contract value, and the same shall be deducted from their payments due / Performance Bank guarantee for O&M period submitted to the Employer. The LD will be calculated with reference to GCC 50.1.2. During the O&M period, at any point of time, the Contractor has to ensure the availability of BG of requisite value with Employer.

25.3. Liquidity Damages during O&M period shall be charged at a rate of:
Difference in units derived from calculated PR x 1.5 times as per the prevailing tariff; for period after commissioning till the O&M contract closure on annual basis, upto 10% of the total contract value and the same shall be deducted from their payments due / Performance Bank guarantee for O&M period submitted to the Employer. The PR shall be evaluated as per the formula mentioned at Clause 7 of TS of this RFP.

25.4. In case the Project fails to generate any power continuously for 1 month any time during the O&M period, apart from the force majeure and grid outages as certified by competent authority from STU/ CTU, it shall be considered as "an event of default". In the case of default the entire O&M Bank Guarantee will be encashed.

## 25. Miscellaneous

26.1. Based on reviewing the Project, if the progress is below expectation as demanded by the Employer then, the employer reserves right to reduce the Scope of the Contractor in part or full and assign the same to other contractor(s) and get the work done at the risk and cost of the existing Contractor.

26.2. The Contractor shall continue to provide all the monitoring services, licenses, software, access to all information (real-time or stored ) that were being used during the O&M to the Employer.

26.3. The Contractor will construct/ provide a temporary facility/ arrangement at site or otherwise for the office of Employer's employee/ consultant at the time of construction of the Rooftop Solar Power Plant. All the temporary facilities constructed for the purpose of execution of the contract shall be removed after taking necessary permissions from the Employer immediately after Operational Acceptance.

26.4. Provision for installing any additional monitoring equipment to facilitate on- line transfer of data shall be provided by the Contractor.

26.5. The Contractor shall check the design criteria and calculations (if any) included in the RFP and satisfy itself regarding their accuracy and adequacy. Contractor shall meet the minimum design and sizing requirements specified in the Bid Documents – a design that does not meet such minimum requirement shall not be acceptable and will result in rejection of the bid as non-responsive. Further, if Contractor believes that the minimum design and sizing requirements are not adequate to meet the minimum performance requirements specified, then Contractor shall make whatever upward adjustments to the design and sizing it deems necessary to meet the performance requirements and include these in the Bid Price. Contractor assumes full responsibility for meeting the specified performance requirements and ensuring the adequacy of the Works for this purpose." The design criteria provided in respective schedules of the same volume is basic design criteria and has to be met in totality. However, if the Contractor feels that, he requires additional work to meet the contractual conditions, the cost of same shall be deemed to be included in the Price and no extra cost shall be paid over and above the quoted price.

26.6. In case, approved make of any item is not available or ambiguity arrives, list of approved make of item with Uttar Pradesh New & Renewable Energy Development Agency shall be applicable.

26.7. In case of discrepancy between GCC Clause and SCC Clause on a particular subject, SCC conditions will prevail.

# Schedule 1: List of Banks

| **SCHEDULED COMMERCIAL BANKS** | | **OTHER PUBLIC SECTOR BANKS** | |
|---|---|---|---|
| 1 | SBI AND ASSOCIATES | 1 | IDBI Bank Ltd. |
| 2 | State Bank of India | **FOREIGN BANKS** | |
| **NATIONALISED BANKS** | | 1 | Bank of America NA |
| 1 | Allahabad Bank | 2 | Bank of Tokyo Mitsubishi UFJ Ltd. |
| 2 | Andhra Bank | 3 | BNP Paribas |
| 3 | Bank of India | 4 | Calyon Bank |
| 4 | Bank of Maharashtra | 5 | Citi Bank N.A. |
| 5 | Canara Bank | 6 | Deutsche Bank A.G |
| 6 | Central Bank of India | 7 | The HongKong and Shanghai Banking Corpn. Ltd. |
| 7 | Corporation Bank | 8 | Standard Chartered Bank |
| 8 | Dena Bank | 9 | Societe Generale |
| 9 | Indian Bank | 10 | Barclays Bank |
| 10 | Indian Overseas Bank | 11 | ABN Amro Bank N.V. |
| 11 | Oriental Bank of Commerce | 12 | Bank of Nova Scotia |
| 12 | Punjab National Bank | 13 | Development Bank of Singapore (DBS, Bank Ltd.) |
| 13 | Punjab & Sind Bank | **SCHEDULED PRIVATE BANKS** | |
| 14 | Syndicate Bank | 1 | Federal Bank Ltd. |
| 15 | Union Bank of India | 2 | ING Vysya Bank Ltd. |

| | | | |
|---|---|---|---|
| 16 | United Bank of India | 3 | Axis Bank Ltd. |
| 17 | UCO Bank | 4 | ICICI Bank Ltd. |
| 18 | Vijaya Bank | 5 | HDFC Bank Ltd. |
| 19 | Bank of Baroda | 6 | Yes Bank Ltd |

# SECTION - V

## SCOPE & TECHNICAL SPECIFICATIONS

# Contents

# A. Introduction

## 1. Site Description

1.1. The area for the proposed project is located at

| | | |
|---|---|---|
| 1. | Collectorate Meeting Hall (District Minority Welfare Office) | Latitude: 27°54'13.33"N<br>Longitude: 78° 4'14.53"E |
| 2. | Nagar Nigam Sewa Bhawan | Latitude: 27°53'49.83"N<br>Longitude: 78° 4'26.40"E |
| 3. | Treasury Office, Badar Bagh | Latitude: 27°54'10.78"N<br>Longitude: 78° 4'16.68"E |
| 4. | Chief Medical Office, Rasalganj | Latitude: 27°54'3.68"N<br>Longitude: 78° 4'40.42"E |
| 5. | NIC Center | Latitude: 27°54'18.13"N<br>Longitude: 78° 4'11.92"E |

1.2. Proposed Project Details:

| **Particulars** | **Description** |
|---|---|
| Details of proposed capacity of the solar power plant | **168 KWp Rooftop Solar Power Plant** |
| **Proposed SPV Plant Size** | **168 KW** |
| State | Uttar Pradesh |
| District | Aligarh District |
| Location | Aligarh |
| Minimum values of PR | PR:75 % |
| Estimated life of PV Power plant | 25 Years |
| Water and Power for Construction | To be arranged by the Contractor |

# B. System Design and Philosophy

## 2. Design Philosophy

2.1. The main objective of the design philosophy is to construct the plant within-built Quality and appropriate redundancy to achieve high availability and reliability with minimum maintenance efforts. In order to achieve this, the following principles shall be adopted while designing system.

2.1.1. Technology: Solar PV Mono/ multi-crystalline modules (>16% Multi-crystalline, >18% mono) of high efficiency Modules shall be installed on the rooftop over an appropriately designed modular and pre-fabricated module mounting structure.

2.1.2. Adequate capacity of SPV module, MMS, PCUs, Junction boxes etc. to ensure generation of power as per design estimates. This to be done by applying liberal de-rating factors for the array and recognizing the efficiency parameters of PCUs, transformers, conductor loss etc.

2.1.3. Use of equipment and systems with proven design and performance that have a high availability track record under similar service conditions.

2.1.4. Selection of the equipment's and adoption of a plant layout to ensure ease of maintenance.

2.1.5. Strict compliance with the approved and proven quality assurance systems and procedures during the different stages of the project starting from sizing, selection of make, shipment, storage ( at site) , during erection, testing and commissioning.

2.1.6. Proper monitoring in the synchronizations which ensures the availability of power to the grid.

2.1.7. The plant instrumentation and control system should be designed to ensure high availability and reliability of the plant to assist the operators in the safe and efficient operation of the plant with minimum effort.

2.1.8. It should also provide for the analysis of the historical data and help in the plant maintenance people to take up the plant and equipment on predictive maintenance.

2.1.9. Inverter output voltage of 230-415V has to be connect to the grid at the point of interconnection.

2.1.10. The power plant has to satisfactorily operate in parallel with the grid system which is infinite electrical system. Any faults not taken care will result in damage of only SPV power plant without affecting state Utility infinite system. Thus suitable protective measure is to be in built so that any disturbance of the grid will not cause any damage of the equipment's of the Solar Power Plant.

2.1.11. Very fast responsive microprocessor based Directional and Reverse power flow protection should be provided to ensure isolation of the Rooftop Solar Power Plant from the grid at the time of any fault or/and any additional suitable protection.

2.2. The basic and detailed engineering of the plant shall aim at achieving high standards of operational performance especially considering following:

2.2.1. Plant layout to ensure optimum availability for generation during the day time without any shading.

2.2.2. High DC system voltage and low current handling requirements.

2.2.3. Selection of PCUs with proven reliability and minimum downtime. Ready availability of requisite spares.

2.2.4. Based on the SOLAR INSOLATION data from reliable sources, the solar PV system should be so designed that it shall take into account the mean energy output after allowing for various losses, temperature corrections, on an average day for each month of the year.

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

2.2.6. SPV power plant should be designed to operate satisfactorily in parallel with the grid within permissible limits of high voltage and frequency fluctuation conditions. It is also extremely important to safeguard the system during major disturbances.

2.2.7. The module mounting structure shall have adequate strength and as per requirement of site to withstand the load of the modules and high wind velocities. The mounting structure steel shall be as per latest IS 2062: 1992 and galvanization of the mounting structure shall be in compliance of latest IS 4759. The MMS shall be designed for simple mechanical on-site installation. There shall be no requirement of welding, masonry or complex machinery at the installation site.

2.3. The specifications provided with this bid document are a functional ones; any design provided in this document is only meant as an example. The Bidder must submit a proposal based upon their own design. Bidder must optimize their own design for Solar Photovoltaic (SPV) system with best proven technology so that it shall meet to guarantee the performance factors as it is a part of the acceptance criteria given in this bid document. The bidders are advised to visit the site before designing the plant.

2.4. The minimum array capacity at STC shall be determined to have 168 KWp output at the time of installation. If the bidder anticipates any degradation of the modules more than 2% of the module output during the first year, it shall be taken care of to meet guaranteed generation to avoid liquidated damages/compensation on account of Generation Performance Guarantees.

2.5. This Bid document specifically cover the rest of the requirements for Zero Export Grid Connected Rooftop Solar Power Plant along with their associated equipment.

2.6. Successful Bidder (Contractor) shall prepare the detailed project report & design basis report and submit a copy to Employer for evaluation within 2 weeks from the date of issue of LOI.

2.7. Component and equipment reliability: Each component offered by the bidder shall be of established reliability. The minimum target reliability of each equipment shall be established by the bidder considering its failure, mean time between failures and mean time to restore, such that the availability of complete system is assured. The guaranteed annual system availability shall not be less than 99%. Bidder recommendation of the spares shall be on the basis of established reliability.

2.8. Bidder shall design the equipment and plant in order to have sustained life of 25 years with minimum maintenance efforts.

2.9. The supply, erection, commissioning and all other allied works for said capacity SPV Power Plant shall be completed as per timelines under SCC Clause 8.

## C. Scope of Supply and Work

### 3. Detailed Scope of Work

3.1. Scope of Supply & Work includes all design & engineering, procurement & supply of equipment and materials, testing at manufacturers works, inspection, packing and forwarding, supply, receipt, unloading and storage at site, preparation of site, reclamation work, associated civil works, services, permits, licences, installation and incidentals, insurance at all stages, erection, testing & commissioning, evacuation and net metering with Zero Export Policy related works of 168 KW Grid Interactive Rooftop Solar Power Plant, clearing the site of any debris after completion and performance demonstration with

associated equipment and materials on turnkey basis and 05 (five) years comprehensive operation and maintenance from the date of commissioning or Operational Acceptance, whichever is later.

3.2. The equipment and materials for the said capacity Grid Interactive Solar PV Power Plant with associated system (Typical) shall include but not be limited to the receipt, unloading, storage, erection, testing and commissioning of all supplied material for the following:

3.2.1. Solar PV modules of suitable rating, in array totalling minimum of the said DC capacity including mounting frames, fasteners and module interconnection.

3.2.2. Array Junction boxes, distribution boxes and Fuse boxes: MCBs, Surge Arrestors with string monitoring capabilities and with proper lugs, glands, ferrules, terminations and mounting structures.

3.2.3. DC and AC cables of appropriate sizes with adequate safety and insulation

3.2.4. Power Conditioning Units (PCU) with SCADA compatibility, common AC power evacuation panel with bus bars and circuit breakers LT & HT Power Interfacing Panels, Plant Monitoring Desk, AC & DC Distribution boards – As required.

3.2.5. Deleted.

3.2.6. Deleted.

3.2.7. Metering and protection system

3.2.8. LT Power and Control Cables including end terminations and other required accessories for both AC & DC power

3.2.9. Data acquisition system with remote monitoring facilities with internet connectivity.

3.2.10. Lightning protection for entire plant area.

3.2.11. PVC pipes, cable conduits, cable trays and accessories/trenches.

3.2.12. Earthing of the entire plant as per relevant standards.

3.2.13. Testing, maintenance and monitoring of equipment.

3.2.14. Mandatory spares, spares, other spares & consumables, as required or recommended, for 05 years O&M period.

3.2.15. Fire extinguishers.

3.2.16. All safety gadgets during Construction and O&M period including but not limited to, rubber mats of appropriate grade, PPE, rubber gloves and shoes etc.

3.2.17. Weather monitoring station with associated systems shall include but not be limited to the following :

- Pyranometers - one for horizontal and one mounted on MMS
- Ultrasonic Anemometer (wind speed and direction)
- Temperature Sensor - Ambient and module surface
- Power source to the all sensors
- Data Logger
- Desktop and Printer

3.2.18. Design of said capacity Grid Interactive Rooftop Solar Power Plant and its associated civil, structural, electrical & mechanical auxiliary systems includes preparation of single line diagrams and installation drawings, manuals, electrical layouts, erection key diagrams, electrical and physical clearance diagrams, GTP and GA drawings for the major equipment, design basis & calculation sheets, and other relevant drawings and documents required

for engineering of all facilities to be provided under this contract, are covered under Bidders scope of work.

3.2.19. In addition to above, the Bidder is required to measure the Solar Radiation and other climatic conditions relevant to measure the plant performance. This is necessary to study Solar Level and Guaranteed Performance of the Solar Power Plant. The satellite based analysis is to be combined with direct ground based measurement equipment in order to achieve the necessary accuracy and level of detail in the assessment of solar levels and climatic conditions.

3.2.20. Estimation and determination of the plant generation on daily basis in form of look ahead scheduling of power output.

3.2.21. Any other equipment / material, not mentioned but essentially required to complete the said capacity Rooftop Solar Power Plant in all respect.

1.3 During the O&M period, the Contractor shall keep the measured daily data at regular interval and provide the same to Employer in electronic form compatible in CSV format. The right to use the data shall remain with Employer.

1.4 Materials and accessories, which are necessary or usual for satisfactory and trouble-free operation and maintenance of the above equipment.

1.5 Availability of vehicles for inspection by Employer as per requirement may be ensured, failing which Employer shall have full right for alternate arrangement at the risk & cost of contractor.

1.6 Bidders shall design suitable power evacuation system including design and construction of a suitable infrastructure to evacuate the power generated from Rooftop Solar Power Plant. Processing the net metering with Zero Export Policy and related works for the power generated from the Rooftop Solar Power Plant is in the scope of the bidder.

1.7 The items of civil design and construction work shall include all works required for solar PV project like all designs, preparation of drawings & approval from Employer, supply & construction of various civil works.

1.8 Obtaining statutory approvals /clearances on behalf of the Employer from various Government Departments, in addition to Central/State Electricity Authorities/ DISCOM/Industrial Development Corporation and including but not limited to, the following-

3.8.1. Pollution control board clearance, if required

3.8.2. Mining Department, if required

3.8.3. Forest Department, if required

3.8.4. All other approval, as necessary for setting up of a Rooftop Solar Power Plant including CEIG, connectivity, power evacuation, railways, PTCC etc. as per the suggested guidelines.

3.8.5. All other statutory approvals and permissions, not mentioned specifically but are required to carry out hassle free Construction and O&M of the plant prevailing at Site.

1.9 The Bidder shall arrange deployment of qualified and suitable manpower and required necessary consumables & spares during commissioning.

1.10 Construction Power & construction Water as required for construction and completion of this contract are to be arranged by the Bidder.

1.11 Total Operation & Maintenance of Rooftop Solar Power Plant for the 05 year's period including deployment of engineering personnel, technicians and security personnel after the commissioning till final acceptance, during this period, the responsibility of O&M shall be with contractor.

1.12 All approvals, equipment, item and works which are not specifically mentioned in this document but are required for completion of work including construction, commissioning, net metering with Zero Export Policy and related works, O&M of Solar PV Power Plant in every respect and for safe and efficient construction & erection, operation and guaranteed performance are included in the scope of this bid.

1.13 Submission of following documents, drawings, data design, and engineering information to Employer or its authorized representative for review and approval in hard copy and soft copy from time to time as per project schedule.

3.13.1. Plant Layout drawing
3.13.2. GA drawings of the entire project.
3.13.3. Design basis Report along with relevant standards (list of standards and respective clause description only)
3.13.4. Solar insolation data and basis for generation data.
3.13.5. Design calculations and sheets.
3.13.6. Detailed technical specifications of all the equipment.
3.13.7. General arrangement and assembly drawings of all major equipment.
3.13.8. Schematic diagram for entire electrical system.
3.13.9. GTP & G.A. drawings for all types of structures/ components, switchgears & other interfacing panels.
3.13.10. Quality assurance plans for manufacturing and field activities
3.13.11. Detailed site EHS plan, fire safety & evacuation plan and disaster management plan.
3.13.12. Detailed risk assessment and mitigation plan.
3.13.13. Test reports (for type, acceptance, and routine tests).
3.13.14. O&M Instruction's manuals and its drawings.
3.13.15. As-built drawings / documents and deviation list from good for construction (GFC)
3.13.16. O&M plans, schedules and operational manuals for all equipment etc. Daily/ Weekly site work progress report with catch-up plan(s), as necessary to monitor actual timelines of the project during construction period along with the real time snap shots during the time of construction.
3.13.17. Weekly/ Monthly O&M reports after commissioning of the project.

1.14 All drawings shall be fully corrected to agree with the actual "as built" site conditions and submitted to Employer after commissioning of the project for record purpose. All as-built drawings must include the Good for Construction deviation list.

1.15 The contractor shall forward the following to Employer within two weeks from issue of LOI:

3.15.1. Schedule for various activities in the form of PERT Chart.

3.15.2. Detailed engineering calculations, Design basis report and complete layout of the plant

3.15.3. Equipment data sheets, guaranteed technical particular of equipment and GA drawings of major equipment like inverter, mounting structure, etc.

1.16 Providing a detailed training plan for all operation, maintenance procedures, which shall after approval by Employer form the basis of the training program. The contractor, shall also provide training to Employer's nominated staff.

1.17 Employ and coordinate the training of contractor's personnel who will be qualified and experienced to operate and monitor the facility and to coordinate operations of the facility with the grid system.

1.18 Establishing a system to maintain an inventory of spare parts, tools, equipment, consumables and other supplies required for the facility's hassle free operation.

1.19 Adequate and seamless insurance coverage during EPC and O&M period to cater all risks related to construction and O&M of plant to indemnify the Employer.

1.20 Maintain at the facility accurate and up-to-date operating logs, records and monthly reports regarding the Operation & Maintenance of facility.

1.21 Perform or contract for and oversee the performance of periodic overhauls or maintenance required for the facility in accordance with the recommendations of the original equipment manufacturer (OEM).

1.22 Procurement for spares parts, overhaul parts, tools, equipment, consumables, etc. required to operate and maintain the project in accordance with the prudent utility practices and having regarded to warranty recommendations during entire O&M period.

1.23 Handover the system to maintain an inventory of spare parts, tools, equipment, consumables and supplies for the facility's operation along-with required details of recommended spares list with all associated information regarding replacement records, supplier details, tentative cost, storage details, specifications on the basis of replacement frequency and mean time between failures and mean time to restore at the culmination of penultimate year under O&M period.

1.24 Maintain and keep all tool rooms, stores rooms, equipment, clean, green and in good & workable conditions.

1.25 Discharge obligations relating to retirement/ Superannuating 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.

1.26 Operation and Maintenance

3.26.1. The contractor shall be entrusted to carry out the total O&M activities of the 168 KW Rooftop Solar Power Plant for the next 05 years after commissioning w.e.f. from the date of operational acceptance.

3.26.2. The Turnkey contractor shall be responsible for all the required activities for the successful running, committed energy generation & maintenance of the Rooftop Solar Power Plant covering:

- Deputation of qualified and experienced engineers and technicians
- Successful running of Rooftop Solar Power Plant for committed energy generation.
- Co-ordination with STU/SLDC/other statutory organizations as per the requirement on behalf of Employer for complying with grid requirements.
- Monitoring, controlling, troubleshooting maintaining of logs &records, registers.
- Supply of all spares, consumables and fixing / application as required.
- Supply & use of consumables such as grease, oil etc. throughout the maintenance period as per recommendations of the equipment manufacturers.
- Conducting periodical checking, testing, overhauling, preventive and corrective action.
- General up keeping of all equipment, Solar PV modules, inverter etc.
- Submission of periodical reports to Employer on the energy generation & operating conditions of the power plant.
- Furnishing generation data monthly to Employer by 1st week of every month for the previous month to enable Employer raise commercial bills on consumers.
- Periodic cleaning of solar modules as per the recommendations of OEM
- Replacement of Modules, Invertors/PCU's and other equipment as and when required

3.26.3. Continuous monitoring the performance of the Solar Power Plant and regular maintenance of the whole system including Modules, MMS, PCU's, cables, outdoor/indoor panels etc. are necessary for extracting and maintaining the maximum energy output from the Solar Power Plant.

3.26.4. Preventive and corrective O&M of the Rooftop Solar Power Plant including supply of spares, consumables, wear and tear, overhauling, replacement of damaged modules, MMS components, invertors, PCU's and insurance covering all risks (Fire & allied perils, earth quake, terrorists, burglary and others) as required, for a period of 05 years from the date of start of O&M of the project shall be carried out at fixed annual cost.

3.26.5. The period of Operation and Maintenance will be deemed to commence from the date of completion of performance demonstration/Operational acceptance and successively the complete Rooftop Solar Power Plant to be handed over to the O&M contractor for operation and maintenance of the same. O&M contract shall further be extended on the mutually agreed terms and conditions for the period of minimum 5 years or as required.

3.26.6. All the equipment required for Testing, Commissioning and O&M for the healthy operation of the Plant must be calibrated, time to time, from the NABL accredited labs and the certificate of calibration must be provided prior to its deployment.

1.27 Operation and Performance Monitoring

3.27.1. Operation part consists of deputing necessary manpower required to operate the Rooftop Solar Power Plant at the full capacity. Operation procedures such as preparation to starting, running, routine operations with safety precautions, monitoring etc., shall be carried out as per the manufacturer's instructions to have trouble free operation of the complete system.

3.27.2. The operation and maintenance in the Rooftop Solar Power Plant involves periodic cleaning of Modules, logging the voltage, current, power factor, power and energy output of the Plant at different levels. The operator shall record monthly energy output, down time, etc.

1.28 Maintenance

3.28.1. The contractor shall carry out the periodical/plant maintenance as given in the manufacturer's service manual and perform operations to achieve committed generation.

3.28.2. Regular periodic checks of the Modules, MMS, PCU's and other switchgears shall be carried out as a part of routine corrective & preventive maintenance. In order to meet the maintenance requirements stock of consumables are to be maintained as well as various spare as recommended by the manufacturer at least for 5 years to be kept for usage.

3.28.3. According to the recommendations stock of special tools and tackles shall be maintained for Modules, MMS, PCU's, switchgears and other major electrical equipment.

3.28.4. A maintenance record is to be maintained by the operator/engineer-in-charge to record the regular maintenance work carried out as well as any breakdown maintenance along with the date of maintenance reasons for the breakdowns steps have taken to attend the breakdown duration of the breakdown etc.

3.28.5. The Schedules will be drawn such that some of the jobs other than breakdown, which may require comparatively long stoppage of the Power Plant, shall be carried out preferably during the non-sunny days. An information shall be provided to Engineer-in- charge for such operation prior to start.

3.28.6. The Contractor shall deploy enough manpower at Rooftop Solar Power Plant site to carryout work instructions and preventive maintenance schedules as specified. The contractor shall keep at least one skilled and experienced supervisor to supervise the jobs that are being carried out at site.

3.28.7. The Contractor will attend to any breakdown jobs immediately for repair/replacement/adjustments and complete at the earliest working round the clock. During breakdowns (not attributable to normal wear and tear) at O&M period, the Contractor shall immediately report the accidents, if any, to the Engineer In-charge

showing the circumstances under which it happened and the extent of damage and or injury caused.

3.28.8. 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, Mines Act 1952, Employees State Insurance Act 1948, Contract Labour (Regulations & Abolishment) Act 1970, Electricity Act 2003, Grid Code, Metering Code, MNRE guidelines or any modification thereof or any other law relating whereto and rules made there under or amended from time to time.

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

3.28.10. The Contractor shall ensure that all safety measures are taken at the site to avoid accidents to his or his sub-contractor or Employer's Workmen.

3.28.11. If negligence / mal operation of the contractor's operator results in failure of equipment such equipment should be repaired replaced by contractor at free of cost.

3.28.12. If any jobs covered in O&M Scope as per O&M Plan are not carried out by the contractor during the O&M period, the Engineer-In-Charge can issue a notice to the Contractor. Repetition of such instances for more than 2 times a year may lead to the Termination of the O&M Contract by the Employer.

1.29 Quality Spares & Consumables

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

1.30 Testing Equipment, Tools and Tackles

The Contractor shall arrange for all the necessary testing equipment, tools and tackles for carrying out all the construction, operation and maintenance work covered under this contract. All the instruments are required to be calibrated from NABL accredited lab before put in use. The certificate of the same shall be submitted to Employer for verification.

## D. Technical Specification of Solar power plant

### 4. Bill of Material:

The equipment and material for said capacity Grid Interactive Rooftop Solar Power Plant with associate system (typical) shall include, but not limited to the following:

| **Item Details** | **Unit** |
|---|---|
| PV Modules | Nos. |
| Module Mounting Structures (MMS) including fasteners and clamps | Set |
| Main Junction Boxes with monitoring capabilities | Lot |
| Solar module array to Junction box Interconnection cable (Cu) | RM |
| Junction box to Inverter Interconnection Cable (Cu/ Al) | RM |
| Connection accessories - lugs, ferrules, glands, terminations etc. | Lot |
| AC Cable (LT/ HT) of appropriate sizes | RM |
| Power Conditioning Units/ Inverters | Nos. |

| | |
|---|---|
| Meteorological station with sensors and data logger | Lot |
| AC & DC distribution panels/ boards, PDB, LDB etc. | Lot |
| Lightning Arresters of suitable ratings | Nos. |
| Control and power cables | Lot |
| Surge Protection devices and Fuses | Set |
| Earth cables, flats and earthing pits | Lot |
| Fire extinguisher - Foam type, CO2 type, ABC type etc., as applicable | Lot |
| Sand Buckets | Lot |
| Metering Equipment (Meters, and associated CT and PT's) | Set |
| Protection Equipment | Set |
| Weather monitoring station including associated systems and with remote monitoring assistance | Set |
| Danger sign plates, anti-climbing, bird protection etc. | Lot |

All the information shown here is indicative only and may vary as per design and planning by the bidder. The bidder must provide the BOM of the plant as per the design during the time of bidding. The technical features of major equipment are described hereunder.

## 5. Photovoltaic Modules

Total capacity of PV Modules to be supplied for the 168 KW project is minimum of 168 KWp which is the cumulative rated capacity of all solar PV module under supply as per relevant IEC standards under Standard Temperature Condition (STC). The Project shall consist of Mono/poly-crystalline silicon photovoltaic modules of reputed make like Vikram, Waaree, Emmvee or equivalent. (If imported only **Tier-1** SPV Modules shall be used) and should comply with the specifications given below:

5.1. The solar photovoltaic modules with efficiency more than 16% for multi-crystalline, 18% for mono-crystalline silicon based modules with positive tolerance only.

5.2. The glass used to make the crystalline silicon modules shall be toughened low iron tempered AR coated glass with minimum thickness of 4.0 mm for 72 cell module and 3.2 mm for 60 cell module.

5.3. The back sheet used in the crystalline silicon based modules shall be of 3 layered structure. Outer layer of fluoropolymer, middle layer of Polyester (PET) based and Inner layer of fluoropolymer or UV resistant polymer. Back sheet with additional layer of Aluminium also will be considered. The thickness of back sheet should be of minimum 300 microns with water vapour transmission rate less than $3g/m^2/day$. The Back sheet shall have voltage tolerance of more than 1000 V.

5.4. The EVA used for the modules should be of UV resistant in nature with UV cut off wavelength in the range of 300-360 nm.

5.5. The sealant used for edge sealing of PV modules shall have excellent moisture ingress protection with good electrical insulation (Break down voltage >15 kV/mm) and with good adhesion strength.

5.6. The junction box used in the modules shall have protective bypass diodes to prevent hot spots in case of cell mismatch or shading. The material used for junction box shall be made

with UV resistant material to avoid degradation during module life and the Junction sealing shall comply IP65 degree of protection.

5.7. The crystalline silicon based modules supplied should be of Potential Induced Degradation (PID) resistant modules and the test certificate from third party lab complying with the same shall be provided.

5.8. The rated output of the modules shall have positive tolerance of +5W and no negative tolerance is allowed.

5.9. PV modules must be warranted for their output peak watt capacity, which should not be less than 90% of the initial value at the end of 10 years and 80% of the initial value at the end of 25 years.

5.10. The modules shall be warranted for minimum of 10 years against all material/ manufacturing defects and workmanship.

5.11. All modules shall be certified

- IEC 61215 2ndEdition (Design qualification and type approval for Crystalline Si modules) for test load of 2400 Pa in the first two cycles and 5400 Pa in third cycle.
- IEC61730 (PV module safety qualification testing @ 1000 V DC or higher)
- IEC 61701: Salt Spray test for highly corrosive environment, if applicable
- IEC 62716: Ammonia Resistant certified, if applicable
- Test certificate from NABL approved or /ILAC member body certified labs shall be provided.
- IEC / BIS Test report of the module should be latest.

5.12. The developer shall arrange for the details of the materials along with specifications sheets of from the manufacturers of the various components used in solar modules along with those used in the modules sent for certification. The Bill of materials (BOM) used for modules shall not differ in any case from the ones submitted for certification of modules.

5.13. The I-V characteristics of all modules as per specifications to be used in the systems are required to be submitted at the time of supply.

5.14. The Contractor would be required to maintain accessibility to the list of module IDs along with the parametric data for each module.

5.15. The temperature co-efficient of power for the modules shall not be more than 0.45% / °C.

5.16. The module mismatch of the modules connected to an inverter should be less than 2%.

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

5.18. The module frame shall be made of anodized Aluminium or corrosion resistant material, which shall be electrically compatible with the structural material used for mounting the modules. In case of metal frames for modules, it is required to have provision for earthing to connect it to the earthing grid.

5.19. All materials used for manufacturing solar PV module shall have a proven history of reliability and stable operation in external applications. Module shall perform satisfactorily in ambient temperature between -10°C to +50°C. The material shall withstand adverse climatic conditions, such as high speed wind, blow with dust, sand particles, and saline climatic / soil conditions and for wind speed, of as per IEC requirement.

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

5.21. Bidder shall provide data sheet for Solar PV Module (Under STC) along with their offer as per Guaranteed Technical Particular Data Sheet- 1. Also, the bidder must provide the commercial data sheet indicating the exact power of the module, if the data sheet consists of a range of modules with varying output power.
5.22. The Employer or its authorized representative reserves the right to inspect the modules at the manufacturer's site prior to dispatch.
5.23. The Bidder is advised to check and ensure the availability of complete capacity of modules prior to submitting the NIT document.
5.24. Entire drawings, detailed test & flash reports and compliance certificates of the offered modules should be submitted for approval of Employer within 60 days from the issuance of LOI and supply should start thereafter.

## 6. PV Array Configurations

The Solar array shall be configured in multiple numbers of sub-arrays, providing optimum DC power to auditable number of sub arrays. The bidder shall submit their own design indicating configuration of PCU and respective sub arrays and associated bill of material.

### 6.1. Module Mounting Structure (MMS):

6.1.1. For module mounting structure refer **Section-F** of this specification.
6.1.2. The grade of steel for MMS structure shall not be more than 350 MPa.
6.1.3. Cable should pass from Pipes and Cable-ties shall be used to hold and guide the Pipes (cables/wires) from the modules to junction boxes or inverters. All the cables were aesthetically tied to module mounting structure.
6.1.4. In case the string monitoring unit (SMU or JB) is mounted on the module mounting structure, bidder to take into consideration of the load thus added on the MMS. Accordingly, suitable supporting members for mounting the SMU/ JB must be designed and supplied. Separate structure for mounting of SMU can also be proposed.
6.1.5. Bidder must submit the complete quality documents i.e. test certificates for all tests conducted starting from raw material stage, in process, final testing w.r.t structure.
6.1.6. Every major Component of the Plant should be suitably named/numbered & marked for ease of traceability, identification and maintenance.

### 6.2. Junction Box/ Combiner Box:

6.2.1. All junction/ combiner boxes including the string junction box, array junction box and main junction box/ combiner box should be equipped with appropriate functionality, safety (including fuses, grounding, contacts etc.) and protection.
6.2.2. The terminals will be connected to copper bus-bar arrangement of proper sizes to be provided. The junction boxes will 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 UV resistant cable ferrules will be fitted at the cable termination points for identification.
6.2.3. The Junction Boxes shall have suitable arrangement for the followings:

- Strings are required to be connected to the bus bar through individual fuses. However, if the bidder propose to use a "Y" Connector; maximum of 2 (two) strings can be combined, keeping the losses within the specified limit.

- Provide arrangement for disconnection for each of the groups.
- Provide a test point for each sub-group for quick fault location and to provide group array isolation.
- SCADA Communication device with all necessary equipment for communicating with main SCADA Server.
- Suitable space for workability and natural cooling.
- Provision of adequate number of spare terminals

6.2.4. The rating of all component of JB's shall be suitable with adequate factor of safety to inter connect the Solar PV array.

6.2.5. The junction boxes shall be dust, vermin ,and waterproof and made of thermoplastic/metallic in compliance with IEC 62208, which should be sunlight/UV resistive as well as fire retardant & must have minimum protection to IP65 (Outdoor) and Protection Class II.

6.2.6. The Array Junction Box will also have suitable surge protection. In addition, over voltage protection shall be provided between positive and negative conductor and earth ground such as Surge Protection Device (SPD). The maintenance free earthing shall be done as per the relevant standards.

6.2.7. DC fuses shall be provided for each string/input and DC disconnector of suitable size should be used. The junction box shall have DIN rail mountable fuse holders.

6.2.8. Details of junction box specifications and data sheet, including all components, shall be provided with the Bid document.

6.2.9. Bidder shall submit all the test reports/ test certificates and compliance certificates before installation at site.

**6.3. Power Conditioning Unit (PCU)**

As SPV array produce direct current electricity, it is necessary to convert this direct current into alternating current and adjust the voltage levels to match the grid voltage. Conversion shall be achieved using an electronic inverter and the associated control and protection devices. All these components of the system are termed the power conditioning unit (PCU). In addition, the PCU shall also house MPPT (Maximum power point tracker), an interface between solar PV array & the inverter, to the power conditioning unit/inverter should also be DG set interactive.

If necessary, Inverter output should be compatible with the grid frequency. Under normal condition the building load is fed from a SPV electricity and in the absence of SPV power or low SPV power conditions an external AC source can be used for supply of electrical energy to load .In case the PV power generated at any instant of time is more than the load requirement of building or at no load conditions this excess PV power shall be reduced or make It open automatically, All these operation should be automatic.

Typical technical features of the inverter shall be as follows:

| | | |
|---|---|---|
| 1 | Total Output power AC | To match solar PV plant capacity while achieving optimum system efficiency |

| | | |
|---|---|---|
| | | Single or three phases as per requirement of site and capacity of plant. |
| 2 | Input DC voltage range | As required for the solar grid inverter for corresponding capacity |
| 3 | Maximum power point (MPPT) | Shall be incorporated |
| 4 | Number of independent MPPT inputs | 1 or more |
| 5 | Operation AC voltage | As per requirement of the site |
| 6 | Operating frequency range | 47.5 - 52.5 Hz |
| 7 | Nominal frequency | 50 Hz |
| 8 | Power factor of the inverter | >0.95 at nominal Power |
| 9 | Total harmonic distortion | Less than 3% |
| 10 | Built-in-Protection | AC high/low voltage; AC high/low frequency, It should work at 30% imbalance phase voltage and loads. |
| 11 | Operating ambient temperature range | -5$^{o}$C to +55$^{o}$C |
| 12 | Humidity | 0 – 95%Rh |
| 13 | Inverter efficiency | >93% (In case of 10 KW or above with in-built galvanic isolation)<br>>97% (In case of 10 KW or above with in-built galvanic isolation) |
| 14 | Inverter efficiency | >90 (In case of less than 10 KW) |
| 15 | Protection degree | IP 65 for outdoor mounting, IP 54 for indoor mounting |
| 16 | Communication interface | RS 485 / RS 232 / RJ45 |
| 17 | Safety compliance | IEC62109-1, IEC 62109-2 |
| 18 | Environmental Testing | IEC 60068-2, (1, 2, 14, 30) |
| 19 | Efficiency Measurement Procedure | IS/IEC 61683 |
| | Cooling | Convection |
| | Display type | LCD for data display, LCD/LED for status display |
| | Display parameters to include | Output Power(W), cumulative Energy (Eh),<br>DC voltage(V), DC current(A),<br>AC voltage(V), AC frequent (Hz),<br>AC (current), cumulative hours of operation(h). |

6.3.1. Three phase PCU/ inverter shall be used with each power plant system (10 KW and/or above) but in case of less than 10 KW single phase inverter or as per building requirement can be used.

6.3.2. PCU/Inverter shall be capable of complete automatic operation including wake-up, synchronization & shutdown. The PCU should also be able to balance grid voltage.

6.3.3. The output of power factor of PCU inverter should be suitable for all voltage range or sink of reactive power, inverter should have internal protection arrangement against any sustainable fault in feeder line and against the lightning on feeder.

6.3.4. Built-in meter and data logger to monitor plant performance through external computer shall be provided.

6.3.5. Anti-islanding (Protection against Islanding of grid): The PCU shall have anti islanding protection in conformity to IEEE 1547/UL 1741/IEC 62116 or equivalent BIS standard

6.3.6. The PCU/inverter general harmonics, flicker, DC injection limits, Voltage range, Frequency Range and Anti-Islanding measures at the point of connection to the utility services should follow the latest CEA (Technical Standards for connectivity Distribution Generation Resources) Guidelines.

6.3.7. The power conditioning units / inverters should comply with applicable IEC/ equivalent BIS standard for efficiency measurements and environment tests as per standard codes IEC 61683/IS 61683 and IEC 60068-2 (1,2,14,30)/ Equivalent BIS Std. The power conditioning units / inverters should comply with applicable IEC/ equivalent BIS standard for measuring relays and protection equipment as per standard codes IEC 60255 – 27.

6.3.8. The MPPT units environmental testing should qualify IEC 60068-2 (1, 2, 14, 30)/ Equivalent BIS std. The junction boxes/ enclosures should be IP 65 (for outdoor)/ IP 54 (indoor) and as per IEC 529 specifications.

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

**6.4. Operational Requirements for Inverter/ PCU**

**INTEGRATION OF PV POWER WITH GRID/ANTI GRID EXPORT**

**The output power from SPV would be fed the inverters which converts DC produced by SPV 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 for synchronization and shall be disconnected from the grid. 4 pole isolation output with respect to the grid power connection need to be provided.**

**PCU/External device shall have power export control features (as Net-metering is not available).**

**6.4.1. The Anti-Grid Export controller/system shall monitor the current flow regularly towards grid from solar inverter within 20ms and it shall control the solar inverter output, if any current flow detected going towards grid, the controller shall reduce the solar power output in the inverter by maintaining the MPPT, so that no excess energy is fed in to the grid. The solar inverter output shall be always equal to the consumption load.**

**6.4.2. Any controller, which will shut down the inverter without controlling the output of solar inverter to avoid current flow towards grid, will not be acceptable.**

**6.4.3. If any kind of protection fails, then it should cut off the inverter from the grid.**

**6.4.4. Up to 30kW, Anti grid export control can be allowed with the help of cloud base algorithm.**

**6.4.5. Above 30 KW, Anti grid export device system should be integral part of the solar power plant, algorithm shall be built in to the plant system, so that it can work without help of IOT.**

**6.4.6. All Hardware and communication cable will be in the scope of bidder.**

**6.4.7. PCU shall have provisions/features to allow interfacing with monitoring software and hardware devices.**

**6.5. Deleted.**

**6.6. Standards& Compliances**

6.5.1. PCU shall confirm to the following standards and appropriately certified by the labs:

- Efficiency measurement: IEC 61683
- Environmental Testing: IEC 60068-2 or IEC 62093
- EMC, harmonics, etc.: IEC 61000 series, 6-2, 6-4 and other relevant Standards.
- Electrical safety: IEC 62109 (1&2), EN 50178 or equivalent
- Recommended practice for PV - Utility interconnections: IEEE standard 929 - 2000 or equivalent
- Protection against islanding of grid: IEEE1547/ UL1741/ IEC 62116 ore equivalent
- Grid Connectivity: Relevant CEA/ CERC regulation and grid code (amended up to date)
- Reliability test standard: IEC 62093 or equivalent

6.5.2. The Bidder should select the inverter as per its own system design so as to optimize the power output.

6.5.3. Desired Technical Specifications of PCU.

- Sinusoidal current modulation with excellent dynamic response.
- Compact and weather proof housing (indoor/ outdoor)
- Comprehensive network management functions (including the LVRT and capability to inject reactive power to the grid)
- Total Harmonic Distortion (THD) <3%
- No load loss < 1% of rated power and maximum loss in sleep mode shall be less than 0.05%
- Optional VAR control
- Power factor Control range: 0.9 (lead - lag)
- Humidity: 95% Non – Condensing
- Unit wise & integrated Data logging
- Dedicated Prefabs / Ethernet for networking

6.5.4. Inverter/ Power Condition unit must provide protection against:

- Over current
- Sync loss
- Over temperature
- DC bus over voltage
- Cooling Fan failure (If provided)
- Short circuit
- Lightning
- Earth fault
- Surge voltage induced at output due to external source
- Power regulation in the event of thermal overloading
- Set point pre-selection for VAR control
- Bus communication via -interface for integration
- Remote control via telephone modem or mini web server
- Integrated protection in the DC and three phase system
- Insulation monitoring of the PV array with sequential fault location

6.5.5. Ground fault detector which is essential for large PV generators in view of appreciable discharge current with respect to ground.
6.5.6. Over voltage protection against atmospheric lightning discharge to the PV array is required.
6.5.7. The power conditioner must be entirely self-managing and stable in operation.
6.5.8. A self-diagnostic system check should occur on start up. Functions should include a test of key parameters on start up.
6.5.9. PCU/inverter front panel shall be provided with display (LCD or equivalent) to monitor, but not limited to, the following:
- DC power input
- DC input voltage
- DC Current
- AC power output
- AC voltage (all the 3 phases and line)
- AC current (all the 3 phases and line)
- Power Factor

6.5.10. Documentary Requirements & Inspection
- The bill of materials associated with PCU's should be clearly indicated while delivering the equipment.
- The Contractor shall provide to the Employer, data sheet containing detailed technical specifications of all the inverters and PCUs, Type test reports and Operation & Maintenance manual before dispatch of PCUs.
- The Employer or its authorized representative reserves the right to inspect the PCUs/ Inverters at the manufacturer's site prior to dispatch.

**6.7. Cable and Wires**

Cables of appropriate size to be used in the system and shall have the following characteristics

6.6.1. Shall meet IEC 60227/IS 694, IEC60502/IS 1554 standard Temp range: -10*C to +80*C Voltage rating 660/1000V
6.6.2. For the DC cabling, Solar cables with multi stranded copper conductors XLPE or XLPO insulted and sheathed with the voltage rating of 1000 V Dc or higher UV stabilized single core flexible copper cables shall be used. Multi-core cables shall not be used.
6.6.3. For the AC cabling, PVC or XLPE insulated and PVC sheathed single or multi-core flexible copper cables shall be used. Outdoor AC cables shall have a UV-stabilized outer sheath.
6.6.4. The total voltage drops on the cable segments form the solar PV modules to the solar grid inverter shall not exceed 1.0%
6.6.5. The total voltage drops on the cable segments form the solar grid inverter to the building distribution board shall not exceed 2.0%
6.6.6. The Dc cables from SPV module array shall run through a UV-stabilized PVC conduit pipe of adequate diameter with a minimum wall thickness of 1.5mm or through a High Density Poly ethylene (HDPE) conduits shall not run across the path way of the terrace flexible corrugated PVC conduits shall not be used.

6.6.7. Cables and wires used for the interconnection of solar PV modules shall be provided with solar PV connectors (MC4) and couplers.

6.6.8. All cables and conduit pipes shall be clamped to the rooftop, walls and ceilings with thermoplastic clamps at intervals not exceeding 50 cm. The minimum DC cable size shall be 4.0 mm2 copper. The minimum AC cable size shall be 4.0 mm2 copper for up to 10kWp and 16.0mm2 for above 10kWp/ required standard size. In three phase systems, the size of the neutral wire shall be equal to the size of the phase wires. The following color coding shall be used for cable wires:

- Dc positive: red (the outer PVC sheath can be black with red line marking)
- DC negative: black
- AC single phase: Phase: red; neutral: black
- AC three phase: Phase: red, yellow, blue; neutral: black Earth Wires: green

6.6.9. Cables and conduits that have to pass through walls or ceilings shall be taken through a PVC pipe sleeve.

6.6.10. Cable conductors shall be terminated with tinned copper end-ferruled to prevent fraying and breaking of individual wire standard. The termination of the DC and AC cables at the solar grid invertor shall be done as per instructions of the manufacture, which in most cases will include the use of special connectors.

6.6.11. Cable lugs and end -ferrules for the all cable conductor and terminations shall be crimped with crimping pliers and end-ferrule pliers

6.6.12. All cable ties shall be UV resistant.

6.6.13. The cable should be so selected that it should be compatible up to the life of the solar PV panels i.e. 25 years

6.6.14. The rating given are approximate. Bidder to indicate size and length as per system design requirement. All the cables required for the plant provided by the bidder. Any change in cabling sizes if desired by the bidder/approved after citing appropriate reasons. All cable schedules/layout drawing approved prior to installation.

**6.8. DC Distribution Box (DCDB)**

A DC distribution box shall be mounted close to the solar grid inverter. The DC distribution box shall be of the thermos-Plastic IP65DIN-rail maintaining type and shall comprise the following components and cable terminations

6.8.1. Incoming Positive and negative DC cables from the DC Combine Box;

6.8.2. DC circuit breaker, 2 poles (the cables from the DC combiner Box will be connected to this circuit breaker on the incoming side);

6.8.3. DC surge protection devise (SPD), class 2 as per IEC 60364-5-53;

6.8.4. Outgoing positive and negative DC cables to the solar grid inverter.

6.8.5. As an alternative to the DC circuit breaker a DC isolator may be used inside the DC Distribution Box or in a separate external thermoplastic IP 65 enclosure adjacent to the DC Distribution Box. If a DC isolator is used instead of a DC circuit breaker, a DC fuse shall be installed inside the DC Distribution Box to protect the DC cables that runs from the DC Distribution Box to the solar grid Invertor.

6.8.6. The fuses should comply with applicable IEC/ equivalent BIS standard for general safety requirements for connectors, switches, circuit breakers, low-voltage switch gear as per standard codes IS/IEC 60947(Part 1, 2 & 3), EN 50521

**6.9. AC Distribution Box (ACDB)**

An AC distribution box shall be mounted close to the solar grid inverter. The AC distribution box shall be of the thermoplastic IP65 DIN rail mounting type and shall comprise the following components and cable terminations

6.9.1. Incoming 3-core/5-core (single-phase/three –phase) cable from the solar grid inverter.

6.9.2. AC circuit breaker, 2-pole/4-pole AC surge protection devise (SPD), class2 as per IEC 60364-5-53

6.9.3.The fuses (AC/DC) should comply with applicable IEC/ equivalent BIS standard for general safety requirements for connectors, switches, circuit breakers, low-voltage switch gear as per standard codes IS/IEC 60947(Part 1, 2 & 3), EN 50521

**6.10. Lightning Protection for PV Array**

The SPV Power plants shall be provided with lighting & overvoltage protection. The main aim in this protection shall be to reduce the over voltage to a tolerable value before it reaches the power PV or other sub system components. The source of over voltage can be lightning, atmosphere disturbances etc. The entire space occupying the SPV array shall be suitably protected against lightning by deploying required number of lighting arrestors. Lightning protection should be provided as per IEC 6205 /IS 2309 standard. The protection against induced high- voltages shall be provided by the use of metal oxide varistors (MOVs) and suitable earthing such that induced transients find an alternate route to earth.

6.10.1. 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 safe level before it reaches the PV or other sub-system components as per NFC 17 - 102. Bidder to provide ESE type lightening arrester, placed at strategic locations to protect the plant from lightening and shall not cause any shadow on the solar modules.

6.10.2. 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.

6.10.3. The site is prone to lightning strikes and hence bidder is suggested to take utmost care while designing the lightning protection system. The Bidder shall submit the drawings, calculations and detailed specifications of the PV array lightning protection equipment to Employer for approval before installation of system.

6.10.4. The lightning conductor shall be earthed through flats and connected to the grounding mats as per applicable Indian Standards with earth pits. Three earth pits shall be provided for each lightning arrestor. 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.

### 6.11. General Standards

6.11.1. The equipment and accessories covered by this specification shall be designed, manufactured and tested in accordance with the latest relevant standards and codes of practice published by the relevant Indian Standards (IS) as applicable.

6.11.2. All electrical equipment and installation shall confirm to the latest Indian Electricity Rules as regards safety, earthing and other essential provisions specified for installation and operation of electrical plants. Relevant national and international standards in this connection can be followed in order to improve the efficiency and safe operations.

6.11.3. All working parts, insofar as possible, are to be arranged for convenience of operation, inspection, lubrication and ease of replacement with minimum downtime. All parts of equipment or of spare equipment offered shall be interchangeable.

6.11.4. The quality of materials of construction and the workmanship of the finished products / components shall be in accordance with the highest standard and practices adopted for the equipment covered by the specification.

6.11.5. All items of equipment and materials shall be thoroughly cleaned and painted in accordance with relevant Indian Standards. The finish paint shall be done with two coats of epoxy based final paint of colour Shade RAL 7032 of IS: 5 for indoor equipment.

6.11.6. Any fitting or accessories which may not have been specifically mentioned in the specification but which are usual or necessary in the equipment of similar plant or for efficient working of the plant shall be deemed to be included in the contract and shall be provided by the Contractor without extra charges. All plant and apparatus shall be complete in all details whether such details are mentioned in the specifications or not.

6.11.7. All equipment shall be designed for operation in humid climate at the required capacity.

### 6.12. Earthing for PV Array

6.12.1. The photovoltaic modules, BOS and other components of power plant requires adequate earthing for protecting against any serious faults as guided by IEC 60364.

6.12.2. 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, Indian Electricity Rules, Codes of practice and regulations existing in the location where the system is being installed.

6.12.3. All metal casing/ shielding of the plant shall be thoroughly grounded in accordance with Indian electricity act / IE Rules.

6.12.4. The earthing for array and LT power system shall be made of 3.0 m long 40 mm diameter perforated GI pipe / chemical compound filled, double walled earthing electrodes including accessories, and providing masonry enclosure

6.12.5. With cast iron cover plate having pad-locking arrangement, watering pipe using charcoal or coke and salt as required as per provisions of IS: 3043.

6.12.6. Necessary provision shall be made for bolted isolating joints of each earthing pit for periodic checking of earth resistance.

6.12.7. Each string/ array and MMS of the plant shall be grounded properly.

6.12.8. For each earth pit, a necessary test point shall be provided.

6.12.9. 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.

6.12.10. The complete earthing system shall be mechanically & electrically connected to provide independent return to earth.

6.12.11. In compliance to Rule 11 and 61 of Indian Electricity Rules, 1956 (as amended up to date), all non-current carrying metal parts shall be earthed with two separate and distinct earth continuity conductors to an efficient earth electrode.

6.12.12. The Bidder should submit the earthing system design calculations along with the system layout for Owner approval. Prior to the installation of the system

6.12.13. Unless otherwise specified, the earthing system primary and secondary grid conductors, equipment connections shall be constructed with galvanized iron flat.

### 6.13. Metering

6.13.1. The metering of electricity shall be carried out as per the regulations stipulated by Uttar Pradesh Electricity Regulatory Commission and/or Central Electricity Authority.

6.13.2. All charges for testing and passing of the meter with relevant government agency shall be borne by Bidder, the Employer will assist Bidder for necessary document as and when required. Bidder has to intimate the required documents at least 7 days prior of such requirements

### 6.14. DATA ACQUISITION SYSTEM / WEATHER MONITORING SYSTEM

6.14.1. Data Acquisition System shall be provided for each of the solar PV plant.

6.14.2. Data Logging Provision for plant control and monitoring, time and date stamped system data logs for analysis with the high quality, suitable PC. Metering and Instrumentation for display of systems parameters and status indication to be provided.

6.14.3. Solar Irradiance: An integrating Pyranometer / Solar cell-based irradiation sensor (along with calibration certificate) provided, with the sensor mounted in the plane of the array, Readout integrated with data logging system for above 50KWp capacity.

6.14.4. Temperature: Temperature probes for recording the solar panel temperature and/or ambient temperature to be provided complete with readouts integrated with the data logging system.

6.14.5. The following Parameters are accessible via the operating interface in real time separately for solar power plant

a) AC Voltage
b) AC Output current

c) Output Power
d) Power factor
e) DC input voltage
f) DC Input current
g) Tim Active
h) Time disabled
i) Time idle
j) Power Produced
k) Protective functions limits (Viz-AC Over voltage, over frequency, under frequency ground fault, PV Stopping voltage

6.14.6. All Major parameters available on the digital bus stand logging facility for energy auditing through the internal microprocessor and read on the digital front panel at any time) and logging facility (the current values, previous values) should be made available for energy auditing through the internal microprocessor and should be read on the digital front panel.

6.14.7. Computerized AC Energy monitoring shall be in addition to the digital AC energy meter.

6.14.8. The data shall be recorded in a common work sheet chronologically date wise. The data file shall be MS Excel compatible. The Data Shall be represented in both tabular and graphical form.

6.14.9. Software shall be provided for USB download and analysis of DC and AC parametric data for individual plant

6.14.10. Provision for instantaneous internet monitoring and download of historical data shall be also incorporated.

6.14.11. Remote server and software for centralized Internet monitoring system shall be also provided for download and analysis of cumulative data of all the plants and the data of solar radiation and temperature monitoring system.

6.14.12. Remote monitoring and data acquisition through Remote Monitoring System software at the owner location with service connectivity for online/real time data monitoring/control complete to be supplied and operation and maintenance/Control to be ensured by the bidder.

**6.15. Danger Plates**

Danger plates/boards should be provided as and where necessary as per IE Act. /IE rules as amended up to date. The location and the size may be finalized in consultation with authority. Danger Notice plates shall be made of mild steel sheet and should be at least 2 mm thick, and vitreous enamelled white on both sides and with inscription in signal red colours on front side as required. The inscriptions shall be in Hindi and English.

**6.16. Fire Extinguishers**

The firefighting system for the proposed power plant for fire protection shall be consisting of portable fire extinguishers in the central room for fire caused by electrical short circuits sand buckets in the control room. The installation of fire extinguisher should confirm to TAC regulations and BIS standards. The fire extinguishers shall be provided in the control room housing PCUs well as on the Roof or Site where the PV arrays have been installed.

### 6.17. Testing Instruments for Electrical & Electronic

Bidder shall also provide required set of onsite testing instruments/equipment viz. earth resistance tester, rheostats, insulation tester, millimetres, clamp meters, hand held temperature meter, inverter testing kit etc. All testing equipment shall possess valid calibration certificate issued from approved NABL labs.

### 6.18. General Guidelines

6.18.1. Any civil or electrical work which is not mentioned or included in this tender document but necessary for the plant shall be borne by the Bidder.

6.18.2. Successful Bidder shall prepare all designs/ drawings have based on the specifications given in the tender and in light of relevant BIS/IS/ equivalent standard.

6.18.3. The bidder shall provide type test reports and datasheet/ GTP for all equipment used for the project.

6.18.4. The Employer reserves right to modify the design at any stage, to meet local site conditions / project requirements.

6.18.5. All work shall be carried out in accordance with the latest edition of the Indian Electricity Act and rules formed there under and as amended from time to time.

### 6.19. Specification of Weather Monitoring System

As a part of weather monitoring system, Bidder shall provide the following measuring instrument with all necessary software and hardware required to integrate with SCADA.

6.19.1. Pyranometer

- Bidder shall provide minimum 1 (one) number of pyranometer for measuring the incidental solar radiation at horizontal plane of array.
- Specification of the pyranometer shall be as follows:

| Details | Values |
|---|---|
| Spectral Response | 0.31 to 2.8 micron |
| Sensitivity | Min 7 micro-volt/w/m2 |
| Time response (95%): | Max 15 s |
| Non linearity | ± 0.5% |
| Temperature Response | ± 2% |
| Tilt error | <±0.5%. |
| Zero offset thermal radiation | ± 7w/m2 |
| Zero offset temperature change | ± 2w/m2 |
| Operating temperature range | 0 deg to+80 deg. |
| Uncertainty(95%confidence Level) | Hourly- Max-3%, Daily- Max-2% |
| Non stability | Max±0.8% |
| Resolution | Min +/- 1 W/m2 |
| Input Power for Instrument & Peripherals | 230V a.c.(If required) |

- Each instrument shall be supplied with necessary cables. Calibration certificate with calibration traceability to World Radiation Reference (WRR) or World Radiation

Centre (WRC) shall be furnished along with the equipment. The signal cable length shall not exceed 20m. Bidder shall provide Instrument manual in hard and soft form. The contractor shall periodically calibrate the Pyranometer as per standards.

6.19.2. Thermometer

Bidder shall provide minimum two thermometers (one for ambient temperature measurement with shielding case and other for module temperature measurement). The thermometers shall be RTD/ semiconductor type measuring instrument. Instrument shall have arrange of 0°C to 80°C.The instrument shall have valid calibration certificate.

6.19.3. Anemometer

Bidder shall provide minimum one no. Ultrasonic anemometer.

| Details | Values |
|---|---|
| Velocity range with accuracy limit | ± 0.11 m/s upto 10.1 m/s<br>±1.1% of true when more than 10.1 m/s |
| Wind direction range with accuracy limit | 0 to $360^0$ with accuracy ± $4^0$ |

## E. Performance Measurement procedure

## 7. Performance Ratio Test Procedure

### 7.1. PR - Provisional Acceptance Test Verification Procedure

7.1.1. The Performance ratio test aims at the comparison of the actual PV plant energy production with the guaranteed value for a limited operation time of the PV plant of 30 consecutive days.

7.1.2. After Commissioning of the Plant and after receiving all the satisfactory results regarding the correct operation of the plant, there will be continuous monitoring of the performance for 30 days. This monitoring will be performed on the site under the supervision of the Employer / Employer's engineer.

7.1.3. The final tests to prove the guaranteed performance parameters shall be conducted at site by the Contractor in presence of the Employer.

7.1.4. The test will consist of guaranteeing the correct operation of plant over 30 days, by the way of the efficiency rate (performance ratio) based on the reading of the energy produced and delivered and the average incident solar radiation.

7.1.5. However, as the SPV Plant is installed under Net Metering with Zero Export Scheme, instantaneous PR shall be calculated at full load and shall be considered for assessment of the performance of the SPV Plant.

7.1.6. The Efficiency or performance ratio (PR) of the PV Plant is calculated as follows (according to IEC 61724)

$$\text{Performance Ratio (PR)} = \{Y_A / Y_R\} * [1 - \alpha * (T_{Cellavg.} - T_{Cell})]$$

Where;

$Y_A$ = Final PV system yield (representing the number of hours that the system would need to operate at its rated output power $P_{Nom}$ to contribute the same energy to the grid as was monitored)

Or $YA = E_{ac}/ P_{Nom}$

$Y_R$ = Reference yield (representing the number of hours during which the solar radiation would need to be at STC irradiance levels in order to contribute the same incident energy as was monitored)

Or $Y_R = I_{R\ Site}/ I_{R\ STC}$

$E_{ac}$ = AC energy injected into the grid during a clearly specified amount of time (kWh)

$P_{Nom}$ = Installed nominal peak power of modules (Flash test rating at STC) (kWp)

$I_{R\ Site}$ = Irradiation on the module plane of array during a clearly specified amount of time (measured with a pyranometer installed on the array plane) (kWh/sq. m)

$I_{R\ STC}$ = Irradiance at STC (kW/sq. m)

$T_{cellavg}$ = Average cell/ module temperature ($^0$C)

$T_{cell}$ = STC cell/ module temperature ($^0$C)

α = temperature coefficient of power (negative in sign) corresponds to the installed Module (%/$^0$C)

**7.2. Monitoring System for PR Verification**

The following instrumentation will be used to determine the Solar Plant Performance:

- Power Meter at the delivery point.
- Power Meter for each inverter/ LT panel incomer for reference only.
- One nos. calibrated pyranometer to determine irradiance on the plane of array (with a target measurement uncertainty of ± 2).
- One nos. calibrated pyranometer to determine irradiance on horizontal plane (with a target measurement uncertainty of ± 2)
- Two nos. thermocouples to measure module temperature with a measurement uncertainty of ±1 °C.
- Shielded ventilated thermocouple with a measurement accuracy of ±1°C.
- An anemometer mounted on a 10m mast to measure wind speed (without additional shadowing on modules).

7.3. Data measurement shall be witnessed in the format mutually agreed before the start of PR test by the Employer and the Contractor jointly for the said period.

7.4. The bidder shall show the specified PR for Operational Acceptance and committed CUF for Final Acceptance (i.e. after one year form the date of commissioning).

7.5. **Deleted.**

# F. Civil & Structural Works

## 8. General

This section of Technical Specifications describes detailed technical and functional requirements of all civil & structural works which are covered under a separate chapter.

All design and construction of civil works shall conform to relevant Indian standards such as BIS, IRC, MORST, NBC etc. Design of steel structures shall conform to IS: 800, 801 or 802 as applicable with working stress method (WSD) of design. Design of concrete structure shall conform to IS: 456. For design of liquid retaining structure IS: 3370 shall be followed. Only in case of non-availability of Indian standard, equivalent American or British standard may be used for design with prior approval of the Employer and the contractor shall submit proper justification along with his request to the Employer for his review. All the design/ drawings shall be prepared/ approved by the chartered structural engineer. The design calculations for MMS, RCC structure, steel structure, foundation system, drainage work, etc. shall be submitted for prior approval of Employer before commencement of construction.

The design calculations shall be supplemented with a neat sketch showing the structure geometry, node and member nos., Lengths of various typical members, support points and type of supports, types of materials with design properties considered, type of sections used in analysis & design. The report shall also include back-up calculations for various loads adopted in design, brief write-up on primary load cases and load combinations considered and conclusions on design results with supporting sketches for easy reference and clarity. Where a computer program (other than STAAD Pro) is used for analysis and design, the contractor shall also include a write-up on the computer program used along with validation check. Input and output file shall also be given in the design report to facilitate its review and approval by the Employer.

The construction methodology for MMS, foundations, drains etc. shall be submitted for prior approval of Employer before start of works.

8.1. The construction shall be done only as per approved drawings.

8.2. Topographical & bathymetric Survey

The contractor shall be responsible for detailed Topographical Survey of the proposed project site. The work shall be carried out through an agency with relevant experience and shall have qualified survey team.

8.3. Other Investigations:

The contractor shall also obtain and study other input data at proposed project site for design of the project. This shall include data related to earthquake and wind, rainfall, maximum & minimum ambient temperature, humidity, high flood level (HFL) etc. The contractor shall carry out Shadow Analysis at proposed site and accordingly design strings and array layout with optimum use of space, material and man power. In case of large and steep variations in topography the study shall also include the effect of topographical variations on array layout. The contractor shall submit all the details/ design to the Employer for review/ approval.

8.4. Plant Layout:

The contractor shall submit drawing showing proposed Project Plant Layout. The Plant layout shall be a comprehensive drawing showing various requirements of the project like, Reference coordinate grid, Geographical and Plant North, including coordinates of all corner points, proposed Array layout, Lightening Arrester etc. The Plant Layout drawing shall be in suitable scale to have proper representation of the information.
The Plant layout drawing shall be submitted by the contractor for review/ approval by the Employer.

**8.5. Module Mounting Structure (MMS)**

8.5.1. PV modules shall be mounted on structures called Module Mounting Structures (MMS) having adequate strength and appropriate design, which can withstand the load of the modules and design wind pressure.

8.5.2. The mounting structure steel shall be as per latest IS 2062: 1992 and galvanization of the mounting structure shall be in compliance of latest IS 4759. Total design and engineering for installation on Rooftop and anchoring technology to be provided by the bidder.

Detailed specifications for the mounting structure are given below

| | |
|---|---|
| Wind velocity withstanding capacity | 150 km/hour<br>The designs have to certified by a recognized lab/Institution/certify engineers in this regard and wind loading calculation sheet to be submitted to the authority. Suitable Fastening arrangement such as grouting and calming should be provided to secure the installation against the specific wind speed. |
| Structure material | Pre galvanized sheet steel with a minimum galvanization thickness of 80 microns and the structural patterns shall be made before galvanizing |
| Bolts, nuts, panel mounting clamps, fasteners (with spring washers) | Stainless steel SS 304 |

| | |
|---|---|
| Mounting arrangement for metal sheet roofs | Mounting directly on the sheet metal, ensuring stability and wind withstanding capacity or penetrating the sheet metal and fixing to the sub-structure, ensuring that the roof remains water proof and ensuring stability and wind withstanding capacity. |
| Mounting arrangement for elevated structures | The elevated structure has to be securely anchored to the supporting surface. Concrete foundations of appropriate weight and depth for elevated structures mounted directly on the ground; Bolted with anchor bolts of appropriate strength for elevated structures mounted on RCC surfaces. |
| Mounting arrangements for ground installations | With removable concrete ballast made of pre- fabricated PCC (1:2:4),<br>M15; assuring enough ground clearance to prevent damage of the module through water, animals and other environmental factors. |
| Mounting arrangements for RCC-flat roofs installation | With removable concrete ballast made of pre-fabricated PCC (1:2:4), M15. The structures shall be designed for simple mechanical on-site installation. There shall be no requirement of wedding or complex machinery at the installation site. |
| Minimum distance between roof edge and mounting structure | 0.5m |
| Access for panel cleaning and maintenance | All solar panels must be accessible from the top for cleaning and from the bottom for access to the module-junction box. |
| Panel tilt angle | North- south orientation with a fixed tilt angle of 27-30 degrees (depending on location), south facing. However, to accommodate more capacity the angle inclination may be reduced until the plant meets the specified performance ratio requirements. |

8.5.3. Regarding civil structures the bidder need to take care of the load bearing capacity of the roof and need arrange suitable structures based on the quality of roof.

8.5.4. The total load of the structure (when installed with PV modules) on the terrace should be less than 60 kg/m2.

### 8.5.5. Module Mounting Structure (MMS) - TECHNICAL REQUIREMENTS

i. The array structure shall be so designed that it will occupy minimum space without sacrificing the output from SPV panels.
ii. The structure shall be designed to allow easy replacement of any module by authorized personnel and shall be in line with the site requirements.
iii. The array structure shall be made of Aluminium alloy (annealed)/ stainless steel SS 316 of suitable size.
iv. The support structure shall normally be designed to withstand wind speed up to 150 kmph.

v. The clearance between lowest part of the module structure and the slab/roof level shall be more than 250mm.
vi. The module alignment and tilt angle, shall be between 1 to 18 degrees. SPV Module shall be mounted facing south and tilted to an angle within the range of 1 degree to 18 degrees for optimum performance and appropriate wind resistance that must be mentioned in engineering drawing for approval of ASCL with documentary proof.
vii. In general bolts, nuts, shims and other hardware should be stainless steel SS316. Fasteners visible outside shall be of stainless steel SS316.

## G. Inspection & Testing

### 9. Inspection:

9.1. Employer shall have free access to Bidder's manufacturer's works to inspect, expedite and witness shop floor tests. Any materials or work found to be defective or which does not meet the requirements of the specification will be rejected and shall be replaced at Bidder's cost. Employer reserves the right to carry out stage wise inspection of fabrication and components. The Bidder shall furnish a detailed quality assurance plan (QAP) for review by the Employer.

9.2. The test & inspection shall be carried out at manufacturer's work and at the site with the Bidders obligation. The test and Inspection shall be done in accordance with the relevant standards and the Manufacturer's standard before the delivery to site as well as after the erection and commission at site. The bidders shall give the list of tests that they will carry out at site to show the performance of plant.

9.3. A detailed 'QAP' for Manufacturing and Inspection shall be submitted by the Bidder for Employer's approval. The data of each test and inspection shall be recorded and submitted as soon as the test/ trials are conducted and will also be a part of final documentation.

9.4. The shop test shall be carried out to prove the performance parameters of the offered model. The testing shall be done in the presence of the representatives of the department.

9.5. The Employer will nominate its representatives (max. of 2 nos.) for inspection of stage manufacturing and testing at works & 7 days training at premises of SPV module and PCU manufacturer. The notice of such inspection shall be given 30 days in advance in case of countries outside India and 15 days in India.

9.6. Manufacturer has to submit procedure for Test carried out at their Factory:

- Start Up Trials
- Load Test
- Records & Measurements
- Safety Device List
- Setting values for all sensors for Pressure and Temperature
- Dimensional Check-up, Overall Inspection, Completeness of Scope of Supply

- Shop Test/Load Test for Solar Power Plant

## 10. Load Trials & Reliability test at Site

10.1. All the tests which are mentioned in the load test of Rooftop Solar Power Plant will be carried out in presence of Employers' Representative at Site under site conditions and the parameters checked in accordance with the data sheet and guaranteed parameters given by the Contractor.

10.2. All the equipment supplied by the vendor will be tested as per relevant standard/ Quality assurance plan at site conditions and the performance monitored.

## 11. Quality Considerations

11.1. Contractor will submit and get finalized detailed comprehensive Standard Field Quality Plan (SFQP) within 30 days from date of issue of the order for bought out items and items manufactured by them. The Standard Field Quality Plan shall relate to the specific and objective erection practices right from storage of equipment till final inspection and testing to be followed for bought out items and items manufactured by Contractor. Accordingly, the Manufacturing Quality Plan shall be submitted broadly under following sub-heads:-

- Raw material/Bought Out items and Components.
- In process inspection and test/checks to establish successful completion/accomplishment of the process.
- Final tests/checks in accordance with relevant national/international standards/specification.

11.2. The quantum of check for each and every inspection/test items shall be based on an established sampling method and the quantum of check indicated in the SFQP should be designed adequate quality protection.

11.3. In case reference documents/acceptance norms are indicated as per plant standards then the same shall be duly substantiated/properly explained by well-established and proven engineering practices. All submissions will be in English language only.

11.4. Bidder will to allow Employer to carry out Quality/Audit/Quality surveillance on bidders and our sub-vendor's work with reference to contractual obligations to ensure that the quality management practices/norms as detailed out in the Quality Manual are adhered to. To facilitate this activity, you shall keep Employer informed all progress of work in this contract on monthly basis.

11.5. Contractor will associate/fully witness in each inspection being carried out at their/their sub-vendor's works by our authorized inspection engineer(s).

11.6. Employer shall also carry out quality audit and quality surveillance of your systems, procedures and quality control activities. However, this shall not relive you of any of your contractual responsibilities under the contract.

## 12. Performance and Functional Warranty / Guarantees

12.1. PV modules used in grid connected solar power plants must be warranted for peak output watt age, which should not be less than 90% at the end of 10 years and 80% at the end of 25 years.

12.2. The modules shall be warranted for at least 10 years for failures due to material defects and workmanship.

12.3. The MMS and anchoring system shall be warranted for 25 years for failures due to material defects and workmanship.

12.4. The mechanical structures, electrical works and overall workmanship of the grid connected Rooftop Solar Power Plant must be warranted for a minimum of 10 years.

12.5. The Contractor must ensure that the goods supplied under the Contract are new, unused and of most recent or current models and incorporate all recent improvements in design and materials unless provided otherwise in the Contract.

12.6. The warranty/guarantee period shall be as follows:

- Solar PV Modules: Modules shall be warranted for a minimum period of 25 years in the Bidder's detailed Warranty / Guarantee certificate.
- The MMS and anchoring system shall be warranted for 25 years for failures due to material defects and workmanship.
- Power Conditioning Units (PCU): PCUs shall be warranted for a period of minimum 10 years or guarantee period provided by the OEM, whichever is higher.
- Associated switch gear and others, Bidder must furnish in detail its warranties / guarantees for these items.
- All other associated equipment, not mentioned, but otherwise included in the scope of the contract must be warrantied for minimum 10 years against its performance and workmanship.

12.7. During the period of Warranty / Guarantee the Contractor shall remain liable to replace any defective parts, that becomes defective in the plant, of its own manufacture or that of its sub-Contractors, under the conditions provided for by the Contract under and arising solely from faulty design, materials or workmanship, provided such defective parts are not repairable at Site .After replacement, the defective parts shall be returned to the Contractors works at the expense of the Contractor unless otherwise arranged.

12.8. At the end of guarantee period, the Contractor's liability shall cease. In respect of goods not covered by the first paragraph of this clause, the Employer shall be entitled to the benefit of such guarantee given to the Contractor by the original Contractor or manufacturer of such goods.

12.9. The performance of the plant will be determined by the performance ratio (PR). The same shall be measured and recorded for a period of one month for operational acceptance of the plant as mentioned under TS Clause 7.

12.10. During the first year of performance demonstration and Operation & Maintenance thereafter, the Contractor shall be responsible for any defects in the work due to faulty workmanship or due to use of sub-standard materials in the work. Any defects in the work during the guarantee period shall therefore, be rectified by the Contractor without any extra cost to the Employer within a reasonable time as may be considered from the date of receipt

of such intimation from the Employer failing which the Employer shall take up rectification work at the risk and cost of the Contractor.

12.11. During the O&M period, the bidder, in concurrence with the Employer, is encouraged to carry out the PR test in similar fashion for a period of 7 days, at regular intervals, in order to check the continued performance of the plant.

## H. Standards and limits - Meters and Grid Interconnection

Following specifications shall be applicable for the activities related to meters and grid interconnection.

| PARAMETER | REFERENCES | REQUIREMENT |
|---|---|---|
| Services Conditions | Relevant regulation/order by utter Pradesh Electricity regulatory Commission | Compliance |
| Overall Grid Standards | Central Electricity Authority (Grid Standard) regulations 2010 | Compliance |
| Equipment | BIS/IEEE/IEC | Compliance |
| Meters | Central Electricity Authority (Installation & Operation of Meters) Regulation 2013 & relevant regulation by Uttar Pradesh Electricity Regulatory Commission | Compliance |
| Safety & Supply | Central Electricity Authority (Measures of Safety & Electricity Supply) Regulation 2010 | Compliance |
| Harmonic Current | IEEE 519 and CEA (Technical Standards for Connectivity of the Distributed Generation Rescores) Regulations 2013 | Harmonic current injection form generation station shall not exceed the limits specified in IEEE 519 |
| Synchronization | IEEE 519 and CEA (Technical Standards for Connectivity of the Distributed Generation Rescores) Regulations 2013 | Photovoltaic system must be equipped with a grid frequency synchronization device. Every time the generating station is synchronization to the electricity system. It shall not cause voltage fluctuation greater than +/- 5% at point of connection. |
| Voltage | IEEE 519 and CEA (Technical Standards for Connectivity of | The voltage operating window should minimize nuisance |

| | | |
|---|---|---|
| | the Distributed Generation Rescores) Regulations 2013 | tripping and should be under operating range of 80% to110% of the nominal connected voltage. Beyond a clearing time of 2 second, the photovoltaic system must isolate itself from the grid. |
| Flicker | IEEE 519 and CEA (Technical Standards for Connectivity of the Distributed Generation Regulations 2013 Resource) | Operation of photovoltaic System Should not cause voltage flicker in excess of the limit stated in IEC 61000 standard or other equivalent Indian standards, if any |
| Frequency | IEEE 519 and CEA (Technical Standards for Connectivity of the Distributed Generation Rescores) Regulations 2013 | When the distribution system frequency deviates outside the specified conditions (50.5HZ on upper side and 47.5HZ on lower side) there should be over and under frequency trip functions with a clearing time of 0.2 Seconds |
| DC Injection | IEEE 519 and CEA (Technical Standards for Connectivity of the Distributed Generation Rescores) Regulations 2013 | Photovoltaic system should not inject DC power more than 0.5 % of full rated output at the interconnection point under any operating condition |
| Power factor | IEEE 519 and CEA (Technical Standards for Connectivity of the Distributed Generation Rescores) Regulations 2013 | While the output of the inverter is greater than 50% a lagging power factor of greater than 0.9 should operate |
| Islanding and Disconnection | IEEE 519 and CEA (Technical Standards for Connectivity of the Distributed Generation Rescores) Regulations 2013 | The Photovoltaic system in the event of fault, voltage or frequency variation must island/Disconnect it self with in IEC standard on stipulated period |
| Over load & over heat | IEEE 519 and CEA (Technical Standards for Connectivity of the Distributed Generation Rescores) Regulations 2013 | The invertor should have the facility to automatically switch off in case of over load or overheating and should restart when normal conditions are restored |
| Paralleling device | IEEE 519 and CEA (Technical Standards for Connectivity of the Distributed Generation Rescores) Regulations 2013 | Pearling device of photovoltaic system shall be capable of with standing 220% of the normal voltage at the interconnection point |

**Note:**

1. The installation should not be protruding outside the building and there should not be over hang type Structure on any terrace
2. Location & area for inverter and other interconnection equipment should be located in suitable and secure place and this should be approved by the authority.
3. Installation diagram & wiring from array to proposed location of inverter and interconnection should be clearly presented by the bidder before work starts to the authority.

## SHEET-1

## Guaranteed Technical Particular data Sheet for Solar PV Module

(To be furnished by the bidder)

| S.No. | Particulars | Unit | Type/value |
|---|---|---|---|
| 1 | PV Module Manufacture (Name & Country) | | |
| 2 | PV Module type (Crystalline- Mono/ Multi) | | |
| 3 | Product Code (commercial) | | |
| 4 | No. of PV cells per Module | cells | 60 or 72 |
| 5 | Mounting arrangement for Solar Module | | |
| 6 | Solar Module frame material (if framed) | | |
| 7 | Module dimensions | | |
| 8 | Output Cables (viz., Polarized Weather Proof DC rated multi-contact connector) | | |
| 9 | Availability of Reverse Blocking Diode and Bypass Diode | | |
| 10 | Construction:<br>Front glass description and thickness<br>Back sheet details<br>Encapsulating details | | 60 or 72 |
| 11 | Cell efficiency | % | |
| 12 | Module efficiency | % | |
| 13 | Nominal Wattage ($P_{nom}$) | W | |
| 14 | Power Tolerance (≤+5W) | W | |
| 15 | Peak power voltage ($V_{mp}$) | V | |
| 16 | Peak power current ($I_{mp}$) | A | |
| 17 | Open circuit voltage ($V_{oc}$) | V | |
| 18 | Short circuit current ($I_{sc}$) | A | |
| 19 | Weight of each module | kg | |
| 20 | Fill Factor | % | |
| 21 | Standards/Approvals from International Agencies | IEC 61215<br>IEC 61730<br>IEC 61646<br>IEC 61701<br>IEC 62716<br>Others | |
| 22 | Module is suitable to operate up to 50° ambient temp | Yes/No | |

## SHEET-2

## Technical Particular Data Sheet for Power Conditioning Unit

(To be furnished by the bidder)

| **Particulars** | **Unit** | **Value** |
|---|---|---|
| Make | | |
| Capacity | | |
| Origin | | |
| **AC Side** | | |
| Nominal AC power @ 25 °C | kW | |
| Nominal AC power @ 50 °C | kW | |
| Output AC voltage | V | |
| Output AC Current | A | |
| Frequency (and Variation) | Hz | |
| Total Harmonic Distortion (< 3%) | % | |
| AC over/under voltage, over/under frequency protection | | |
| Phase shift (cos phi) | | |
| **DC Side** | | |
| Maximum Input DC power | kW | |
| Maximum DC voltage | V | |
| MPPT voltage range | V | |
| Maximum DC current | A | |
| DC over voltage protection | | |
| DC voltage ripple | % | |
| **Others** | | |
| Maximum Efficiency | % | |
| Euro Efficiency | % | |
| Ambient temperature range | °C | |
| Humidity (non-condensing) | RH | |
| Quiescent power | kW | |
| Degree of protection | IP | |
| Dimensions approx. (H x W x D) | mm | |
| Weight | kg | |
| Compliances (Reference Standards) | | |

## Annexure 1: Details of Site

### 1. Collectorate Meeting Hall (District Minority Welfare office)

**Latitude: 27°54'13.33"N, Longitude: 78° 4'14.53"E**

**Google Images**


**Site Image**

**Proposed SPV Plant Detail**

| Description | Value | UoM |
|---|---|---|
| Contracted Load | 45 | KVA |
| | | |
| Available Roof Top Area | 3600 | Sq.m. |
| | | |
| Proposed SPV Plant Size | 45 | kWp |

## 2. Nagar Nigam

**Latitude: 27°53'49.83"N, Longitude: 78° 4'26.40"E**

### Google Images


### Site Images

### Proposed SPV Plant Detail

| Description | Value | UoM |
|---|---|---|
| Contracted Load | 49 | KVA |
| | | |
| Available Roof Top Area | 500 | Sq.m. |
| | | |
| Proposed SPV Plant Size | 49 | kWp |

### 3. Treasury Office

**Latitude: 27°54'10.78"N, Longitude: 78° 4'16.68"E**

**Google Image**


**Site Images**

**Proposed SPV Plant Detail**

| Description | Value | UoM |
|---|---|---|
| Contracted Load | 36 | KVA |
| | | |
| Available Roof Top Area | 400 | Sq. Mts. |
| | | |

| | | |
|---|---|---|
| Proposed SPV Plant Size | 25 | kWp |

### 4. CMO Office

**Latitude: 27°54'3.68"N, Longitude: 78° 4'40.42"E**

**Google Image**


**Site Images**

**Proposed SPV Plant Detail**

| Description | Value | UoM |
|---|---|---|

| | | |
|---|---|---|
| Contracted Load | 42 | KVA |
| | | |
| Available Roof Top Area | 260 | Sq. Mts. |
| | | |
| Proposed SPV Plant Size | 42 | kWp |

## 5. NIC Center

**Latitude: 27°54'18.13"N, Longitude: 78° 4'11.92"E**

### Google Image


### Site Images

**Proposed SPV Plant Detail**

| Description | Value | UoM |
|---|---|---|
| Contracted Load | 7 | KW |
| | | |
| Available Roof Top Area | 242 | Sq. Mts. |
| | | |

| | | |
|---|---|---|
| Proposed SPV Plant Size | 7 | kWp |

# Section - VI

## Forms and Formats

# Contents

## Appendix 5: Performa for Financial Proposal (TO BE SUBMITTED ONLINE ONLY)

## Appendix 12(a): Format of Bank Guarantee for Bid Security

(Refer Clauses 16 of ITB)

B.G. No.

Dated:

1. In consideration of the Aligarh Smart City Limited represented by Chief Executive Officer having its office at Manasi Ganga Building, Baraula By Pass, Near Shanti Lodge, Aligarh, Uttar Pradesh 202001, India, (hereinafter referred to as the "ASCL", which expression shall unless it be repugnant to the subject or context thereof include its, successors and assigns) having agreed to receive the Bid of ..... and having its registered office at ..... (hereinafter referred to as the "Bidder" which expression shall unless it be repugnant to the subject or context thereof include its/their executors, administrators, successors and assigns), for "Design, Supply, Installation, Commissioning and Maintenance for a period of 5 years of Rooftop Solar PV Power Plants of different capacities under Net Metering with Zero Export Policy in Aligarh City on turnkey basis along with associated electrical & civil works under implementation of smart city mission" (hereinafter referred to as "the Project") pursuant to the RFP Document issued in respect of the Project and other related documents (hereinafter collectively referred to as "Bidding Documents"), we [Name of the Bank] having our registered office at ..... and one of its branches at ..... (hereinafter referred to as the "Bank"), at the request of the Bidder, do hereby in terms of RFP Document, irrevocably, unconditionally and without reservation guarantee the due and faithful fulfilment and compliance of the terms and conditions of the Bidding Documents (including the RFP Document) by the said Bidder and unconditionally and irrevocably undertake to pay forthwith to the ASCL an amount of Rs. ***** (Rupees***** only) (hereinafter referred to as the "Guarantee") as our primary obligation without any demur, reservation, recourse, contest or protest and without reference to the Bidder if the Bidder shall fail to fulfil or comply with all or any of the terms and conditions contained in the said Bidding Documents.

2. Any such written demand made by the ASCL stating that the Bidder is in default of the due and faithful fulfilment and compliance with the terms and conditions contained in the Bidding Documents shall be final, conclusive and binding on the Bank.

3. We, the Bank, do hereby unconditionally undertake to pay the amounts due and payable under this Guarantee without any demur, reservation, recourse, contest or protest and without any reference to the Bidder or any other person and irrespective of whether the claim of the ASCL is disputed by the Bidder or not, merely on the first demand from the ASCL stating that the amount claimed is due to the ASCL by reason of failure of the Bidder to fulfil and comply with the terms and conditions contained in the Bidding Documents including failure of the said Bidder to keep its Bid open during the Bid validity period as set forth in the said Bidding Documents for any reason

whatsoever. Any such demand made on the Bank shall be conclusive as regards amount due and payable by the Bank under this Guarantee. However, our liability under this Guarantee shall be restricted to an amount not exceeding Rs. ***** (Rupees ***** only).

4. This Guarantee shall be irrevocable and remain in full force for a period of 210 (two

hundred and ten) days from the Bid Due Date/last date for bid submission or for such extended period as may be mutually agreed between the ASCL and the Bidder, and agreed to by the Bank, and shall continue to be enforceable till all amounts under this Guarantee have been paid.

5. We, the Bank, further agree that the ASCL shall be the sole judge to decide as to

whether the Bidder is in default of due and faithful fulfilment and compliance with the terms and conditions contained in the Bidding Documents including, inter alia, the failure of the Bidder to keep its Bid open during the Bid validity period set forth in the said Bidding Documents, and the decision of the ASCL that the Bidder is in default as aforesaid shall be final and binding on us, notwithstanding any differences between the ASCL and the Bidder or any dispute pending before any Court, Tribunal, Arbitrator or any other ASCL.

6. The Guarantee shall not be affected by any change in the constitution or winding up of the Bidder or the Bank or any absorption, merger or amalgamation of the Bidder or the Bank with any other person.

7. In order to give full effect to this Guarantee, the ASCL shall be entitled to treat the Bank as the principal debtor. The ASCL shall have the fullest liberty without affecting in any way the liability of the Bank under this Guarantee from time to time to vary any of the terms and conditions contained in the said Bidding Documents or to extend time for submission of the Bids or the Bid validity period or the period for conveying acceptance of Letter of Award by the Bidder or the period for fulfilment and compliance with all or any of the terms and conditions contained in the said Bidding Documents by the said Bidder or to postpone for any time and from time to time any of the powers exercisable by it against the said Bidder and either to enforce or forbear from enforcing any of the terms and conditions contained in the said Bidding Documents or the securities available to the ASCL, and the Bank shall not be released from its liability under these presents by any exercise by the ASCL of the liberty with reference to the matters aforesaid or by reason of time being given to the said Bidder or any other forbearance, act or omission on the part of the ASCL or any indulgence by the ASCL to the said Bidder or by any change in the constitution of the ASCL or its absorption, merger or amalgamation with any other person or any other matter or thing whatsoever which under the law relating to sureties would but for this provision have the effect of releasing the Bank from its such liability.

8. Any notice by way of request, demand or otherwise hereunder shall be sufficiently given or made if addressed to the Bank and sent by courier or by registered mail to the Bank at the address set forth herein.

9. We undertake to make the payment on receipt of your notice of claim on us addressed to [name of Bank along with branch address] and delivered at our above

branch which shall be deemed to have been duly authorised to receive the said notice of claim.

10. It shall not be necessary for the ASCL to proceed against the said Bidder before proceeding against the Bank and the guarantee herein contained shall be enforceable against the Bank, notwithstanding any other security which the ASCL may have obtained from the said Bidder or any other person and which shall, at the time when proceedings are taken against the Bank hereunder, be outstanding or unrealised.

11. We, the Bank, further undertake not to revoke this Guarantee during its currency except with the previous express consent of the ASCL in writing.

12. The Bank declares that it has power to issue this Guarantee and discharge the obligations contemplated herein, the undersigned is duly authorised and has full power to execute this Guarantee for and on behalf of the Bank.

13. For the avoidance of doubt, the Bank's liability under this Guarantee shall be restricted to Rs. ******** (Rupees *******) only. The Bank shall be liable to pay the said amount or any part thereof only if the ASCL serves a written claim on the Bank in accordance with paragraph 9 hereof, on or before [*** (indicate date falling 210 days after the Bid Due Date/last date for bid submission)].

14. Notwithstanding anything contained herein:

a) Our liability under this bank Guarantee shall not exceed Rs..... (Rupees .....

Only)

b) This Bank Guarantee shall be valid up to ..... And

c) We are liable to pay the guaranteed amount or any part thereof under this bank

Guarantee only and only if we receive a written claim or demand on or before..... (

date of expiry of guarantee)

Signed and Delivered by .....Bank

By the hand of Mr./Ms. ....., its ..... and authorised official.

(Signature of the Authorised Signatory)

(Official Seal)

## Appendix 12(b): Format for Performance Bank Guarantee for Performance Security during EPC

**FORMAT OF PERFORMANCE SECURITY (GUARANTEE)**

**BANK GUARANTEE BOND**

To,

Chief Executive Officer

Aligarh Smart City Limited (ASCL),

Manasi Ganga Building, Baraula By Pass Road,

Near Shanti Lodge, Aligarh,

Uttar Pradesh 202001, India

WHEREAS, M/s_____ (hereinafter called "the Contractor") has undertaken, in pursuance of his bid dated _____ to execute the____ _____ (hereinafter called the "Contract") and the bid of bidder has been accepted by the Aligarh Smart City Limited (ASCL) vide letter of acceptance No._____ dated _____ .

AND WHEREAS it has been stipulated by you in the said contract that the contractor shall furnish you with a bank guarantee by a recognized bank for the sum specified therein as security for compliance with his obligations in accordance with the contract;

AND WHEREAS we have agreed to give the Contractor such a bank guarantee.

NOW THEREOF we hereby affirm that we are the Guarantor and responsible to you, on behalf of the Contractor, up to a total of Rs._____(Rupees _), such sum being payable in the type of currency in which Contract Price is payable, and we undertake to pay you, upon your first written demand and without cavil or argument, any sum or sums within the limits of Rs……..as aforesaid without your needing to prove or to show grounds or reasons for your demand for the sum specified therein. The Bank will deliver the money required by you immediately on demand without delay and demur and without reference to the Contractor and without the necessity of a previous notice or of judicial or administrative procedures and without it being necessary to prove to the Bank the liability or damages resulting from any defects or shortcomings or debts of the Contractor. The Bank shall pay to you any money so demanded notwithstanding any

dispute/disputes raised by the Contractor in any suit or proceedings pending before any Court, Tribunal or Arbitrator/s relating thereto and the liability under this guarantee shall be absolute and unequivocal.

We hereby waive the necessity of your demanding the said debt from the Contractor before presenting us with the demand.

We further agree that no change or addition to or other modification of the terms of the Contract or of the works to be performed thereunder or of any of the Contract documents, which may be made between you and the Contractor, shall in any way release us from any liability under this guarantee and we hereby waive notice of any such change, addition or modification.

The liability of the Bank under this bank guarantee shall not be affected by any change in the constitution of the Contractor or of the Bank.

This Guarantee will remain valid and in force up to _____.

Notwithstanding anything contained herein above, our liability under this guarantee is restricted to Rs.____(Rupees _____) and the guarantee shall remain valid till _____ . Unless a claim or a demand in writing is made upon us on or before _ all our liability under this guarantee shall cease.

DATE _____

SIGNATURE OF THE ISSUING AUTHORITY OF THE BANK _____

SEAL OF THE BANK _____

ADDRESS OF THE BANK _____

IN THE PRESENCE OF

SIGNATURE OF THE WITNESS _____

NAME AND ADDRESS OF THE WITNESS _____

## Appendix12(c): Format of Bank Guarantee for Performance of O&M

(On stamp paper of Rs.100/-)

Reference No. ……. Bank Guarantee No. ……. Dated: …….

WHEREAS ……. [Insert name of the Contractor] with address ……. [Insert address of the Contractor] having its registered office at ……. [Insert address of the Contractor] (Hereinafter, the "Bidder") wishes to participate in RFP document No. _____ issued by Aligarh Smart City

Limited ("ASCL") (hereinafter, the "Beneficiary") for Operation and Management of Performance of Solar Power Project.

And WHEREAS a Bank Guarantee for Rupees [……] valid till ……. [Insert date 05 years from the date of Operational Acceptance] is required to be submitted by the Contractor as per the terms and conditions of the RFP.

We, ……[Insert name of the Bank and address of the Branch giving the Bank Guarantee] having our registered office at ……. [Insert address of the registered office of the Bank] hereby give this Bank Guarantee No. ……. [Insert Bank Guarantee number] dated ……. [Insert the date of the Bank Guarantee], and hereby agree unequivocally and unconditionally to pay immediately on demand in writing from the Beneficiary any officer authorized by it in this behalf any amount not exceeding Rupees [……] to the said Beneficiary on behalf of the Bidder.

We ……. [Insert name of the Bank] also agree that withdrawal of the Bid or part thereof by the Bidder within its validity or non-submission of further O&M Performance Bank Guarantee by the Bidder within the stipulated time of the Letter of Intent to the Bidder or any violation to the relevant terms stipulated in the RFP would constitute a default on the part of the Bidder and that this Bank Guarantee is liable to be invoked and encashed within its validity by the Beneficiary in case of any occurrence of a default on the part of the Bidder and that the encashed amount is liable to be forfeited by the Beneficiary.

This agreement shall be valid and binding on this Bank up to and inclusive of ……. [Insert the date of validity of the Bank] and shall not be terminable by notice or by Guarantor change in the constitution of the Bank or the firm of the Bidder or by any reason whatsoever and our liability hereunder shall not be impaired or discharged by any extension of time or variations or alternations made, given, conceded with or without our knowledge or consent by or between the Bidder and the Beneficiary.

NOTWITHSTANDING anything contained hereinbefore, our liability under this guarantee is restricted to Rupees …….. (Insert the Amount). Our Guarantee shall remain in force till ……. [Insert date]. Unless demands or claims under this Bank Guarantee are made to us in writing on or before ……. [Insert date], all rights of the Beneficiary under this Bank Guarantee shall be forfeited and we shall be released and discharged from all liabilities there under.

| | |
|---|---|
| [Insert the address of the Bank with complete postal branch code, telephone and fax numbers, and official round seal of the Bank] | [Insert signature of the Bank's Authorized Signatory] |

Attested:

…… [Signature] (Notary Public)

Place: …….

Date: …….

## Appendix 14: Contract Agreement

This agreement is made at Aligarh, the ----------day of ----------in the year Two thousand ---------- between ---------- (herein after referred to as "The Contractor" which expression shall unless excluded by or repugnant to the contract include its successors or permitted assigns) of the one part and the ASCL having their Office at …….. (Hereinafter called "ASCL" which expression shall unless excluded by or repugnant to the context include its successors or assigns) of the other part.

WHEREAS the aforesaid ASCL has accepted the tender of the aforesaid Contractor for ---------- ---------- as per ASCL's LOI/LOA No.---------- ----------hereinafter called "the Works" and more particularly described enumerated or referred to in the specification, terms and conditions prescribed in the LOI which for the purpose of identification have been signed by ---------- on behalf of the Contractor and by ---------- ----------on behalf of ASCL a list whereof is made out in the Schedule hereunder written and all of which said documents are deemed to form part of this contract and included in the expression " the Works" wherever herein used, upon the terms and subject to the conditions hereinafter mentioned.

AND WHEREAS ASCL has accepted the tender of the Contractor for the said works for the sum of Rs. ---------- (Rupees :----------) upon the terms and subject to the conditions herein mentioned.

NOW THIS AGREEMENT WITNESSES AND IT IS HEREBY AGREED AND DECLARED THAT:-

a) The Contractor shall do and perform all works and things in this contract mentioned and described or which are implied therein or therefrom respectively or are reasonably necessary for the completion of the works as mentioned and at the times, in the manner and subject to the terms, conditions and stipulations contained in this contract, and in consideration of the due provision, executions, construction and completion of the works agreed to by the contractor as aforesaid, ASCL doth hereby covenant with the Contractor to pay all the sums of money as and when they become due and payable to the Contractor under the provisions of the contract. Such payments to be made at such times and in such manner as is provided by the contract.
b) The conditions and covenants stipulated herein before in this contract are subject to and without prejudice to the rights of the ASCL to enforce penalty for delays and / or any other rights whatsoever including the right to reject and cancel on default or breach by the Contractor of the conditions and the covenants as stipulated in the general conditions, specifications, forms, or tender schedule, drawing, etc., attached with ASCL's LOI No. ---------- ----------.

   The contract value, extent of supply delivery dates, specifications, and other relevant matters may be altered by mutual agreement and if so altered shall not be deemed or construed to mean or apply to affect or alter other terms and conditions of the contract and the general conditions and the contract so altered or revised shall be and shall always be deemed to have been subject to and without prejudice to said stipulation.

   SCHEDULE

   List of documents forming part of the contract:

   1.
   2.
   3.

   In witness whereof the parties hereto have set their hands and seals this day and month year first above written.

1. Signed, Sealed and delivered by:

(Signature with Name, Designation & official seal)

for and on behalf of M/s. [Inset Name of Contractor]

In the presence of name, Full Address & Signatures. :

i) ----------

ii) ----------

2. Signed, Sealed and Delivered by:

(Signature with Name, Designation & official seal)

For and on behalf of ASCL.

In the presence of Name, Full Address & Signature:

i) ----------

ii) ----------

## Appendix 17: Indemnity Bond to be executed by The Contractor for The Removal / Disposal of Scrap/Disposal of Surplus Material

(TO BE EXECUTED ON STAMP PAPER OF APPROPRIATE VALUE)

**INDEMNITY BOND**

This INDEMNITY BOND executed this …… day of ……. 20…... by ……..(Name of Company), a Company registered under the Companies Act, 1956/ Partnership Firm/ Proprietary Concern and having its registered office(s) at ……..(Office Address)……, hereinafter called the Indemnifier(s)/ Contractor(s) (which expression shall, unless excluded by or repugnant to the context, be deemed to mean and include its successors, administrators, executors and permitted assigns).

IN FAVOUR OF

"Aligarh Smart City limited", having its registered office at, ROOM NO 108, SEWA BHAWAN, NEAR GHANTA GHAR, CHURCH COMPOUND, CIVIL LINES, LAL DIGGI ROAD, ALIGARH, UTTAR PRADESH, INDIA, Pin: 202001.

1. ASCL has awarded the Contractor(s), contract for execution of work ( "Scope of Work") as mentioned in the contract agreement/LOI no…….. dated ……., entered into between ASCL and Contractor(s), relating to ……..(Name & Address of Project/Station) …… (hereinafter called 'the Project').
2. The Indemnifier(s) for the purpose of execution of its Scope of Work had from time to time procured and stored …….(Details of Material)……. at the Project Site.
3. After completion of the Scope of Work by Indemnifier(s), it has been identified that scrap …… (Details of Scrap Material & its Quantity)…….and/or surplus …… (Details of Surplus Material & its Quantity)…….. belonging to Indemnifier(s) is lying at the said Project Site.

4. Now, the scrap …… (Details of Scrap Material & its Quantity)……..and/or surplus …… (Details of Surplus Material & its Quantity)…….. belonging to the Indemnifier(s), requires to be removed by Indemnifier(s) from the Project Site.

NOW THEREFORE THIS INDEMNITY BOND WITNESSETH AS UNDER:

1. That Indemnifier(s) by way of this indemnity requests ASCL to issue approval in favour of Indemnifier(s) for removal of scrap …… (Details of Scrap Material & its Quantity)……..and/or surplus ……(Details of Surplus Material & its Quantity)…….. belonging to Indemnifier(s), from the project.
2. That the Indemnifier(s) shall ensure clearing of its scrap …… (Details of Scrap Material & its Quantity)……..and/or surplus …… (Details of Surplus Material & its Quantity)…….. by itself, as aforesaid.
3. That Indemnifier(s) in consideration of the premises above, for itself and its respective, executors, administrators and assigns, jointly and severally agree and undertake from time to time and at all times hereafter to indemnify ASCL and keep ASCL indemnified from and against all claims, demands, actions, liabilities and expenses which may be made or taken against or incurred by ASCL by reason of the issue of necessary approval by ASCL and permitting Indemnifier(s) to remove scrap ……(Details of Scrap Material & its Quantity)……..and/or surplus ……(Details of Surplus Material & its Quantity)…….. belonging to Indemnifier(s), from the project.
4. That Indemnifier(s) undertakes to indemnify and keep ASCL harmless from any act of omission or negligence on the part of the Contractor in following the statutory requirements with regard to removal/disposal of scrap and surplus belonging to Indemnifier(s), from the Project Site aforesaid, by the Indemnifier(s). Further, in case the laws require ASCL to take prior permission of the relevant Authorities before handing over the scrap and/or surplus to the Indemnifier, the same shall be obtained by the Indemnifier on behalf of ASCL.

IN WITNESS WHEREOF, the Indemnifier(s), through its authorized representative, has executed these presents on the Day, Month and Year first mentioned above at

……(Name of the Place)……

Witness:

Indemnifier

1. ……

2. ……

(Authorised Signatory)

## Appendix 18: Indemnity Bond to be executed by the contractor for the plant handed over by ASCL for Performance of its O&M Contract (Entire Rooftop Solar Power Plant)

(On non-judicial stamp paper of appropriate value)

**INDEMNITY BOND**

THIS INDEMNITY BOND IS made this …….. day of …….. 20 …….. By ..... a Company registered under the Companies Act, 1956/2013 having its Registered Office at ……. (hereinafter called as "Contractor" or "Obligor" which expression shall include its successors and permitted assigns) in favour of ASCL, a Company incorporated under the Companies Act, 1956 having its Registered Office at ROOM NO 108, SEWA BHAWAN, NEAR GHANTA GHAR, CHURCH COMPOUND, CIVIL LINES, LAL DIGGI ROAD, ALIGARH, UTTAR PRADESH, INDIA, Pin:202001, its Project at …….. (Hereinafter called "ASCL" which expression shall include its successors and assigns) :

WHEREAS ASCL has awarded to the Contractor a Contract for ..... vide its Letter of Intent/Award Letter/Contract No …….. Dated and its Amendment No …… (Applicable when amendments have been issued) (hereinafter called the "Contract") in terms of which ASCL is required to hand over various Equipment and facilities provided under Supply Contract, Erection Contract, herein after called "Rooftop Solar Power Plant" to the Contractor for execution of the Contract.

AND WHEREAS by virtue of Clause No. 27.3 of Section III:GCC of the said Contract, the Contractor is required to execute an Indemnity Bond in favour of ASCL for the Rooftop Solar Power Plant handed over to it by ASCL for the purpose of Performance of the Contract/O&M portion of the Contract.

NOW, THEREFORE, this Indemnify Bond witnesseth as follows:

1. That in consideration of Rooftop Solar Power Plant as mentioned in the Contract, Valued at Rs ……#……. (Rupees ……) handed over to the Contractor for the purpose of Performance of the Contract, the Contractor hereby undertakes to indemnify and shall keep ASCL indemnified, for the full value of the Rooftop Solar Power Plant. The Contractor hereby acknowledges actual receipt of the Rooftop Solar Power Plant as detailed in the Schedule appended hereto. The Contractor shall hold such Rooftop Solar Power Plant in trust as a "Trustee" for and on behalf of ASCL.
2. That the Contractor is obliged and shall remain absolutely responsible for the safe O&M/protection and custody of the Solar Photo Voltaic Project against all risks whatsoever

till completion of O&M Contract in accordance with the terms of the Contract and is taken over by ASCL. The Contractor undertakes to keep ASCL harmless against any loss or damage that may be caused to the Rooftop Solar Power Plant.

3. The Contractor undertakes that the Rooftop Solar Power Plant shall be used exclusively for the Performance/execution of the Contract strictly in accordance with its terms and conditions and no part of the Rooftop Solar Power Plant shall be utilised for any other work or purpose whatsoever. It is clearly understood by the Contractor that no-observance of the obligations under this Indemnify Bond by the Contractor shall inter-alia constitute a criminal breach of trust on the part of the Contractor for all intents and purposes including legal/penal consequences.
4. That ASCL is and shall remain the exclusive owner of the Rooftop Solar Power Plant free from all encumbrances, charges or liens of any kind, whatsoever. The Rooftop Solar Power Plant shall at all times be open to inspection and checking by Engineer-in-Charge/Engineer or other employees /agents authorised by him in this regard. Further, ASCL shall always be free at all times to take possession of the Rooftop Solar Power Plant in whatever form the Rooftop Solar Power Plant may be, if in its opinion, the Rooftop Solar Power Plant are likely to be endangered, miss-utilised or converted to uses other than those specified in the Contract, by any acts of omission of commission on the part of the Contractor or any other person or on account of any reason whatsoever and the Contractor binds itself and undertakes to comply with the directions of demand of ASCL to return the Rooftop Solar Power Plant without any demur or reservation.
5. That this Indemnify Bond is irrevocable. If at any time any loss or damage occurs to the Rooftop Solar Power Plant or the same or any part thereof is miss- utilised in any manner whatsoever, then the Contractor hereby agrees that the decision of the Engineer-in-Charge/Engineer of ASCL as to assessment of loss or damage to the Rooftop Solar Power Plant shall be final and binding on the Contractor. The Contractor binds itself and undertakes to replace the lost and/or damaged Rooftop Solar Power Plant at its own cost and / or shall pay the amount of loss to ASCL without any demur, reservation or protest. This is without prejudice to any other right or remedy that may be available to ASCL against the Contractor under the Contract and under this Indemnify Bond.
6. NOW THE CONDITION of this Bond is that if the Contractor shall duly and punctually comply with the terms of and conditions of this Bond to the satisfaction of ASCL, THEN, the above Bond shall be void, but otherwise, it shall remain in full force and virtue.

IN WITNESS WHEREOF, the Contractor has hereunto set its hand through its authorised representative under the common seal of the Company, the day, month and year first above mentioned

SCHEDULE

| **Particulars of the Equipment / Facilities handed-over** | **Quantity** | **Value** | **Other details (if any)** | **Signature of Attorney in token of receipt** |
|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| | | | | |

WITNESS

For and on behalf of

M/s ……..

I. 1. Signature ---------- Name ----------

2. Signature ---------- Name ----------

3. Address ---------- Designation of ----------

Authorised representative*

II. 1. Signature ----------

2. Name ---------- Common Seal

(In case of Company)

3. Address ----------

* Indemnity Bonds are to be executed by the authorised persons and (i) In case of contracting Company under common seal of the Company of (ii) having the power of attorney issued under common seal of the company with authority to execute Indemnity Bonds, (iii) In case (ii) the original Power of Attorney if it is specifically for our contract or a Photostat copy of the Power of Attorney if it is a General Power of Attorney and such documents should be attached to Indemnity Bond.

\# The value shall be sum of Supply and Erection Contract value.

## Appendix 19(a): Indemnity bond to be executed by the contractor for the equipment handed over by the employer for performance of its contract (entire equipment consignment in one lot)

(On non-Judicial stamp paper of appropriate value)

**INDEMNITY BOND**

THIS INDEMNITY BOND is made this .....day of..... 20..... by..... *(Contractor's Name)* a Company registered under the Companies Act, 1956/2013 having its Registered Office at..... (Hereinafter called as 'Contractor' or "Obligor" which expression shall include its successors and permitted assigns) in favour of ..... *(Name of Employer)*, a Company incorporated under the Companies Act, 1956 having its Registered Office at..... and its project at ..... (Hereinafter called "....."*.{Abbreviated name of the Employer}*" which expression shall include its successors and assigns):

WHEREAS .....@..... has awarded to the Contractor a Contract for.....vide its Notification of Award/ Contract No.....dated ..... and its Amendment No. ..... and Amendment No....., *(applicable when amendments have been issued)* (hereinafter called the Contract") in terms of which .....@..... is required to hand over various Equipment to the Contractor for execution of the Contract.

And WHEREAS by virtue of Clause No..... of the said Contract, the Contractor is required to execute an Indemnity Bond in favour of.....@..... for the Equipment's handed over to it by .....@..... for the purpose of performance of the Contract/Erection portion of the contract (hereinafter called the "Equipment's")

AND THEREFORE, This Indemnity Bond witnesseth as follows:

1. That in consideration of various Equipment's as mentioned in the Contract, valued at *(Currency and amount in Figures)*..... *(Currency and amount in words)*..... Handed over to the Contractor for the purpose of performance of the Contract, the Contractor hereby undertakes to indemnify and shall keep .....@..... indemnified, for the full value of the Equipment's. The Contractor hereby acknowledges actual receipt of the Equipment etc. as per despatch title documents handed over to the Contractor as detailed in the Schedule appended hereto. The Contractor shall hold such Equipment etc. in trust as a "Trustee" for and on behalf of .....@.....

@ Fill in abbreviated name of Employer

2. That the Contractor is obliged and shall remain absolutely responsible for the safe transit/protection and custody of the Equipment at .....@..... project site against all risks whatsoever till the Equipment's are duly used/erected in accordance with the terms of the Contract and the plant/package duly erected and commissioned in accordance with the terms of the Contract is taken over by .....@..... . The Contractor undertakes to keep .....@..... harmless against any loss or damage that may be caused to the Equipment's.
3. The Contractor undertakes that the Equipment's shall be used exclusively for the performance/execution of the Contract strictly in accordance with its terms and conditions and no part of the equipment shall be utilised for any other work of purpose whatsoever. It is clearly understood by the Contractor that non-observance of the obligations under this Indemnity Bond by the Contractor shall inter-alia constitute a criminal breach of trust on the part of the Contractor for all intents and purpose including legal/penal consequences.
4. That .....@..... is and shall remain the exclusive owner of the Equipment's free from all encumbrances, charges or liens of any kind, whatsoever. The Equipment's shall at all times be open to inspection and checking by the Project Manager or other employees/agents authorised by him in this regard. Further ...@..... Shall always be free at all times to take possession of the Equipment's in whatever form the Equipment's may be, if in its opinion, the Equipment's are likely to be endangered, miss-utilised or converted to uses other than those specified in the Contract, by any acts of omission or commission on the part of the Contractor or any other person or on account of any reason whatsoever and the Contractor binds himself and undertakes to comply with the directions of demand of .....@..... to return the Equipment's without any demur or reservation.
5. That this Indemnity Bond is irrevocable. If at any time any loss or damage occurs to the Equipment's or the same or any part thereof is miss-utilised in any manner whatsoever, then the Contractor hereby agrees that the decision of the Project Manager of .....@..... as to assessment of loss or damage to the Equipment shall be final and binding on the Contractor. The Contractor binds itself and undertakes to replace the lost and/or damaged Equipment's at its own cost and/or shall pay the amount of loss to .....@..... without any demur, reservation or protest. This is without prejudice to any other right or remedy that may be available to .....@..... against the Contractor under the Contract and under this Indemnity Bond.
6. NOW THE CONDITION of this Bond is that if the Contractor shall duly and punctually comply with the terms and conditions of this Bond to the satisfaction of .....@....., THEN, the above Bond shall be void, but otherwise, it shall remain in full force and virtue.

@ Fill in abbreviated name of Employer

IN WITNESS WHEREOF, the Contractor has hereunto set its hand through its authorised representative under the common seal of the Company, the day, month and year first above mentioned.

**SCHEDULE**

| Particulars of the Equipment's handed over | Quantity | Particulars of Despatch title | | Value of the Equipment's | Signature of Attorney in token of receipt |
|---|---|---|---|---|---|
| | | RR/GR/ Bill of lading No & Date | Carrier | | |
| | | | | | |

WITNESS

For and on behalf of

M/s …….

I. 1. Signature ---------- Name ----------

2. Signature ---------- Name ----------

3. Address ---------- Designation of ----------

Authorised representative*

II. 1. Signature ----------

2. Name ---------- Common Seal

(In case of Company)

3. Address ----------

* Indemnity Bonds are to be executed by the authorised persons and (i) In case of contracting Company under common seal of the Company of (ii) having the power of attorney issued under common seal of the company with authority to execute Indemnity Bonds, (iii) In case

(ii) the original Power of Attorney if it is specifically for our contract or a Photostat copy of the Power of Attorney if it is a General Power of Attorney and such documents should be attached to Indemnity Bond.

# The value shall be sum of Supply and Erection Contract value.

## Appendix 19 (b): Form of indemnity bond to be executed by the contractor for the equipment handed over in instalments by the employer for performance of its contract

(On non-Judicial stamp paper of appropriate value)

**INDEMNITY BOND**

THIS INDEMNITY BOND is made this.....day of..... 20..... by..... *(Contractor's Name)* a Company registered under the Companies Act, 1956/2013 having its Registered Office at..... (Hereinafter called as 'Contractor' or "Obligor" which expression shall include its successors and permitted assigns) in favour of ..... *(Name of Employer),* a Company incorporated under the Companies Act, 1956 having its Registered Office at ..... and its project at ..... (Hereinafter called "....."*{Abbreviated name of the Employer}*"Which expression shall include its successors and assigns):

WHEREAS .....@..... has awarded to the Contractor a Contract for .....vide its Notification of Award/Contract No.....dated..... And it's Amendment No. ..... and Amendment No.....*, (applicable when amendments have been issued)* (hereinafter called the Contract") in terms of which .....@..... is required to hand over various Equipment's to the Contractor for execution of the Contract.

And WHEREAS by virtue of Clause No..... of the said Contract, the Contractor is required to execute an Indemnity Bond in favour in .....@..... For the Equipment's handed over to it by .....@..... for the purpose of performance of the Contract/Erection portion of the contract (hereinafter called the "Equipment's")

NOW THEREFORE, This Indemnity Bond witnessed as follows:

1. That in consideration of various Equipment's as mentioned in the Contract, valued at (*Currency and amount in figures)*..... *(Currency and amount in words)* ..... to be handed over to the Contractor in instalments from time to time for the purpose of performance of the Contract, the Contractor hereby undertakes to indemnify and shall keep .....@..... indemnified, for the full value of the Equipment's. The Contractor hereby acknowledges actual receipt of the initial instalment of the Equipment etc. as per details in the Schedule appended hereto. Further, the Contractor agrees to acknowledge actual receipt of the subsequent instalments of the Equipment's etc. as required by .....@..... in the form of Schedules consecutively numbered which shall be attached to this Indemnity Bond so as to form integral parts of this Bond. The Contractor shall hold such Equipment's etc. in trust as a "Trustee" for and on behalf of .....@.....

   @ Fill in abbreviated name of Employer.

2. That the Contractor is obliged and shall remain absolutely responsible for the safe transit/protection and custody of the Equipment at .....@..... project site against all risks whatsoever till the Equipment's are duly used/erected in accordance with the terms of the Contract and the plant/package duly erected and commissioned in accordance with the terms of the Contract, is taken over by .....@..... . The Contractor undertakes to keep .....@..... harmless against any loss or damage that may be caused to the Equipment's.
3. The Contractor undertakes that the Equipment's shall be used exclusively for the performance/execution of the Contract strictly in accordance with its terms and conditions and no part of the equipment shall be utilised for any other work of purpose whatsoever. It is clearly understood by the Contractor that non-observance of the obligations under this Indemnity Bond by the Contractor shall inter-alia constitute a criminal breach of trust on the part of the Contractor for all intents and purpose including legal/penal consequences.
4. That .....@..... is and shall remain the exclusive owner of the Equipment's free from all encumbrances, charges or liens of any kind, whatsoever. The Equipment's shall at all times be open to inspection and checking by the Project Manager or other employees/agents authorised by him in this regard. Further, .....@..... shall always be free at all times to take possession of the Equipment's in whatever form the Equipment's may be, if in its opinion, the Equipment's are likely to be endangered, mis-utilised or converted to uses other than those specified in the Contract, by any acts of omission or commission on the part of the Contractor or any other person or on account of any reason whatsoever and the Contractor binds himself and undertakes to comply with the directions of demand of .....@..... to return the Equipment's without any demur or reservation.
5. That this Indemnity Bond is irrevocable. If at any time any loss or damage occurs to the Equipment's or the same or any part thereof is mis-utilised in any manner whatsoever, then the Contractor hereby agrees that the decision of the Project Manager of .....@..... as to assessment of loss or damage to the Equipment shall be final and binding on the Contractor. The Contractor binds itself and undertakes to replace the lost and/or damaged Equipment's at its own cost and/or shall pay the amount of loss to .....@..... without any demur,

reservation or protest. This is without prejudice to any other right or remedy that may be available to .....@..... against the Contractor under the Contract and under this Indemnity Bond.

6. NOW THE CONDITION of this Bond is that if the Contractor shall duly and punctually comply with the terms and conditions of this Bond to the satisfaction of .....@....., THEN, the above Bond shall be void, but otherwise, it shall remain in full force and virtue.

@ Fill in abbreviated name of Employer

IN WITNESS WHEREOF, the Contractor has hereunto set its hand through its authorised representative under the common seal of the Company, the day, month and year first above mentioned.

**SCHEDULE No.1**

| Particulars of the Equipment's handed over | Quantity | Particulars of Despatch title | | Value of the Equipment's | Signature of Attorney in token of receipt |
|---|---|---|---|---|---|
| | | RR/GR/ Bill of lading No & Date | Carrier | | |
| | | | | | |

**(Please number subsequent schedules)**

WITNESS

For and on behalf of

M/s ……..

I. 1. Signature ---------- Name ----------

2. Signature ---------- Name ----------

3. Address ---------- Designation of ----------

Authorised representative*

II. 1. Signature ----------

2. Name ---------- Common Seal

(In case of Company)

3. Address ----------

* Indemnity Bonds are to be executed by the authorised persons and (i) In case of contracting Company under common seal of the Company of (ii) having the power of attorney issued under common seal of the company with authority to execute Indemnity Bonds, (iii) In case (ii) the original Power of Attorney if it is specifically for our contract or a Photostat copy of the Power of Attorney if it is a General Power of Attorney and such documents should be attached to Indemnity Bond.