B. COMMUNICATION CABLES

I. Optical Fibre Cables

a. Optic Fibre cable shall be 4/8/12 core, galvanized corrugated steel taped armoured, fully water blocked with dielectric central member for outdoor/ indoor application so as to prevent any physical damage.

b. The cable shall have multiple single-mode or multimode fibres on as required basis so as to avoid the usage of any repeaters.

c. The outer sheath shall have Flame Retardant, UV resistant properties and are to be identified with the manufacturer's name, year of manufacturing, progressive automatic sequential on-line marking of length in meters at every meter on outer sheath.

d. The cable core shall have suitable characteristics and strengthening for prevention of damage during pulling.

e. All testing of the optic fibre cable being supplied shall be as per the relevant IEC, EIA and other international standards.

f. The Contractor shall ensure that minimum 100% cores are kept as spare in all types of optical fibre cables.

g. Cables shall be suitable for laying in conduits, ducts, trenches, racks and underground buried installation.

h. Spliced/ Repaired cables are not acceptable. Penetration of water resistance and impact resistance shall be as per IEC standard.

II. Communication Cable (Modbus)

a) Data (Modbus) Cable to be used shall be shielded type with stranded copper conductor. Cable shall have minimum 2 pair each with conductor size of 0.5 Sq.mm. Cable shall be flame retardant according to IEC 60332-1-2.

b) Cable shall be tested for Peak working voltage of not less than 300 V and shall be suitable for serial interfaces (RS 422 and RS 485).

c) Communication cable shall be laid through underground with suitable HDPE ducts.

4.4.4 GENERAL SYSTEMS

4.5.4.1 WEATHER MONITORING STATION

4.5.4.1.1 Weather Monitoring System

i.

s a part of weather monitoring station **(1 number WMS)**, the contractor shall provide following measuring instruments with all necessary software & hardware required to integrate with SCADA so as to enable availability of data in SCADA.

ii.

ll the weather sensors shall be supplied with all required certification and shall be proven for Solar Plant Application.

iii.

ocation of Sensors and Data Acquisition to SCADA shall be decided during detailed Engineering Stage

4.5.4.1.2 Pyranometer

The Contractor shall provide secondary minimum two (02) number of standard pyranometers (ISO 9060 classification) for measuring incident global solar radiation. One of them shall be placed on horizontal surface and the other on adjustable inclined plane. The specification for pyranometers shall be as follows:

Sl.No	Details	Values
1.	Spectral Response.	0.31 to 2.8 micron
2.	Accuarcy Class	According to ISO 9060: Secondary Standard.
3.	Sensitivity	Min 7 micro-volt/w/m^2
3.	Time response (95%):	Max 15 s
4.	Non linearity:	±0.5%
5.	Temperature Response:	±2%
6.	Tilt error:	< ±0.5%.
7.	Zero offset thermal radiation:	±7 w/m^2
8.	Zero offset temperature change	±2 w/m^2
9.	Operating temperature range:	0 deg to +80 deg.
10.	Uncertainty (95% confidence Level):	Hourly- Max-3%, Daily- Max-2%
11.	Non stability:	Max ±0.8%
12.	Resolution:	Min + / - 1 W/m2

4.5.4.1.3 Temperature Sensor

Contractor shall provide minimum six (6) thermometers (one for ambient temperature measurement with shielding case and five (5) for module temperature measurement). The thermometers shall be RTD / semiconductor type measuring instrument. Instrument shall have a range of 0^{O}C to 80^{O}C. The instrument shall have valid calibration certificate

4.5.4.1.4 Anemometer

Contractor shall provide minimum one no. anemometer with wind vane of rotating cup type

Sl. No	Details	Values
1.	Velocity range with accuracy limit	± 0.11 m/s upto 10.1 m/s ± 1.1 % of true when more than 10.1 m/s
2.	Wind direction range with accuracy limit	0 to 360 deg with accuracy ± 4 deg
3.	Mounting Bracket	Anodized Aluminium bracket to reduce corrosion, all mounting bolts of SS
4.	Protection Class	IP 66

4.5.4.1.5 All the above instruments shall have valid calibration certificate. The contractor shall submit all test certificates /Calibration Certificates to RECPDCL as per Engineering Information Schedule. The Contractor shall provide instrument manual in hard and soft form.

Note: *Contractor will be required to submit this data to UPNEDA/IMPLEMENTING AGENCY/MNRE on line and/or through a report on regular basis every month for the entire duration of O&M period. The Contractor shall provide access to UPNEDA/IMPLEMENTING AGENCY/MNRE & RECPDCL or their authorized representatives for installing any additional monitoring equipment to facilitate on-line transfer of data.*

The plant shall be equipped with measuring and recording following parameters, these will be required to be submitted to UPNEDA/MNRE on line and/or through a report on regular basis every month for the entire duration of PPA:-

- **Global Horizontal Irradiation**
- **Irradiation on Collector Plane**
- **Module Temperature**
- **Wind Speed**
- **Ambient Temeprature**
- **DC Input power to all the Inverters**
- **AC output power of all the Inverters**
- **Electrical parameters at outgoing feeders**
- **The SPD shall maintain the list of Module IDs along with performance characteristic data for each module. The data shall be submitted to UPNEDA/MNRE.**

4.5.4.1.6 Data logger and Data Acquisition System

Data logger for the weather monitoring station should have the following features:

Provision for analog, digital and counter type inputs for interfacing with various type of sensors

i. **Analog Input**

- Adequate nos. for all analog sensors with redundancy
- Provision for operation in different current and voltage ranges as per connected sensors
- Accuracy of +/-0.1% of FS

ii. **Digital Inputs**

a. Adequate no. of Digital inputs and outputs for the application

b. Provision for RS232 and RS485 serial outputs

c. Built-in battery backup

d. Connectivity and Data transmission:
   - Built-in GSM/ GPRS modem for wireless data transmission to SCADA/ cloud server (procurement of GPRS enabled SIM Card and connection subscription to be the responsibility of Contractor). It should be possible to remotely communicate with the device for configuration settings.
   - RS485 MODBUS interface for data collection and storage on SCADA
   - Web interface with provision for user login to enable viewing and downloading of weather data in XLS/ CSV format.
   - Communication protocol should support fast data transmission rates, enable operation in different Frequency bands and have an encryption-based data security layer for secure data transmission

e. Display Settings: Graphic LCD screen which should be easily accessible and should display relevant details like all sensor values, battery strength, network strength etc.

f. Provision of Time synchronization from telecom time or server time

g. Data Storage: Provision for at least 2 MB internal Flash Memory and at least 8 GB Micro SD card (expandable)

h. Protection level: IP65

4.5.4.2 FIRE FIGHTING SYSTEM

4.5.4.2.1 The SPV plant shall be equipped with suitable fire protection & firefighting systems (including Portable fire extinguishers, Sand buckets, fire alarm panel and other equipment as required) for protection of entire equipment, switchyard & control room as per CEIG and other statutory requirements. The installation shall meet all applicable statutory requirements, safety regulations in terms of fire protection.

4.5.4.2.2 Fire protection system

Liquefied CO2 fire extinguisher shall be upright type of capacity 10 kg having IS: 2171. 7 IS: 10658 marked. . The fire extinguisher shall be suitable for fighting fire of Oils, Solvents, Gases, Paints, Varnishes, Electrical Wiring, Live Machinery Fires, and All Flammable Liquid & Gas.

Fire protection for different equipment as per NFPA standard and NBC Norms.

Fire-fighting system for main control room having SCADA room, battery room, Panel room, store room etc.

Firefighting system for switchyard equipment's, Power/Inverter Transformers & Auxiliary Transformer.

Contractor shall provide adequate fire protection system for transformer as per the practises adopted by Solar Park authority or as per statutory requirements/relevant standard for power/inverter transformer.

Firefighting system for inverter rooms having Power Conditioning Units & Inverter Transformers.

Nitrogen based fire protection system shall be provided for power/inverter transformers if required.

Fire detection and alarm system for Main control Room, Switchyard & transformer area, Inverter Rooms etc.

Notification devices such as fire horns/ alarms/ hooters/ bells, light or text display. Manual Call point, Fault Isolation Modules, Control Modules, Digital output or through RS 485/ any other compatible network form the fire detection system shall be integrated with SCADA.

Any other Items not mentioned specifically but necessary for the satisfactory completion of the system.

4.5.4.2.3 General Requirements

The complete fire detecting & fire-fighting system shall be coordinated and established in accordance with latest standards. It shall be sole responsibility of the contractor to ensure proper installation and operation of the system in compliance with the applicable statutory /regulatory requirements.

4.5.4.2.4 Fire Alarm Control Panel Indication

Alarm conditions shall be immediately displayed on the control panel. Alarm LED shall flash on the control panel until the alarm has been acknowledged. Once acknowledged the LED shall remain lit.

During an alarm condition, an alarm tone shall sound within the control panel until the alarm is acknowledged

4.5.4.2.5 Ratings of complete fire-fighting including auxiliary system shall be taken in accordance with prevailing standards & practices. They shall work satisfactorily for the specified conditions.

4.5.4.2.6 The fire fighting should have followings-

1. Main Control room - Fire alarm system
2. Control room :

a) DCP Type ABC - 2 No's
b) Co2 9 kG capacity - 2 No's
c) Foam type 9 kG - 1 Number
d) Hand portable co2 9kG Capacity - 1 Number
e) Sand bucket -1 Number

2. Inverter station :

a) DCP Type ABC - 1 No's
b) Co2 9 kG capacity - 1 No's

3. Transformer Yard :

a) DCP Type ABC - 1 No's
b) Co2 9 kG capacity - 1 No's
c) Foam type 9 kG - 1 Number
d) Sand bucket -1 Number
4. Switch yard
a) DCP Type ABC - 2 No's
b) Co2 9 kG capacity - 2 No's
c) Sand bucket -1 Number
5) Pantry room
a) Hand portable co2 9kG Capacity - 2 Number

4.5.4.3 MODULE CLEANING SYSTEM and CLOSED CIRCUIT TELEVISION (CCTV) System

4.5.4.3.1 Module Cleaning System

The Contractor shall provide permanent arrangement for Module cleaning system in the Solar PV Plant after taking into consideration the site conditions. The Module cleaning system shall be complete in all respect and shall conform to the relevant IS Codes standards. This shall include pumps and motors, requisite storage arrangement and laying of HDPE Pipes with sufficient number of isolating valves conforming to IS 4984 and other relevant code and other equipment as required for completion of the system. The contractor shall also install a flow meter for measurement of water consumption. The contractor shall take all necessary approvals required from respective authorities for digging deep bore wells in plant area.

In case of Solar Park if the water supply will be provided by Solar Park developers then contractor shall ensure that the storage arrangement/ Water tank shall have sufficient storage capacity for cleaning of modules and other requirements as per the frequency of water supply.

Design of the Module cleaning system shall be such that complete solar plant shall be cleaned once in 15 days cycle. The water used for cleaning should be of appropriate quality fit for cleaning purpose as per the recommendations of the module manufacturer. The contractor shall also install the water purification/filtration/DM Plant (if necessary) so as to achieve the required quality of water for cleaning of modules as per manufacturer's recommendations. The Contractor shall ensure that each of these tube wells shall provide sufficient yield to meet the water requirement as stipulated above. The Contractor shall also submit the design details of the same to the Employer.

The HDPE Pipe shall be suitably protected against any impact load and shall be protected with higher diameter GI Pipes or other protection system at road crossings and other locations where higher loads are expected. .

Contractor shall furnish calculations based on the head and discharge requirements of the pump rating and the water-line details. Contractor shall provide the single line

diagram of water washing arrangement with location of pump to Employer for approval during detailed engineering

The contractor may propose any advanced cleaning solution like waterless cleaning system, if required, depending upon the site conditions for satisfactory and reliable operation & maintenance of the plant. The Contractor shall provide the Process and Instrumentation Diagrams (P & ID) of Module Cleaning arrangement and other relevant information for review of the Employer during detailed Engineering as per Engineering Information Schedule.

4.5.4.4 CLOSED CIRCUIT TELEVISION SYSTEM

The contractor shall provide CCTV Cameras along with monitoring stations (sufficient numbers) and all other accessories including but not limited to all the power supply (UPS), cables, cable trays, power packs, erection hardware (viz. junction boxes, brackets glands, nut-bolts, conduits etc.) and mounting required for its proper operation.

CCTV Cameras must be installed to have complete coverage of following areas

Switchyard

Main Entry: Covering all the entry/exist 24 Hrs

Plant Solar Array area (PTZ cameras shall be high speed integrated dome type, 1 no. PTZ type camera at each inverter room locations)

Control Rooms: Covering Entry/Exit and activities within Control Rooms

Monitoring Station of all the CCTV Network shall be installed in the Main Control Room **(2nos CCTV Workstation each with 22" monitor at each Unit)**.

The equipment furnished under this section shall meet the requirements of all the applicable International codes and standards or their latest amendment Codes and Standard.

Contractor has to propose the locations and number of cameras required for the Plant during bidding, however Employer's decision on number of cameras and location shall be final. The exact locations and number of Cameras shall be decided during detailed engineering

The Contractor shall ensure that CCTV Cameras and related equipment must have appropriate rating to work in prevailing site conditions as per the current opportunity. The CCTV Cameras along with all its system components i.e. network switches, storage devices, servers, LAN switches, media converters etc. shall be powered from UPS system.

The CCTV system shall be designed as a standalone IP based network architecture. System shall use video signals from different cameras at different locations, process the video signals for viewing on monitors at different locations and simultaneously record all the video streams.

CCTV System shall be provided with all relevant safety standards and network standards.

Camera server shall be provided with sufficient storage space to store recordings of all cameras at 25/30 FPS at 1920X1080 (For HD cameras)for a period of 02 Months or more using necessary compression techniques.

Contractor has to ensure that the data of all the CCTV Cameras shall be compatible for remotely monitoring **(5 numbers concurrent view at each Unit)** at the Employers Corporate office/any other office as desired.

It shall be possible to view, record, search and replay simultaneously without affecting performance of the system.

All the cameras shall capture video stream in colour and be suitable for day and night surveillance (under complete darkness conditions). There will be two types of cameras viz. PTZ & Fixed. PTZ cameras shall be high speed integrated dome type.

4.4.5 QUALITY ASSURANCE PLAN

i.

or all major/critical items, the contractor shall submit Manufacturing and Site/Field Quality Assurance Plans, considering the latest practices being followed in Solar Power Industry/Standard requirements/technical specifications requirements, in the format widely accepted in the Solar Power Industry. The final Quality Assurance Plans shall be mutually agreed upon with the successful bidder during the Pre-Award stage. For any constraints, if occur, the Quality Assurance Plans shall be finalized jointly with the successful bidder within 21 days after placement of Letter of Award. However, inputs are required to be submitted by the bidder for proposed Quality Assurance Plans at the time of Pre- Award stage in any case. This Quality Plan will detail out various tests / inspection to be carried out as per the requirements of the Technical Specifications and standards mentioned therein and Quality Practices and procedures to be followed by Supplier/Contractor's Quality Assurance Department., the relevant reference documents and standards and acceptance norms etc. during all stages of material procurement, manufacture, assembly and final testing/performance testing.

ii.

uring inspection, the Supplier/Contractor shall provide reference documents/plant standards/acceptance norms/test and inspection procedure etc. as referred in Quality Plan. The approved Quality plan shall form a part of the contract. During approval of Quality Plan, RECPDCL jointly with the contractor will identify Customer Hold Points (CHPs) for the major/critical items i.e. testing checks which shall be carried out in the presence of RECPDCL authorized representative. For each Lot of major/critical items/assemblies offered for inspection, RECPDCL's authorized representative will identify 10% (minimum 01 no per lot) quantity except for the Solar PV Modules (to be finalized by the Employer before the finalization of QAP) for testing/inspection in his presence as per approved Quality Plan. These 10% quantity of the major/critical items whose testing/ inspection has been carried out jointly, shall have to be used in the project identified for RECPDCL and should be readily traceable/identifiable.

For the remaining 90% of the major/critical items, testing/inspection will be carried out in house by the Quality Assurance Department of the contractor/supplier as per the approved Quality Plan. The documents of such testing/inspection carried out in house, will be submitted to RECPDCL for review and subsequent issuance of Material Dispatch Clearance Certificate (MDCC). The material/item/assembly for which MDCC has been issued by RECPDCL, shall have to be used in the project identified for RECPDCL and should be readily traceable/identifiable. No material shall be dispatched from the manufacturer's works before the same is accepted, subsequent to pre-dispatch final inspection including verification of records of all previous tests/inspections by Employer's Project Manager/Authorized representative and duly authorized for dispatch by issuance of Material Dispatch Clearance Certificate (MDCC).

iii.

he site/field quality assurance plans shall detail out the various quality practices, tests and procedures etc. to be followed by the Supplier/Contractor's Site Quality Assurance Dept. during various stages of site activities from receipt of material/equipment at site till final commissioning/acceptance/handover. The site/ Field Quality Assurance Plan shall be mutually agreed upon with successful Bidder/Supplier during the Pre-award Stage. For any constraints, if occur, the Quality Assurance Plans shall be finalized jointly with the successful bidder within 21 days after placement of Letter of Award. However, inputs are required to submit for proposed Quality Assurance Plans at the time of Pre- Award stage in any case. However, 30 days Performance Guarantee test shall be conducted at site as described in Clause 4.4.6 .respectively.

iv.

he inspection calls shall be placed at least one month in advance for overseas inspections and 10 days for inspections within India

v.

nly calibrated testing and measuring instruments would be used during manufacturing, testing and commissioning by the Supplier/contractor. Copy of the valid calibration certificates would be provided during inspection to RECPDCL by the Supplier/contractor

vi.

or all spares and replacement items, the quality requirements as agreed for the main equipment supply shall be applicable

vii.

he contractor will provide a compliance certificate regarding confirmation that repair/rectification has been carried out as per the standard procedure to make the job acceptable.

viii.

pproval of the results of the tests and inspection will not, however, prejudice the right of RECPDCL to reject the equipment if it does not comply with the specification in service and the above shall in no way limit the liabilities and responsibilities of the contractor in ensuring complete conformance of the materials/equipment supplied to relevant specification, standard, data sheets,

drawings etc.

ix.

or item/material/assembly covered in QAP, the Supplier/contractor shall be required to submit copies of the following Quality Assurance documents in original along with the request letter for issuance of MDCC (Material Dispatch Clearance Certificate)

a. Factory test result for testing required as per applicable codes and standards referred in the Specifications and approved Quality Assurance Plan.
b. Inspection reports duly signed by authorized representative of RECPDCL and Supplier for the 10% quantity for which inspection has been jointly carried out. For remaining 90% quantity, duly accepted test reports by the authorized representative of the Quality Assurance Dept of the Supplier/Contractor in accordance with the approved Quality Assurance Plan.
c. The accepted deviation, if any, shall be included with complete technical details

For item/material/assembly not covered in QAP, the Supplier/contractor shall be required to submit copies of the following Quality Assurance documents in original along with the request letter for issuance of MDCC:

a. Internal inspection reports/compliance certificate duly signed by authorized representative of Supplier/contractor's Quality Assurance Department.
b. The accepted deviation, if any, shall be included with complete technical details.
c. Undertaking from the Supplier/contractor that the components requested for MDCC meets the requirements of applicable standards and other relevant requirements of the contract.

x. (a) Non-conformities observed during manufacturing, handling, packaging, transportation, storage, preservation, erection, testing and commissioning including the corrective action taken by the Supplier/contractor to ensure that the supplied components/items meet the various requirements of the contract will be intimated by the Supplier/contractor for information of RECPDCL promptly.

(b) In case, Supplier/contractor agrees to replace such items/components having non-conformities with new items/components and redo the services having non-conformity, without any additional cost to RECPDCL, the Clause No 4.4.5(a) will not be applicable.

xi.

ny test which is the part of the contract document but not mentioned in the Quality Plan will also be carried out by the Supplier/contractor without any additional cost to RECPDCL.

xii.

he Contractor shall have to submit the Quality Assurance Plans for the following (but not limited to) Equipment/systems.

1. Solar PV Module
2. Power Conditioning Unit (PCU)
3. String Combiner Box (SCB)
4. Cables (DC,LT,HT, Control Cables)
5. Transformers (Power/Inverter Transformer)
6. HT Switchgear, LT Switchgear
7. Switchyard Equipment
8. SCADA

9. Civil Works
10. Erection Works
11. Commissioning of the Plant
12. Plant Performance Tests

4.4.6 PERFORMANCE GUARANTEE

4.4.6.1 Solar PV Power Plant Net Power generation

i. The Contractor shall guarantee at least 110.98 MU for Package-1 and 166.48 MU for Package-2 Net Annual Guaranteed Generation (NAGGs) at the delivery/interconnection point.

ii. The minimum year wise Net Annual Guaranteed Generation (NAGGs) to be supplied at the delivery/interconnection point is as per the Appendix A to Attachment 10 of this bid document. However, Contractor shall declare the Net Annual Guaranteed Generation (NAGGs) at Metering Point (CTU/STU end) for the annual basis as per the Attachment 10 of this bid document. The Bid having Declared NAGGs less than Minimum NAGGs provided by the Employer shall be rejected.

iii. The Contractor shall demonstrate "Actual Net Annual Guaranteed Generation (NAGGs)" at Metering Point (CTU/STU end) as compared to the Declared Net Annual Guaranteed Generation (NAGGs) for every year from the date of starting of O&M period.

4.4.6.2 PERFORMANCE GUARANTEE (PG) TEST

The final acceptance test as to prove the Performance Guarantee shall be conducted at each 110.98 MU for Package-1 and 166.48 MU for Package-2by the Contractor in presence of the Employer. The PG test shall be conducted on the basis of PG test procedure to be submitted by the contractor and approved by RECPDCL. This test shall be binding on all the parties of the Contract to determine compliance of the equipment with the functional guarantee. Any special equipment, instrumentation tools and tackles and manpower, required for the successful completion of the Performance Guarantee Test shall be provided by the Contractor free of cost. The accuracy class of the instrumentation shall be as per the relevant clause of documents.

The procedure for PG demonstration test shall be as follow:

Any consecutive three months period for the purpose of conducting performance guarantee test shall be chosen on the discretion of RECPDCL.

1. Bidder is required to quote the annual target generation in the techno-commercial bid.
2. Bidder has also to quote the month wise Target Generation per MWp solar capacity for **Fixed tracking** mode in the techno-commercial bid.
3. Based on the actual installed capacity in the mode of generation the month wise generation target for the bidder shall be derived and extrapolating the same to the quoted generation.
4. If the plant is not able to achieve the target generation as per the PG procedure during the test period, then contractor shall compensate RECPDCL with an amount equivalent to the loss of generation based on tariff and as per sample calculation in Table-B.

5 **The maximum amount of liquidated damages for shortfall in generation during PG Test shall not exceed 20% of the contract value, First & Second Contract.**

6 Sample calculation sheet for arriving month wise target generation for an annual quoted generation of 110.98 MU for Package-1 and 166.48 MU for Package-2from Fixed tracking based system having **175 MWp** DC capacity is shown in Table- A.

Month	Solar Insolation (kWhr/m2)	Target Generation (Mwhr) **Fixed** tracking (1 Mwp) Quoted by Bidder #	Final Monthwise Target generation for Bidder in MWhr
		A*	B**=A X 175
January	118	137	23975
February	135	133	23275
March	179	144	25200
April	187	149	26075
May	202	166	29050
June	165	138	24150
July	138	115	20125
August	135	99	17325
September	143	128	22400
October	138	130	22750
November	114	133	23275
December	106	129	22575
Year	**1760**		280175

Note:

1. Generation assumed by RECPDCL for illustration purpose.
2. Only the generation arrived in the column 'B' shall be used for arriving LD during PG test procedure as shown in sample calculation.

* Generation assumed by RECPDCL for illustration purpose.
** B=Sum of Final month wise target generation for bidder.

RECPDCL has right to question the rationality of the month wise quoted generation.

7 In addition to the two pyranometers to be supplied under the scope of work, the contractor shall install one more calibrated pyranometers at horizontal plane at locations mutually agreed by Contractor and RECPDCL. The additional pyranometer shall be free of cost on

returnable basis.

8 Contractor shall also install data logger to store all the pyranometers data during test period. A valid test reports for the installed pyranometers shall be submitted by the Contractor for approval to RECPDCL. The output of both pyranometers mounted on horizontal plane shall be made available at SCADA during the complete PG test duration i.e. three month period.

9 During the PG test period, the module tilt shall be kept as per approved schedule.

10 Actual energy exported from the plant shall be noted for three consecutive month period. For this purpose, the net energy exported at the metering point **(As per RFS)** and pyranometers reading shall be noted at agreed frequency on daily basis for entire PG test period.

This measured value of energy shall be compared with "Month wise Target Generation" for the PG test.

Following factors shall be considered for computing the "target Generation" and shortfall (if any)

a) Effect of any meteorological parameters shall not be considered except of solar radiation.

b) Variation of Performance Guarantee on account of Generation loss due to grid outage (or power evacuation system which is not in the scope of the Bidder): The measured global solar radiation of the period of the outage of the power evacuation system shall be excluded to calculate the cumulative global Insolation for the month. Under such situation, the radiation corresponding to the warm-up time of inverter as per data sheet shall also be adjusted to arrive at the cumulative global insolation for the month.

If the difference of reading between the two horizontally mounted pyranometers exceeds more than 2%, the test shall be halted and resumed only after rectification of errors which has led to mismatch. The data of that particular day(s) shall be discarded and test period shall be extended by same numbers of day(s).

The test shall be repeated in case of outage of following equipment for more than 7 days.

1. Inverter transformer
2. Power Conditioning Unit
3. SCADA and data logger combined
4. Both pyranometers.

If bidder is not able to demonstrate PG test during these three (03) months he shall be given one more chance to demonstrate the PG test. In that case, the steps for PG test shall be repeated again as above after carrying out necessary modification/replacement.

A sample calculation for shortfall in energy generation for period January to April and LD calculation for the site is given in **Table-B**.

Table-B: A sample calculation for the Solar Plant for Total Short fall in Energy for Design life

Month	(a) Global Solar Insolation of the month (kWhr/(m^2Xday)	(b) Target Generation (Mwhr) (Final Target generation as per **Table-A**)	(c) No of test days of the month	(d) Refernce Solar Insolation (a) X (c) / (Ndm*)	(e) Modified Target Generation of the month (Mwhr) (b) X (d) / (a)	(f) Measured Global Horizontal Solar Insolation (kWhr/ m^2)	(g) Corrected Target Generation (Mwhr) (e) X (f) / (d)	(h) Measured Generation at Metering Point (Mwhr)	Shortfall in energy for PG Test (g-h)#
Jan	118.00	14385	22	83.74	10,208.71	109	13,287.84	13,280	7.84
Feb	135.00	13965	28	135.00	13,965.00	152	15,723.56	15,639	84.56
March	179.00	15120	31	179.00	15,129.00	176	14,866.59	14,897	-30.41
April	187.00	15645	9	56.10	4,693.50	63	5,270.78	5,246	24.78
					43,987.21				86.76

* Ndm= Nos of days in the month

** Test is assumed to start from 10 January till 9th April

-ve value denotes excess generation

Total Short fall in Energy for the test period (TP)	7.84+84.56(-30.41)+24.78=86.76MWhr
Modified Target generation for the test period (GTP)	**43,987.31 MWhr**
Target yearly generation(GY)	**168105 MWhr**
Yearly shortfall in generation(Y)	GY X GTP / GTP 168105 X 86.76/43,987.21 = **331.58 MWhr**
Yearly loss of Revenue and applicable LD (**INR**)	GY X 1000 X R
Applicable LD for complete life of plant (in INR)	**331.58 X** 1000 X **R X 10.6454**

Where **R** is the applicable **tariff for LD as per clause 4.2.7**

4.4.7 ERECTION CONDITIONS OF CONTRACT (ECC)

I. General Conditions

The following provisions shall supplement the conditions already contained in the other parts of these specifications and documents and shall govern that portion of the work of this contract which is to be performed at site. The erection requirements and procedures not specified in these documents shall be in accordance with the recommendations of the equipment manufacturer, or as mutually agreed to between the Employer and the Contractor prior to commencement of erection work.

II. Electrical Safety Regulations

The contractor shall ensure that entire electrical installation work is executed by adopting applicable statutory safety regulations and best practices in the industry. The Contractor shall employ the necessary number of qualified, full time electricians to maintain his temporary electrical installation.

III. Inspection and Testing Inspection Certificates

The provisions of the clause entitled Inspection and Testing in the Technical Specification, shall also be applicable to the erection portion of the Works. The Employer shall have the right to re-inspect any equipment though previously inspected and approved by him at the Contractor's works, before and after the same are erected at Site. If by the above inspection, the Employer rejects any equipment, the Contractor shall make good for such rejections either by replacement or modification/ repairs as may be necessary to the satisfaction of the Employer. Such replacements will also include the replacements or re-execution of such of those works of other Contractors and/or agencies, which might have got damaged or affected by the replacements or re-work done to the Contractor's work.

IV. Contractor's Field Operation

The Contractor shall keep the Employer informed in advance regarding his field activity plans and schedules for carrying out each part of the works. Any review of such plan or schedule or method of work by the Employer shall not relieve the Contractor of any of his responsibilities towards the field activities. Such reviews shall also not be considered as an assumption of any risk or liability by the Employer or any of his representatives and no claim of the Contractor will be entertained because of the failure or inefficiency of any such plan or schedule or method of work reviewed. The Contractor shall be solely responsible for the safety, adequacy and efficiency of plant and equipment and his erection methods.

The Contractor shall have the complete responsibility for the conditions of the Work-Site including the safety of all persons employed by him or his Sub-Contractor and all the properties under his custody during the performance of the work. This requirement shall apply continuously till the completion of the Contract and shall not be limited to normal working hours. The construction review by the Employer is not intended to include review of Contractor's safety measures in, on or near the Work-Site, and their adequacy or otherwise.

V. Protection of Work

The Contractor shall have total responsibility for protecting his works till it is finally taken over by the Employer. No claim will be entertained by the Employer or the representative of the Employer for any damage or loss to the Contractor's works and the Contractor shall be responsible for complete restoration of the damaged works to original conditions to comply with the specification and drawings. Should any such damage to the Contractor's Works occur because of any other agency/individual not being under his supervision or control, the Contractor shall make his claim directly with the party concerned. The Contractor shall not cause any delay in the repair of such damaged Works because of any delay in the resolution of such disputes. The Contractor shall proceed to repair the Work immediately and no cause thereof will be assigned pending resolution of such disputes.

VI. Facilities To Be Provided By The Contractor

Contractor's site office Establishment: The Contractor shall establish a site office at the site and keep posted an authorized representative for the purpose of the contract.

Tools, tackles and scaffoldings: The Contractor shall provide all the construction equipments, tools, tackles and scaffoldings required for pre-assembly, installation, testing, commissioning and conducting Guarantee tests of the equipments covered under the Contract. The Contractor shall arrange machinery & equipment such as Dozer, Hydra, Cranes, Trailer, etc. wherever required for the purpose of fabrication, erection and commissioning.

Testing Equipment and Facilities: The contractor shall provide the necessary testing, equipment and facilities

Testing of construction material at the site: Contractor shall make arrangements for the testing of construction material at the site wherever required, under the scope of services of the contract.

First-aid: The Contractor shall provide necessary first-aid facilities for all his employees, representatives and workmen working at the Site. Enough number of Contractor's personnel shall be trained in administering first-aid.

Water: Contractor shall make all arrangements himself for the supply of construction water as well as potable water for labour and other personnel at the worksite.

VII. Security

The Contractor shall have total responsibility for all equipment and materials in his custody stores, loose, semi-assembled and/or erected by him at Site. The Contractor shall make suitable security arrangements including employment of security personnel to ensure the protection of all materials, equipment and works from theft, fire, pilferage and any other damages and loses.

VIII. Fire Protection

a.

he work procedures that are to be used during the erection shall be those, which

minimize fire hazards to the extent practicable. Combustible materials, combustible waste and rubbish shall be collected and removed from the Site regularly. Fuels, oils and volatile or flammable materials shall be stored away from the construction and equipment and materials storage areas in safe containers. Untreated canvas, paper, plastic or other flammable flexible materials shall not at all be used at Site for any other purpose unless otherwise specified. If any such materials are received with the equipment at the Site, the same shall be removed and replaced with acceptable material before moving into the construction or storage area.

b.

ll materials used for storage or for handling of materials shall be of water proof and flame resistant type. All the other materials such as working drawings, plans etc., which are combustible but are essential for the works to be executed shall be protected against combustion resulting from welding sparks, cutting flames and other similar fire sources.

c.

ll the Contractor's supervisory personnel and sufficient number of workers shall be trained for fire-fighting and shall be assigned specific fire protection duties. Enough of such trained personnel must be available at the Site during the entire period of the Contract.

d.

he Contractor shall provide suitable quantity & type fire protection equipment for the warehouses, office, temporary structures etc.

IX. Materials Handling and Storage. All the equipment furnished under the Contract and arriving at Site shall be promptly received, unloaded and transported and stored in the storage spaces by the Contractor. Modules, Inverters, Transformers and Other Balance of items etc. must be thoroughly protected and stored in a suitable manner to prevent damage or deterioration in quality by storage. All the materials stored in the open or dusty location must be covered with suitable weather proof and flameproof covering material wherever applicable. The Contractor shall be responsible for any loss or damage during transportation, handling & storage due to improper packing.

X. Construction Management

Contractor shall be responsible for performance of his works in accordance with the specified construction schedule. If at any time, the Contractor is falling behind the schedule, he shall take necessary action to make good for such delays by increasing his work force or by working overtime or otherwise accelerate the progress of the work to comply with the schedule and shall communicate such actions in writing to the Employer, satisfying that his action will compensate for the delay. The Contractor shall not be allowed any extra compensation for such action.

XI. Unfavorable Working Conditions

The Contractor shall confine all his field operations to those works which can be performed without subjecting the equipment and materials to adverse effects during inclement weather conditions, like monsoon, storms, etc. and during other unfavourable construction conditions. No field activities shall be performed by the Contractor under conditions which might adversely affect the quality and efficiency thereof, unless special precautions or measures are taken by the Contractor in a proper and

satisfactory manner in the performance of such Works and with the concurrence of the Employer. Such unfavourable construction conditions will in no way relieve the Contractor of his responsibility to perform the Works as per the schedule.

XII. Employment Of Labour

In addition to all local laws and regulations pertaining to the employment of labour to be complied with by the Contractor as mentioned elsewhere in the document, the Contractor will be expected to employ on the work only his regular skilled employees with experience of the particular work. No female labour shall be employed after darkness. No person below the age of eighteen years shall be employed.

The Contractor shall also comply with the Minimum Wages Act and the Payment of Wages Act (both of the Government of India) and the rules made there under in respect of its labour and the labour of its sub-contractors currently employed on or connected with the contract.

The contractor shall be solely responsible for discharge of all obligations relating to retirement /superannuation benefits to employees or any other benefit accruing to them in the nature of compensation, profit in lieu /in addition to salary etc. for the period of service with the contractor, irrespective continuance of employees with the project as employees of contractor after conclusion of O& M period.

All travelling expenses including provisions of all necessary transport to and from Site, lodging allowances and other payments to the Contractor's employees shall be the sole responsibility of the Contractor.

4.4.8 OPERATIONS AND MAINTENANCE (O&M)

I. Scope of Operation & Maintenance (O&M)

Comprehensive O&M of the solar PV plant (s) for a period of **Three (03)** years from the date of operational acceptance is in the scope of the Contractor. The contractor shall be responsible for all the required activities for the successful Operation and Maintenance of the entire Solar PV plant during the O&M period. The contractor shall be responsible for arranging at his own cost all spare parts required for routine repair/replacement for keeping the Solar power plant operational, repairs /replacement of any defective equipment(s) at his own cost as required from time to time, scheduled and preventive maintenance, maintaining log sheets/records of operational details, deployment of competent staff for continuous operation and qualified engineers for supervision of O&M work so as to ensure trouble free operation & healthy condition of the entire system at the designed efficiency/ performance level for the entire period of O&M Contract. Unless otherwise specified in the contract(s), the Employer shall not pay any other amount except the agreed O&M charges.

II. The scope of works shall include (but not limited to) the following: -

Ensuring successful operation of SPV Plant for achieving Declared Net Annual Guaranteed Generation (NAGGs) at Metering Point (CTU/STU end) on the annual basis.

Ensuring Breakdown maintenance, Periodic maintenance, Preventive maintenance, predictive maintenance, overhauls, arranging visit of O&M experts (when required) to maximize the availability of the solar plant.

Daily work of the operators involves logging the voltage, current, power factor, power and energy output of the SPV plant, temperature, logging down individual array output data once a day.

The operator shall record periodic energy output of each array and transformer /Inverter and reports shall be prepared on performance of SPV plant.

Operation procedures such as preparation to start, routine operations with safety precautions, monitoring of Solar Power Plant etc. shall be carried out as per the manufacturer's instructions to have trouble free operation of the complete system.

Contractor shall adhere to the terms & conditions as specified in the RFS document and subsequent clarifications or amendments issued from time to time.

Submission of periodical reports to the Employer on the energy generation & operating conditions of the SPV plant containing the plant performance data as finalised by the employer.

Ensuring Safety and protection of the plant by deputing sufficient security personals.

Monitoring, controlling, troubleshooting, maintaining of records, registers.

Supply of all type of spares, consumables and fixing / application of the same as required. List and quantity to be submitted for which stock will be maintained during O & M period.

Cleaning of the plant including array yard on regular basis and as and when required.

General up keeping of all equipment, buildings, roads, other common facilities in the plant area.

Cleaning of drains, cable trenches, box culverts etc.

Module washing/Cleaning as per as per approved schedule (Preferably, modules cleaning cycle shall be 15 days) Record of washing/Cleaning activities to be submitted periodically as per instruction of the employer.

Herbicide spray and grass cutting on a periodic basis.

Module tilt angle changing/adjustment as per the schedule approved during detailed engineering/as per requirements.

The contractor shall at his own expense provide all amenities to his workmen as per applicable laws and rules.

The Contractor shall ensure that all safety measures are taken at the site to avoid accidents to his employees or his Contractor's employees.

The Contractor shall immediately report the accidents, if any, to the Engineer In charge & to all the concerned authorities as per prevailing laws of the state.

The Contractor shall comply with the provision of all relevant Acts of Central or State Governments including payment of Wages Act 1936, Minimum Wages Act 1948, Employer's Liability Act 1938, Workmen's Compensation Act 1923, Industrial Dispute Act 1947, Maturity Benefit Act 1961, Employees State Insurance Act 1948, Contract Labour (Regulations & Abolishment) Act 1970 or any modification thereof or any other law relating whereto and rules made there under from time to time.

In order to ensure longevity, safety of the core equipment and optimum performance of the system the contractor should use only genuine spares of high quality standards.

Deployment of Plant in Charge, adequate number of technical support staff and other supporting personnel during the O&M period.

Energy estimation and scheduling: The work regarding the Estimation, Scheduling & Forecasting on daily basis in form of day ahead schedule or applicable guidelines shall be in the scope of contractor without any additional cost to Employer during period of O & M Contract. Any financial losses on account of scheduling and forecasting shall be on the account of the contractor. Coordination with concerned Agencies (SLDC/RLDC etc.) for the above shall also be in the scope of the contractor.

Co-ordination with STU/CTU/SLDC/RLDC/ other statutory organizations as per the requirements on behalf on the Employer for JMR recording, furnishing Generation Schedules as per requirement, revising schedules as necessary and complying with grid requirement.

To maintain compliance to the applicable Grid Code requirements and directions, if any, as specified by concerned SLDC/RLDC from time to time.

Contractor shall be responsible to carry out all test and work as required by statutory regulation in effect during O&M period.

Contractor is required to maintain adequate O&M spare during the O&M contract period of the Solar PV plant with the view to maximize availability of the plant.

At the time handing over of the plant by the contractor to the Employer, the contractor shall handover equipment in healthy condition.

III. Operation and Performance Monitoring

Operation part consists of all activities including deputing necessary manpower required to operate the plant at the optimum capacity, including

Monitoring performance of each PCUs & Modules

i. Monitoring performance of each Distribution Transformer, Substation equipments & Metering Panels.
ii. The plant would be operated at unity power factor.
iii. Contractor shall have a proper compatible Bar code reader along with thermal image sensor at the site during the entire O&M period of the plant.

The following points would be taken care of to ensure healthy operation of the plant:

i. Regular cleaning of the module surfaces at every 15 day cycle.
ii. Continuous monitoring through SCADA of plant performance and external grid conditions
iii. Frequent checking and calibration of instruments;
iv. Monitoring and maintaining performance, operations & maintenance records
v. Coordinate with various agencies, departments for continuous operations, maximum generation and revenue realization
vi. Comply with applicable rules, regulations, grid codes, and the specific guidelines for MW solar PV plants set under the MNRE and other schemes
vii. The system shall include logging the voltage, current, power factor, Active and Reactive Power output of the plant, individual panels/ arrays output data once a day, etc. The system shall also record failures, interruption in supply and tripping of different relays, reason for such tripping, duration of interruption etc. and inform Employer of such interruptions with details on periodic basis. Necessary auto data recording instruments will be

provided.

viii. The system shall record daily and monthly energy output of each array. Monthly Performance reports indicating array wise energy production, down time, capacity utilization factor, etc. shall be prepared for the plant and furnished in soft mode to Employer in the first week of the following month along with the details of saleable energy as calculated/ arrived at by power utility and /or by contractor.

Maintenance

The contractor shall ensure:

Establish robust preventive maintenance system to maximize up time and to ensure peak generation in peak periods

i. Careful logging of operation data/historical information from the Data Monitoring Systems, and periodically processing it to determine abnormal or slowly deteriorating conditions.

ii. alk down checks of the plant.

ii. areful control and supervision of operating conditions

iii. Regulate routine maintenance work such as keeping equipment clean, preventive maintenance and checks of delicate ingredients of transformers, circuit breakers, junction boxes, module mismatches, Cleanliness of isolators also to be ensured.

iv. epairs and replacements to ensure maximum uptime for the plant.

Handing over of the Plant

At the end of the contract period, the contractor shall hand over the plant and equipment back to the Employer in completely safe and healthy condition and without any pending defect.

The items supplied by the Employer on returnable basis, such as spares parts, consumables, tools and plants, documents etc. shall be returned back to the Employer, else, suitable recoveries shall be made from the Contractor's bills.

The contractor shall hand over all technical documents, literature, instruction manuals, lists of spare part & tools & tackles. Contractor shall also hand over all the relevant record/documents, spares and consumable required for **two year's Operation & Maintenance at the time of vacating the project. The spares and Consumables required shall be decided mutually based on the past consumption at no extra cost.**

After O&M period, Employer may at its discretion decide to extend the existing O&M contract on mutually acceptable terms & conditions or undertake the O&M of the SPV Plant on its own.

4.4.9 List of Mandatory Spares

S. No.	Equipment/Material	Quantity (for each type and rating)
1.	**PV Modules**	**0.25% of total supply**
2.	MC4 connectors (including Y-connector if used)	1% of total supply
3.	String Monitoring Unit	1% of total supply
4.	Power Conditioning Unit	
	(i) Central Inverter	As per OEM recommendation
5.	Inverter Transformer	
	(i) HV bushing with metal parts and gaskets	2 set
	(ii) LV bushing with metal parts and gaskets	2 set
	(iii) WTI with contacts	2 set
	(iv) OTI with contacts	2 set
	(v) Buchholz relay	2 set
	(vi) Magnetic Oil Gauge	2 set
	(vii) Complete set of gaskets 2 set	2 set
6.	HT Switchgear	
	(i) Vacuum pole	2 Nos.
	(ii) Closing coil	2 Nos.
	(iii) Tripping coil	2 Nos.
	(iv) Spring charging motor	2 Nos.
	(v) Relay	2 Nos.
	(vi) Meter	2 Nos.
	(vii) Current Transformer	2 Nos.
	(viii) MCCB	2 Nos.
	(ix) MCB	2 Nos.
	(x) Fuse	10% of total supply
	(xi) Indicating lamp	10% of total supply
	(xii) Rotary switch	10% of total supply
7.	LT Switchgear	
	(i) MCCB	2 Nos.
	(ii) MCB	2 Nos.

S. No.	Equipment/Material	Quantity (for each type and rating)
	(iii) Fuse	10% of total supply
	(iv) Relay	2 Nos.F
	(v) Meter	2 Nos.
	(vi) Current Transformer	2 Nos.
	(vii) Voltage Transformer	2 Nos.
	(viii) Indicating lamp	10% of total supply
	(ix) Rotary switch	10% of total supply
8.	Solar Cable	1% of total supply
9.	DC Cable	1% of total supply
10.	AC Cable	1% of total supply
11.	Communication Cable	1% of total supply
12.	Fuse	10% of total supply
13.	Set of Valves for Power transformer	1 Set
14.	WTI with contacts of Power transformer	1 Nos.
15.	OTI with contacts of Power transformer	1 Nos.
16.	Buchholz relay complete of Power transformer	1 Nos.
17.	Pressure Relief Device of Power Transformer	1 Nos.
18.	Magnetic Oil Gauge (MOG) of Power Transformer	1 Nos.
19.	HV and LV Bushing with metal parts and gaskets of Tie Transformer(each type)	1 Nos.
20	33 kV outdoor Current Transformer	1 no. Of each rating
21.	33 kV Outdoor Potential Transformer	1 no. Of each type
22.	33 kV Outdoor Surge Arrestor	1 nos.
23.	33 kV Isolator (one pole)	1 nos.
24.	Switchyard Spares	
25.	Current Transformer (Protection)	1 no of each rating
26.	Current Transformer (Metering)	1 nos.
27.	CVT (For Protection)	1 nos.
28.	Voltage Transformer (Metering)	1 nos.
29.	Outdoor Surge Arrestor	1 nos.
30	Isolator (one pole)	1 no of each rating
31	Circuit Breaker (one pole)	1 no of each rating

S. No.	Equipment/Material	Quantity (for each type and rating)
32	Swyd Control& Protection-Numerical protection Relay	1 no of each type
33	Swyd Control& Protection-Auxilliary Relay	1 no of each type
34	Swyd Control& Protection-Bay Control Unit (BCU)	1 no of each type
35	Wave trap	1 nos.

Remarks:

a) Components mentioned in mandatory spares list, which are not applicable as per plant design consideration shall not be applicable.

b). All the mandatory spares may be kept at site with record for use by the Contractor during O&M. Spares, if used, during O&M period shall be replenished by Contractor. All the mandatory spares shall be handed over to Employer in working condition at the end of O&M Period.

c). Contractor shall furnish the recommended spare list as part of design/drawing approval stage.

4.4.10 Engineering Information Schedule

The Contractor shall submit to the Employer necessary documents, drawings, data, Design and Engineering Information in 3 (three) Hard & Soft copies from time to time as per the Engineering Information Schedule. The Engineering Information Schedule shall be finalized with the Employer.

The list of documents to be submitted by the contractor before the signing of Contract Agreement shall include (but not limited to) the following:-

Documents to be submitted

1) Detailed Schedule for various activities including Supply, Erection and Civil Works in the form of PERT Chart for the entire project indicating Start Date and End Date for each activity

2) Billing Break up for the Supply, Erection & Civil Works

3) Quality Assurance Plan

4) Solar Resource Assessment Report containing Solar Insolation data, Generation data etc. using latest software (METEONORM, PVSYST etc.)

5) List of Sub Venders for all Bill of Material items supplied under this Contract

6) Details of PV Module and PCU as par Clause 4.4.10.2.1 & 4.4.10.2.2 respectively

7) PO copy of Modules, Inverters & MMS.

4.4.10.1.1 The Contractor shall also submit following Documents/ Information pertaining to PV Modules **during detailed engineering**

i. Complete Data Sheet of the offered PV Module indicating all the parameters specified in the detailed Scope of Work.
ii. Performance Data at STC as well as NOCT.
iii. IEC Certificates as mentioned in Technical Document of PV Modules

A.	**Minimum Guaranteed Performance Parameters.**	**Information to be filled by the Contractor**
1.	Manufacture	
2.	Model	
3	Type of Technology	
4	Total Installed Capacity of Module	
5	Quantity of Modules	

6	Power Rating at STC
7	Power Rating at NOCT
8	Tolerance in Power Rating
9	Module Efficiency at STC
10	Temperature Coefficient of Power (%/°C)
11	Permitted Module Temperature under continuous duty
12	Series Fuse Rating
B.	**General Electrical Characteristic under STC**
1	Voc (Open Circuit Voltage at STC)
2	Isc (Short Circuit Current at STC)
3	Vmp(Voltage at maximum power point at STC)
4	Imp(Current at maximum power point at STC)
5	Individual cell voltage, current, power & efficiency.
6	No. of Bus Bar in Module
7	Fill Factor
C.	**Guaranteed Overall design specifications**
1	General module specification
2	Maximum system voltage
3	Maximum Reverse current
4	Structural Strength for sustaining wind/snow load
5	Permitted Module temperature on continuous duty
6	Front glass
7	Module frame material
8	Weather module frame is anodized (YES/NO)
9	Encapsulants/sealants

D. Junction Box

1 No. of Bypass Diodes

2 Diode rating

3 IP Protection

E. Module Connecting Cable

1 Type of Conductor

2 Size of Conductor

3 Electrical Rating

4 Length

F. Cable Connector

1 Type

2 Electrical Rating

3 Compatibility

4 Contact Resistance

5 IP Protection

G. Physical Parameter of Module

1 Length in mm

2 Width in mm

3 Depth in mm

4 Module area in sq. meter

5 Cell size in mm

6 No. of cells in Module

7 Weight of Module in Kg

H. Commercial

1 Material/Product Warranty(Years)

2 First year degradation (Max % to be quoted)

3 Standard Degradation per year after the first year (%)

4 Power Output Warranty (years)

4.4.10.1.2 PCU

The Contractor shall also submit following Documents pertaining to PCU before the signing of Contract Agreement.

a. Data Sheets of the PCU

b. Performance Data at STC
c. Graphs indicating
   i. Efficiency and AC Output v/s temperature
   ii. Efficiency and Output curves at various incident radiation
   iii. Power output AC v/s Power input DC
d. Efficiency profile v/s Input Power
e. IEC Certificates

The contractor shall provide the Schedule/Time Line for submission of the following documents (to be finalized in discussion with RECPDCL). The below list is indicative only.

S. No.	Documents to be submitted
1.	Design Memorandum/Design Basis Report
2.	Geotechnical investigation data and Topographical survey report including topographical survey data in digital format (excel file) and Contour plan of the area.
3.	Bill of Material shall include item description, type, weight/quantity specification etc. for all equipment/items supplied for the project.
4.	List of approvals/clearances required during period of contract
5.	List of all the drawings, GA Drawings, Schematic drawings and other Technical documents are detailed out in point 4.4.10.3.1
6.	Test reports (for type, acceptance, and routine tests) for all the equipment's supplied under this Tender.
7.	Technical Data Sheets, System Design Documents/philosophy for all equipment's supplied under this Tender.
8.	Testing Procedure for all equipment's supplied under this Tender.
9.	Installation Manual, Erection Manual and Warranty Certificate of equipments supplied under this Tender
10.	Operation Manual for all equipment's supplied under this Tender.
11.	Detailed Manpower deployment schedule.
12.	Any other documents required for the efficient project management of the project not mentioned above.
13.	PR Test Procedures
14.	Safety Instruction Manual

4.4.10.1.3 List of the Drawings, GA Drawings and other technical documents to be submitted by the Contractor.

The Contractor shall submit all drawings, GA Drawings, technical documents & other documents for the satisfactory completion–of the project to RECPDCL including (but not limited to) the following:

a) Drawings

i. Civil MMS Foundation Drawing, MMS drawing along with weight

ii. Stadd Pro Software file soft copy for Civil Foundation and Structure

iii. Drawing of PV Module indicating detailed Dimensions, location of Junction Box, DC Cable length, details of Mounting Holes etc.

iv. Plant General Layout of Solar PV Power Plant which includes module yard, LT/HT Transmission system, Switch yard, internal roadways / pathways / landscaped areas, gate, drainage system and water distribution system mentioning all lines and levels, yard earth pits, yard lightings, lightning posts / earth pits, etc

v. Transmission line drawings and erection plans as per DISCOM/STU guidelines.

vi. Inverter Room GA Layout and Inverter Room Trench Layout

vii. String Combiner Box Grouping Layout

viii. AC side & DC Single line diagram and Switchyard Layout

ix. General Equipment Layout drawing for Sub Station showing Switchgear room, SCADA room, Office, stores, pantry, toilet, parking and security cabin.

x. Civil foundation design & drawing for MMS structure, Solar PV module array footings, Pre-Fabricated Building and RCC building, yard equipment such as CT, PT, CB & LAs, Isolators, Power/Inverter Transformers, Watchmen cabin, fencing, gate, etc

xi. Cable Routing diagram of DC, AC, Control & Communication Cabling

xii. Trench layout drawing for DC, AC cables.

xiii. WMB Road Cross Section and Drain Detail Drawing

xiv. General Layout of earth pits in the yard for lightning protecting and equipment Earthing.

xv. Perimeter fencing and transformer yard fencing.

xvi. Fire Protection & Alarm system layout drawing

xvii. Plant Lighting Layout (Indoor & Outdoor)

xviii. Design calculation for UPS and battery sizing.

xix. Weather Monitoring System drawings including pyranometer, anemometer etc.

b) GA DRAWINGS

i. GA Drawing of PV Module indicating detailed Dimensions, location of Junction Box, DC Cable length, details of Mounting Holes

ii. GA drawing of string / array / main junction boxes, String Monitoring units and combiner boxes with part details

iii. GA drawing of PCU with overall dimensions, schematics, Wiring diagram and performance data sheet.

iv. GA drawing along with schematics of SCADA System

v. GA drawing along with schematics for lightning protection system for buildings and array

vi. GA drawing along with schematics for module cleaning system
vii. GA drawings along with schematics for Switchyard equipment such as CT, PT, CB & LAs, Isolators
viii. GA drawings along with schematics for all DC Cables, AC Cables & Control Cables along with their cable trays.
ix. GA drawings along with schematics for Power/Inverter transformer, Marshalling boxes.
x. GA drawings along with schematics for LT & HT Panels, C&R Panels, Numeric relays.
xi. GA drawings along with schematics for DC battery, charger, UPS, lighting fixtures.

c) Documents to be submitted at the end of every year

i. Inventory of spares at project site
ii. As-Built Drawings – Where ever corrections involved
iii. Operation log book
iv. List and description of major maintenance works done on equipment

On completion of complete Operation and Maintenance period, the contractor has to submit Completion Report highlighting all major miles stone events, Spares list with part number, do's and don'ts, special instructions, lessons learnt, etc.

The above list is indicative only. It shall be the responsibility of the contractor to furnish all requisite engineering information in respect of all equipment/systems/spares as required for the successful execution of the contract. The contractor shall be obligated to furnish to the Employer, any other specific information as requested by the Employer

All the documents/drawings shall be submitted in PDF as well as editable format like AutoCAD, Excel, Word etc. as per the requirement of RECPDCL.

4.4.11 Documents to be submitted before the COD

As per the requirements of RFS document, Contractor has to submit the following documents (duly signed and stamped by authorized signatory) well in advance prior to the scheduled commissioning date to RECPDCL. These documents then will be uploaded to UPNEDA/IMPLEMENTING AGENCY-CRM Portal. It is the responsibility of the Contractor to upload these documents on the UPNEDA/IMPLEMENTING AGENCY's-CRM portal.

Note- ***The list of all the documents shall be as per the RFS Opportunity.

4.4.12 LD for shortfall in Generation during O&M

Methodology for calculation of LD on shortfall in stipulated generation shall be as follows:

i) Quoted Generation by the Bidder **for each year** in Attachment 10=G1
ii) Reference Global Horizontal Insolation (Ref clause 4.2.7) = H1
iii) Measured Generation during the O&M period=G2
iv) Measured Global Horizontal Insolation during the O&M period= H2
v) Modified target Generation during the O&M period(G2')
G2'=(H2/H1)xG1x MCF x PGF
where,
MCF=Module correction factor for performance degradation = (1- Year of Operation X 0.006)
Thus for 2nd year of operation MCF = (1- 2*0.006) = 0.988
O&M period after PG shall start after successful completion of PG Test and issuance of Operational acceptance certificate.

PGF=Performance Guarantee Factor which is ratio of achieved generation to modified target generation during the PG Test. It shall be always less than or equal to 1(one), if contractor has not met their guaranteed generation during the PG Test. It's maximum value shall be 1 even if generation achieved during PG Test is more than guaranteed generation.
Therefore, Liquidated Damages for shortfall in Energy shall be applicable, if
G= Shortfall in generation = G2'-G2
In case G2' < or = G2 then no liquidated damages for the corresponding O&M period.

The maximum Liquidated Damages for the shortfall of generation during O&M period shall be limited to an amount equivalent to 10 % of the quoted generation **for each year** by the bidder.

Tariff for computing Liquidity damage for O&M Period as per clause mentioned in clause 4.7.2 .

#In case, the GHI is not available because of instrumentation or SCADA problem, the corresponding insolation and generation shall be excluded from the time block for estimation of loss of generation.

Generation loss due to the grid outage not attributed to the contractor shall also be excluded for arriving loss of generation.

One day shall be equally divided into 96 blocks of 15 minutes each starting from 00:00 Hrs, i.e. 42nd time block shall be from 10:15-10:30 Hrs.

In case of shortfall in generation, recovery of LD shall be first deducted from payment towards O&M contract value up to limiting level of 10% of the Annual Contract Value. The adjustment of LD amount shall be done in the 4th Quarter.

In case the LD recovery amount exceeds above limiting value, balance amount shall be recovered through Bank Guarantee submitted by EPC Contractor against '**Liquidity Damages for shortfall in Generation during Operation and Maintenance period**'**.**

The value of amount encashed from above BG shall have to be replenished by EPC contractor within three months.

Calculation of BG and Proposal for 125 MW (50 MW & 75 MW) Sample Project

a) Value of the Annual O&M Contract= Say Rs. Y per Year
b) O&M Charges payable to the contractor on Quarterly basis= Rs. Y / 4 per Quarter

• Maximum LD deductible from O&M contract = 10 % of Annual O&M Contract value in Q4 =Rs. (Y / 4)

The complete LD amount shall be adjusted in the 4th Quarter.

Sample Procedure for determining LD for shortfall in generation during O&M period as follow

a) O&M Period being considered 2nd Year i.e. MCF=0.988
b) PGF=0.98 if during the PG Test, the shortfall in generation is 2%.
c) Quoted Annual Generation by the Bidder(G1 in Million Unit) = 168.19 MU
d) Reference Global Horizontal Insolation(H1) = 1760 kWh/m2-year *(Actual reference GHI for the site shall be as per Cl 4.2.7)*

• Measured Generation by the Bidder(**G2 in Million Units**) = 166 MU (say)

• Measured Global Horizontal Insolation during the O&M period(H2)=1806 kWh/m2-year (say)

• Modified target Generation during the 2nd year of the O&M period(**G2'**)

=G1 x (H2/H1) x MCF x PGF

=168.19 x (1806/1760) x 0.988 x 0.98=167.10 MU

G = G2'-G2=168.19– 167.10 MU = 1.10 MU

Since G2'>G2, LD applicability =Yes

Value of LD in INR = Shortfall in Generation (MU) x Tariff = INR x R

Maximum Value of LD towards shortfall in generation during O&M period = Energy charges for 10% of Quoted generation =0.1×G1×R INR

Where R is the applicable tariff for LD. G is the quoted 1st Year Generation by the bidder.

*********END OF SECTION********