

- (power loss) of the entire solar system to the minimum (2%)
- g. For the DC cabling, XLPE or, XLPO insulated and sheathed, UV-stabilized single core multi- stranded flexible copper cables shall be used; Multi-core cables shall not be used.
 - h. For the AC cabling, PVC or, XLPE insulated and PVC sheathed single or, multi-core multi- stranded flexible Copper/Aluminium cables shall be used; Outdoor AC cables shall have a UV- stabilized outer sheath.
 - i. The cables (as per IS) should be insulated with a special grade PVC compound formulated for outdoor use. Outer sheath of cables shall be electron beam cross-linked XLPO type and black in colour.
 - j. The DC cables from the SPV module array shall run through a UV-stabilized PVC conduit pipe of adequate diameter with a minimum wall thickness of 1.5mm.
 - k. Cables and wires used for the interconnection of solar PV modules shall be provided with solar PV connectors (MC4) and couplers.
 - l. All cables and conduit pipes shall be clamped to the rooftop, walls and ceilings with thermo plastic 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. In three phase systems, the size of the neutral wire size shall be equal to the size of the phase wires.
 - m. Cable Routing/ Marking: All cable/wires are to be routed in a GI cable tray and suitably tagged and marked with proper manner by good quality ferule or by other means so that the cable easily identified. In addition, cable drum no./ Batch no. to be embossed/ printed at every one meter.
 - n. Cable Jacket should also be electron beam cross-linked XLPO, flame retardant, UV resistant and black in colour.
 - o. All cables and connectors for use for installation of solar field must be of solar grade which can withstand harsh environment conditions including High temperatures, UV radiation, rain, humidity, dirt, salt, burial and attack by moss and microbes for 25 years and voltages as per latest IEC standards. DC cables used from solar modules to array junction box shall be solar grade copper (Cu) with XLPO insulation and rated as per relevant standards only.
 - p. The ratings given are approximate. Project developer to indicate size and length as per system design requirement. All the cables required for the plant shall be provided by the Project developer. Any change in cabling sizes if desired by the Project developer shall be approved after citing appropriate reasons. All cable schedules/ layout drawings shall be approved prior to installation.
 - q. Multi Strand, Annealed high conductivity copper conductor PVC type 'A' pressure extruded insulation or XLPE insulation. Overall PVC/XLPE insulation for UV protection Armoured cable for underground laying. All cable trays including covers to be provided. All cables conform to latest edition of IEC/ equivalent BIS Standards as specified below: BoS item / component Standard Description Standard Number Cables General Test and Measuring Methods, PVC/XLPE insulated cables for working Voltage up to and including 1100 V, UV resistant for outdoor installation IS /IEC 69947.
 - r. The total voltage drop on the cable segments from the solar PV modules to the solar grid inverter shall not exceed 2.0%.
 - s. The total voltage drop on the cable segments from the solar grid inverter to the building distribution board shall not exceed 2.0%.

7. PROTECTIONS:

The system should be provided with all necessary protections like Earthing, Lightning, and grid islanding as follows:

8. LIGHTNING PROTECTION

The SPV power plants shall be provided with lightning & overvoltage protection. The main aim in this protection shall be to reduce the over voltage to a tolerable value before it reaches the PV or other sub system components. The source of over voltage can be lightning, atmosphere disturbances etc. The entire space occupying the SPV an-ay shall be suitably protected against Lightning by deploying required number of Lightning Arrestors. Lightning protection should be provided as per IEC62305 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.

9. SURGE PROTECTION

Internal surge protection shall consist of three MOV type surge - arrestors connected from +ve and -ve terminals to earth (via Y arrangement).

10. EARTHING PROTECTION

Each array structure of the PV yard should be grounded/ earthed properly as per IS: 3043-1987. In addition, the lightning arrester/masts should also be earthed inside the array field. Earth Resistance shall be tested in present of the representative of UBI as and when required after earthing by calibrated earth tester. PCU, ACDB and DCDB should also be earthed properly.

Earth resistance shall not be more than 5 ohms. It shall be ensured that all the earthing points are bonded together to make them at the same potential.

11. GRID ISLANDING:

In the event of a power failure on the electric grid, it is required that any independent power- producing inverters attached to the grid turn off in a short period of time. This prevents the DC to- AC inverters from continuing to feed power into small sections of the grid, known as "Islands." Powered Islands present a risk to workers who may expect the area to be unpowered, and they may also damage grid-tied equipment. The Rooftop PV system shall be equipped with islanding protection. In addition to disconnection from the grid (due to islanding protection) disconnection due to under and over voltage conditions shall also be provided.

12. JUNCTION BOXES: -

- a. The junction boxes are to be provided in the PV array for termination of connecting cables. The J. Boxes (JBs) shall be made of GRP / FRP / Powder Coated Aluminium /cast aluminium alloy with full dust, water & vermin proof arrangement. All wires / cables must be terminated through cable lugs. The JB's shall be such that input & output termination can be made through suitable cable glands.
- b. Copper bus bars / terminal blocks housed in the junction box with suitable

termination threads Conforming to IP65 standard and IEC 62208 Hinged door with EPDM rubber gasket to prevent water entry. Single / double compression cable glands. Provision of earthing's. It should be placed at 5 feet height or above for ease of accessibility.

- c. Each Junction Box shall have High quality Suitable capacity Metal Oxide Varistors (MOVs) / SPDs, suitable Reverse Blocking Diodes. The Junction Boxes shall have suitable arrangement monitoring and disconnection for each of the groups.
- d. Suitable markings shall be provided on the bus bar for easy identification and the cable ferrules must be fitted at the cable termination points for identification.
- e. All fuses shall have DIN rail mountable fuse holders and shall be housed in thermoplastic IP 65 enclosures with transparent covers.

13. DC DISTRIBUTION BOARD:

- a) DC Distribution panel to receive the DC output from the array field.
- b) DC DPBs shall have sheet from enclosure of dust & vermin proof conform to IP 65 protection. The bus bars are made of copper of desired size. Suitable capacity MCBs/MCCB shall be provided for controlling the DC power output to the PCU along with necessary surge arrestors.

14. AC DISTRIBUTION PANEL BOARD:

- a) AC Distribution Panel Board (DPB) shall control the AC power from PCU/ inverter and should have necessary surge arrestors. Interconnection from ACDB to mains at LT Bus bar while in grid tied mode.
- b) All switches and the circuit breakers, connectors should conform to IEC 60947, part I, II and III/ 1S60947 part I, II and III.
- c) The changeover switches, cabling work should be undertaken by the bidder as part of the project.
- d) All the Panel's shall be metal clad, totally enclosed, rigid, floor mounted, air - insulated, cubical type suitable for operation on three phase / single phase, 415 or 230 volts, 50 Hz
- e) The panels shall be designed for minimum expected ambient temperature of 45 degree Celsius, 80 percent humidity and dusty weather.
- f) All indoor panels will have protection of IP54 or better. All outdoor panels will have protection of 1P65 or better.
- g) Should conform to Indian Electricity Act and rules (till last amendment).
- h) All the 415 AC or 230 volts devices/ equipment like bus support insulators, circuit breakers, VTs etc., mounted inside the switchgear shall be suitable for continuous operation and satisfactory performance under the following supply conditions;

Variation in voltage	supply	+/-10%
Variation in frequency	supply	+/- 3Hz

15. Inverter:

As 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 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. Typical technical features of the inverter shall be as follows:

- Switching devices: IGBT/MOSFET
 - Control: Microprocessor /DSP
 - Nominal AC output voltage and frequency: 415V, 3 Phase, 50 Hz
 - Output frequency: 50 Hz
 - Grid Frequency Synchronization range: + 3 Hz or more
 - Ambient temperature considered: -20° C to 50° C
 - Humidity: 95 % Non-condensing
 - Protection of Enclosure: LP-20(Minimum) for indoor. IP-65(Minimum) for outdoor.
 - Grid Frequency Tolerance range: + 3 or more
 - Grid Voltage tolerance: - 20% & + 15 %
 - No-load losses: Less than 1% of rated power
 - Inverter efficiency(minimum): >93% (In case of 10kW or above)
 - Inverter efficiency (minimum):> 90% (In case of less than 10 kW)
 - THO: <3%
 - PF:> 0.9
- a) Three phase PCU/ inverter shall be used with each power plant system (5kW or above) but In case of less than 5kW single phase inverter can be used. PCU/inverter shall be capable of complete automatic operation including wake-up, synchronization & shutdown.
 - b) The output of power factor of PCU inverter is suitable for all voltage ranges or sink of reactive power, inverter should have internal protection arrangement against any sustainable fault in feeder line and against the lightning on feeder.
 - c) Built-in meter and data logger to monitor plant performance through external computer shall be provided.
 - d) The power conditioning units / inverters should comply with applicable IEC/ equivalent BIS standard for efficiency measurements and environmental tests as per standard codes IEC 61683/IS 61683 and IEC 60068- 2(1,2,14,30) /Equivalent BIS Std.
 - e) The charge controller/ 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.

- f) The PCU/ inverters should be tested from the MNRE approved test centers/ NABL /BIS /IEC accredited testing- calibration laboratories. Test certificate to be produced.
- g) The combined wattage of all inverters should not be less than rated capacity of power plant
- h) Maximum power point tracker shall be integrated in the inverter to maximize energy drawn from the array.

16. DATA ACQUISITION SYSTEM/ PLANT MONITORING:

- a) Data Acquisition System shall be provided for the solar PV plant.
- b) 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.
- c) Solar Irradiance: An integrating Pyranometer for site (Class II or better, along with calibration certificate) provided, with the sensor mounted in the plane of the array. Readout integrated with data logging system.
- d) Temperature: Temperature probes for recording the Solar panel temperature and ambient temperature to be provided complete with readouts integrated with the data logging system.
- e) The following parameters are accessible via the operating interface display in real time separately for solar power plant:
 - i) AC Voltage.
 - ii) AC Output current.
 - iii) Output Power
 - iv) Power factor.
 - v) DC Input Voltage.
 - vi) DC Input Current.
 - vii) Time Active.
 - viii) Time disabled.
 - ix) Time Idle.
 - x) Power produced
- a) Protective function limits (Viz-AC Over voltage, AC Under voltage, Over frequency, Under frequency ground fault, PV starting voltage, PV stopping voltage).
- b) All major parameters available on the digital bus and 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 for up to a month and the average values) should be made available for energy auditing through the internal microprocessor and should be read on the digital front panel.
- c) Array energy production: Digital Energy Meters to log the actual value of AC/ DC voltage, Current & Energy generated by the PV system provided. Energy meter along with CT/PT should be of 0.5 accuracy class.

- d) Computerized DC String/Array monitoring and AC output monitoring shall be provided as part of the inverter and/or string/array combiner box or separately.
- e) String and array DC Voltage, Current and Power, Inverter AC output voltage and current (All 3 phases and lines), AC power (Active, Reactive and Apparent), Power Factor and AC energy (All 3 phases and cumulative) and frequency shall be monitored.
- f) Computerized AC energy monitoring shall be in addition to the digital AC energy meter.
- g) 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.
- h) All instantaneous data shall be shown on the computer screen.
- i) Software shall be provided for USB download and analysis of DC and AC parametric data for individual plant.
- j) Provision for Internet monitoring and download of data shall be also incorporated.
- k) 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 the solar radiation and environment monitoring system.
- l) Solar Radiation and Environment Monitoring System
- m) Computerized solar radiation and environment monitoring system shall be installed on one of the buildings along with the solar rooftop power plant.
- n) The system shall consist of various sensors, signal conditioning, data acquisition, LCD display and remote monitoring.
- o) Global and diffuse beam solar radiation in the plane of array (POA) shall be monitored on continuous basis.
- p) Ambient temperature and relative humidity near array, control room temperature, at the level of array plane shall be monitored on continuous basis.
- q) Solar module back surface temperature shall be also monitored on continuous basis.
- r) Simultaneous monitoring of DC and AC electrical voltage, current, power, energy and other data of the plant for correlation with solar and environment data shall be provided.
- s) Solar radiation and environment monitoring system shall have real time clock, internal reliable battery backup and data storage capacity to record data round the clock for a period of min. 1 year.
- t) The data shall be recorded in a common work sheet chronologically date wise. The data file should be MS Excel compatible. The data shall be represented in both tabular and graphical form.

- u) All instantaneous data shall be shown on the computer screen.
- v) Historical data shall be available for USB download and analysis.
- w) Provision for Internet monitoring and download of data shall be incorporated.
- x) Remote Monitoring and data acquisition through Remote Monitoring System software at the owner location with latest software/hardware configuration and service connectivity for online / real time data monitoring/control complete to be supplied and operation and maintenance/control to be ensured by the supplier. Provision for interfacing these data on UBI server and portal in future.

17. EVACUATION OF SOLAR POWER:

- a) The power from the solar plant will be evacuated to the suitable 415V/230 V UBI's system.
- b) Most of the locations the power can be evacuated at 415 V level.
- c) Power Consumption: The generated Power will be utilized for internal consumption only.

18. CIRCUIT BREAKERS:

- a) Should be of suitable type for the plant feeder.
- b) The circuit breaker and accessories will be in general conforming to IEC standards.
- c) The circuit breaker will be totally re-strike-free under all duty conditions and will be capable of breaking magnetizing current of transformer and capacitive current of unloaded overhead lines without causing over voltages of abnormal magnitudes.
- d) The circuit breakers will be suitable for use in the switchgear under the operating conditions.
- e) Closing coil will be suitable for operation at all values of voltages between 85% and 110% of the rated voltage.
- f) Shunt trip will operate correctly under all operating conditions of the circuit breaker up to the rated breaking capacity of the circuit breaker and at all values of supply voltage between 70% and 110% of rated voltage.

19. DANGER BOARDS AND SIGNAGES:

Danger boards should be provided as and where necessary as per IE Act. /IE rules as amended up to date. Three signages shall be provided one each at battery -cum- control room, solar array area and main entry from administrative block. Text of the signages may be finalized in consultation with owner.

20. PLANNING AND DESIGNING:

- a) The bidder should carry out Shadow Analysis at the site and accordingly design strings & arrays layout considering optimal usage of space, material and labour. The bidder should submit the array layout drawings along with Shadow Analysis Report to UBI for approval.
- b) UBI reserves the right to modify/change the site and specification of sub-systems and components at any stage as per local site conditions/requirements.
- c) The bidder shall submit preliminary drawing for approval & based on any

modification or recommendation, if any. The bidder submits three sets and soft copy in CD of final drawing for formal approval to proceed with construction work.

21. DRAWINGS & MANUALS:

- a) Two sets of Engineering, electrical drawings and Installation and O&M (Operation & Maintenance) manuals are to be supplied. Bidders shall provide complete technical data sheets for each equipment giving details of the specifications along with make/makes in their bid along with basic design of the power plant and power evacuation, synchronization along with protection equipment.
- b) Approved ISI and reputed makes for equipment be used.
- c) For complete electro-mechanical works, bidders shall supply complete design, details and drawings for approval to UBI before progressing with the installation work.

22. DRAWINGS TO BE FURNISHED BY BIDDER AFTER AWARD OF CONTRACT

- a) The Contractor shall furnish the following drawings Award/Intent and obtain approval
- b) General arrangement and dimensioned layout
- c) Schematic drawing showing the requirement of SV panel, Power conditioning Unit(s)/ inverter, Junction Boxes, AC and DC Distribution Boards, meters etc.
- d) Structural drawing along with foundation details for the structure.
- e) Itemized bill of material for complete SV plant covering all the components and associated accessories.
- f) Layout of solar Power Array
- g) Shadow analysis of the roof

23. TOOLS & TACKLES AND SPARES:

- a) After completion of installation & commissioning of the power plant, necessary tools & tackles are to be provided free of cost by the bidder for maintenance purpose. List of tools and tackles to be supplied by the bidder for approval of specifications and make from UBI.
- b) A list of requisite spares in case of PCU/inverter comprising of a set of control logic cards, IGBT driver cards etc. Junction Boxes. Fuses, MOVs / arrestors, MCCBs etc along with spare set of PV modules be indicated, which shall be supplied along with the equipment. A minimum set of spares shall be maintained in the plant itself for the entire period of warranty and Operation & Maintenance, which upon its use shall be replenished.

24. SAFETY MEASURES:

- a) The bidder shall take entire responsibility for electrical safety of the installation(s) including connectivity with the grid and follow all the safety rules & regulations applicable as per Electricity Act, 2003 and CEA guidelines etc.
- b) The bidder has to display a board at the project site (On every roof) mentioning the following:
- c) Plant Name, Capacity, Location, Date of commissioning, estimated Power

- generation FY wise.
- d) The size and type of board and display shall be appropriate.
 - e) Please refer Annexure for IEC standards to be mandatorily adhered.

25. INSURANCE OF PLANT:

- a) The Contractor shall bear the responsibility to arrange PV module insurance for entire contract period encompassing all the probable risks associated with the PV Modules. All the expenses in relation to such insurance of the project will have to be borne by the Contractor.
- b) The insurance shall be in the name of UBI and the policy shall be submitted to UBI. The performance warranty shall be specifically a warrant and indemnity insurance against excessive loss of output of PV module.

26. MODULE TESTING:

PV modules must be tested and approved by one of the IEC authorized test centers. Test certificate to be produced for random sampling. The cost of these testing shall be borne by Contractor.

The acceptance criteria for all these tests shall be as per the applicable IEC/IS. Standard Industry practice will be adopted with mutual understanding in case if no such guidelines are available in IEC for any of the test.

27. FACTORY TESTS & INSPECTIONS:

- a) Manufacturing date of all modules used in the project shall not be more than 12 months prior to the date of transfer of ownership to UBI.
- b) The CONTRACTOR shall provide the electrical characteristics, of each solar PV module that is to be supplied these electrical characteristics includes current-voltage (I-V) performance curves and temperature coefficients of power, voltage and current etc.
- c) Modules deployed must use a RF identification tag. The RFID tag must be fixed only by the module manufacturer in the factory at the time of testing and before dispatch of modules. The following information must be mentioned in the RFID used on each module (This can be inside or outside the laminate but must be able to withstand harsh environmental conditions).
 - i. Name of the manufacturer of the PV module
 - ii. Name of the manufacturer of Solar Cells.
 - iii. Month & year of the manufacture (separate for solar cells and modules) 1v. Country of origin (separately for solar cells and module)
 - iv. I-V curve for the module
 - v. Wattage, I_m , V_m and FF for the module
 - vi. Unique Serial No and Model No of the module

- vii. Date and year of obtaining IEC PV module qualification certificate.
- viii. Name of the test lab issuing IEC certificate.
- ix. Other relevant information on traceability of solar cells and module as per ISO 9001 and ISO14001.

8. LANGUAGE OF BID

The response/bid prepared by the Bidder, as well as all correspondence and documents, along with the recommendations/acknowledgements from their existing clients, relating to the Bid exchanged by the Bidder and the Bank and supporting documents and printed literature shall be in English language only.

9. INSTRUCTIONS FOR BID SUBMISSION

9.1 Cost of RFP

9.1.1 RFP document can be downloaded from the Bank's website www.unionbankofindia.co.in or from Government tender portal www.eprocure.gov.in.

9.1.2 All costs and expenses (whether in terms of time or material or money) incurred by the Recipient/Bidder in any way associated with the development, preparation and submission of responses, including but not limited to attendance at meetings, discussions, demonstrations, etc. and providing any additional information required by the Bank, will be borne entirely and exclusively by the Bidder.

9.2 Security Deposit:

The successful bidder will have to submit performance security deposit for a sum of 5% of the value of the accepted tender in the form of an Account Payee DD or Performance Bank Guarantee from a Schedule Commercial Bank in an acceptable form safeguarding the interest of the bank in all respect, within 7 days of issuing the work order. The Earnest Money shall be returned to successful bidder on submission of performance Bank Guarantee or retained in the case the successful tenderer desires to do so, as part of the performance security deposit for due fulfillment of the Contract. No interest shall be paid on this deposit. Security money deposit of the successful contractor who fails to carry out the job after issue of work order by the Bank shall be forfeited.

In the event of non-performance of obligation or failure to meet terms of this tender the Bank shall be entitled to invoke the performance guarantee or withhold the security deposit as the case may be, without notice or right of demur to the successful bidder.

Any amount pending for payment due to non-achieving of milestone/s set under the agreement or any other reason solely attributable to the successful bidder should be included in the remaining amount of the contract value.

The Bank reserves the right to recover any dues payable by the selected bidder from any