuum gauge or mercury manometer reading irrespective of their positions:

Vd = Velocity at delivery gauge/sensor connection, m/s;

Vs = Velocity at suction gauge/sensor connection, m/s;
and g = Acceleration due to gravity in m/s2.

The Total Static Suction Lift in surface pump (H_{SSL})

H_{SSL} = Height in meter from water level to impeller + Altitude correction in meter + water temperature correction in meter.

10.1.1 Correction for Altitude

Barometric pressure shall be recorded at test place. The difference between atmospheric pressure at the test place and 10.33 mWC (that is atmospheric pressure at MSL) shall be deducted from Static suction lift.

10.1.2 Correction for Water temperature

Static suction lift specified in below Table shall be increased or reduced as given below when water temperature is below or above 33°C.

Table 4 – Correction for water temperature

Hourly Average of Water Temperature °C	Vapour pressure mWC	Correction in Static suction lift above and below 33°C water temperature mWC
10	013	+ 0.39
15	0.18	+ 0.34
20	0.24	+ 0.28
25	0.33	+ 0.19
30	0.43	+ 0.09
33	0.52	0.00
35	0.58	- 0.06
40	0.76	- 0.24
45	1.00	- 0.48
50	1.28	- 0.76

Suction head shall be adjusted minimum 3 time in a day as per average water temperature and barometric pressure, by adjusting water level of tank.

Following formula can also be used on behalf of

table 4 $y = -0.0007\ x^2 + 0.0130\ x + 0.3079$

Where y = Correction in Static suction lift x = Average of water temperature.

10.2 Computation of Total Head for Submersible Pump-sets

Total head $H = H_d + Z + ((V_d^2) / 2g)$

Where:

H_d = Delivery gauge/sensor reading in meters of water column;
Z = Gauge distance correction factor for delivery gauge. Distance between gauge/sensor center to tank water level (refer figure 1).
V_d = Velocity at delivery gauge/sensor connection in m/s;
g = Acceleration due to gravity in m/s^2.

10.3 Total Water Per-Day

Total per day water output shall be calculated by Integration (Sum) of flow rate with respect to time. Integration shall start from the time when pump set achieve desired constant head in morning time (start point refer figure 5) and end at the time when pump set unable to achieve desired constant head in evening time (End point refer figure 5).

In case if Average Daily Solar Radiation found less than requirement then test shall be performed on next sunny day.

10.4 Water Output Per Day Per Watt Peak

Water output per day per watts peak (ltr/Wp) = Water output (Liters) per day at specified head / Array STC power in watts-peak

10.5 Cumulative Daily Solar Radiation

Cumulative Solar Radiation (kWh/m^2) in a day= Average of instantaneous irradiance reading from Dawn to Dusk (kW/m^2) X period of time in hours.

This can be obtained through time weight summation of pyranometer readings. Dawn = Time of sunrise when irradiance become positive from zero value.
Dusk = Time of sunset when irradiance become zero from positive value.

10.6 Mismatch in maximum power at STC among modules of array

The mismatch shall be calculated as under:

$$\% \, Power\ mismatch\ in\ array = (P_{Max} - P_{Min}) / (P_{Max} + P_{Min}) \times 100$$

P_{Max} = Maximum power among modules in array
P_{Min} = Minimum power among modules in array

10.7 Efficiency of Array

Efficiency of Array = The power output from array / (total area of modules in m^2 X Sun radiation in watts/ m^2)

10.8 Fill Factor of Array

Fill factor of Array = This has to be measured using a PV array tester. This depends on the overall series resistances and shunt resistances of modules in the array.

10.9 Output Voltage of Array

Output Voltage of Array = Sum of voltages of modules in series
In parallel connected module strings, the lowest voltage generating strings will set the voltage.

10.10 Output Current of Array

Output Current of an Array = Sum of currents of the parallel strings in the array.
The output current of a string is controlled by the lowest current generating module.

10.11 Output Power of Array

Output Power of Array = Sum of power of all modules- mismatch loss
This can be measured by PV array tester.

11 EXAMPLES:

11.1 Total per day flow

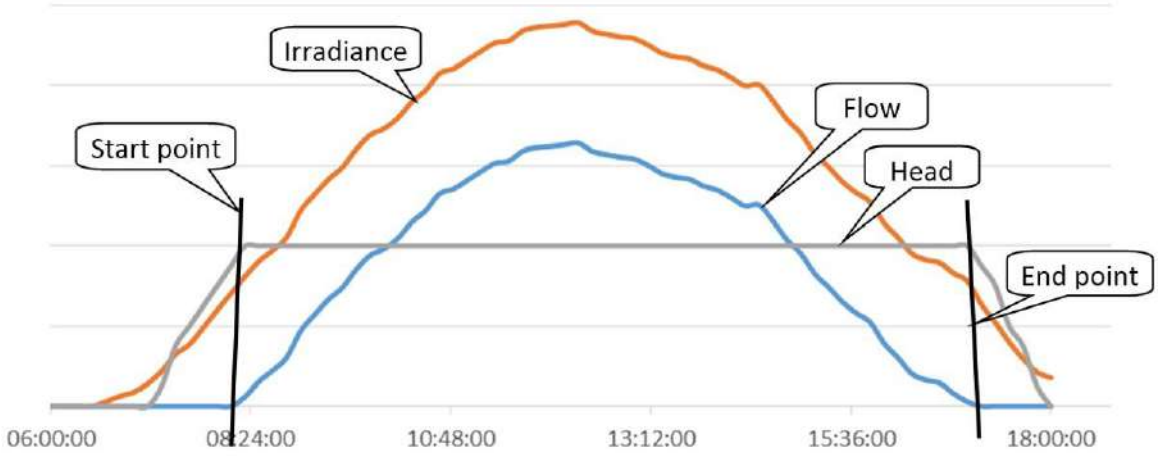


FIGURE 5- TYPICAL GRAPH FOR UNDERSTANDING CALCULATION

If pump achieved constant head at 8:15:30 AM (Start point in figure 5) and in evening pump unable to keep constant desired head at 17:45:30 PM (End point in figure 5).

Flow rate in lps is recorded from 08:15:30 AM to 17:45:30 PM (start point to end point)
If the average lps calculated is 3.55 lps then total flow will be

Total duration of flow = End Time - Start time

= 17:45:30 – 8:15:30

= 9 h: 30 m : 0 s

Total duration from start to end seconds:

= (9x3600) + (30x60) + (0x1) = 34200seconds

Total per day flow in liters = Average flow in lps x total seconds

= 3.55 x 34200 = 121410 litters

For realistic test, correct total flow at reference Average Daily Solar Radiation as specified in MNRE specifications.

12 TEST REPORTS

In order to have uniformity, the test reports issued by the Labs shall use common format developed by NISE. The test report shall be issued only in the name of applicant and shall clearly indicate whether the Solar PV water pumping system qualifies as per MNRE

specifications or not along with details. A soft copy of test report shall also be provided to the applicant and shall be made available on web-portal of test lab, which may be accessed by the implementing agencies to verify the authenticity of the report.
However, if the lab do not have such feature on their portal, the same can be verified by implementing agency by directly contacting the testing lab.

13 USE OF OTHER BRAND OF SOLAR MODULES

In case a test lab has tested and issued approval certificate for a particular model of SPV pumping system using a particular brand of SPV Modules, the applicant may use SPV Modules of other brand for the same model of SPV pumping system without going for retesting of SPV pumping system with other brand of SPV Modules provided the test lab certifies that the SPV Module of other brand is atleast of same wattage capacity and its parameters and characteristics are not inferior to the brand of SPV Module with which the model of SPV pumping system was tested and certified by the testing lab. In addition, configuration of solar array i.e. the number of solar modules in series and/or parallel combination will remain unaltered. Further, in each case the SPV module shall follow the quality control order issued by MNRE from time to time. Following criterion shall be followed:

- Solar Array Maximum voltage Vmpp with new brand module shall be within ±2% of earlier module.
- Modules Efficiency and Fill Factor shall qualify minimum requirement of MNRE specifications
- Array and module Mismatch shall meet the MNRE specifications.

13 LABS AUTHORISED FOR SOLAR PUMP TESTING

The National Institute of Solar Energy and any other lab accredited by NABL for testing of solar PV water pumping system as per MNRE specifications and testing procedure are authorized to issue approval certificate on successful testing of a solar PV water pumping system.

ANNEX A
(*Clause* **2**)

LIST OF REFERRED STANDARDS

IS NO.	*Title*
14286 : 2010	Crystalline Silicon Terrestrial Photovoltaic (PV) Modules — Design Qualification and Type Approval
3043:1987	Code of Practice for Earthing
5120:1977	Technical requirements for rotodynamic special purpose pumps (First revision)
11346:2003	Tests for Agricultural and Water Supply Pumps - Code of Acceptance
6603:2001	Stainless Steel Bars and Flats
6911:2017	Stainless steel plate, sheet and strip Stainless steel plate, sheet and strip
7538:1996	Three-phase squirrel cage induction motors for centrifugal pumps for agricultural applications
8034:2002	Submersible pump sets - Specification (second revision)
9079:2002	Electric monoset pumps for clear, cold water for agricultural and water supply purposes - Specification (second revision)
9283:2013	Motors for submersible pump sets
11346:2002	Code of acceptance tests for agricultural and water supply pumps (first revision)
14220:1994	Open well submersible pump sets - Specification
14582:1998	Single-phase small AC electric motors for centrifugal pumps for agricultural applications
ISO 9905:1994	Technical specifications for centrifugal pumps -- Class I
IEC 60068-2-6:2007	Environmental testing – Part 2-6: Tests – Test Fc: Vibration (sinusoidal)
IEC 60068-2-30:2005	Environmental testing – Part 2-30: Tests – Test Db: Damp heat, cyclic (12+ 12h cycle)
IEC 60146-1-1:2009	Semiconductor converters - General requirements and line commutated converters - Part 1-1: Specification of basic requirements
IEC 60364-4-41:2005	Low-voltage electrical installations - Part 4-41: Protection for safety - Protection against electric shock
IEC 60364-7-712:2017	Low voltage electrical installations - Part 7-712: Requirements for special installations or locations - Solar photovoltaic (PV) power supply systems
IEC 60529:1989	Degrees of protection provided by enclosures (IP Code)
IEC 60947-1:2007	Low-voltage switchgear and control gear - Part 1: General rules
IEC 61000-6-2:2016	Electromagnetic compatibility (EMC) - Part 6-2: Generic standards - Immunity standard for industrial environments
IEC 61000-6-3:2006	Electromagnetic compatibility (EMC) - Part 6-3: Generic standards - Emission standard for residential, commercial and light-industrial environments
IS/IEC 61683 :1999	Photovoltaic Systems — Power Conditioners— Procedure for Measuring Efficiency
IS/IEC 61730-1 : 2004	Photovoltaic (Photo Voltaic (PV)) Module Safety Qualification Part 1 Requirements for Construction

IS/IEC 61730-2 : 2004	Photovoltaic (Photo Voltaic (PV)) Module Safety Qualification Part 2 Requirements for Testing
IEC 61800-3:2017	Adjustable speed electrical power drive systems - Part 3: EMC requirements and specific test methods
IEC 62109-1:2010	Safety of power converters for use in photovoltaic power systems - Part 1: General requirements
IEC 62305-3:2010	Protection against lightning - Part 3: Physical damage to structures and life hazard
IEC 62458:2010	Sound system equipment – Electro-acoustical transducers - Measurement of large signal parameters

Universal Solar Pump Controller (USPC) Specifications for Stand-alone applications

1. Preamble:

The Controller for Solar PV pumping system is the heart and brain of the system. The Solar PV pumping system deployed at huge cost to the farmer and the exchequer for the Government is currently utilised only for half of the days in a year (around 150 days per year) on an average. In order to optimally utilize the solar photovoltaic system that generates the electricity throughout the year during sunshine hours, the controller supplied for installation of solar pumping system should be able to perform several other tasks for agricultural and other needs of a farmer. This will increase the productivity of agriculture sector and income of farmer. With the use of USPC the solar system could be used effectively throughout the year.

2. Technical Specification for Stand Alone Application

The USPC with SPV modules and structure can be used for agrarian applications such as water pumping, apple grading and polishing system, wheat (grain) flour grinding machine / aata chakki, cutter/chaff, deep-fridger / cold storage, blower fan for cleaning of grains, heating loads and any other standard voltage (400/415V) three phase motor/equipment of capacity not more than the capacity of Solar PV pumping system. The USPC operation schematic diagram is shown in Fig. 1. Further, the applications are not limited upto the few shown in the figure.

I. Following table gives specifications of electrical supply from USPC for motors other than the solar pumps. For operating the pump the USPC must follow the MNRE specifications for SPV pumping systems.

Sr No.	Description	Desired requirement
1	Motor Supply Phases	Three phase R-Y-B
2	Rated motor frequency	48-50Hz
3	Frequency operation	0 to 52Hz
4	Rated motor voltage	415V ± 5%
5	Desired motor operation	Constant V by F or constant motor flux control

II. Proposed electrical properties of USPC when operating motors other than motor-pump set:

Sr No.	Description	Desired requirement
1	Characteristic of voltages	Pure sinusoidal or Filtered AC output voltage at motor terminal. No PWM pulses allowed at the motor terminal, as it generates pronounced voltage spikes. The USPC output is intended to use for the traditional induction motors based applications which are design for sinusoidal grid supply.
2	THD of motor terminal voltages	Below 3%
3	THD of motor current (in case of balance/linear motor)	Below 5%
4	Balance supply	Three phases should be balanced and no negative sequence components to be allowed
5	Voltage spikes	Recurring or non-recurring voltage spikes more than 620V (peak of 440V AC supply) is not allowed between any two terminals
6	Alarms and Protections	Output voltage low, Output frequency low/high, Low irradiance/PV power, Current overload, Peak Torque overload

III. Controller should be able to run SPV pumping system as per MNRE specifications as well as any other type of motor of suitable rating, subject to the load characteristics of the equipment in which the motor is used is any of the following:

a) Constant torque loads
b) Constant power loads
c) Quadratic loads
d) Impact loads
e) Hydraulic loads

Subject to the maximum torque being not more than 150% of the rated torque of the motor.

IV. To ensure energy efficiency of solar PV system and to maintain reliability of PV installation against aging effect, module mismatch with time, partial shading, etc. , the desired USPC properties and configuration should be as follows:

(a) Static MPPT efficiency of USPC should be equal or more than 98% during operation of 10 to 100% of rated STC PV power, and average MPPT tracking efficiency in the dynamic condition should be greater than 97 % with hot and cold profiles when feeding the water pumping, hydraulic or heating loads, so as to maintain MPPT irrespective of variation in solar energy or irradiance. `

(b) USPC efficiency should be as follows for the operation at 80% rated STC power of the PV array:

Sr No.	SPV pumping system capacity	Controller power efficiency should be more than or equal to
1	3 HP	93.00%
2	5 HP	93.00%
3	7.5 HP	94.00%
4	1-10 HP	94.50%
5	15 HP	94.50%

(c) Considering voltage variation over the year due to variation in temperature, irradiance and effect due to ageing, environmental damages to PV panels with time, USPC should have MPPT channels as an integral part of system (or externally connected part) with wide range of input PV voltage for MPPT tracking of the PV panels. Input voltage range variation should be tested as per manufacturer declaration (min, nominal or 90% of the maximum) or if no declaration is made than at least it should be tested as per the table given below.

Sr No.	**Motor Pump set capacity**	**Input voltage range**		
		Minimum	**Nominal**	**Maximum**
1	3 HP	(Vnominal-50)	Nominal	(Vnominal+50)
2	5 HP	(Vnominal-70)		(Vnominal+70)
3	7.5 HP	(Vnominal-70)		(Vnominal+70)
4	1-10 HP	(Vnominal-100)		(Vnominal+100)
5	15 HP	(Vnominal-100)		(Vnominal+100)

V. There should be Mode selection located on control panel of the USPC along with display and user should be able to select either to run motor-pump set of any other application. The software/firmware required to operate these applications must get automatically loaded when an appropriate position of the switch is engaged.

VI. USPC must have at least four numbers of three phase output cables to feed power to the applications. The output power cable for specific application should get selected automatically upon selection of applications via keypad or via mobile or via remote control connectivity. The manual selector switch should not be used at the output to manage different loads. This is to ensure the hassle free operation of applications by farmer with adequate safety.

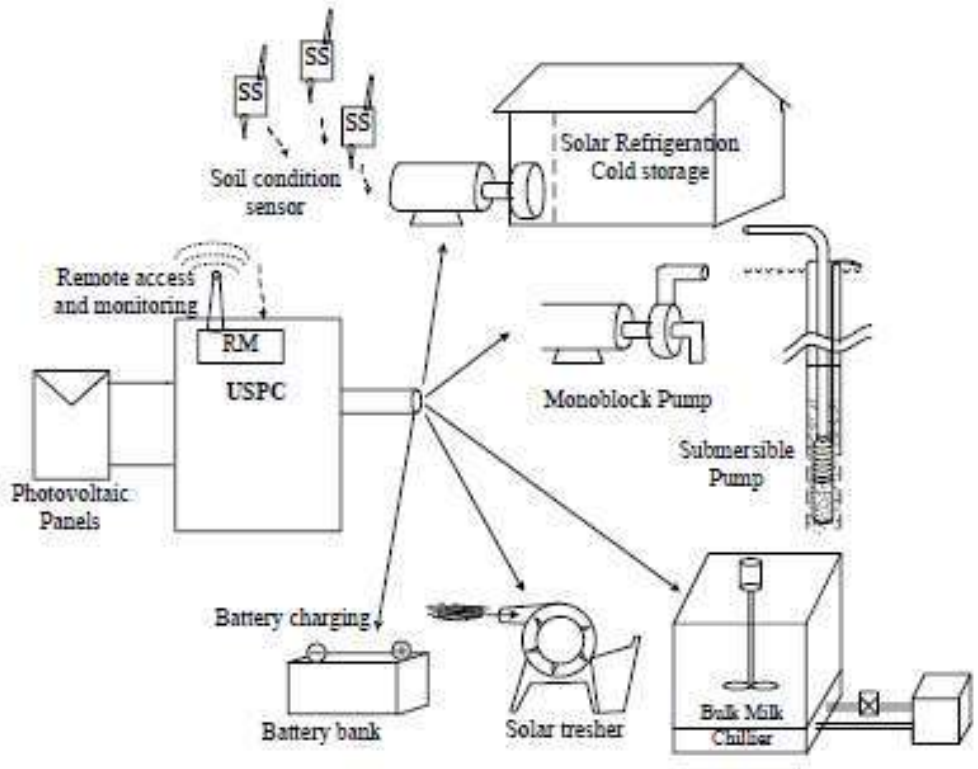


Fig. 1. USPC operation schematic diagram.

VII. USPC based Solar system must be equipped with Remote monitoring and remote fault identification:

(a) Remote monitoring features should be integral part of solar pump controller and should provide time wise remote monitoring of PV voltage, PV Power, Water output, head, when used in solar pump mode. When operated in farm equipment mode, it should show, PV voltage, PV power, motor voltage, motor current and motor frequency.

(b) Cumulative energy generation from PV panels for a month, year and 5 years should be provided.

(c) Remote monitor should show current status of system like On, Off and fault.

(d) Software associated with remote monitoring should also provide location of SPV pumping system.

(e) Controller should have support of sufficient Internal memory/ SD card / memory card to support remote monitoring in case of network failure.

USPC must have IP65 protection or must be housed in a cabinet having at least IP65 protection.

Testing Procedure for Universal Solar Pump Controller (USPC)

USPC must be tested in two principle modes:

1. As an offgrid solar pump controller: the testing should be as per MNRE specifications and Test procedure.
2. As a controller to operate motorized farm equipment: The testing should be as described below.

To test the USPC in the second mode the test centres must have standard actual mode suitable for 4 loading modes. The input to the USPC must be from a solar PV simulator using the hot and cold profiles issued by MNRE. Following tests may be performed on USPC driving the agrarian load like Atta Chakki, Chaff Cutter and Deep Freezer under test. The USPC must be able to operate these motors of the attached agrarian load, so that they deliver the rated torque and are able to also operate till 150% of the rated torque for 30 seconds.

S.No.	Test Performed	Expected result	Test Lab Observation	Remarks
1	Application description on screen and selection of applications	LCD screen provided on controller need to shows various applications which can be selected by keypad using up-down and enter key		
3	Mode operation of applications (Automatic: through keypad or remote / Manual: control switches)	Universal Solar Agriculture controller should come with multiple outputs which can be permanently connected to the application by selecting appropriate options for example following applications should automatically started by USPC by appropriate mean such as keypad or remote for selection. (i) Water Pumping (ii) Chaff Cutter (iii) Deep fridge/ Cold Storage (iv) Atta Chakki Manual changeover is not allowed.		
4	Application Specific output (Application specific software)	USPC should have inbuilt individual application specific software to run the agrarian applications other than pumps and output of the controller should be suitable for above mentioned applications	-	

<table>
<tr><td>5</td><td>Input PV voltage range
Minimum – Voc at STC
Nominal – Voc at STC
Maximum – Voc at STC</td><td></td><td></td><td></td></tr>
<tr><td>6</td><td>USPC Efficiency measurement in Hot and cold profile should be measured as per BS EN 50530/IEC 62891</td><td colspan="3">
<table>
<tr><td colspan="4">Efficiency of the UPSC at minimum……… VOC</td></tr>
<tr><td>Load %</td><td>Charge controller eff (%)</td><td>Power tracking Efficiency (%)</td><td>Overall charge controller efficiency (%)</td></tr>
<tr><td>10</td><td></td><td></td><td></td></tr>
<tr><td>25</td><td></td><td></td><td></td></tr>
<tr><td>50</td><td></td><td></td><td></td></tr>
<tr><td>75</td><td></td><td></td><td></td></tr>
<tr><td>100</td><td></td><td></td><td></td></tr>
<tr><td colspan="4"></td></tr>
<tr><td colspan="4">Efficiency of the UPSC at Nominal ……… VOC</td></tr>
<tr><td>10</td><td></td><td></td><td></td></tr>
<tr><td>25</td><td></td><td></td><td></td></tr>
<tr><td>50</td><td></td><td></td><td></td></tr>
<tr><td>75</td><td></td><td></td><td></td></tr>
<tr><td>100</td><td></td><td></td><td></td></tr>
<tr><td colspan="4"></td></tr>
<tr><td colspan="4">Efficiency of the UPSC at 90 % of Max ……. VOC</td></tr>
<tr><td>10</td><td></td><td></td><td></td></tr>
<tr><td>25</td><td></td><td></td><td></td></tr>
<tr><td>50</td><td></td><td></td><td></td></tr>
<tr><td>75</td><td></td><td></td><td></td></tr>
<tr><td>100</td><td></td><td></td><td></td></tr>
<tr><td colspan="4"></td></tr>
<tr><td colspan="4">Dynamic MPPT Efficiency</td></tr>
<tr><td>Hot Profile</td><td colspan="3"></td></tr>
<tr><td>Cold Profile</td><td colspan="3"></td></tr>
</table>
</td></tr>
<tr><td>7</td><td>Ripple and distortion at output on full load</td><td>Should below 5 % after 25 % loading condition</td><td></td><td></td></tr>
<tr><td>8</td><td>Measurement of Output voltage waveform</td><td>Three phase output with up to 440 V rms pure Sine Wave to be measured at least 4 times between 300W/m2 irradiance and maximum irradiance as per the irradiance profile.</td><td>CF value should be provided by lab for voltage and current</td><td></td></tr>
<tr><td>9</td><td>Operation at different output from array with all four load types (Array wattage as per MNRE model:</td><td>Above …………. Watt DC output Should not stop functioning at any load condition. Observation should be recorded.</td><td>Power value should be recorded by the lab with all agrarian load</td><td>Motor current should be recorded (for torque behavior) It must be almost constant</td></tr>
</table>

	Example 4800 Wp array) At 40% Power At 50% Power At 75% Power At 100% Power		supported by USPC	irrespective of available DC power from array (motor running condition). This is for Impact loading condition (such as Chaff cutter) current variation need to be recorded by laboratory.
10	Operation at different output from array with all four load types (Array wattage as MNRE model: Example 4800 Wp array) At 10 % Power At 25 % Power At 30 % Power	USPC need to run all the agrarian load in variable frequency at the lower irradiance value The load may be increased beyond 150% of rated torque to determine at what level the motor is stalling and stopping and it must trigger 'torque overload' alert. If it goes beyond 150% of the motor rated torque the USPC must trip indicating an 'overload tripping'.	Motor current should be recorded (for torque behavior) as it is a function of V/F ratio controlled by USPC	
11	Total circuit protection observation	Soft Startup, low radiation protection, overload protection, Open circuit protection Reverse polarity protection		

Expected output of individual applications must be specify as per their power rating and SPV capacity, such as:

1. kg/hour grinding of atta chakki, and granularity.
2. Volumetric Iceing of cold storage in x hours.
3. Output in terms of kg/hours for a specific capacity grass-cutter.
4. Output must be quantify in terms of rate of volume or weight as above for any other applications.

ANNEXURE-II

QUALIFYING REQUIREMENT (QR)

In addition to the satisfactory fulfillment of requirements stipulated under section ITB, the following shall also apply:

Sr. No (A)	Criteria (B)	Documents to be Submitted (C)	Particulars in brief of the Documents submitted by the Bidder on Covering Letter (D)
1	The bidder should be a firm registered/incorporated under Companies Act, 1956 or Companies Act, 2013/ and further amendment (s), OR A registered partnership firm (registered under section 59 of the Partnership Act, 1932) OR A limited liability partnership (under the Limited Liability Partnership Act, 2002). ****Joint Venture is allowed in this tender**	Copy of certificate of incorporation under Indian Companies Act 1956, repealed as 2013 and further amendment(s) from Registrar of Companies. OR A Registered partnership deed OR A LLP registration certificate issued by registrar of companies In addition, PAN Card and GST Registration Certificate shall also be submitted.	Company Incorporation Certificate/Partnership/LLP No.
2	The bidder should be, either of the following: i) Manufacturer of Solar PV Module OR ii) Manufacturer of Solar Pump OR iii) Manufacturer of Solar Pump Controller using indigenous technology OR iv) EPC/SI of 'similar works' in Joint venture with Solar PV Module Manufacturer or Solar Pump Manufacturer or Manufacturer of Solar Pump Controller using indigenous technology 'Similar Works' means - Design, Supply, Erection, Testing and Commissioning of standalone (off-grid) solar PV based water pump	Work order copies/LoA's and Completion Certificates from registered central/state/PSU (Public Sector Undertaking)/Distribution Company (**DISCOM**). AND Memorandum of Association, Article of Association needs to be attached along with the bid. The bidder should also highlight the **relevant provision/ article number** which highlights the objects relating to the business fields mentioned in the previous column. AND Copy of Factory License Indian Factories Act, 1948 or any document to establish factory in running operations under the and GST registration Certificate, supporting the fact of the bidder being engaged in the business field mentioned in column B. If factory	Tabular details comprising of Order No.; Order Date; Client's Name; Description of Project; Supply/Completion Period (with from-/to-dates); Ref. No. & Date of Material Receipt Certificates/ PO/Work Completion Certificates

	sets. Past experience required for the bidders to be counted from 01-04-2015 shall be as per Table 1 below	license does not specify that business field, a separate Government issued document shall be submitted in support of the bidder being engaged in the business field mentioned in column B	
3	Bidders should have Average Annual Turnover (ATO) as per **Table 2** below for any 3 years out of the last 4 years i.e 2016-17, 2017-2018, 2018-2019 and 2019-2020.	Duly authorized copy of audited annual report/Balance Sheet for any three financial years out of last four years (i.e 2016-17, 2017-18, 2018-19 and 2019-20) is to be submitted by respondent along with CA certificate. Turnover means operating income. Profitability means: Profit after tax	M/s 2016-17 2017-18: 2018-19: 2019-20 Refer Format-1 in Annexure-III
4	The bidder should be profitable in at least two of the last four financial year out of 2019-20, 2018-19, 2017-18 and 2016-17.	Duly authorized copy of audited annual report/Balance Sheet for any three financial years out of last four years (i.e 2016-17, 2017-18, 2018-19 and 2019-20 is to be submitted by respondent along with CA certificate. Turnover means operating income. Profitability means: Profit after tax	M/s 2016-17 2017-18: 2018-19: 2019-20 Refer Format-2 in Annexure-III
5	The Net worth of bidder as on the last day of preceding financial year (2018-19 or 2019-20) shall not be less than 100% of the paid-up share capital.	Duly authorized copy of audited annual report/Balance Sheet for any three financial years out of last four years (i.e 2016-17, 2017-18, 2018-19 and 2019-20 is to be submitted by respondent along with CA certificate. Turnover means operating income. Profitability means: Profit after tax In case of partnership, total closing capital of last financial year (2018-19) should not be less than total opening capital of 2018-19. The same will be treated as negative net worth and vice versa.	Individual Net Worth Details M/s 2016-17 2017-18: 2018-19: 2019-20

6	Bidder needs to submit documentary evidence that components should be indigenously manufactured for the supplied systems.	Declaration of sourcing/ manufacturing of components, clearly specifying as being indigenously manufactured. Details of the manufacturing/ sourcing firm/ facility, including Company Profile, to be provided accordingly. AND The bidder should submit the list and pictures of the manufacturing and testing facilities and submit an undertaking that if the details provided by the bidders are in deviation with the provision of the scheme, it will call for disqualification. If considered necessary, a team of SIA officials may visit the facilities of the bidders for verification Along with above documents required to be annexed to the invoice (at the time of payment in case of successful bidder), copies of the Excise invoice(s) of the manufacturing unit(s) of the Solar PV Module, Pumps etc. shall also be annexed to the invoice for claiming payment.	**Attachment 15**

*In accordance with order No: P-45021/2/2017-PP (BE-II) dated: 16-Sept-2020 of Department of Promotion of Industry and Internal Trade and Order No F. No. 283/22/2019-GRID SOLAR, Ministry of New & Renewable Energy dated: 23-09-2020, **only 'Class-I Local Suppliers' are eligible to bid in this tender.**

** Conditions for Joint Venture: A joint venture (JV) is a business arrangement in which two or more parties agree to come together, pool their resources for the purpose of accomplishing a specific project or business activity. In the current context, JV includes any Joint Venture company (hereby referred as JV Company) registered under Companies Act, 1956 and any consortium formed among two or more parties. The terms JV and Consortium may have been used interchangeably, in the following section and submissions by the bidder may be made (as applicable).

In case Bidder wishes to participate in as a JV, following conditions are additionally applicable: -

1. The term Bidder used hereinafter would therefore apply to both a single entity and a Consortium/ JV.
2. Consortium of companies/organizations (maximum of two members) registered in India and in existence for at least (3) years as on publication of this tender.
3. Lead Bidder should be a registered as an MSE to claim the benefits provided to the MSE.
4. A consortium of maximum two (02) members is allowed in this RfP including one as lead bidder.
5. In case of JV, either one may act as a lead member.
6. In case of JV all the members should mandatorily be from the business as defined in the QR for similar work.
7. Lead Bidder accepts primary responsibility for providing a robust and quality product meeting technical specifications of tender.

8. Member of any Joint Venture Firm shall not be permitted to participate either in individual capacity or as a member of any other Consortium/Joint Venture Firm in the same tender. Submission or participation in more than one bid will cause disqualification of all the proposals submitted by the bidder.
9. All formalities in respect of submission of tender shall be done only in the name of 'Lead Member' and not in the name of Joint Venture Firm. However, name & other details of both the members of Consortium/ Joint Venture Firm should be clearly mentioned in the Bid/Response.
10. A copy of Memorandum of Understanding (MOU) executed between the members of JV shall be submitted along with the tender. The complete details of the members of the Joint Venture Firm, their share and responsibility in the JV etc. particularly with reference to financial, technical and other obligations shall be furnished in the MOU.
11. Once the offer/ bid is submitted, the MOU shall not be modified / altered/ terminated during the period of execution including any extension thereafter by EESL or validity of any letter of award awarded to the said Consortium/Joint Venture Firm. In case, the tenderer fails to observe/comply with this stipulation, the full Security Deposit/ Performance Bank Guarantee (PBG) shall be liable to be forfeited.
12. A duly notarized agreement of Joint Venture Firm shall be executed between the 'Lead Member' and Consortium/JV Partner. This Agreement should be submitted in original with your offer/ bid.
13. Authorized Member of Joint Venture Firm: 'Lead Member' shall be authorized on behalf of Joint Venture Firm to deal with the tender/EESL, sign the agreement or enter into contract in respect of the said tender, to receive payment and such activities in respect of the said tender/ contract. All notices/ correspondences with respect to the contract would be sent only to this 'Lead Member' of Joint Venture Firm.
14. Required processing fee shall be submitted by the 'Lead Member'. Submission of processing fee by the 'Lead Member' it should be deemed as processing fee submitted by the Joint Venture Firm.
15. Duration of MOU and JV Agreement shall be valid during the entire execute in period/ validity of letter of award and any extension thereafter /currency of the contract including the period of extension, if any
16. Any change in constitution of Joint Venture Firm shall not be allowed.
17. On award of any contract to the Joint Venture Firm, a single Performa i.e Bank Guarantee shall be submitted by the lead bidder as per tender conditions. All the Guarantees like Security Deposit, Earnest money Deposit, Performance Guarantee, and Bank Guarantee for Mobilization Advance etc. shall be accepted only in the name of 'Lead Member' and splitting of guarantees among the members of JV shall not be permitted.
18. Members of the Joint Venture Firm shall be jointly and severally liable to the EESL for execution of the project/ Work/ Assignment etc. The JV members shall also be liable jointly and severally for the loss, damages caused to the EESL during the course of execution of any awarded contract or due to non-execution of the contract or part thereof. Governing Laws for Consortium/ Joint Venture Firm: The JV Agreement in all respect be governed by and interpreted in accordance with Indian Laws.

19. In case a group of MSMEs registered with NSIC (under single point registration scheme) form a JV under NSIC, the Consortium needs to provide an authorization letter from NSIC accepting the terms and conditions of tender (except for those terms and conditions in which NSIC consortia are given special status as per Government of India Policy for the Government Purchase Programme) and also provide details of Consortium members, their manufacturing capacities, the share-out of quantities with schedule of supplies as per EESL tender schedule. Further, NSIC consortium mandatorily submit their service tax, pan card and other relevant documents.
20. Further, MSMEs are also eligible to participate in tender directly provided they meet all QRs in their individual capacities and are not part of NSIC Consortium or any other Consortium.
21. In case of Consortium of NSIC, the lead members/ partners in the consortium shall not separately participate as independent bidder or as members of any other consortium in this bidding process. All bids in contravention of this shall be rejected.
22. In case of participation as NSIC, it is clarified as consortium of maximum three member are allowed including NSIC as lead member.
23. NSIC consortium members *should be* from industries as mentioned in Qualifying Requirement (QR).
24. In one tender, only bid from one NSIC Consortium will be accepted.
25. All correspondence by EESL will be done with 'Lead member' only.

Notes:

1. Bidder has to submit the test certificates for each pump category in which bidder gets empanelled based on MNRE technical specs 2019 along with the CPG. Bidder has to provide a declaration as per **Attachment-17**
2. Test certificate already available for a solar pumping system can be used for other installers provided the user obtains written consent from the owner of test certificate to use the same. Further, in case of any change in the component of already tested solar pumping system the user shall get technical compatibility certificate for the changes component along with the consent from certificate owner.

For manufacturer of Solar Pump or SPV modules or Solar Pump Controller using indigenous technology:

1. If a bidder has submitted LoA/work experience certificates for supplying solar pump or SPV modules or Solar pump controllers to successful bidder (some other firm) who got that work from some Govt. tender, then, such work experiences shall only be considered on submission of the following along with the work experience certificate (as asked above):
    a. LoA and completion certificate given by Govt. department to the firm for which supply work has been completed by the bidder. The LoA and completion certificate shall be in line with the documents as asked in the tender document.

Table-1 (Past Experience):

Cluster	State	Quantity (State-wise)	Quantity (Cluster-wise)	For Solar Pumps/Controller (No. of Solar Pumps installed/Controller installed or supplied)	For Solar PV Modules (Experience in MWp)
1	Chhattisgarh	20000	20000	1200	6
2	Haryana	22000	22000	1320	6.6
3	Madhya Pradesh	50000	50000	3000	15
4	Maharashtra	100000	100000	6000	30
5	Rajasthan	50000	50000	3000	15
6	Uttar Pradesh	15000	15000	900	4.5
7	Tripura	2600	2600	156	0.78
8	Jammu & Kashmir	5000	5600	336	1.68
	Ladakh	600			
9	Bihar	1000	11000	660	3.3
	Jharkhand	10000			
10	Karnataka	10000	10200	612	3.06
	Goa	200			
11	Himachal Pradesh	1000	1100	66	0.33
	Uttarakhand	100			
12	Assam	500	6000	360	1.8
	West Bengal	500			
	Odisha	5000			
13	Gujarat	775	875	52.5	0.26
	Dadra & Nagar Haveli	50			
	Daman & Diu	50			
14	Punjab	15000	15600	936	4.68
	Chandigarh	100			
	Delhi	500			
15	Tamil Nadu	5000	7200	432	2.16
	Andhra Pradesh	1000			
	Kerala	100			
	Telangana	1000			
	Puducherry	100			

16	Arunachal Pradesh	50	800	48	0.24
	Sikkim	50			
	Manipur	50			
	Meghalaya	500			
	Mizoram	100			
	Nagaland	50			
	Total	**317975**	**317975**	**19078.5**	**95.39**

NOTE 1: The combine past experience for all clusters applied by the bidder shall be considered for evaluation. For example: If bidder quoted for Cluster 1 and Cluster 2, the past experience for Solar Pumps/Controller should be 2520 (1200 + 1320), past experience for Solar PV Modules should be 12.6 Mega Watt-peak (6+ 6.6).

Experience in any i.e. Pumping or Solar PV modules or Solar Pump Controller is Sufficient

Table-2 (Annual Turn Over Requirement):

Cluster	State	Quantity (State-wise)	Quantity (Cluster-wise)	ATO in INR Crore
1	Chhattisgarh	20000	20000	28.38
2	Haryana	22000	22000	31.22
3	Madhya Pradesh	50000	50000	70.95
4	Maharashtra	100000	100000	141.90
5	Rajasthan	50000	50000	70.95
6	Uttar Pradesh	15000	15000	21.29
7	Tripura	2600	2600	4.06
8	Jammu & Kashmir	5000	5600	8.75
	Ladakh	600		
9	Bihar	1000	11000	15.61
	Jharkhand	10000		
10	Karnataka	10000	10200	14.47
	Goa	200		
11	Himachal Pradesh	1000	1100	1.72
	Uttarakhand	100		
12	Assam	500	6000	8.59
	West Bengal	500		

	Odisha	5000		
13	Gujarat	775	875	1.24
	Dadra & Nagar Haveli	50		
	Daman & Diu	50		
14	Punjab	15000	15600	22.14
	Chandigarh	100		
	Delhi	500		
15	Tamil Nadu	5000	7200	10.22
	Andhra Pradesh	1000		
	Kerala	100		
	Telangana	1000		
	Puducherry	100		
16	Arunachal Pradesh	50	800	1.25
	Sikkim	50		
	Manipur	50		
	Meghalaya	500		
	Mizoram	100		
	Nagaland	50		
	Total	**317975**	**317975**	**452.73**

NOTE 2: The combine ATO for all the states applied by the bidder shall be consider for evaluation. For example: If bidder has quoted for Cluster 1 and Cluster 2, the ATO of the bidder should be at least INR 59.6 Cr (28.38 Cr +31.22 Cr)

Note:

- NSIC Consortium shall consist of maximum Two members including NSIC as lead member.
- In case a group of MSMEs registered with NSIC (under single point registration scheme) form a consortium under NSIC, the Consortium needs to provide an authorization letter from NSIC accepting the terms and conditions of tender (except for those terms and conditions in which NSIC consortia are given special status as per Government of India Policy for the Government Purchase Program) and also provide details of Consortium members, their manufacturing capacities, the share-out of quantities with schedule of supplies as per EESL tender schedule. Further, NSIC consortium mandatorily submits their GSTN, pan card and other relevant documents.
- In this tender, only one bid from NSIC Consortium will be accepted.
- In case of Consortium of NSIC, the lead members/ partners in the consortium shall not separately participate as independent bidder or as members of any other consortium in this bidding process. All bids in contravention of this shall be rejected. NSIC consortium members should be from relevant industry only as mentioned in QR.
- Further, MSMEs are also eligible to participate in tender directly provided they meet all QRs in their

individual capacities and are not part of NSIC Consortium or any other Consortium. "Holding Company "and "Subsidiary "shall have the meaning ascribed to them as per Companies Act, 1956 or, in vogue.

- In case bidder is not able to furnish its audited financial statements on standalone entity basis, the unaudited unconsolidated financial statements of the bidder can be considered acceptable provided the bidder furnishes the following further documents on substantiation of its qualification:
    - Copies of the unaudited unconsolidated financial statements of the Bidder along with copies of the audited consolidated financial statements of the Holding Company with a letter of undertaking from holding company supported by Board pledging unconditional and financial support. Irrevocable in the format enclosed in Attachemnt-9 of Section-6, Forms & Procedures.
    - A Certificate from the CEO/CFO of the Holding Company, stating that the unaudited unconsolidated financial statements form part of the Consolidated Annual Report of the Company.
- In case a bidder does not satisfy the financial criteria, the holding company would be required to meet the stipulated turn over requirements, provided that the net worth of such holding company as on the last day of the preceding financial year is at least equal to or more than the paid-up share capital of the holding company. In such an event, the bidder would be required to furnish along with its bid, a letter of Undertaking from the holding company, supported by the Board Resolution, as per the format enclosed in the bid documents (Attachemnt-9 of Section-6, Forms & Procedures), pledging unconditional and irrevocable financial support for the execution of the Contract by the bidders in case of award.
- In case the Bidder meets the requirement of Net worth based on the strength of its Subsidiary(ies) and/or Holding Company and/or Subsidiaries of its Holding Companies wherever applicable, the Net worth of the Bidder and its Subsidiary(ies) and/or Holding Company and/or Subsidiary(ies) of the Holding Company, in combined manner should not be less than 100% of their total paid up share capital. However individually, their Net worth should not be less than 75% of their respective paid up share capitals.
- Net worth means the sum total of the paid up share capital and free reserves. Free reserve means all reserves credited out of the profits and share premium account but does not include reserves credited out of the revaluation of the assets, write back of depreciation provision and amalgamation. Further any debit balance of Profit and Loss account and miscellaneous expenses to the extent not adjusted or written off, if any, shall be reduced from reserves and surplus.
- Other income shall not be considered for arriving at annual turnover.
- The supporting documents in support of above Qualification Requirement should be submitted along with tender document, otherwise Techno-commercial offer submitted by the bidder is liable to be considered as non-responsive.
- All the required documents must be properly annexed and submitted as mentioned above with necessary details in brief in Column D.
- In case bidder has been found to be defaulting on the delivery period (in each LoA issued) as per assessment (supply, installation etc.) will be liable to be rejected. Bidder have to provide the quantity (Nos. & Percentage) supplied and installed against each LoA awarded by SIA at the date of submission of bid.

ANNEXURE- III

Format 1

Information on Average Annual Turnover

{*To be printed on the Letterhead of the bidder including full postal address, telephone, faxes and e-mail address*}

Annual Turnover Data for the Last 3 Years

Year	Net Worth(in INR)	Annual Turnover (in INR)
2019-20		
2018-19		
2017-18		
2016-17		
Annual Average		

{This format should be certified by the practicing CA's of the Bidder}

Format 2

Information on Profitability

{*To be printed on the Letterhead of the bidder including full postal address, telephone, faxes and e-mail address*}

Profit After Tax Data for the last 4 years

Year	Amount (in INR)
2019-20	
2018-19	
2017-18	
2016-17	

{This format should be certified by the practicing CA of the Bidder

Annexure-IV

SPECIFIC CONFIRMATION BY BIDDER **Note: Please submit the table below duly filled, signed and stamped along with Techno-Commercial Bid.**	
Description	**Remarks**
In case more than one bidder gets qualified based on the Techno-commercial Bid, then the bidder quoting the lowest total price for SPWPS defined in price-bid table will qualify as the successful bidder.	Agreed
Bidders should have financial and technical capabilities to execute the Scope of Work as specified in the RFP.	Vendor to give their acceptance along with supporting documents
Offer of Warranty less than 5 YEARS from the date of delivery of respective consignment will not be accepted and bidder shall be disqualified.	Agreed
Payment Terms–as per SCC Clause No. 1.0.	Agreed
Test Reports of SPWPS are to be submitted as per MNRE technical specifications and testing procedures issued in 2019 and its subsequent amendment(s) if any.	Agreed
For the purpose of this Tender, the successful bidder needs to provide name, address, mobile no., email addresses, designations of at least 3 Senior Nodal Officers (Regular Employees of their organization), nominated by their top management, who are reachable through any means of modern communication and who shall be accountable to deliver the product and associated services to SIA as per the tender.	To be indicated. To be enclosed separately
Any entity which has been barred by the Central/State Government or PSUs (Public Sector Undertakings), from participating in any bid, and the bar subsists as on the Bid Due date, would not be eligible to submit a Bid. Necessary declaration to this effect has to be given by the bidder as per format in the tender form.	Vendor to give a declaration on its letterhead pad.
Bidder should have an existing network or has to set-up a local service network in the Project Areas to support post-delivery maintenance activities. The Successful Bidder has to further support the project by opening office in the state for delivery with one Project Manager and one Project Engineer dedicated full-time to support supply and post-distribution warranty commitments.	Details of service support network or plans for deployment of such network in project area to be provided. To be enclosed separately as Annexure.
EESL/SIA reserves the right to ask other qualified bidders to match the evaluated price of L-1 Bidder. EESL/SIA reserves the right to offer up-to 25 % of L-1 quantity to NSIC Consortium, provided they meet all tender terms and conditions (except where they are exempted by Government Order) and also comply with the L-1 rate, quality, supply schedules of tender for bidders.	Agreed
EESL/SIA reserves the right for quantity variation up to +/- 20%. Further EESL/SIA reserves the right to place a repeat order in case of urgency for part quantity in the Letter of Award for similar work on same prices, terms and conditions.	Agreed

EESL/SIA shall give preference domestically manufacturers as per Policy Notification no. F.No.33 (3)/2013-IPHW dated 22.05.14 of Department of Electronics & Information Technology, provided they meet all terms and conditions of tender on price, quality, supply schedule, branding, etc.	Agreed
It will be the sole discretion of EESL/SIA to award the quantity irrespective of the quantity mentioned by the bidder and the band provided.	Agreed
Detailed Test certificate for SPWPS being offered meets Technical Specifications as per RfP.	Agreed
Sample copy of batch test report specifying all the required tests will be reported with each consignment.	Agreed
Undertaking by authorized signatory that all Central/State taxes, duties, levies, etc. shall be complied with by the supplier.	Undertaking to be provided. To be enclosed separately as Annexure.
Declaration that Bidder has not been barred/ banned/ black-listed by Central/ State Government or PSUs (Public Sector Undertakings).	Agreed
Price Validity till 365 days from the date of Price Bid opening	Agreed
Declaration for using same make of equipment's as per test certificate in accordance with Attachment-16	Attachment-16 to be filled and submitted

Annexure-V

PRICE BID FORMAT

(For Indicative purpose. To be filled online only).

Name of Work: - Design, Manufacture, Supply, Transport, Installation, Testing and Commissioning of Off Grid Solar Photovoltaic Water Pumping Systems of 1-10 HP in selected States on PAN India basis, including complete system warranty and its repair and maintenance for 5 Years under MNRE KUSUM scheme Component-B.

NIT/Bid Document No.: - EESL/06/2020-21/KUSUM/SWPS/1-10 HP/Off Grid/202101032 Dated:- 14.01.2021

Sr. No	Description	Quantity	Unit of Measurement (UOM)	Unit Rate exclusive of GST (IGST/SGST/ CGST/ UGST) (in Rs.) on F.O.R Destination Basis (In Figure)	Unit Rate exclusive of GST (IGST/ SGST/ CGST/UGST) (in Rs.) on F.O.R Destination Basis (In Words)
For Cluster 1 - Chattisgarh					
1	Cluster-1 1 HP DC - Submersible Water Filled Pump with normal controller	1	Nos		
2	Cluster-1 1 HP AC - Submersible Water Filled Pump with normal controller	1	Nos		
3	Cluster-1 1 HP DC - Submersible Oil Filled Pump with normal controller	1	Nos		
4	Cluster-1 1 HP AC - Submersible Oil Filled Pump with normal controller	1	Nos		
5	Cluster-1 1 HP DC - Surface Pump with normal controller	1	Nos		
6	Cluster-1 1 HP AC - Surface Pump with normal controller	1	Nos		
7	Cluster-1 2 HP DC - Submersible Water Filled Pump with normal controller	1	Nos		
8	Cluster-1 2 HP AC - Submersible Water Filled Pump with normal controller	1	Nos		
9	Cluster-1 2 HP DC - Submersible Oil Filled Pump with normal controller	1	Nos		
10	Cluster-1 2 HP AC - Submersible Oil Filled Pump with normal controller	1	Nos		
11	Cluster-1 2 HP DC - Surface Pump with normal controller	1	Nos		
12	Cluster-1 2 HP AC - Surface Pump with normal controller	1	Nos		
13	Cluster-1 3 HP DC - Submersible Water Filled Pump with normal controller	1	Nos		

14	Cluster-1 3 HP AC - Submersible Water Filled Pump with normal controller	1	Nos		
15	Cluster-1 3 HP DC - Submersible Oil Filled Pump with normal controller	1	Nos		
16	Cluster-1 3 HP AC - Submersible Oil Filled Pump with normal controller	1	Nos		
17	Cluster-1 3 HP DC - Submersible Water Filled Pump with USPC	1	Nos		
18	Cluster-1 3 HP AC - Submersible Water Filled Pump with USPC	1	Nos		
19	Cluster-1 3 HP DC - Submersible Oil Filled Pump with USPC	1	Nos		
20	Cluster-1 3 HP AC - Submersible Oil Filled Pump with USPC	1	Nos		
21	Cluster-1 3 HP DC - Surface Pump with normal controller	1	Nos		
22	Cluster-1 3 HP AC - Surface Pump with normal controller	1	Nos		
23	Cluster-1 3 HP DC - Surface Pump with USPC	1	Nos		
24	Cluster-1 3 HP AC - Surface Pump with USPC	1	Nos		
25	Cluster-1 5 HP DC - Submersible Water Filled Pump with normal controller	1	Nos		
26	Cluster-1 5 HP AC - Submersible Water Filled Pump with normal controller	1	Nos		
27	Cluster-1 5 HP DC - Submersible Oil Filled Pump with normal controller	1	Nos		
28	Cluster-1 5 HP AC - Submersible Oil Filled Pump with normal controller	1	Nos		
29	Cluster-1 5 HP DC - Submersible Water Filled Pump with USPC	1	Nos		
30	Cluster-1 5 HP AC - Submersible Water Filled Pump with USPC	1	Nos		
31	Cluster-1 5 HP DC - Submersible Oil Filled Pump with USPC	1	Nos		
32	Cluster-1 5 HP AC - Submersible Oil Filled Pump with USPC	1	Nos		
33	Cluster-1 5 HP DC - Surface Pump with normal controller	1	Nos		
34	Cluster-1 5 HP AC - Surface Pump with normal controller	1	Nos		
35	Cluster-1 5 HP DC - Surface Pump with USPC	1	Nos		
36	Cluster-1 5 HP AC - Surface Pump with USPC	1	Nos		
37	Cluster-1 7.5 HP DC - Submersible Water Filled Pump with normal controller	1	Nos		
38	Cluster-1 7.5 HP AC - Submersible Water Filled Pump with normal controller	1	Nos		
39	Cluster-1 7.5 HP DC - Submersible Oil Filled Pump with normal controller	1	Nos		
40	Cluster-1 7.5 HP AC - Submersible Oil Filled Pump with normal controller	1	Nos		
41	Cluster-1 7.5 HP DC - Submersible Water Filled Pump with USPC	1	Nos		
42	Cluster-1 7.5 HP AC - Submersible Water Filled Pump with USPC	1	Nos		
43	Cluster-1 7.5 HP DC - Submersible Oil Filled Pump with USPC	1	Nos		

44	Cluster-1 7.5 HP AC - Submersible Oil Filled Pump with USPC	1	Nos		
45	Cluster-1 7.5 HP DC - Surface Pump with normal controller	1	Nos		
46	Cluster-1 7.5 HP AC - Surface Pump with normal controller	1	Nos		
47	Cluster-1 7.5 HP DC - Surface Pump with USPC	1	Nos		
48	Cluster-1 7.5 HP AC - Surface Pump with USPC	1	Nos		
49	Cluster-1 10 HP DC - Submersible Water Filled Pump with normal controller	1	Nos		
50	Cluster-1 10 HP AC - Submersible Water Filled Pump with normal controller	1	Nos		
51	Cluster-1 10 HP DC - Submersible Oil Filled Pump with normal controller	1	Nos		
52	Cluster-1 10 HP AC - Submersible Oil Filled Pump with normal controller	1	Nos		
53	Cluster-1 10 HP DC - Submersible Water Filled Pump with USPC	1	Nos		
54	Cluster-1 10 HP AC - Submersible Water Filled Pump with USPC	1	Nos		
55	Cluster-1 10 HP DC - Submersible Oil Filled Pump with USPC	1	Nos		
56	Cluster-1 10 HP AC - Submersible Oil Filled Pump with USPC	1	Nos		
57	Cluster-1 10 HP DC - Surface Pump with normal controller	1	Nos		
58	Cluster-1 10 HP AC - Surface Pump with normal controller	1	Nos		
59	Cluster-1 10 HP DC - Surface Pump with USPC	1	Nos		
60	Cluster-1 10 HP AC - Surface Pump with USPC	1	Nos		
For Cluster 2 - Haryana					
1	Cluster-2 1 HP DC - Submersible Water Filled Pump with normal controller	1	Nos		
2	Cluster-2 1 HP AC - Submersible Water Filled Pump with normal controller	1	Nos		
3	Cluster-2 1 HP DC - Submersible Oil Filled Pump with normal controller	1	Nos		
4	Cluster-2 1 HP AC - Submersible Oil Filled Pump with normal controller	1	Nos		
5	Cluster-2 1 HP DC - Surface Pump with normal controller	1	Nos		
6	Cluster-2 1 HP AC - Surface Pump with normal controller	1	Nos		
7	Cluster-2 2 HP DC - Submersible Water Filled Pump with normal controller	1	Nos		
8	Cluster-2 2 HP AC - Submersible Water Filled Pump with normal controller	1	Nos		
9	Cluster-2 2 HP DC - Submersible Oil Filled Pump with normal controller	1	Nos		
10	Cluster-2 2 HP AC - Submersible Oil Filled Pump with normal controller	1	Nos		
11	Cluster-2 2 HP DC - Surface Pump with normal controller	1	Nos		
12	Cluster-2 2 HP AC - Surface Pump with normal controller	1	Nos		

13	Cluster-2 3 HP DC - Submersible Water Filled Pump with normal controller	1	Nos		
14	Cluster-2 3 HP AC - Submersible Water Filled Pump with normal controller	1	Nos		
15	Cluster-2 3 HP DC - Submersible Oil Filled Pump with normal controller	1	Nos		
16	Cluster-2 3 HP AC - Submersible Oil Filled Pump with normal controller	1	Nos		
17	Cluster-2 3 HP DC - Submersible Water Filled Pump with USPC	1	Nos		
18	Cluster-2 3 HP AC - Submersible Water Filled Pump with USPC	1	Nos		
19	Cluster-2 3 HP DC - Submersible Oil Filled Pump with USPC	1	Nos		
20	Cluster-2 3 HP AC - Submersible Oil Filled Pump with USPC	1	Nos		
21	Cluster-2 3 HP DC - Surface Pump with normal controller	1	Nos		
22	Cluster-2 3 HP AC - Surface Pump with normal controller	1	Nos		
23	Cluster-2 3 HP DC - Surface Pump with USPC	1	Nos		
24	Cluster-2 3 HP AC - Surface Pump with USPC	1	Nos		
25	Cluster-2 5 HP DC - Submersible Water Filled Pump with normal controller	1	Nos		
26	Cluster-2 5 HP AC - Submersible Water Filled Pump with normal controller	1	Nos		
27	Cluster-2 5 HP DC - Submersible Oil Filled Pump with normal controller	1	Nos		
28	Cluster-2 5 HP AC - Submersible Oil Filled Pump with normal controller	1	Nos		
29	Cluster-2 5 HP DC - Submersible Water Filled Pump with USPC	1	Nos		
30	Cluster-2 5 HP AC - Submersible Water Filled Pump with USPC	1	Nos		
31	Cluster-2 5 HP DC - Submersible Oil Filled Pump with USPC	1	Nos		
32	Cluster-2 5 HP AC - Submersible Oil Filled Pump with USPC	1	Nos		
33	Cluster-2 5 HP DC - Surface Pump with normal controller	1	Nos		
34	Cluster-2 5 HP AC - Surface Pump with normal controller	1	Nos		
35	Cluster-2 5 HP DC - Surface Pump with USPC	1	Nos		
36	Cluster-2 5 HP AC - Surface Pump with USPC	1	Nos		
37	Cluster-2 7.5 HP DC - Submersible Water Filled Pump with normal controller	1	Nos		
38	Cluster-2 7.5 HP AC - Submersible Water Filled Pump with normal controller	1	Nos		
39	Cluster-2 7.5 HP DC - Submersible Oil Filled Pump with normal controller	1	Nos		
40	Cluster-2 7.5 HP AC - Submersible Oil Filled Pump with normal controller	1	Nos		
41	Cluster-2 7.5 HP DC - Submersible Water Filled Pump with USPC	1	Nos		
42	Cluster-2 7.5 HP AC - Submersible Water Filled Pump with USPC	1	Nos		

43	Cluster-2 7.5 HP DC - Submersible Oil Filled Pump with USPC	1	Nos		
44	Cluster-2 7.5 HP AC - Submersible Oil Filled Pump with USPC	1	Nos		
45	Cluster-2 7.5 HP DC - Surface Pump with normal controller	1	Nos		
46	Cluster-2 7.5 HP AC - Surface Pump with normal controller	1	Nos		
47	Cluster-2 7.5 HP DC - Surface Pump with USPC	1	Nos		
48	Cluster-2 7.5 HP AC - Surface Pump with USPC	1	Nos		
49	Cluster-2 10 HP DC - Submersible Water Filled Pump with normal controller	1	Nos		
50	Cluster-2 10 HP AC - Submersible Water Filled Pump with normal controller	1	Nos		
51	Cluster-2 10 HP DC - Submersible Oil Filled Pump with normal controller	1	Nos		
52	Cluster-2 10 HP AC - Submersible Oil Filled Pump with normal controller	1	Nos		
53	Cluster-2 10 HP DC - Submersible Water Filled Pump with USPC	1	Nos		
54	Cluster-2 10 HP AC - Submersible Water Filled Pump with USPC	1	Nos		
55	Cluster-2 10 HP DC - Submersible Oil Filled Pump with USPC	1	Nos		
56	Cluster-2 10 HP AC - Submersible Oil Filled Pump with USPC	1	Nos		
57	Cluster-2 10 HP DC - Surface Pump with normal controller	1	Nos		
58	Cluster-2 10 HP AC - Surface Pump with normal controller	1	Nos		
59	Cluster-2 10 HP DC - Surface Pump with USPC	1	Nos		
60	Cluster-2 10 HP AC - Surface Pump with USPC	1	Nos		
For Cluster 3 - Madhya Pradesh					
1	Cluster- 3 1 HP DC - Submersible Water Filled Pump with normal controller	1	Nos		
2	Cluster- 3 1 HP AC - Submersible Water Filled Pump with normal controller	1	Nos		
3	Cluster- 3 1 HP DC - Submersible Oil Filled Pump with normal controller	1	Nos		
4	Cluster- 3 1 HP AC - Submersible Oil Filled Pump with normal controller	1	Nos		
5	Cluster- 3 1 HP DC - Surface Pump with normal controller	1	Nos		
6	Cluster- 3 1 HP AC - Surface Pump with normal controller	1	Nos		
7	Cluster- 3 2 HP DC - Submersible Water Filled Pump with normal controller	1	Nos		
8	Cluster- 3 2 HP AC - Submersible Water Filled Pump with normal controller	1	Nos		
9	Cluster- 3 2 HP DC - Submersible Oil Filled Pump with normal controller	1	Nos		
10	Cluster- 3 2 HP AC - Submersible Oil Filled Pump with normal controller	1	Nos		
11	Cluster- 3 2 HP DC - Surface Pump with normal controller	1	Nos		