Government of Rajasthan
RAJASTHAN AGRICULTURAL COMPETITIVENESS PROJECT
II FLOOR, ACADEMIC BLOCK, SIAM CAMPUS, DURGAPURA, JAIPUR-302017
Tel.No.0141-2554215, 2554218; Fax: 0141-2554214; E-mail: pd@racpmis.com

IFB No.IN -PMU-RACP-153471-GO-RFB-2019-20/ 12.8.27 Date: 5/3/20 2

CORRIGENDUM-3

In reference to IFB No.IN -PMU-RACP-153471-GO-RFB-2019-20/10823 dated 23.01.2020 and corrigendum-1 and II issued on 20.02.2020 and 03.03.2020 respectively for Supply, Installation, Testing and Commissioning of Distributed Grid Connected Solar PV system, following para maybe read as

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Reference Clause</th>
<th>Amendment in Bidding Documents</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Section IV – Bidding Forms, Table of Forms, 3. Price Schedule Forms</td>
<td>Attached as Annexure 1 below</td>
</tr>
<tr>
<td>2</td>
<td>Section VII: Schedule of Requirements 3. Technical Specifications</td>
<td>Revised Technical Specifications are as listed in Annexure 2 below</td>
</tr>
<tr>
<td>3</td>
<td>Section VII: Schedule of Requirements 4. Inspection and Tests</td>
<td>Revised Inspection and Test clauses are as listed in Annexure 3 below</td>
</tr>
<tr>
<td>4</td>
<td>Section VII: Schedule of Requirements 2. Detailed Scope of work 2.1 Overall scope Clause 2.1.7</td>
<td>Revised clause 2.1.7&lt;br&gt;2.1.7. The Contractor shall be entirely responsible for the execution of the Scope of Work in accordance to this Bidding Document including but not limited to its specification, schedules, and annexure. The Contractor shall further provide guarantee and be responsible for the quality and workmanship of all materials and completed works, survey, correct designs and drawings in line with MNRE specifications in Annexure A, correct delivery of material, erection, testing, commissioning and comprehensive maintenance</td>
</tr>
<tr>
<td>5</td>
<td>Section VII: Schedule of Requirements 2. Detailed Scope of work 2.1 Overall scope Clause 2.1.12</td>
<td>Revised Clause 2.1.12&lt;br&gt;2.1.12. Submission of brochures, technical specifications, designs, data sheets, etc. at the time of Bidding do not imply approval of the same. All such approvals shall be taken up separately at the time of project execution by the Contractor from Discom</td>
</tr>
<tr>
<td>6</td>
<td>Section VII: Schedule of Requirements 2. Detailed Scope of work 2.1 Overall scope Clause 2.1.13</td>
<td>Revised Clause 2.1.13&lt;br&gt;2.1.13. All final specifications, designs, drawings (in line with MNRE specifications in Annexure A) bill of material, quality assurance plan, etc. shall be inspected, vetted and approved by the Discom/TPDA</td>
</tr>
<tr>
<td>7</td>
<td>Section VII: Schedule of Requirements 2. Detailed Scope of work</td>
<td>2.1.15. It will be mandatory for Contractor to create remote monitoring system to monitor performance of the system post-installation. Detailed specifications of</td>
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<tr>
<td>Page</td>
<td>Section VII: Schedule of Requirements</td>
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<tr>
<td>8</td>
<td>2. Detailed Scope of work</td>
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<tr>
<td></td>
<td>2.1 Overall scope</td>
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<tr>
<td></td>
<td>Clause 2.1.15</td>
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</table>

Remote Monitoring System (RMS) enclosed as Annexure B. It will be mandatory to submit quarterly maintenance report along with performance data of solar power plant online to MNRE and/ or Discom / or RACP in a manner and format prescribed by MNRE and/ or Discom / or RACP.

| Additional Clauses are as follows: |
| 2.1.18. Format for Guarantee Card is attached in Section X: Table of Forms, Form 11. |
| 2.1.19. The contractor shall adopt and implement all required measures to ensure non tampering with any equipment or theft of electricity. This shall include but not limited to, installation of both the energy meters (solar meter and net meter) at adequate height with the metering console and proper sealing |
| 2.1.20. In line with maintenance and servicing report requirement (Section X: Table of Forms, Form 12) cleaning of dust from SPV panel shall be in scope of the contractor |

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<th>Section VII: Schedule of Requirements</th>
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Revised Clause 2.2.3 to read as follows:

2.2.3. The Contractor shall identify a suitable location for the installation of the PV system within the premises of the Agriculture Consumer. This location shall be identified in close coordination with concerned Official of RACP/DISCO and agreement of the Agriculture Consumer in writing. The cable routing of the PV system shall also be mutually agreed upon by the Contractor, RACP/DISCO Official and the Agriculture Consumer in writing. The Scope of Work includes AC cabling for a distance between the inverter and interconnection point.

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<th>Section VII: Schedule of Requirements</th>
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Revised Clause 2.2.4 to read as follows:

2.2.4 The Contractor shall provide prompt service to the Agriculture Consumer in times of fault of breakdown of the PV system. Any complaint received from the Agriculture Consumer/ Discom shall be rectified by the Contractor within 72 (seventy two) hours of such complaint. In case of theft, the complaint is to be resolved within 15 calendar days provided theft is duly certified by the nodal officer. If the down time period for any beneficiary complaint exceeds 72 hours (15 calendar days in case for theft cases) and the contractor fails to make the plant operational, a penalty for the time period exceeding 72 hours (15 calendar days in case for theft cases), as per the below mentioned schedule shall be deposited by the contractor to the concerned AO of circle/ as decided by DISCOM.
<table>
<thead>
<tr>
<th>Section VII: Schedule of Requirements</th>
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<tbody>
<tr>
<td>2. Detailed Scope of work</td>
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<tr>
<td>2.2 Obligation towards Agriculture Consumers</td>
</tr>
<tr>
<td>Additional Clauses</td>
</tr>
</tbody>
</table>

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<thead>
<tr>
<th>Water pump capacity (in HP)</th>
<th>Penalty applicable (in INR per day)</th>
</tr>
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<tbody>
<tr>
<td>5</td>
<td>235</td>
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<tr>
<td>7.5</td>
<td>355</td>
</tr>
</tbody>
</table>

2.2.5. The loss in generation shall be decided on a daily basis

2.2.6. For any system / consumer complaint, the maximum applicable amount as penalty against loss of generation shall not be more than 10% of the respective cost of the SPV system installed at the consumer premises.

2.2.7. The Contractor shall be issued a notice to pay the applicable penalty within 7 days to the concerned AO of circle / as decided by DISCOM. If the Contractor fails to pay the penalty within notice period, the Discom shall encash the Performance Security immediately.

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<tr>
<th>Section VII: Schedule of Requirements</th>
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</thead>
<tbody>
<tr>
<td>2. Detailed Scope of work</td>
</tr>
<tr>
<td>2.3 Interfacing with metering and communication solution provider</td>
</tr>
<tr>
<td>Additional Clause</td>
</tr>
</tbody>
</table>

Clause 2.3.1(a)

2.3.1 (a) Detailed specifications of Remote Monitoring System (RMS) of MNRE enclosed as Annexure B (below) and any further amendment(s) issued by MNRE shall be used by bidder for the purpose of metering and communication.

Revised Clause 2.3.7 to read as follows

Net-Meter: The bi-directional Smart energy meter shall be installed for the measurement of import/Export of energy, as per relevant specifications by MNRE/CEA/Discom. Detailed indicative specifications shall be shared with successful bidder.

Revised Clause 2.3.8 to read as follows

Solar Meter: Uni-directional Smart energy meter shall be installed to log the actual value of Energy generated by the PV system be provided, as per relevant specifications by MNRE/ CEA/Discom. Detailed indicative specifications shall be shared with successful bidder.

Revised Clause 4.1.3 to read as follows

The Contractor shall attend to any complaint from the Agriculture Consumer and rectify any faults or breakdown within a timeframe of 72 (Seventy Two) hours from such complaint. In case of theft, the complaint is to be resolved within 15 calendar days provided theft is duly certified by the nodal officer.
| 16 | Section VII: Schedule of Requirements 4.2 Generation Guarantee Additional Clause | Clause 4.2.6  
In case of theft (duly certified by the nodal officer of the Discom) or, non-availability of grid due to fault in feeder, the DISCOM reserves the right to consider appropriate adjustment in CUF for the corresponding period.  
Revised Clause 6.2.3 to read as follows  
The Contractor shall bear the entire cost of metering arrangement provided including its accessories. The fee and other charges, if applicable, such as security deposit payable to office of Discom & Electrical inspector will also be borne by the contractor. The refund of security deposit and any other charges by Discom against meter already installed at the farmer premises, will accrue to the farmer. |
| 17 | Section VII: Schedule of Requirements 6. Other Key Responsibilities 6.2 Net-Metering of Power Clause 6.2.3 |  |
| 18 | Section IX. SPECIAL CONDITIONS OF CONTRACT GCC 16.1 | GCC 16.1  
Payment shall be made in Indian Rupees in the following manner:  
1. An advance payment may be made on specific request of the contractor @ 10% of the contract value on submission of an irrevocable bank guarantee of equivalent amount (from nationalized/scheduled banks only).  
2. 30% payment would be made after delivery of PV Module along with Balance of System (BoS) required for Distributed Grid Connected Solar PV System.  
For all the payments to be made, against Bank guarantees, the bank guarantee shall be issued by a Scheduled Indian Bank or a foreign bank located in India in the format enclosed at Section VIII. The guarantees issued by other banks should be confirmed by a Scheduled Indian Bank or a foreign bank operating in India.  
Bank guarantees for advance payment shall be released not later than 30 days after the date of completion of supply of the goods at their final destination. |
| 19 | Section IX. SPECIAL CONDITIONS OF CONTRACT GCC 18.1 | Performance Security to the Purchaser shall be for an amount of 10% of the contract value, valid up to 60 days after the date of completion of performance obligations including comprehensive maintenance and completion of Comprehensive Maintenance Contract period |
| 20 | Section IX. SPECIAL CONDITIONS OF CONTRACT GCC 28.3 | The period of validity of the Comprehensive Maintenance Contract shall be: 60 months  
For purposes of the Warranty, the place(s) of final destination(s) shall be: |
If, for reasons attributable to the Supplier, these guarantees are not attained in whole or in part, the Supplier shall, at its discretion, either:

(a) make such changes, modifications, and/or additions to the Goods or any part thereof as may be necessary in order to attain the contractual guarantees specified in the Contract at its own cost and expense and to carry out further performance tests in accordance with SCC 4,

or

(b) pay liquidated damages to the Purchaser with respect to the failure to meet the contractual guarantees. The rate of these liquidated damages shall be 10% of contract price

| 21 | Section X – Contract forms  
|    | Table of Forms  
|    | 9. Installation Certificate  
|    | Form 9 - Installation Certificate Revised as in Annexure 4 below |
| 22 | Section X – Contract forms  
|    | Table of Forms  
|    | 11. Guarantee Card  
|    | Form 11 - Installation Certificate Revised as in Annexure 5 below |
| 23 | Section X – Contract forms  
|    | Table of Forms  
|    | 12. Maintenance and Service Report  
|    | Form 12 - Installation Certificate Revised as in Annexure 6 below |
| 24 | Section X – Contract forms  
|    | Table of Forms  
|    | 13. Operational Acceptance  
|    | 14. Taking over Certificate  
|    | Formats will be provided after award of contract |

The last date of submission of bid has been extended from 06.03.2020 to 20.03.2020 up to 2:00 P.M. The bid will be opened on the same day at 2:30 P.M. The bid security shall be valid for the period up to 165 days from the revised date of bid submission. Other terms and conditions of the bidding document will remain unchanged.

(Dr. V.P. Singh)  
Joint Director Ag.
### PRICE SCHEDULE FORMS

#### 3. PRICE SCHEDULE AS per Schedule of Requirements

<table>
<thead>
<tr>
<th>Line Item No</th>
<th>Description of Goods</th>
<th>Delivery Date</th>
<th>Quantity and physical unit in Nos.</th>
<th>Unit price EXW [including excise duty if any] (Col. 4x5)</th>
<th>Total EXW price per line item [including Excise Duty if any]</th>
<th>Price per line item for inland transportation, insurance and other services required to convey the Goods to their final destination (ITB 14.8 (a)(ii))</th>
<th>GST payable per item if Contract is awarded (in accordance with ITB 14.8(a)(ii))</th>
<th>Total Price per line item (Col. 6+7) excluding GST</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Supply, Installation, Testing, Commissioning and Maintenance of Distributed Grid Connected Solar PV System</td>
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</tr>
<tr>
<td>1</td>
<td>8 kWp</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>12 kWp</td>
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<tr>
<td><strong>Total Price Quoted</strong></td>
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</table>
- The bidder must quote rate for all the items as mentioned in the price schedule.
- The unit price shall include the cost of comprehensive maintenance contract (CMC) for 5 years.
- In case of discrepancy between unit price and total price, the unit price shall prevail. Total Price is only for evaluation purpose and purchase orders will be issued by Purchaser and/or Users using unit price quoted above.

| Name of Bidder [insert complete name of Bidder] | Signature of Bidder [signature of person signing the Bid] | Date [insert date] |
3. TECHNICAL SPECIFICATIONS

3.1. PV System Capacity

3.1.1. The AC and DC Capacity of the grid-connected PV system shall be based on the sanctioned load of the Agriculture Consumer’s pump connection. In case the Agriculture Consumer is applying addition/alteration in sanctioned load, prior to installation of the PV system, then the Contractor shall size the PV system based on the revised capacity of the connection as confirmed by the Discom.

3.1.2. The AC and DC Capacity of the PV system shall be based on the pump connection capacity as follows:

<table>
<thead>
<tr>
<th>S.N. No.</th>
<th>Sanctioned Load (HP)</th>
<th>Minimum AC (Inverter) Capacity (kW)</th>
<th>Minimum DC (PV Module) Capacity (kW @STC)</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>5</td>
<td>8</td>
<td>8</td>
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<td>2</td>
<td>7.5</td>
<td>12</td>
<td>12</td>
</tr>
</tbody>
</table>

3.2. APPLICABLE STANDARDS

3.2.1. Table of Applicable Standard with description

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Applicable Standard</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Solar PV Modules</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(a) IEC 61215/IS 14286</td>
<td>Design qualification and type of approval for crystalline silicon Terrestrials photovoltaic Modules</td>
</tr>
<tr>
<td></td>
<td>(b) IEC 61853-1/IS 16170-1</td>
<td>Photovoltaic (PV) module performance testing and energy rating-Irradiance and temperature performance measurements and power rating</td>
</tr>
<tr>
<td></td>
<td>(c) IEC 61730-1.2</td>
<td>Photovoltaic (PV) Module safety Qualifications</td>
</tr>
<tr>
<td></td>
<td>(d) IEC 62759-1</td>
<td>Photovoltaic (PV) modules - Transportation testing</td>
</tr>
<tr>
<td></td>
<td>(e) IEC 61701:</td>
<td>Salt Mist Corrosion Testing of Photovoltaic (PV) Modules</td>
</tr>
<tr>
<td></td>
<td>(f) IEC 62716:</td>
<td>Photovoltaic (PV) Modules – Ammonia (NH3) Corrosion Testing (As per the site condition like dairies, toilets)</td>
</tr>
<tr>
<td></td>
<td>Solar PV Grid-tie Inverters</td>
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<tr>
<td></td>
<td>(a) IEC 62109-1,2</td>
<td>Safety of power converters for use in photovoltaic power systems</td>
</tr>
<tr>
<td></td>
<td>(b) BS EN 50530:2010+A1:2013 /IEC 62891</td>
<td>Overall efficiency of grid connected photovoltaic inverters</td>
</tr>
<tr>
<td></td>
<td>(c) IEC 61683</td>
<td>Photovoltaic Systems — Power conditioners: Procedure for Measuring Efficiency (10%, 25%, 50%, 75% &amp; 90-100% Loading Conditions)</td>
</tr>
<tr>
<td></td>
<td>(d) IEC 62116/UL 1741/IEEE 1547</td>
<td>Utility-interconnected photovoltaic inverters - Test procedure of islanding prevention measures</td>
</tr>
<tr>
<td></td>
<td>(e) VDE V 0126-1-1</td>
<td>Automatic disconnection device between a generator and the public low-voltage grid</td>
</tr>
<tr>
<td></td>
<td>(f) IEC 60255-27:2013</td>
<td>Measuring relays and protection equipment - Part 27: Product safety requirements</td>
</tr>
<tr>
<td></td>
<td>(g) IEC 60068-2(1,2,14,27,30,64)</td>
<td>Environmental testing of PV system — Power Conditioners and inverters</td>
</tr>
<tr>
<td></td>
<td>(h) IEC 62093</td>
<td>Balance-of-system components for photovoltaic systems - Design qualification natural environments</td>
</tr>
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<thead>
<tr>
<th></th>
<th>Fuses and switches</th>
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<tbody>
<tr>
<td></td>
<td>(a) IS/IEC 60947(1,2,3),EN 50521</td>
<td>General Requirements for connectors, switches, circuit breakers (AC/DC)</td>
</tr>
<tr>
<td></td>
<td>(b) IEC 60269-6</td>
<td>Supplementary requirements for fuse-links for the protection of solar photovoltaic energy systems</td>
</tr>
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<tr>
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<th>Cables</th>
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<tr>
<td></td>
<td>(a) IEC 60227/IS694, IEC 60502/IS 1554(1,2)</td>
<td>General Test and measuring method for PVC insulated cables</td>
</tr>
<tr>
<td></td>
<td>(b) IS 7098-1</td>
<td>Cross linked polyethylene insulated PVC sheathed cables up to 1000 V</td>
</tr>
<tr>
<td></td>
<td>(c) BS EN 50618</td>
<td>Electric cables for photovoltaic systems, mainly for DC cables</td>
</tr>
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<tr>
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<th>Surge Arrestors</th>
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<tbody>
<tr>
<td></td>
<td>(a) IEC 61643-11/IS 15086-5</td>
<td>Low voltage surge and protection devices, requirements and test methods</td>
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<tr>
<td></td>
<td>(b) BFC 17-102:2011</td>
<td>Lightning Protection Standard</td>
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<th>Earthing/ Lightning</th>
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<tbody>
<tr>
<td></td>
<td>(a) IEC 62561 (1,2,7)</td>
<td>Lightning protection system components</td>
</tr>
</tbody>
</table>
3.2.2. If the equipment offered by the Contractor conform to other standards, salient points of difference between the standards adopted and the specific standards shall be clearly brought out in relevant schedule. In case of any difference between provisions of these standards and provisions of this specification, the provisions contained in this specification shall prevail. One hard copy of such standards with authentic English Translations shall be furnished for consideration of such approvals.

3.3. **PV Modules**

3.3.1. The Contractor shall employ solar PV module of mono/poly-crystalline silicon solar technology only. The Contractor shall provide detail Technical Data Sheets, Certifications of Standard Testing Conditions (STC: defined as Standard Testing Condition with air mass AM1.5, irradiance 1000W/m2, and cell temperature 25°C) as per the latest edition of IEC 61215 and IEC 61730 and as tested by MNRE/IEC-recognized test laboratory.

3.3.2. The PV modules to be employed shall fulfil MNRE’s criteria of domestic content requirement. The manufacturer of the PV module shall have supplied net PV modules of a capacity more than 5 MW in other projects, and the same shall be successfully performing for over 1 year prior to the date of submission of the Bid.

3.3.3. PV modules shall consist of 60 or 72 numbers of solar cells, each with a dimension of 156 mm x 156 mm. PV modules with 60 cell configuration shall have a minimum capacity of 250 W at STC, while PV modules with 72 cell configuration shall have a minimum capacity of 300 W at STC.

3.3.4. The rated power of solar PV module shall have maximum tolerance upto +3%. No negative tolerance in the rated capacity of solar PV module is allowed.

3.3.5. All PV modules shall be certified IEC 61215 2nd Ed. (Design qualification and type approval for Crystalline Si modules), IEC 61730 (PV module safety qualification testing @ 1000 V DC or higher).

3.3.6. Minimum certified PV module efficiency shall be 15.75% for crystalline. The temperature co-efficient power of the PV module shall not be less than - 0.50% / °C.
3.3.7. All PV modules shall carry a performance warranty of >90% during the first 10 years, and >80% during the next 15 years. Further, module shall have performance warranty of >97% during the first year of installation. Degradation of module shall not be more than 0.7% per annum.

3.3.8. All PV modules shall be PID-free, and documents for the same shall be submitted with conditions of the PID test for a humidity of 85% and a cell temperature of 85°C at 1000VDC.

3.3.9. The warranty on the workmanship of the PV modules including its electrical connections and mechanical construction shall be at least for 5 (five) years.

3.3.10. The mismatch losses for PV modules connected to an inverter shall be less than 1%.

3.3.11. PV module shall have module safety class-II and shall be highly reliable, light weight and must have a service life of more than 25 years.

3.3.12. The PV modules shall be equipped with IP67 or higher protection level junction box with a minimum of 3 (three) numbers of bypass diodes of appropriate rating and appropriately sized output power cable of symmetric length with MC4 or equivalent solar connectors.

3.3.13. The SPV module shall be made up of high transmissivity glass and front surface shall give high encapsulation gain and the module shall consists of impact resistance, low iron and high transmissibility toughened glass. The module frame shall be made of corrosion resistant anodized aluminium, which shall be electrically compatible with the structural material used for mounting the modules.

3.3.14. The PV modules shall have suitable encapsulation and sealing arrangements to protect the silicon cells from environment. The encapsulation arrangement shall ensure complete moisture proofing for the entire life of PV modules.

3.3.15. The PV module frame shall be made of aluminium or corrosion resistant material, which shall be electrolytically compatible with the structural material used for mounting the PV modules.

3.3.16. All materials used for manufacturing solar PV module shall have a proven history of reliability and stable operation in external applications. It shall perform satisfactorily in temperature between -40°C to +85°C and shall withstand adverse climatic conditions, such as high speed wind, blow with dust, sand particles, saline climatic/or soil conditions.

3.3.17. Modules only with the same rating and manufacturer shall be connected to any single inverter.

3.3.18. The Bidder shall provide in the Bid power performance test data sheets of all modules. The exact power of the module shall be indicated if the data sheet consists of a range of modules with varying output power.

3.3.19. RACP or the Discom or the TPIA reserves the right to inspect the PV modules at the manufacturer’s site prior to dispatch.

3.3.20. The Contractor would be required to maintain accessibility to the list of module IDs/
3.3.21. Modules deployed must use a RF identification tag. The following information must be mentioned in the RFID used for each module (This should be inside laminate only and must be able to withstand harsh environmental conditions).

(a) Name of the manufacturer of the PV module
(b) Name of the manufacturer of Solar Cells.
(c) Month & year of the manufacture (separate for solar cells and modules)
(d) Country of origin (separately for solar cells and module)
(e) I-V curve for the module Wattage, Im, Vm and FF for the module
(f) Unique Serial No and Model No of the module
(g) Date and year of obtaining IEC PV module qualification certificate.
(h) Name of the test lab issuing IEC certificate.
(i) Other relevant information on traceability of solar cells and module as per ISO 9001 and ISO 14001

3.4. GRID-TIE INVERTER

3.4.1. Specifications for SPV water pumping systems of MNRE vide Circular No. F. No.41/3/2018-SPV Division dated 17.7.2019 enclosed as Section L.3 and any further amendment(s) issued by MNRE, shall be applicable under this tender.

3.4.2. Make of only those Grid-tie Inverters which are commissioned for more than 1 MW capacity in other solar PV projects in India and operational for more than 1 (year) shall be considered.

3.4.3. The Contractor shall provide sufficient information for the satisfaction of RACP / Discom prior placing the order for the inverters.

3.4.4. All inverters shall consist of associated control, protection and data logging devices and remote monitoring hardware, software for string level monitoring.

3.4.5. Capacity of single unit of inverter shall be at least 5 kW.

3.4.6. Inverter shall conform to the following details:

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Particulars</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Nominal AC Output Voltage</td>
<td>As per the manufacturer’s guidelines</td>
</tr>
<tr>
<td>2</td>
<td>Type of solar charge controller</td>
<td>415 VAC ±15%, 3 phase, 50 Hz</td>
</tr>
<tr>
<td>3</td>
<td>Switching Devices</td>
<td>MPPT-based Solar Charge Controller</td>
</tr>
<tr>
<td>4</td>
<td>Maximum Input Voltage</td>
<td>MOSFET/ IGBT-based</td>
</tr>
<tr>
<td>5</td>
<td>Output Waveform</td>
<td>Not more than 1000 VDC</td>
</tr>
<tr>
<td>6</td>
<td>DC voltage range, MPPT</td>
<td>Pure Sine wave</td>
</tr>
<tr>
<td>7</td>
<td>Peak Efficiency</td>
<td>As per design</td>
</tr>
<tr>
<td>8</td>
<td>Euro Efficiency</td>
<td>At least 97%, measure as per IEC 61683</td>
</tr>
<tr>
<td>9</td>
<td>Output frequency</td>
<td>At least 96%, measure as per IEC 61683</td>
</tr>
<tr>
<td>10</td>
<td>Power Factor</td>
<td>50 Hz +3% to - 5% Hz</td>
</tr>
<tr>
<td>11</td>
<td>Maximum THD at rated power</td>
<td>0.8 lag- 0.8 lead</td>
</tr>
<tr>
<td>12</td>
<td>Ambient dry bulb temperature range</td>
<td>≤ 3 % 0 to 50° deg C</td>
</tr>
<tr>
<td>13</td>
<td>Humidity</td>
<td>15% to 95% non-condensing</td>
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14. Enclosure | At least IP21 for indoor installation. At least IP65 for outdoor installation, as per IEC-60068-2 (environmental)

15. Protection rating (as per IEC-60721-3-3) | Classification of chemically active substances: 3C2
| Classification of chemically active substances: 3S2

16. Grid Specifications | IEC 61727, VDE 0126

17. Nominal Voltage & Frequency | 415 Volts, 3-phase & 50 Hz

18. Grid Voltage Tolerance | ± 15% and -10%

19. Communication protocol and interface | Modbus protocol over RS-485 interface

3.4.7. The inverters shall comply with applicable IEC/ equivalent BIS standard for environmental tests as per standard codes IEC 60068-2 (1,2,14,30)/ Equivalent BIS Standard.

3.4.8. All inverters shall be IEC 61000 compliant for electromagnetic compatibility, harmonics, etc.

3.4.9. All inverters shall be safety rated as per IEC 62109 (1 & 2), EN 50178 or equivalent DIN or UL standard.

3.4.10. All inverters shall be compliant with IEEE standard 929-200 or equivalent. The Contractor shall select the inverter as per its own system design so as to optimize the power output.

3.4.11. Display: The inverter shall have LCD (Liquid crystal display) and keypad for monitoring instantaneous parameters, event logs and data logs. Display should be simple and self-explanatory, and should indicate:
(a) Instantaneous DC power input
(b) DC input voltage
(c) DC Current
(d) Instantaneous active AC power output
(e) Instantaneous reactive AC power output
(f) AC voltage (all the 3 phases and line)
(g) AC current (all the 3 phases and line)
(h) kWh Produced during entire day
(i) Total kWh produced during its life time
(j) PCU must be provided with display

3.4.12. DC input terminals must be in enough numbers so as each terminal is connected to dedicated single input from the PV string. Two DC inputs cannot be connected to a single input DC terminal of the inverter. If adequate number of inputs are not available in the selected inverter by the Contractor then a DC junction box shall be incorporated into the design.

3.4.13. The inverter shall be tropicalized and design shall be compatible with conditions prevailing at site. Provision of exhaust fan with proper ducting for cooling of inverter’s internal circuitry shall be incorporated in the inverter, keeping in mind the extreme climatic condition of the site.
3.4.14. The Contractor shall completely adhere to the installation guidelines of the inverter manufacturer including but not limited to protection from exposure to sun, rain and other weather condition.

3.4.15. Nuts and bolts and the PCU enclosure shall have to be adequately protected taking into consideration the atmosphere and weather prevailing in the area.

3.4.16. (Grid Connectivity) CERC/ RERC regulations and grid code as amended and revised from time to time shall be complied with.

3.4.17. All three phases shall be supervised with respect to rise/fall in programmable threshold values of frequency.

3.4.18. The inverter output shall always follow the grid in terms of voltage and frequency. This shall be achieved by sensing the grid voltage and phase and feeding this information to the feedback loop of the inverter. Thus, control variable then shall control the output voltage and frequency of the inverter, so that inverter is always synchronized with the grid.

3.4.19. The inverter shall be capable of synchronizing with the grid in less than 1 (one) minute.

3.4.20. The inverter shall automatically “wake up” in the morning and begin to export power provided there is sufficient solar energy and the grid voltage and frequency is in range.

3.4.21. Sleep Mode: Automatic sleep mode shall be provided so that unnecessary losses are minimized at night. The power conditioner must also automatically re-enter standby mode when threshold of standby mode reached.

3.4.22. Stand-by Mode: The control system shall continuously monitor the output of the solar power plant until pre-set value is exceeded & that value to be indicated.

3.4.23. Basic System Operation (Full Auto Mode): The control system shall continuously monitor the output of the solar power plant until pre-set value is exceeded and that value to be indicated.

3.4.24. The inverter shall include appropriate self-protective and self-diagnostic features to protect itself and the PV array from damage in the event of inverter component failure or from parameters beyond the inverter’s safe operating range due to internal or external causes. The self-protective features shall not allow signals from the inverter front panel to cause the inverter to be operated in a manner which may be unsafe or damaging. Faults due to malfunctioning within the inverter, including commutation failure, shall be cleared by the inverter’s protective devices. In addition, the inverter shall have following minimum protection against various possible faults:
   (a) Ground fault monitoring
   (b) Grid monitoring
   (c) DC surge protection. Type II (if the inverter does not have integrated DC surge arrestors, then the surge arrestors shall be separately installed in the DC junction box on the positive and negative DC inputs)
   (d) DC reverse polarity
   (e) AC short-circuit capability
   (f) Over-voltage and over-current
(g) Anti-islanding (as per IEEE 1547/UL 1741/ equivalent BIS standard)
(h) Balancing of unequal phases
(i) Negative earthing
(j) Manual DC isolator

3.4.25. Reactive Power: The output power factor of the inverter shall be of suitable range to supply or sink reactive power. The inverter shall have internal protection arrangement against any sustained fault in the feeder line and against lightning in the feeder line.

3.4.26. Inverter shall meet the reactive Power requirement of the induction motor pump set installed in Agriculture connections.

3.4.27. DC inputs of the inverters shall have suitably rated isolators on both positive and negative DC inputs to allow safe start up and shut down of the system. Circuit breakers used in the DC lines must be rated suitably.

3.4.28. No load loss < 1% of rated power and maximum loss in sleep mode shall be less than 0.05%.

3.4.29. The inverter shall have the facility of unit wise and integrated data logging.

3.4.30. The inverter shall be entirely self-managing and stable in operation. A self- diagnostic system check shall occur on start-up. Functions shall include a test of key parameters on start up.

3.4.31. The inverters shall be tested from the MNRE approved test centres/ NABL/BIS/IEC- accredited testing/ calibration laboratories.

3.4.32. Maximum power point tracker (MPPT) shall be integrated in the inverter to maximize energy drawn from the Solar PV array. The MPPT shall be microprocessor- based to minimize power losses. The MPPT unit shall confirm to IEC 62093 for design qualification and efficiency of MPPT shall be greater than 99%.

3.4.33. Inverter shall be capable to convert the DC using its MPPT feature to produce AC power as per following:

(a) The AC output voltage and frequency of the inverter must synchronize automatically to the exact AC voltage and frequency of the grid. Grid voltage shall be continuously monitored and in the event of voltage dip or rise above a pre-set value, the solar system shall be disconnected from the grid within the set time.
(b) In the case of inverters connected on different phases in the plant shall be capable of communicating with other and in the event of the fault even on a single phase all the inverters must be disconnected from the grid.
(c) Inverters shall have adjustable voltage setting and time settings. The output power factor shall be of suitable range to supply or sink reactive power.

3.4.34. The inverter shall have an RS-485 interface and support communication of its operational parameters and logs over Modbus protocol. The register mapping/ memory mapping of the inverter data shall be made available by the Contractor from the inverter supplier and the Contractor/ inverter supplier shall provide full support for integration of inverter's communication data with third- party software and hardware as directed by the Discom.

3.4.35. RACP or the Discom or the TPIA reserves the right to inspect the inverters at the
manufacturer’s site prior to dispatch.

3.4. (A) SPV CONTROLLER

3.4.1. Maximum Power Point Tracker (MPPT) shall be included to optimally use the power available from the SPV array and maximize the water discharge.

3.4.2. The SPV Controller must have IP (65) protection or shall be housed in a cabinet having at least IP (65) protection.

3.4.3. Adequate protections shall be provided in the SPV Controller to protect the solar powered pump set against the following:

   a) Dry running;
   b) Open circuit;
   c) Accidental output short circuit;
   d) Under voltage;
   e) Reverse polarity;
   f) SPD to arrest high current surge; and
   g) Lightening arrester.

3.4.4. A good reliable DC Circuit Breaker as per IS/IEC 60947-2 suitable for switching DC power ON and OFF shall be provided in the SPV Controller.

3.4.5. All cables used shall be as per IS 694. Suitable size of cable shall be used in sufficient length for inter-connection between the SPV array to SPV Controller and the SPV Controller to solar powered pump set. Selection of the cable shall be as per IS 14536.

3.4.6. Controller shall be integrated with GSM/GPRS Gateway with Geo tagging. GSM/ GPRS Charges to be included in the Costing till the end of Warranty period of the Pump set.

3.5. MODULE MOUNTING STRUCTURE

3.5.1. Specification of module mounting structure shall be in line with specifications for SPV water pumping systems of MNRE vide Circular No. F. No. 41/3/2018-SPV Division dated 17.7.2019 enclosed as Annexure A and any further amendment(s) issued by MNRE.

3.5.2. Supply, installation, erection and acceptance of module mounting structure (MMS) with all necessary accessories, auxiliaries and spare part shall be in the scope of the Contractor.

3.5.3. Design of MMS shall take into consideration site conditions, soil report, loading data, wind data and design standards as per latest applicable standard.

3.5.4. The structure shall be designed for simple mechanical and electrical installation. It shall support SPV modules at a given orientation and tilt, absorb and transfer the mechanical loads to the ground properly.

3.5.5. The Contractor shall be fully responsible for any damages caused by high wind velocity within guarantee period. The parameters of prevailing wind speed, soil conditions, load, and upward lift shall be taken care of while preparing the design and the same is required to be mentioned on design.
3.5.6. MMS shall be designed and positioned such that the PV modules are completely shadow-free solar during generation hours.

3.5.7. All solar panels shall be easily accessible for cleaning and the Agriculture Consumer shall not be inclined to climb on the MMS or PV modules for cleaning the PV modules.

3.5.8. Junction boxes shall be mounted on the MMS such that they are easily accessible and are protected from direct sunlight and harsh weather.

3.5.9. All the cables shall be aesthetically tied to module mounting structure.

3.5.10. Cutting, Welding, drilling etc. at site is not allowed for MMS. Contractor shall carry out all correction in structure (if required) at his works. If any cutting, welding, drilling is required to be done after material arrived at site then material shall be again sent for hot dip galvanization. No zinc spray shall be allowed on the MMS.

3.5.11. Contractor shall submit the all the quality test documents and test certificates complying with the requirement of the structure.

3.5.12. Contractor shall submit detailed drawings of the MMS and its civil foundations in line with MNRE specifications placed in Annexure A, results of design computations and stability calculations for foundations, and structural fitness of PV module mounting structures as per STADD Pro analysis.

3.6. DC JUNCTION BOX

3.6.1. The Contractor shall provide sufficient numbers of array junction boxes/ PV combiner boxes/ DC distribution boxes to comply with design requirements of the PV system.

3.6.2. All switch boards shall be provided with adequately rated bus-bar, incoming control, outgoing control etc. as a separate compartment inside the panel to meet the requirements of the Chief Electrical Inspector of Government (CEIG). All live terminals and bus bars shall be shrouded. The outgoing terminals shall be suitable to receive suitable runs and size of cables required for the inverter/transformer rating.

3.6.3. The degree of protection for junction boxes shall be:
   (a) Indoor Junction box: IP 21 (Minimum)
   (b) Outdoor Junction Box: IP 65 (Minimum)

3.6.4. Junction boxes including the module junction box, string junction box, shall be equipped with appropriate functionality, safety (including fuses, grounding, etc.), and protection (surge, etc.) if not provided on the DC-side of the inverter.

3.6.5. The terminals shall be connected to bus bar arrangement of proper sizes to be provided. The junction boxes shall have suitable cable entry points fitted with cable glands of appropriate sizes for both incoming and outgoing cables. Suitable markings shall be provided on the bus bars for easy identification and cable ferrules will be fitted at the cable termination points for identification.

3.6.6. For array junction box/ PV combiner box, Contractor may also provide polyamide glands and MC4 Connectors. The rating of the junction box shall be suitable with adequate safety factor to interconnect the Solar PV array.
3.6.7. The junction boxes shall be dust, vermin, and waterproof and made of thermoplastic/metallic in compliance with IEC 62208, which shall be sunlight/UV-resistant as well as fire retardant and Protection Class II or higher.

3.6.8. The current carrying rating of the Junction Boxes shall be rated with standard safety factor to interconnect the Solar PV array.

3.6.9. Suitable markings shall be provided on the bus-bars for easy identification and cable ferrules will be fitted at the cable termination points for identification.

3.6.10. Detailed junction box specifications, certifications and data sheet shall be provided by the Contractor for approval during project execution.

3.6.11. RACP or the Discom or the TPIA reserves the right to inspect the junction box at the manufacturer’s site prior to dispatch.

3.6.12. It is recommended that the interim, the cables of 1000 Volts DC for outdoor installations shall comply with the draft EN 50618 for service life expectancy of 25 years.

3.7. AC DISTRIBUTION BOARD

3.7.1. The inverter output shall have the necessary rated AC surge arrestors and MCB/MCCB. MCB shall be used for currents up to 63 Amperes, and MCCB shall be used for currents greater than 63 Amperes. RCCB shall be used by the Agency if required for successful operation of the PV system.

3.7.2. AC Distribution Board (ACDB) shall house all the equipment described above.

3.7.3. All switches and the circuit breakers, connectors shall conform to IEC 60947, part I, II and III/IS60947 part I, II and III.

3.7.4. All the 415 VAC devices/ equipment like bus support insulators, circuit breakers, SPDs, VTs etc., mounted inside the switchgear shall be suitable for continuous operation and satisfactory performance under the following supply conditions:
(a) Variation in supply voltage: +/- 15 %
(b) Variation in supply frequency: +/- 3 Hz

3.8. CABLES AND WIRES

3.8.1. All cables and connectors for use for installation of solar field must be of solar grade which can withstand harsh environment conditions for 25 years and voltages as per latest IEC standards. (Note: IEC standards for DC cables for PV systems is under development, the cables of 1000 volts DC for outdoor installations shall comply with the draft EN 50618 for service life expectancy of 25 years.)

3.8.2. Wires with sufficient ampacity and parameters shall be designed and used so that average voltage-drop at full power from the PV modules to inverter shall not be more than 2% (including diode voltage drop). PV Modules shall be connected with USE-2/RHW-2 cables array to junction box conductors and junction box to photovoltaic disconnector with the sunlight resistant insulation cable. Due consideration shall be made for the de-rating of the cables with respect to the laying pattern in buried trenches/on cable trays, while sizing the cables. The Contractor shall provide voltage drop
calculations in excel sheet during the design approvals.

3.8.3. All cables shall be supplied in the single largest length to restrict the straight-through joints to the minimum number. Only terminal cable joints shall be accepted. No cable joint to join two cable ends shall be accepted. All wires used on the LT side shall conform to IS and shall be of appropriate voltage grade. Only copper conductor wires of reputed make shall be used for DC connections, while copper or aluminium conductor wires may be used for AC connections.

3.8.4. Insulation shall be LT PVC Type-C conforming to the requirements given in Table -I of IS: 5831/1984 with latest amendments. The thickness of inner sheath shall be as given in Table 4 of IS 1554 (Pt-I)/1988. The outer sheath shall consist if type ST-2 PVC Compound conforming to the requirements of IS:5831/1984. The thickness and tolerance on thickness of insulation shall be as per Clause No. 9.2 of IS 1554(Pt- I)/1988

3.8.5. Cable routing/ marking: All cable/ wires are to be suitably tagged and marked with proper manner by good quality ferule or by other means so that the cable easily identified.

3.8.6. The cables shall be adequately insulated for the voltage required and shall be suitably colour coded for the required service. Bending radius for cables shall be as per manufacturer's recommendations and IS: 1255.

3.8.7. All the cables required for the installation provided by the Contractor. All cable schedules/ layout drawings shall be submitted by the Contractor for approval of RACP or the Discom or TPIA prior to installation.

3.8.8. Multi-strand, annealed high conductivity copper conductor PVC type ‘A’ pressure extruded insulation. Overall PVC insulation for UV protection Armoured cable shall be used for underground laying (if required). All cable trays including covers to be provided. All cables conform to latest edition of IEC/ equivalent BIS Standards as specified below: BoS item / component Standard Description Standard Number Cables General Test and Measuring Methods, PVC insulated cables for working Voltage up to and including 1100 V .UV resistant for outdoor installation IS/IEC 69947.

3.8.9. Technical Specification of LT PVC Cables: General Constructional Features

(a) The medium voltage cables shall be supplied, laid, connected, tested and commissioned in accordance with the drawings, specifications, relevant Indian Standards specifications, manufacturer’s instructions. The cables shall be delivered at site in original drums with manufacturer’s name, size, and type, clearly written on the drums.

(b) Material: The conductor shall be composed of plain aluminium or copper wires complying with IS:8130/1984 with latest amendments.

(c) Conductor: Uncoated, annealed copper, of high conductivity upto 4 mm² size, the conductor shall be solid and above 4 mm², conductors shall be concentrically stranded as per IEC: 228.

(d) Insulation: Insulation shall be LT PVC Type -C confirming to the requirements given in Table-I of IS 5831/1984 with latest amendments.
(e) Core Identification:

Two core : Red and Black
Three core : Red, Yellow and Blue
Four core  : Red, Yellow, Blue and Black
Single core: Green cable with Yellow strips for earthing Black shall always be used for neutral. Solar DC cable shall be black with red strip for positive and black for negative in colour.

3.8.10. Armour: All cables laid underground shall be armoured. And laid in ground at a minimum depth of 0.5 meter. Armour shall be of galvanised steel flat strip/ round wires applied helically in single layers complete with covering the assembly of cores.

(a) For cable size up to 25 Sq. mm. Armour of 1.4 mm dia G.I. round wire
(b) For cable size above 25 Sq. mm. Armour of 4 mm wide 0.8 mm thick G.I strip.

3.8.11. Sheath: The cable shall be rated extruded for XLPE 90°C. Inner sheath shall be extruded type and shall be compatible with the insulation provided for the cables. Outer sheath shall be of an extruded type layer of suitable PVC material compatible with the specified ambient temp 50°C and operating temperature of cables. The sheath shall be resistant to water, ultraviolet radiation, fungus, termite and rodent attacks. The colour of outer sheath shall be black. Sequential length marking required at every 1.0 meter interval on outer sheath shall be available. The Contractor shall furnish resistance/ reactance/ capacitances of the cable in the technical datasheet. Packing and marking shall be as per Clause No. 18 of IS 7098 (part I)/1988 amended up to date.

3.8.12. Cable terminations shall be made with suitable cable lugs and sockets, crimped properly and passed through brass compression type cable glands at the entry and exit point of the cubicles.

3.8.13. All cable/wires shall be provided with Punched Aluminium tags only. The marking on tags shall be done with good quality letter and number ferrules of proper sizes so that the cables can be identified easily.

3.8.14. The wiring for modules interconnection shall be in the GI/ HDPE/DWC Pipe of reputed make.

3.8.15. The RS-485 cable from inverter to the metering box shall be armoured and may be laid along with the AC power cables only if there is no mutual interference. In case any interference is found between the power cables and the RS-485 cable, the RS-485 cable shall be separated by the Contractor from AC power cable with a clearance of 300 mm.

3.9. LIGHTENING PROTECTION FOR PV ARRAY

3.9.1. All PV systems shall have lightning protection.

3.9.2. The source of over voltage can be lightning or other atmospheric disturbance. Main aim of over voltage protection is to reduce the over voltage to a tolerable level before it reaches the PV or other sub-system components as per IS: 2309 – 1989 (Reaffirmed-2005), Edition 3.1 (2006-01).

3.9.3. Necessary foundation/ anchoring for holding the lightning conductor in position to be made after giving due consideration to shadow on PV array, maximum wind speed and maintenance requirement at site in future.
3.9.4. The lightning conductor shall be earthed through flats and connected to the earth mats as per applicable Indian Standards with earth pits. Two earth pits shall be provided for each lightning arrester. Each lightning conductor shall be fitted with individual earth pit as per required Standards including accessories, and providing masonry enclosure with cast iron cover plate having locking arrangement, watering pipe using charcoal or coke and salt as required as per provisions of IS & Earth Resistance of Lightening System must be less than one (1) Ohm.

3.9.5. If necessary more numbers of lightning conductors may be provided. The Contractor is also free to provide franklin rod/ early streamer type of lightning arrestors on the MMS structure designed in such a way not to cast shadow on the next row of solar PV modules.

3.9.6. The Contractor shall submit the drawings and detailed specifications of the PV array lightning protection equipment to the RACP or Discom or TPIA for approval before installation of system.

3.9.7. Contractor shall provide dedicated earth pits for Lightening Arrester as per relevant IS standard.

3.10. POWER EVACUATION

3.10.1. Individual plant shall be connected to grid as per guidelines of CEA, RERC and Chief Electrical Inspector.

3.10.2. The output power from PV array would be fed to the inverters which converts DC produced by PV array to AC and feeds it into the main electricity grid after synchronization. In case of grid failure, or low or high voltage, solar PV system shall be out of synchronization and shall be disconnected from the grid.

3.10.3. Contractor shall follow the maximum capacity for interconnection with the grid at a specific voltage level shall be as specified in the Distribution Code/Supply Code of the State and amended from time to time.

3.10.4. Interconnection Voltage level: All solar plant interconnection voltage level shall be at LT 415VAC, 3-phase, 50 Hz.

3.11. EARTHING

3.11.1. Each array structure of the PV yard, LT power system, earthing grid for switchyard, all electrical equipment, inverter, all junction boxes, etc. shall be grounded properly as per IS 3043-1987. All metal casing/ shielding of the plant shall be thoroughly grounded in accordance with Indian Electricity Act/ Rules.

3.11.2. Each string/ array and MMS of the plant shall be grounded properly. The array structures are to be connected to earth pits as per IS standards. Necessary provision shall be made for bolted isolating joints of each earthing pit for periodic checking of earth resistance.

3.11.3. The complete earthing system shall be mechanically and electrically connected to provide independent return to earth.
3.11.4. Earthing bus bar shall be terminated at both ends of the switchgear to suit the connections to outside earthing conductor. All components and the module are required to be earthed individually and are to be looped and connected to the earthing grid.

3.11.5. There will be three separate earthings viz. one for Lightening, Arrester, another for all mounting structure and third earthing for inverter and all electrical circuit

3.11.6. Earthing system shall consist of earth grids and electrodes buried in soil in the plant area, embedded in concrete inside the buildings/rooms to which all the electrical equipment, metallic structures are connected to have earth continuity for safety reasons.

3.11.7. All the bolts of earthing system shall be of Stainless steel (SS) type.

3.11.8. Minimum earthing conductor size shall be 25 x 6 Sq. mm for aluminum strips.

3.11.9. The earthing system shall be designed with consideration of the earth resistivity of the project area. The earth resistivity values shall be measured prior to designing the earthing system. Unless otherwise specified, earthing system shall be in accordance with IS: 3043 and IEEE 80-2000, Indian Electricity Rules, Codes of practice and regulations existing in the location where the system is being installed.

3.11.10. The earthing shall be maintenance free gel with Pipe in pipe/pipes in strip technology filled with anti-corrosive conducive compound (CPRI tested) below the ground in 150-200 mm dia.

(a) Gel earthing & Chemical compound should be type tested from Govt. approved / Govt. recognized / NABL Accredited laboratory / ILAC i.e. International Laboratory Accredited Laboratory (in case of foreign laboratory).
(b) 50 mm dia GI pipe should be B class and strip of 25x6mm should be inserted top to bottom with no joint.
(c) GI strip should be top to bottom inserted & welded on bottom part of electrode.
(d) GI strip should be hot dip galvanized as per IS-3043 standard 80-100 micron zinc coating.
(e) CCM (crystalline conductive mixture) should be anticorrosive & to be filled top to bottom in electrode.
(f) Chemical compound PH value should not be less than 8.
(g) With 3/6 mtr electrode 2 bags (25kg each)/4 bags chemical compound has to be filled in bore.
(h) For semi rocky & rocky area 8 bags (25 kg each) chemical compound has to be filled in open bore.
(i) Chemical compound has to mixed with water to make it in paste form and pour surrounding area of electrode.
(j) For 50mm dia electrode bore size should be 6 inch x 3.5/6.5 mtr depth.
(k) Earth resistance for single earth should be less than 2 ohms.
(l) All body connections should be connected with gi earthing Supply & Erection of Maintenance free Gel earthing with strip in pipe technology filled with anti corrosive conducive compound (CPRI Tested) below the ground in 150-200 mm dia. Earth pit & surrounding filled with required mineral filling compound (MFC should have hygroscopic property to retain the moisture for long time to create low resistance zone ) and C.C. finished chamber covered with hinged type with locking arrangement C.I. Cover, C.I. Frame of size 300mm X 300mm complete testing of earth resistance as required G.I Pipe (IS : 1239 marks) GI pipe 3000/6000 mm long, 50 mm Dia, GI/Cu Strip. Earthing as per IS:3043-1987 and its latest amendments.
3.12. **LOW VOLTAGE (LV) SWITCHGEARS**

3.12.1. LV switchboard shall be IP 21 for indoor and IP 65 for outdoor application made with heavy duty PVC/metal enclosure.

3.12.2. LV switchboard with metal enclosure shall be minimum 2mm thick and with properly coated.

3.12.3. MCB/MCCB/ RCCB and cables shall be rated as per rated current of the circuit, application voltage class, short circuit capacity.

3.12.4. All switchboards shall be supplied completely wired internally upto the terminals, ready to receive external cables.

3.12.5. No extra holes shall be allowed in the gland plate. Proper vermin proofing of the panel is required.

3.12.6. Suitable cable entry shall be provided considering bending radius of the incoming and outgoing cable.

3.12.7. All cables, MCB, MCCB, RCCB shall be of reputed make.

3.13. **SOLAR METER**

3.13.1. Uni-directional Smart Energy Meters to log the actual value of Energy generated by the PV system be provided, as per relevant specifications by MNRE/CEA/Discom. Detailed indicative specifications shall be shared with successful bidder.

3.14. **NET-METER**

3.14.1. The bi-directional Smart Energy Meter shall be installed for the measurement of import/export of energy, as per relevant specifications by MNRE/CEA/Discom. Detailed indicative specifications shall be shared with successful bidder.

3.14.2. Old meter of the existing Agriculture consumer shall be replaced by the Contractor after issue of Meter Change Order by concerned AEN (O&M) of Discom on the same day of installation of net-meter. The old meter is to be deposited by the Contractor in the concerned Office of AEN (O&M) of Discom.

3.14.3. Net-meter shall be installed in the presence of the Contractor, the Agriculture Consumer, concerned AEN (O&M), AEN (M&P) and Nodal Officer jointly with preparation of “Joint Inspection Report” (JIR) in prescribed format.

3.15. **CIVIL WORK**

3.15.1. Specification of civil work shall be in line with specifications for SPV water pumping systems of MNRE vide Circular No. F. No. 41/3/2018-SPV Division dated 17.7.2019 enclosed as **Annexure A** and any further amendment(s) issued by MNRE.

3.15.2. The scope works shall cover for all services required for completion of civil works in all respect for PV plant. All machineries, tools and designs to be arranged by
Contractor.

3.15.3. Contractor shall carry out geotechnical survey prior to design and installation of the PV system.

3.15.4. The work shall be executed according to the specifications and good standard practice necessary to fulfil the objective of the survey work, strictly in accordance with the instructions and satisfaction of RACP / the Discom.

3.15.5. Foundations:

(a) The Contractor is responsible for the detailed soil investigation and subsequent foundation design of the structures in the plant. Minimum 5 (five) numbers of soil exploration is to be carried out for each feeder. The foundation of the module mounting structures foundation and other important equipment foundation must be approved through RACP or Discom or TPIA prior to construction. The Contractor shall provide the detailed design report with calculations of the proposed foundation. Pedestals over the MMS foundation shall be projected minimum 150 mm above the finished ground level.

(b) The foundations shall be designed considering the weight and distribution of the load of structure and its assembly. The foundation shall be design in accordance to recommendation and results of soil investigation reports and mounting structure shall be designed for maximum wind speed as per the wind zone of the location and relevant IS. Seismic effect relevant to the seismic zone of the area and highest water logging level has to be considered while making the design of the foundation.

(c) The MMS foundation shall be constructed using RCC concrete pile foundation of required diameter and depth based on approved design.

(d) The elevated structure has to be securely anchored to the supporting surface, also bolted with anchor bolts of appropriate strength for elevated structures mounted on RCC surfaces.

3.16. CAUTION SIGNS

3.16.1. In addition to the standard caution and danger boards or labels as per Indian Electricity Rules, the AC distribution box near the solar grid inverter and the distribution board to which the AC output of the solar PV system is connected shall be provided with a noncorrosive caution label with the following text:

WARNING – DUAL POWER SOURCE
SECOND SOURCE IS SOLAR SYSTEM

3.16.2. The size of the caution label shall be 105mm (width) x 20mm (height) with white letters on a red background.

3.17. SIGN BOARDS

3.17.1. The sign board containing brief description of various components of the power plant as well as the complete power plant in general shall be installed at appropriate location near the PV system.

3.17.2. The Signboard shall be made of MS angle or pipe for vertical post with ACP
(Aluminium Composite Panel) sheet of not less than 3 mm. The Contractor shall provide detailed specifications of the sign boards as per requirement of the RACP / Discom.

3.17.3. Name Plate: Name Plate in Hindi language of size 600 mm x 600 mm x 2 mm on iron plate is required to be prepared as provided in Section X Format 8 separately and required to be fixed on the system for every installation.

3.18. DRAWINGS & MANUALS

3.18.1. Two sets of engineering, electrical drawings and Installation and O&M manuals are to be supplied. Bidder shall provide complete technical data sheets for each equipment giving details of the specifications along with make/makes in their bid along with basic design of the PV Installation setup and power evacuation, synchronization along with protection equipment.

3.18.2. The Contractor shall furnish the following drawings (inline with MNRE specifications placed in Annexure L3) after Letter of Award/ Letter of Intent and obtain approval:
(a) General arrangement and dimensioned layout.
(b) Schematic drawing showing the requirement of PV panel, Power conditioning Unit(s)/ inverter, Junction Boxes, AC and DC Distribution Boards, meters etc.
(c) Routing diagram of cables and wires.
(d) Data sheets and user manuals of the solar PV panels and the solar grid inverter.
(e) Structural drawing along with foundation details for the structure.
(f) Itemized bill of material for complete SV plant covering all the components and associated accessories.
(g) Layout of solar Power Array
(h) Shadow analysis of the site
(i) Maintenance register.

3.18.3. Approved ISI and reputed makes for equipment be used.

3.18.4. For complete electromechanical works, Contractor shall supply complete design, details and drawings for approval to RACP / Discom and TPIA before progressing with the installation work.

3.19. PLANNING & DESIGNING

3.19.1. RACP / the Discom reserves the right to modify the layout and specification of sub-systems and components at any stage as per local site conditions/requirements.

3.19.2. The Contractor shall submit preliminary drawing for approval and based on any modification or recommendation, if any. The Contractor shall submit three sets and soft copy in CD of final drawing for formal approval to proceed with construction work.

3.20. SAFETY MEASURES

3.20.1. The Contractor shall take entire responsibility for electrical safety of the installation(s) including connectivity with the grid and follow all the safety rules & regulations applicable as per Electricity Act, 2003 and CEA guidelines, as well as applicable rules & regulations of Rajasthan State, etc.
INSPECTIONS AND TESTS

The following inspections and tests shall be performed:

Inspection of Material Prior to Dispatch

a. Prior to dispatch, the materials may be inspected and tested by respective RACP/Discom or TPIA, at the works of OEM (Original Equipment Manufacturer), where SPV (Solar Photovoltaic) panels, Grid tie Inverters, Module mounting structure, other components of the project are manufactured. The Contractor shall inform RACP/Discom/TPIA for such inspection at least 10 (ten) days in advance before the probable date of dispatch. Materials dispatched without RACP’s approval shall not be accepted and the RACP shall have right to reject it and recover the cost incurred from the contractor.

b. Cost of inspection: All the expenses related to inspection team like lodging, boarding, travelling, and air tickets to be borne by the Contractor. The Contractor will provide necessary inspection & testing facility at his cost.

c. However, if the material is not kept ready for inspection after intimation of the offered quantity on the scheduled date for inspection then all consequences will be to Contractor account and RACP will recover the re-inspection charges @ Rs. 15,000/- for outside Rajasthan State inspection and within Rajasthan State @ Rs. 7,500/-.

d. The Contractor will offer Solar PV Panels, BOS and components of system for inspection at the OEM works to RACP/Discom/TPIA and inspection can also be offered at one place in Rajasthan (main distributor’s place), where requisite inspection facilities are available. RACP reserves the right to inspect any number of SPV systems at OEM works at their discretion.

e. Systems installed under the allocated work in this tender shall meet technical specification and construction standards as specified by BIS and MNRE from time to time. Non-compliance will be taken seriously to the extent of blacklisting of the vendor, in the same manner as specified, apart from taking action under any other law in force. Evaluation of implementation of Component-C will be carried out through third party selected for this purpose. In order to ensure, the scheme meets expected outcomes continues evaluation of scheme would be undertaken and mid-course correction, as required, shall be implemented.

f. On Commissioning quality monitor as appointed under KUSUM Scheme, as applicable shall inspect the SPV system. Contractor shall provide all requisite details built drawings (in line with MNRE specifications in Annexure L.3 and Joint measurement sheet to the inspector to conduct. Contractor shall rectify defects/deficiencies and submit compliance to the observations with supporting photographs in digital form within one month from receipt of observations.

g. The inspection of materials and components of the project carried out by RACP / MNRE / TPIA representative shall not relieve the Contractor from full responsibility of completing the project confirming to the requirement of the Contract
Inspection and Testing Post Installation and Commissioning

a. After successful installation, commissioning, testing with User Acceptance Testing (UAT) of complete SPV system, the asset is to be jointly handed over to the beneficiary and concerned representative of RACP/engineer in-charge of the Discom. The Handing over note covering the details of all the materials used and total work executed must be signed jointly by the beneficiary, Contractor & the concerned representative of RACP /Discom’s Engineer In-charge. The copy of Installation Certificate along with beneficiary’s certificate (SECTION X: Form 7 and Form 9) to final bill is required to be submitted by Contractor for release of payment.

b. User Acceptance Test (UAT) shall comprise of measurement and reporting of all technical parameters of system with jointly signed by contractor, engineer-in-charge and beneficiary. All BIS/MNRE technical standards shall be applicable for such UAT including inspection of support structures, modules, mounting, cabling, equipment labels, markings, placards, manufacturer identification, and specifications and ratings. Relevant IEC / BIS / MNRE standards shall be guiding standard for such tests or inspections.

c. The Taking over Certificate (Format K.11) & Operational Acceptance Certificate (Format K.10) as well as completion certificate (K.9) shall be issued accordingly on completion of requisite works and completion of Contract Period, if the complete scope of work is completed.
Installation Certificate

<table>
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<th>Phone No</th>
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(Contractor... Address of)

INSTALLATION CERTIFICATE

Date of Installation:  
Payment claim Note No:

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<tr>
<td>1.</td>
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<td>Father/ Husband Name</td>
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<td>Dhani Name</td>
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<td>Name of Village</td>
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<td>Name of Gram Panchayat</td>
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<td>Name of Panchayat Samiti</td>
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<td>Name of District</td>
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<td>Name of Rajasthan State Constituency</td>
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<td>15.</td>
<td>Name of Parliamentary Constituency</td>
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<td>16.</td>
<td>Caste Group: (Gen/SC/ST/OBC/Other...specify)</td>
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<tr>
<td>17.</td>
<td>Site Co-ordinate (Longitude / Latitude)</td>
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Certified that ............... KW PV Capacity Grid-Connected SPV system in reference to ............... Name of Discom Work Order No:.......................... Dated:............ has been installed and commissioned at the place of Agriculture Consumer mentioned above and the system has been handed over to the Agriculture Consumer in good working condition.
The details of material supplied and installed are as under:

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<th>Quantity</th>
<th>Make</th>
<th>Serial Numbers</th>
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</table>

Signature of Agriculture Consumer  
Signature of Nodal Officer

Name of Agriculture Consumer  
Name of Nodal Officer

Date  
Name of Discom

Place  
Seal of Discom

Signature of and on behalf of Contractor  
Signature of AEN (O&M)

Name of Authorized Signatory  
Name of AEN

Name of Contractor  
(O&M) Name of Discom
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<td>Seal of Discom</td>
<td>Date</td>
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Guarantee Card

Format for guarantee card to be supplied with each grid connected solar PV system

1. Name & Address of the supplier of the System:
2. Name & Address of Discom:
3. Date of supply of the system:
4. Details of PV Module (s) supplied in the System Make (Name of the Contractor):
   1. Model Serial No(s)
   2. Wattage of the PV Module (s) under STC Guarantee valid up to
5. Details of Electronics & other BOS items:
   1. System Make (Name of the Contractor) Model
   2. Serial No(s) Guarantee valid up to
6. Designation & Address of the person to be Contacted for claiming Guarantee obligations

(Signature)
Name & Designation
Name & Address of the Agency (SEAL)
Place & Date:

(During the guarantee period Discom reserves the right to cross check the performance of the systems with the minimum performance levels specified in the Tender Document specifications).
Maintenance & Servicing Report

QUARTERLY MAINTENANCE & SERVICING REPORT

1. DETAILS OF SOLAR PHOTOVOLTAIC SYSTEM INSTALLED
   a) Supplied by:
   b) Date of installation:
   c) Servicing period: From to

2. USER PROFILE
   1. Name and address of User:

3. TECHNICAL DETAILS
   1. Module Capacity, make and serial numbers:
   2. Inverter Capacity, make and serial no.

4. CHECK OF THE PRODUCT
   1. Correct inclination and orientation of SPV panel:
   2. Cleaning of dust from SPV panel:
   3. Interconnection of modules, charge controller etc.:
   4. Fuse of charge controller:
   5. Working of inverter

5. DIFFICULTIES IN OPERATION/ PROBLEM FACED BY USER:

6. DIAGNOSIS DETAILS/ REPAIR ACTION:

7. DATE ON WHICH SYSTEM WAS LAST ATTENDED:

8. IT IS MANDATORY TO SUBMIT INSTALLATION WISE QUARTERLY ENERGY

9. GENERATION DATA TO RESPECTIVE PGVCL OFFICE.

10. REMARKS:

    Beneficiary Name & Signature                Contractor’s Name & Signature

    Date: (with rubber stamp)

Signature for and on behalf of Discom

Name of Nodal Officer
(DISCOM Name)
Date and Place
ANNEXURE A

MNRE Specifications of SPV water pumping systems
SPECIFICATION FOR SOLAR PHOTOVOLTAIC WATER PUMPING SYSTEMS

Annexure-I of Circular No. F. No. 41/3/2018-SPV Division dated 17.7.2019

MINISTRY OF NEW AND RENEWABLE ENERGY

SPECIFICATION FOR SOLAR PHOTOVOLTAIC WATER PUMPING SYSTEMS

1. SCOPE

These specification covers design qualifications and performance specifications for Centrifugal Solar Photo Voltaic (SPV) Water Pumping Systems to be installed on a suitable bore-well, open well, water reservoir, water stream, etc., and specifies the minimum standards to be followed under New Scheme for Farmers launched by Government of India on 8.3.2019.

2. TERMINOLOGY

In addition to the terminology specified in 3 of IS 5120 and IEC 62253, the following shall also apply.

2.1 Static Water Depth — It is the depth of water level below the ground level when the pump is not in operation.

2.2 Draw-Down — It is the elevation difference between the depth of static water level and the consistent standing water level in tube well during operation of pump set.

2.3 Submergence — It is the minimum height of water level after drawdown above the pump suction casing.

2.4 Manometric Suction Lift — Manometric suction lift is the vacuum gauge/suction manometer reading in meter of water column when pump operates at suction lift.

2.5 Static Suction Lift — Static suction lift/head is the vertical distance between sump water level and center of pump inlet.

2.6 Daily Water Output — It is the total water output on a clear sunny day with three times tracking SPV panel, under the “Average Daily Solar Radiation” condition of 7.15 KWh / m² on the surface of SPV array (i.e. coplanar with the SPV Modules).

2.7 Wire to Water Efficiency — It is the combined system efficiency of SPV Converter/Controller with Inbuilt MPPT mechanism, Pump set and piping.
2.8 **SPV Controller** — Pump Controller converts the DC voltage of the SPV array into a suitable DC or AC, single or multi-phase power and may also include equipment for MPPT, remote monitoring, and protection devices.

2.9 **Maximum Power Point Tracker (MPPT)** — MPPT is an algorithm that is included in the pump controller used for extracting maximum available power from SPV array under a given condition. The voltage at which SPV array can produce maximum power is called 'maximum power point' voltage (or peak power voltage).

### 3. CONSTRUCTIONAL FEATURES

#### 3.1 General

3.1.1 SPV Water Pumping System set uses the irradiance available through SPV array. The SPV array produces DC power, which can be utilized to drive a DC or an AC pump set using pump controller.

3.2 A SPV Water Pumping system typically consists of:

3.2.1 **Pump Set**

- Pump set may be of any one of the following types:
  - i) Mono-set pump;
  - ii) Open well submersible pump;
  - Submersible pump;

3.2.2 **Motor**

- The motor of the pump set may be of the following types:
  - i) AC Induction Motor.
  - ii) DC Motor [PMSM/BLDC/SRM (with brush or brushless)].

3.2.3 **SPV Controller** See 2.8

- Note: Some controllers are inbuilt in the motors

3.2.4 Provision for remote monitoring for the pumps must be made in the pump controller through an integral arrangement having following basic functions:

- Controller must be assigned with a unique serial number and its live status must be observed remotely on online portal through login credentials.
- Live status must indicate whether controller is ON/ OFF
- The parameter i.e. the water output, water flow rate, in fault condition, array input voltage/ current, power and motor frequency should at logged at an interval of 10 minutes
- Controller must have a back up to store the data locally (at least for 1 year)
3.3 Solar Photo Voltaic (SPV) Array

3.3.1 SPV arrays contain specified number of same capacity, type and specification modules connected in series or parallel to obtain the required voltage or current output. The SPV water pumping system should be operated with a PV array minimum capacity in the range of **900 Watts peak to 9000 Watts peak**, measured under Standard Test Conditions (STC). Sufficient number of modules in series and parallel could be used to obtain the required voltage or current output. The power output of individual PV modules used in the PV array, under STC, should be a minimum of 200 Watts peak, with adequate provision for measurement tolerances. Use of PV modules with higher power output is preferred.

3.3.2 Modules supplied with the SPV water pumping systems shall have certificate as per IS14286/IEC 61215 specifications or equivalent National or International Standards. STC performance data supplied with the modules shall not be more than one year old.

3.3.3 Modules must qualify to IS/IEC 61730 Part I and II for safety qualification testing.

3.3.4 The minimum module efficiency should be minimum 15 percent and fill factor shall be more than 70 percent.

3.3.5 Modules must qualify to IEC TS 62804-1:2015 for the detection of potential-induced degradation - Part 1: Crystalline silicon (Mandatory in case the SPV array voltage is more than 600 V DC)

3.3.6 In case the SPV water pumping systems are intended for use in coastal areas the solar modules must qualify to IEC TS 61701:2011 for salt mist corrosion test.

3.3.7 The name plate shall conform the IS 14286/IEC 61215

3.3.8 Module to Module wattage mismatch in the SPV array mismatch shall be within ± 3 percent.

3.3.9 Variation in overall SPV array wattage from the specified wattages shall be within zero percent to +10 percent.

3.3.10 The PV Modules must be warranted for output wattage, which should not be less than 90% of the rated wattage at the end of 10 years and 80% of the rated wattage at the end of 25 years.
3.4 Motor-Pump Set

3.4.1 The SPV water pumping systems may use any of the following types of motor pump sets:

a) Surface mounted motor-pump set
b) Submersible motor-pump set
c) Floating motor-pump set
d) Any other type of motor pump set after approval from Ministry.

3.4.2 The “Motor-Pump Set” should have a capacity in the range of 1 HP to 10 HP and should have the following features:

a) The mono block DC/AC centrifugal motor pump set with the impeller mounted directly on the motor shaft and with appropriate mechanical seals which ensures zero leakage.

b) The motor of the capacity ranging from 1 HP to 10 HP should be AC/DC. The suction and delivery head will depend on the site specific condition of the field.

c) Submersible pumps could also be used according to the dynamic head of the site at which the pump is to be used.

3.4.3 The pump and all external parts of motor used in submersible pump which are in contact with water, should be of stainless steel of grade 304 or higher as required. The motor-pump set should have a 5 years warranty and therefore, it is essential that the construction of the motor and pump should be made using parts which have a much higher durability and do not need replacement or corrode for at least 5 years of operation after installation.

3.4.5 The suction/delivery pipe shall be of HDPE or uPVC column pipes of appropriate size, electric cables, floating assembly, civil work and other fittings required to install the Motor Pump set. In case of HDPE pipes the minimum pressure rating of 8 kg/sqcm-PE100 grade for pumps up to 3 HP, 10 kg/sqcm-PE100 grade for 5 HP pumps and further higher minimum pressure rating for above 5 HP as appropriate shall be used.

3.5 Module Mounting Structures and Tracking System

3.5.1 The PV modules should be mounted on metallic structures of adequate strength and appropriate design, which can withstand load of modules and high wind velocities up to 150 km per hour. The raw material used and process for manufacturing of module mounting structure including welding of joints should conform to applicable IS. The module mounting structure should be hot dip galvanized according to IS 4759. Zinc content in working area of the hot dip galvanizing bath should not be less than 99.5% by mass.

3.5.2 To enhance the performance of SPV water pumping systems arrangement for seasonal tilt angle adjustment and three times manual tracking in a day should be provided. In order to make structure rigid, the gap between Telescopic pattern supports should be minimal, further, for bearing of center load of whole structure only pins should be used instead of threaded bolts.

3.5.3 The general hardware for structure fitment should be either SS 304 or 8.8 grade. Modules should be locked with antitheft bolts of SS 304 Grade. Foundation should be as per the site condition, based on the properties of Soil. Foundation can be done either with the help of ‘J Bolt’ (refer IS 5624 for foundation hardware) or direct pilling, it should be decided as per the site and
relevant IS i.e. IS 6403 / 456 / 4091 / 875 should be referred for foundation design.

3.5.4 Details of Module Mounting Structure for different capacity of SPV pumps are attached at Annexure-I. These are indicative of minimum standards and an Implementing Agency may specify higher standards.

3.6 SPV Controller

3.6.1 Maximum Power Point Tracker (MPPT) shall be included to optimally use the power available from the SPV array and maximize the water discharge.

3.6.2 The SPV Controller must have IP (65) protection or shall be housed in a cabinet having at least IP (65) protection.

3.6.3 Adequate protections shall be provided in the SPV Controller to protect the solar powered pump set against the following:
   a) Dry running;
   b) Open circuit;
   c) Accidental output short circuit;
   d) Under voltage;
   e) Reverse polarity;
   f) SPD to arrest high current surge; and
   g) Lightening arrestor.

3.6.4 A good reliable DC Circuit Breaker as per IS/IEC 60947-2 suitable for switching DC power ON and OFF shall be provided in the SPV Controller.

3.6.5 All cables used shall be as per IS 694. Suitable size of cable shall be used in sufficient length for inter-connection between the SPV array to SPV Controller and the SPV Controller to solar powered pump set. Selection of the cable shall be as per IS 14536.

3.6.6 Controller shall be integrated with GSM/GPRS Gateway with Geo tagging. GSM/ GPRS Charges to be included in the Costing till the end of Warranty period of the Pump set.

3.7 Earthing Arrangement

3.7.1 Earthing of the motor shall be done as per IS 9283 in accordance with the relevant provisions of IS 3043. Separate earthing shall be provided for Controller, pump and SPV array.

3.7.2 For safety purpose, it shall be ensured during installation that the earthing is capable of taking care of leakage current.

3.7.3 In case of uPVC/HDPE pipes used as discharge pipe, a separate non-corrosive, low resistance conductor from motor earth terminal to control panel earth terminal shall be provided for earthing.

3.7.4 A lightening arrestor shall be provided with every SPV Water Pumping System.
3.8 Use of indigenous components
It will be mandatory to use indigenously manufactured solar modules with indigenous mono/ multi crystalline silicon solar cells. Further, the motor-pump-set, controller and balance of system should also be manufactured indigenously. The vendor has to declare the list of imported components used in the solar water pumping system.

4. PERFORMANCE REQUIREMENTS

4.1 Under the “Average Daily Solar Radiation” condition of 7.15 KWh / sq.m. on the surface of PV array (i.e. coplanar with the PV Modules), the minimum water output from a Solar PV Water Pumping System at different “Total Dynamic Heads” should be as specified below:

For D.C. Motor Pump Set:

i) 110 liters of water per watt peak of PV array, from a Total Dynamic Head of 10 meter (Suction head, if applicable, maximum of 7 meter) and with the shut off head being at least 12 meter.

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

iii) 38 liters of water per watt peak of PV array, from a Total Dynamic Head of 30 meters and the shut off head being at least 45 meter.

iv) 23 liters of water per watt peak of PV array, from a Total Dynamic Head of 50 meter and the shut off head being at least 70 meter.

v) 15 liters of water per watt peak of PV array, from a Total Dynamic Head of 70 meters and the shut off head being at least 100 meter.

vi) 10.5 liters of water per watt peak of PV array, from a Total Dynamic Head of 100 meters and the shut off head being at least 150 meter.

The actual duration of pumping of water on a particular day and the quantity of water pumped could vary depending on the solar intensity, location, season, etc.

Indicative performance specifications for the Shallow and Deep well SPV Water Pumping Systems are given in the Annexure II.

For A.C. Induction Motor Pump Set:

i) 99 liters of water per watt peak of PV array, from a Total Dynamic Head of 10 meter (Suction head, if applicable, maximum of 7 meters) and with the shut off head being at least 12 meter.

ii) 49 liters of water per watt peak of PV array, from a Total Dynamic Head of 20 meter (Suction head, if applicable, up to a maximum of 7 meters) and with the shut off head being at least 25 meter.

iii) 35 liters of water per watt peak of PV array, from a Total Dynamic Head of 30 meter and the shut off head being at least 45 meter.
iv) 21 liters of water per watt peak of PV array, from a Total Dynamic Head of 50 meter and the shut off head being at least 70 meter.

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

vi) 9 liters of water per watt peak of PV array, from a Total Dynamic Head of 100 meter and the shut off head being at least 150 meter.

The actual duration of pumping of water on a particular day and the quantity of water pumped could vary depending on the solar intensity, location, season, etc.

Indicative performance specifications for the Shallow and Deep well SPV Water Pumping Systems are given in the Annexure III.

5. TESTS FOR HYDRAULIC AND ELECTRICAL PERFORMANCE OF PUMPSET

5.1 The motor-pump set shall be tested independently for hydraulic and electrical performance as per the relevant IS specification including following test

   a) Constructional requirements/features
   b) General requirements
   c) Design features
   d) Insulation resistance test
   e) High voltage test
   f) Leakage current test

5.2 Testing of SPV Water Pumping Systems shall be done as per procedure specified by the MNRE.

6. GUARANTEE OF PERFORMANCE

6.1 The SPV Water Pumping Systems shall be guaranteed for their performance of the nominal volume rate of flow and the nominal head at the guaranteed duty point as specified in 7.1 under the "Average Daily Solar Radiation" condition of 7.15 kWh/m² on the surface of SPV array (i.e. coplanar with the Photo Voltaic (PV) Modules). The actual duration of pumping of water on a particular day and the quantity of water pumped could vary depending on the solar intensity, location, season, etc.

6.2 Solar Photo Voltaic Water Pumping Systems shall be guaranteed by the manufacturer against the defects in material and workmanship under normal use and service for a period of at least 60 months from the date of commissioning.

6.3 Sufficient spares for trouble free operation during the Warranty period should be made available as and when required.

7. MARKING AND PARAMETERS TO BE DECLARED BY THE MANUFACTURER

7.1 The motor pump-set and Controller used in SPV Water Pumping Systems shall be
securely marked with the following parameters declared by the manufacturer:

7.1.1 Motor Pump-set
   a) Manufacturer's name, logo or trade-mark;
   b) Model, size and S1 No of pump-set;
   c) Motor Rating (kW / HP);
   d) Total head, m, at the guaranteed duty point;
   e) Capacity (LPD) at guaranteed head;
   f) Operating head range, m;
   g) Maximum Current (A);
   j) Voltage Range (V) and:
   k) Type - AC or DC Pump set; &
   l) Photo Voltaic (PV) Array Rating in Watts peak ($W_p$)

7.1.2 Controller
   a) Manufacturer's name, logo or trade-mark;
   b) Model Number;
   c) Serial Number;
   d) Voltage Range;
   e) Power Range in kW for Controller; and
   f) Current rating (A)

8. OPERATION AND MAINTENANCE MANUAL

8.1 An Operation and Maintenance Manual, in English and the local language, should be provided with the solar PV pumping system. The Manual should have information about solar energy, photovoltaic, modules, DC/AC motor pump set, tracking system, mounting structures, electronics and switches. It should also have clear instructions about mounting of PV module, DO's and DON'T's and on regular maintenance and Trouble Shooting of the pumping system. Helpline number and Name and address of the Service Centre and contact number of authorized representative to be contacted in case of failure or complaint should also be provided. A warranty card for the modules and the motor pump set should also be provided to the beneficiary.
Standard MMS for 4, 6 and 8 solar modules have been specified. These standard MMS may be used in combinations for different capacities of solar water pumping systems as follows:

1. Standard MMS of 4 Modules for 1 HP
2. Standard MMS of 6 Modules for 2 HP
3. Combination of standard MMS of 4 Modules and 6 Modules for 3 HP
4. Combination of two standard MMS of 8 Modules for 5 HP
5. Combination of three standard MMS of 8 Modules for 7.5 HP

and so on....

Specifications of main parts used in MMS are given below:

1. **Centre Shaft:** - Centre shaft used in structure should be of minimum 139 OD with minimum thickness of 4 mm with base plate minimum 10 mm thickness if used and foundation hardware should be as per IS 5624. For system without base plate i.e. direct pilling is should be as per the site condition based on the properties of Soil and refer (IS 6403 / 456 / 4091 / 875) for foundation design.

2. **Rafter:** - The Main and secondary rafter used in structure should be of either SHS & RHS pipe sections.

3. **Purlin:** - Mounting Purlins used in the structure should be made of Cold form steel section as per IS 1079 with minimum thickness of 2mm.
4. **Provision for Seasonal Tilt:** In one structure at least four telescopic supports (three may be used in MMS for 4 modules) either round hollow sections or square hollow section to be provided to support the mounting structure.

5. **Provision for Daily Tracking:** Provision for Daily tracking should be provided by the way of providing min. 8 mm thick metal sheet with precision cut grooves.

6. **Module Locking System:** Modules should be locked with anti-theft bolts of SS 304 Grade.

7. **General Hardware for Structure Fitment:** Either SS 304 or 8.8 grade hardware should be used for fitment.

8. **Hot Dip Galvanizing:** All structure parts should be hot dip galvanized according to IS 4759.

9. **Tolerance for fabrication:** Tolerance for fabrication of steel structure should be as per IS: 7215.

10. **Welding:** Welding should be done as per IS: 822 & grade of welding wire should be (ER70S-6).
Raw material test certificates (MTC) of all types of raw material used in dual axis manual tracking type MMS as per appropriate IS code should be submitted along with dispatch documents.

Tests to be performed on Dual Axis Manual Tracking Type MMS for Solar Water Pumping System:

1. For ascertaining proper welding of structure part following should be referred:
   a. Weld wire grade should be of grade (ER 70 S - 6)
   b. D.P. Test (Pin Hole / Crack) (IS 822)

2. For ascertaining hot dip galvanizing of fabricated structure following should be referred:
   a. Min coating required should be as per IS 4759.
   b. Testing of galvanized material.
      i. Precece Test (CuSO₄ Dip Test) (IS 2633)
      ii. Mass of Zinc (IS 6745)
      iii. Adhesion Test (IS 2629)
Part 1 – Mail Column

Notes:

1. All Dimensions are in mm.
2. Main Column material grade should be YST - 240 as per: IS: 1161 / 1239 & E250 as per: IS: 1079 / 2062.
Part 2 – Top Plate

Notes:

1. All Dimensions are in mm.
2. Top Plate material grade should be YST - 240 as per: -IS: 1161 / 1239 & E250 as per: -IS: 1079 / 2062.
Notes:

1. All Dimensions are in mm.
2. Main Tube material grade should be YST - 240 as per: IS: 1161 / 1239 & E250 as per: IS: 1079 / 2062.
Part 4 – Side Tube

Notes:

1. All Dimensions are in mm.
2. Side Tube material grade should be YST - 240 as per: -IS: 1161 / 1239 & E250 as per: -IS: 1079 / 2062.
Notes: -
1. All Dimensions are in mm.
2. Mounting Purlin material grade should be E250 as per: - IS: 1079 / 2062 & IS: 811.
Part 6 – Clamp with Blade

Notes:

1. All Dimensions are in mm.
2. Clamp with Blade material grade should be as per: - IS: 1079 & E250 as per: - IS: 2062.
Part 7 – Supporting Pipes

Notes:
1. All Dimensions are in mm.
2. Supporting Pipes material grade should be YST - 240 as per: IS: 1161 / 1239 & E250 as per: IS: 1079 / 2062.
<table>
<thead>
<tr>
<th>SR. NO.</th>
<th>PART NAME</th>
<th>CROSS SECTION DETAIL</th>
<th>LENGTH (MM)</th>
<th>QUANTITY PER SET</th>
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<tbody>
<tr>
<td>A</td>
<td>Common for MMS for 4, 6 and 8 Modules</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>MAIN POLE</td>
<td>139 OD</td>
<td>1500</td>
<td>1</td>
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<tr>
<td>2.</td>
<td>TOP PLATE</td>
<td>300 OD</td>
<td>--</td>
<td>1</td>
</tr>
<tr>
<td>3.</td>
<td>CLAMP WITH BLADE</td>
<td>75X8</td>
<td>--</td>
<td>1</td>
</tr>
<tr>
<td>4.</td>
<td>SUPPORTING PIPES</td>
<td>41 OD &amp; 33 OD</td>
<td>380</td>
<td>2</td>
</tr>
<tr>
<td>B</td>
<td>Different for MMS for 4, 6 and 8 Modules</td>
<td></td>
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</tr>
<tr>
<td>5.</td>
<td>MAIN TUBE</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 and 6 Module</td>
<td>60X60X3.6</td>
<td>3300</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>8 Modules</td>
<td>122X61X3.6</td>
<td>3300</td>
<td>1</td>
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<tr>
<td>6.</td>
<td>SIDE TUBE</td>
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<td></td>
<td></td>
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<tr>
<td>4 and 6 Module</td>
<td>50X50X3.6</td>
<td>3300</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>8 Modules</td>
<td>80X40X3.2</td>
<td>3300</td>
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<td>7.</td>
<td>MOUNTING PURLIN</td>
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<td></td>
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<tr>
<td>4 Module</td>
<td>80X50X15X2</td>
<td>2050</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>6 Module</td>
<td>80X50X15X2</td>
<td>3100</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>8 Modules</td>
<td>80X50X15X2</td>
<td>4150</td>
<td>4</td>
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</tr>
</thead>
<tbody>
<tr>
<td>PV array (Wp)</td>
<td>900</td>
<td>1800</td>
<td>2700</td>
<td>2700</td>
<td>4800</td>
<td>4800</td>
<td>4800</td>
<td>6750</td>
<td>6750</td>
<td>6750</td>
<td>9000</td>
<td>9000</td>
<td>9000</td>
</tr>
<tr>
<td>Motor Pump-set capacity (HP)</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>7.5</td>
<td>7.5</td>
<td>7.5</td>
<td>10</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Shut-off Dynamic Head (meters)</td>
<td>12</td>
<td>12</td>
<td>12</td>
<td>25</td>
<td>25</td>
<td>45</td>
<td>12</td>
<td>25</td>
<td>45</td>
<td>12</td>
<td>25</td>
<td>45</td>
<td></td>
</tr>
<tr>
<td>Water output * (Liters per day)</td>
<td>99000 (from a total head of 10 meters)</td>
<td>198000 (from a total head of 10 meters)</td>
<td>297000 (from a total head of 10 meters)</td>
<td>148500 (from a total head of 20 meters)</td>
<td>528000 (from a total head of 10 meters)</td>
<td>264000 (from a total head of 10 meters)</td>
<td>182400 (from a total head of 30 meters)</td>
<td>742500 (from a total head of 10 meters)</td>
<td>371250 (from a total head of 20 meters)</td>
<td>256500 (from a total head of 30 meters)</td>
<td>990000 (from a total head of 10 meters)</td>
<td>4950000 (from a total head of 20 meters)</td>
<td>3420000 (from a total head of 30 meters)</td>
</tr>
</tbody>
</table>

* 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, maximum 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.
## 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.)

<table>
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<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>PV array (Wp)</td>
<td>1200</td>
<td>1800</td>
<td>3000</td>
<td>3000</td>
<td>4800</td>
<td>4800</td>
<td>4800</td>
<td>6750</td>
<td>6750</td>
<td>6750</td>
<td>9000</td>
<td>9000</td>
<td>9000</td>
<td>9000</td>
<td></td>
</tr>
<tr>
<td>Motor Pump-set capacity (HP)</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>7.5</td>
<td>7.5</td>
<td>7.5</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Shut Off Dynamic Head (meters)</td>
<td>45</td>
<td>45</td>
<td>45</td>
<td>70</td>
<td>100</td>
<td>100</td>
<td>150</td>
<td>70</td>
<td>100</td>
<td>150</td>
<td>70</td>
<td>100</td>
<td>150</td>
<td>150</td>
<td></td>
</tr>
<tr>
<td>Water output (Liters per day)</td>
<td>45600 (from a total head of 30 meters)</td>
<td>68400 (from a total head of 30 meters)</td>
<td>11400 (from a total head of 30 meters)</td>
<td>69000 (from a total head of 50 meters)</td>
<td>45000 (from a total head of 70 meters)</td>
<td>11040 (from a total head of 70 meters)</td>
<td>72000 (from a total head of 100 meters)</td>
<td>50400 (from a total head of 100 meters)</td>
<td>15525 (from a total head of 70 meters)</td>
<td>10125 (from a total head of 70 meters)</td>
<td>70875 (from a total head of 70 meters)</td>
<td>20700 (from a total head of 70 meters)</td>
<td>13500 (from a total head of 100 meters)</td>
<td>94500 (from a total head of 100 meters)</td>
<td></td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>PV array (Wp)</td>
<td>900</td>
<td>1800</td>
<td>2700</td>
<td>2700</td>
<td>4800</td>
<td>4800</td>
<td>4800</td>
<td>6750</td>
<td>6750</td>
<td>6750</td>
<td>9000</td>
<td>9000</td>
<td>9000</td>
</tr>
<tr>
<td>Motor Pump-set capacity (HP)</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>7.5</td>
<td>7.5</td>
<td>7.5</td>
<td>10</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Shut Off Dynamic Head (meters)</td>
<td>12</td>
<td>12</td>
<td>12</td>
<td>12</td>
<td>25</td>
<td>25</td>
<td>25</td>
<td>45</td>
<td>12</td>
<td>25</td>
<td>45</td>
<td>12</td>
<td>25</td>
</tr>
<tr>
<td>Water output * (Liters per day)</td>
<td>89100 (from a total head of 10 meters)</td>
<td>178200 (from a total head of 10 meters)</td>
<td>267300 (from a total head of 20 meters)</td>
<td>132300 (from a total head of 10 meters)</td>
<td>475200 (from a total head of 20 meters)</td>
<td>235200 (from a total head of 20 meters)</td>
<td>168000 (from a total head of 30 meters)</td>
<td>641025 (from a total head of 20 meters)</td>
<td>330750 (from a total head of 20 meters)</td>
<td>236250 (from a total head of 30 meters)</td>
<td>890000 (from a total head of 20 meters)</td>
<td>441000 (from a total head of 30 meters)</td>
<td>324000 (from a total head of 30 meters)</td>
</tr>
</tbody>
</table>

* 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. co-planar with the PV Modules).

**Notes:**
1. Suction head, if applicable, maximum 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.
Indicative Technical Specifications of Solar Deep well (submersible) Pumping Systems with A.C. Induction Motor Pump Set

<table>
<thead>
<tr>
<th>Description</th>
<th>Model I</th>
<th>Model II</th>
<th>Model III</th>
<th>Model IV</th>
<th>Model V</th>
<th>Model VI</th>
<th>Model VII</th>
<th>Model VIII</th>
<th>Model IX</th>
<th>Model X</th>
<th>Model XI</th>
<th>Model XII</th>
<th>Model XIII</th>
<th>Model XIV</th>
</tr>
</thead>
<tbody>
<tr>
<td>PV array (Wp)</td>
<td>1200</td>
<td>1800</td>
<td>3000</td>
<td>3000</td>
<td>4800</td>
<td>4800</td>
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<td>6750</td>
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<td>6750</td>
<td>9000</td>
<td>9000</td>
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<td>9000</td>
</tr>
<tr>
<td>Motor Pump-set capacity (HP)</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>5</td>
<td>5</td>
<td>7.5</td>
<td>7.5</td>
<td>7.5</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Shut Off Dynamic Head (meters)</td>
<td>45</td>
<td>45</td>
<td>45</td>
<td>70</td>
<td>100</td>
<td>70</td>
<td>100</td>
<td>150</td>
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<td>100</td>
<td>150</td>
<td>70</td>
<td>100</td>
<td>150</td>
</tr>
<tr>
<td>Water output * (Liters per day)</td>
<td>42000</td>
<td>63000</td>
<td>105000</td>
<td>63000</td>
<td>42000</td>
<td>100800</td>
<td>67200</td>
<td>43200</td>
<td>141750</td>
<td>14500</td>
<td>94500</td>
<td>60750</td>
<td>189000</td>
<td>126000</td>
</tr>
<tr>
<td></td>
<td>(from a total head of 30 meters)</td>
<td>(from a total head of 30 meters)</td>
<td>(from a total head of 50 meters)</td>
<td>(from a total head of 70 meters)</td>
<td>(from a total head of 50 meters)</td>
<td>(from a total head of 70 meters)</td>
<td>(from a total head of 100 meters)</td>
<td>(from a total head of 70 meters)</td>
<td>(from a total head of 100 meters)</td>
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</tr>
</tbody>
</table>

* 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.
MNRE Specifications of Remote Monitoring System (RMS)

State Implementing Agency (SIA) will have a common SWPS (Solar Water Pumping System) Management platform for monitoring of operation and performance of SWPS installed under PM KUSUM Scheme.

Remote Monitoring System (RMS) of SWPS should have following minimum features or modules:

(a) Solar System Performance: DC Voltage, DC current, AC output Current, Power, Drive frequency, Energy, etc.
(b) Pump Performance: Running Hours, Water Discharge (Output), etc.
(c) RMS Performance: %Device Connectivity, %Data Availability, etc.
(d) Geo Location: Real time latitude and longitude should be captured. This is required to ensure that system is not moved from its original location.
(e) Events and Notifications: Faults related to Pump Operation, Solar generation, Controller/Drive faults like overload, dry run, short circuit, etc.
(f) Consumer Management: Name, Agriculture details, Service No. Contact Details, etc.
(g) Asset Management: Ratings, Serial Number, Make, Model Number of Pump, Panel and Controller, Geo Location, IMEI number (of communication module) and ICCID (of SIM).
(h) Complaint and Ticket Management: Complaint management system is a part of centralized monitoring software platform – State Level Solar Energy Management Platform to be operated and maintained by the State implementing agency (SIA).
(i) Consumer Mobile Application: Generation, Running Hours, Water Discharge, Complaint logging, etc.

RMS provided by all bidder's should connect to State Level Solar Energy Data Management platform, which will have interface with National Level Solar Energy Data Management platform i.e. SIA will provide server infrastructure as well as software. SIA will maintain the same. All vendors should provide SIM card of suitable ISP having maximum Signal Strength in the respective location of SWPS and ensure connectivity as well as pushing of data to centralized platform as mentioned in specifications.

Communication Architecture should be as per following:

a) Communication Connectivity:
   i. Pump Controller Connectivity: Communication between RMS and Pump Controller should be on UART/RS485 MODBUS RTU protocol to ensure interoperability irrespective of make and manufacturer
   ii. Remote Connectivity: RMS of SWPS should be using GSM/GPRS/2G/3G/4G cellular connectivity
   iii. Local Connectivity: Ethernet/Bluetooth/Wi-Fi connectivity to configure parameters, notifications, communication interval, set points etc. or to retrieve locally stored data.
   iv. Sensor Connectivity: RMS should have provision for at least two Analog/Digital inputs with 0.1% accuracy to address the requirement of local sensors connectivity if required by SIA/Consumer for applications such as irradiation, flow meter for water discharge, moisture sensor for micro irrigation, etc. Analog/digital sensor inputs will be required for integration of
flow meter for water discharge, moisture sensor for micro irrigation, level sensor for overhead tank water storage etc. Only provision for Analog/digital inputs with 0.1% accuracy of Full Scale Range is required. Sensors will not be in scope of bidder.

v. RMS should have provision to give remote On/Off command to pump through farmer mobile app. to save ground water.

b) Communication Modes:
   i. Push Data on Event/Notification: such as pump on, pump off, protection operated, etc.
   ii. Push Data Periodically: important parameters of solar pump (as mentioned above) should be pushed to central server on configurable interval. Interval should be configurable for 15 mins. However, if required, it should be possible to configure the periodic interval in multiple of 1 minute starting from 1 minute and up to 15 minutes. Further, in case of any abnormalities or event, RMS should push on event immediately.
   iii. Command On Demand: It should be possible to send commands via GSM or GPRS to RMS either to control pump operations or to update configuration

C) Communication Protocol: RMS should provide data on MQTT protocol to establish communication with thousands of systems.

D) Security:
   i. Communication between RMS and Server should be secured and encrypted using TLS/SSL/X.509 certificate etc.
   ii. As a part of IoT protocol, Authentication and Authorization should be implemented using token/password mechanism

E) Message Format: RMS should provide data in a JSON message format as required by respective SNA

F) Data Storage: In case of unavailability of cellular network, RMS should store data locally and on availability of network it should push data to central Server. Local data storage should be possible for at least one year in case of unavailability of cellular network.

G) Configuration update over the Air of multiple parameters such as IP, APN, Data logging Interval, Set Points etc. is essential. Software updating should be possible with 2G and even without the presence of SD card. Software updating process and/or failure to update software shouldn’t disrupt pumping operations