

TECHNICAL SPECIFICATIONS FOR GRID CONNECTED SPV SYSTEMS

The specifications of SPV systems, for which EOI are invited, are as under. The self-certified Test Report(s) of each of the components/ systems mentioned shall be submitted before starting System installation. To ensure optimum performance of the solar installation and its related safety aspects, the provisions of the publication of GERMI on “Best Practices in Operation and Maintenance of Roof Top Solar PV systems in India” published in May, 2018 be followed.

The proposed projects shall be commissioned as per the technical specifications given below. Any short comings will lead to cancelation of Empanelment as may be decided by GETCO. The specifications, in the GERC Regulation on Net Metering shall also be applicable.

1. DEFINITION:

A Grid Tied Solar Rooftop Photo Voltaic (SPV) power plant consists of SPV array, Module Mounting Structure, Power Conditioning Unit (PCU) consisting of Maximum Power Point Tracker (MPPT), Inverter, and Controls & Protections, interconnect cables, solar meter, bi-directional energy meter and switches. PV Array is mounted on a suitable structure. Grid tied SPV system is without battery and should be designed with necessary features to supplement the grid power during daytime. Components and parts used in the SPV power plants including the PV modules, metallic structures, cables, junction box, switches, PCUs etc., should confirm to the BIS, IEC, or international specifications, wherever such specifications are available and applicable.

Solar PV system shall consist of following equipment/components.

1. Solar Photo Voltaic (SPV) modules consisting of required number of Crystalline PV modules.
2. Inverter and Remote Monitoring System.
3. Module mounting structures.
4. Energy Meter.
5. Array Junction Boxes.
6. DC Distribution Box.
7. AC Distribution Box.
8. Protections – Earthing, Lightning, Surge.
9. Cables.
10. Drawing & Manuals.
11. Miscellaneous.

a. SOLAR PHOTOVOLTAIC MODULES:

- 1.1.1 The PV modules and Solar Cell used should be made in India. Necessary documents in this regards must be provided to GETCO.

Violation of norms of Domestic Content Requirement (DCR) UNDER Solar PV projects will lead to penalties and actions as mentioned in office memorandum of MNRE GOI vide letter no. 283/2018-GRID SOLAR dated 20th February, 2018 as under:

- a) Filing of criminal case under IPC 420 and related Sec.
- b) Blacklisting of developers for period of 10 years
- c) Forfeiting of relevant bank guarantee(s)
- d) Disciplinary case against the Officers of concerned CPSU/ State Govt.
- e) Any other action, in addition to those above

SPV Modules and Solar Cells must be used for this Scheme shall be domestically manufactured as per MNRE's requirement. The Empanelled Agencies shall require to submit the Self declaration, regarding the Modules and Solar cells used under the Scheme are "Made in India", from the concerned manufacturer of Solar Modules, supplied for this scheme of GoG/GOI, before commissioning of the System. Violation of this condition will be reported to the MNRE and GoG for taking actions against the Manufacturer of the Solar Modules and Empanelled Agency. Such firm and Empanelled Agency may be put under the black list or stop deal list as may be decided by the DISCOM Authority.

In absence of the ALMM, the Empanelled Agencies shall have to submit self-declaration regarding domestically manufactured Cell and Modules used in the SPV System in this project. Whenever, the ALMM list published by the MNRE, the Model and Manufactures of the Module and Cell shall be from the ALMM only used in the SPV System in this project.

The PV modules used must qualify to the latest edition of IEC standards or equivalent BIS standards, i.e. IEC 61215/IS14286, IEC 61853-Part I/IS 16170-Part I, IEC 61730 Part-1 & Part 2. For the PV modules to be used in a highly corrosive atmosphere throughout their lifetime, they must qualify to IEC 61701/IS 61701.

- a) The total solar PV array capacity should not be less than allocated capacity (kWp) and should comprise of solar Mono **crystalline (bi-facial)modules of minimum 520 Wp**. Module capacity less than **520** watts shall not be accepted
- b) Protective devices against surges (SPD) at the PV module shall be provided. Low voltage drop bypass diodes shall be provided. Surge Protective Device (SPD) of appropriate capacity & type shall be provided either in the inverter or in DC Junction Box for protection against surges. Low voltage drop bypass diodes shall be provided.
- c) PV modules must be tested and approved by one of the NABL accredited and BIS Approved test centers.
- d) The module frame shall be made of corrosion resistant materials, preferably having anodized aluminum.
- e) The bidder shall carefully design & accommodate requisite numbers of the modules to achieve the rated power in his bid.
- f) Solar PV modules of minimum fill factor 75%, to be used..
- g) Other general requirement for the PV modules and sub systems shall be the following:
 - I. The rated power of solar PV module shall have maximum tolerance up to +3%.

- II. The peak-power point current of any supplied module string (series connected modules) shall not vary by +1% from the respective arithmetic means for all modules and/or for all module strings (connected to the same MPPT), as the case may be.

The peak-power point voltage of any supplied module string (series connected modules) shall not vary by + 2% from the respective arithmetic means for all modules and/or for all module strings (connected to the same MPPT), as the case may be.

- III. All electrical parameters at STC shall have to be provided.
- IV. Minimum certified PV module efficiency shall be +17 % for crystalline The temperature co-efficient power of the PV module shall be equal to or better than -0.45%/°C
- V. All PV modules should carry a performance warranty of >90% during the first 10 years, and >80% during the next 15 years. Further, module shall have performance warranty of >97% during the first year of installation. Degradation of module should not be more than 1 % per annum.

The PV modules shall be equipped with IP 65 or better protection level junction box with required numbers of bypass diodes of appropriate rating and appropriately sized output power cable of symmetric length with MC4 or equivalent solar connectors. The IP level for protection may be chosen based on following conditions:

- i. An IP 65 rated enclosure is suitable for most outdoor enclosures that won't encounter extreme weather such as flooding.
- ii. An IP 67 rated enclosure is suitable at locations which may encounter temporary submersion at depths of up to one meter.
- iii. An IP 68 enclosure is recommended if there may exist situations of submergence for extended periods of time and at substantial depths.
- iv.

1.1.3. Modules deployed must use a RF identification tag. The following information must be mentioned in the RFID used on each modules (This can be inside or outside the laminate, but must be able to withstand harsh environmental conditions).

- a) Name of the manufacturer of the PV module
- b) Name of the manufacturer of Solar Cells.
- c) Month & year of the manufacture (separate for solar cells and modules)
- d) Country of origin (separately for solar cells and module)
- e) I-V curve for the module Wattage, I_m , V_m and FF for the module
- f) Unique Serial No and Model No of the module
- g) Date and year of obtaining IEC PV module qualification certificate.
- h) Name of the test lab issuing IEC certificate.
- i) Other relevant information on traceability of solar cells and module as per ISO 9001 and ISO 14001
- j) Nominal wattage +3%.
- k) Brand Name, if applicable.

Other details as per IS/IEC 61730-1 clause 11 should be provided at appropriate place. The actual Power Output P_{max} shall be mentioned on the label pasted on the back side of PV Module. In addition to the above, the following information should also be provided:

- i. Polarity of terminals or leads (color coding is permissible) on junction Box housing near cable entry or cable and connector.
- ii. The Maximum system voltage for which the module is suitable to be provided on the back sheet of the module.

1.1.4. Warranties:

a) Material Warranty:

- i. Material Warranty is defined as: The manufacturer should warrant the Solar Module(s) to be free from the defects and/or failures specified below for a period not less than five (05) years from the date of commissioning.
- ii. Defects and/or failures due to manufacturing
- iii. Defects and/or failures due to quality of materials
- iv. Non conformity to specifications due to faulty manufacturing and/or inspection processes. If the solar Module(s) fails to conform to this warranty, the manufacturer will repair or replace the solar module(s), at the Owners sole option.

b) Performance Warranty:

- i. The predicted electrical degradation of power generated not exceeding 20% of the minimum rated power over the 25 year period and not more than 10% after ten years period of the full rated original output.

2. **ARRAY STRUCTURE:**

The mounting structure steel shall be as per latest IS 2062: 2011 and hot dip galvanization of the mounting structure shall be in compliance of latest IS 4759.

Module Mounting Structure (MMS):

- 3.1. Supply, installation, erection and acceptance of module mounting structure (MMS) with all necessary accessories, auxiliaries and spare part shall be in the scope of the work.
- 3.2. Module mounting structures can be made from two types of materials. They are Hot Dip Galvanized Iron or Hot Dip Galvanized Mild Steel (MS). However, MS will be preferred for raised structure.
- 3.3. MMS Steel shall be as per latest IS 2062:2011 and galvanization of the mounting structure shall be in compliance of latest IS 4759.
- 3.4. All bolts, nuts, fasteners shall be of stainless steel of grade SS 304 or hot dip galvanized, panel mounting clamps shall be of aluminum and must sustain the adverse climatic conditions. Structural material shall be corrosion resistant and

electrolytically compatible with the materials used in the module frame, its fasteners, nuts and bolts.

- 3.5. The module mounting structures should have angle of inclination as per the site conditions to take maximum insolation and complete shadow-free operation during generation hours. However, to accommodate more capacity the angle of inclination may be reduced until the plant meets the specified performance ratio requirements.
- 3.6. The Mounting structure shall be so designed to withstand the speed for the wind zone of the location where a PV system is proposed to be installed. The PV array structure design shall be appropriate with a factor of safety of minimum 1.5.
- 3.7. The upper edge of the module must be covered with wind shield so as to avoid build air ingress below the module. Slight clearance must be provided on both edges (upper & lower) to allow air for cooling.
- 3.8. Suitable fastening arrangement such as grouting and calming should be provided to secure the installation against the specific wind speed. The Empanelled Agency shall be fully responsible for any damages to SPV System caused due to high wind velocity within guarantee period as per technical specification.
- 3.9. The structures shall be designed to allow easy replacement, repairing and cleaning of any module. The array structure shall be so designed that it will occupy minimum space without sacrificing the output from the SPV panels. Necessary testing provision for MMS to be made available at site.
- 3.10. Adequate spacing shall be provided between two panel frames and rows of panels to facilitate personnel protection, ease of installation, replacement, cleaning of panels and electrical maintenance.
- 3.11. The structure shall be designed to withstand operating environmental conditions for a period of minimum 25 years.
- 3.12. The Rooftop Structures maybe classified in three broad categories out of one as follows

I. RCC Elevated structure: It can be divided into further three categories:

A. Minimum Ground clearance (300MM – 1200 MM)

- a. The structure shall be designed to allow easy replacement of any module and shall be in line with site requirement. The gap between modules should be minimum 30MM.
- b. Base Plate – Base plate thickness of the Structure should be 5MM for this segment.
- c. Column – Structure Column should be minimum 2MM in Lip section / 3MM in C-Channel section. The minimum section should be 80MM in Web side and 40MM in flange side in Lip section.
- d. Rafter - Structure rafter should be minimum 2MM in Lip section / 3MM in C-Channel section. The minimum section should be 80MM in Web side (y-axis) and 40MM in flange side (x-axis).
- e. Purlin - Structure purlin should be minimum 2MM in Lip section. The minimum section should be 60MM in Web side and 40MM in flange side in Lip section.
- f. Front/back bracing – The section for bracing part should be minimum 2MM thickness.

- g. Connection – The structure connection should be bolted/welded completely. Leg to rafter should be connected with minimum 12 diameter bolt. Rafter and purlin should be connected with minimum 10 diameter bolt. Module mounting fasteners should be SS-304 only and remaining fasteners either SS-304 or HDG 8.8 Grade.
- h. For single portrait structure, the minimum ground clearance should be 500MM.

3.13. Material standards:

- i. Design of foundation for mounting the structure should be as per defined standards which clearly states the Load Bearing Capacity & other relevant parameters for foundation design (As per IS 6403 / 456 / 4091 / 875).
- ii. Grade of raw material to be used for mounting the structures so that it complies the defined wind loading conditions (As per IS 875 - III) should be referred as follows (IS 2062 – for angles and channels, IS 1079 – for sheet, IS 1161 & 1239 for round pipes, IS 4923 for rectangular and square hollow section)
- iii. Test reports for the raw material should be as per IS 1852 / 808 / 2062 / 1079 / 811.
- iv. In process inspection report as per approved drawing & tolerance should be as per IS 7215.
- v. For ascertaining proper welding of structure part following should be referred:
 - a. D.P. Test (Pin Hole / Crack) (IS 822)
 - b. Weld wire grade should be of grade (ER 70 S - 6)
- vi. For ascertaining hot dip galvanizing of fabricated structure following should be referred: -
 - a. Min coating required should be as per IS 4759 & EN 1461.
 - b. Testing of galvanized material
 - Pierce Test (IS 2633)
 - Mass of Zinc (IS 6745)
 - Adhesion Test (IS 2629)
 - CuSO4 Test (IS 2633)
 - Superior High Grade Zinc Ingot should be of 99.999% purity (IS 209) (Preferably Hindustan Zinc Limited or Equivalent).
- vii. Foundation Hardware – If using foundation bolt in foundation then it should be as per IS 5624.

3.14. Design Validation- The Structure design and drawing should be duly verified by a licensed Structural designer before installation for all types of structure arrangements including the extension made, as per specification.

3. JUNCTION BOXES (JBs):

- a) The junction boxes are to be provided in the PV array for termination of connecting cables. The Junction 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. **Suitable markings shall**

be provided on the busbars for easy identification and cable ferrules will be fitted at the cable termination points for identification.

- 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 should be provided.
- c) For array junction box/ PV combiner box, Empanelled Agency may also provide polyamide glands and MC4 Connectors. The rating of the junction box shall be suitable with adequate safety factor to interconnect the Solar PV array
- 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) Junction boxes shall be mounted on the MMS such that they are easily accessible and are protected from direct sunlight and harsh weather.

4. DC DISTRIBUTION BOX (DCDB):

May not be required for small plants, if suitable arrangement is available in the inverter.

- a) DC Distribution Box (DCDB) to receive the DC output from the PV array field.
- b) DC DBs shall be dust & vermin proof conform having. IP 65 or better protection, as per site conditions.
- c) The bus bars are made of EC grade copper of required size. Suitable capacity MCBs/MCCB shall be provided for controlling the DC power output to the inverter along with necessary surge arrestors. MCB shall be used for currents up to 63 Amperes, and MCCB shall be used for currents greater than 63 Amperes

5. AC DISTRIBUTION BOX (ACDB):

- 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 IEC60947:2019, part I, II and III/ IS60947 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 IP65 or better as per site conditions.
- g) Should conform to Indian Electricity Act and CEA safety regulations (till last amendment).
- h) All the 415 AC or 230 volts devices / equipment like bus support insulators, circuit breakers, SPDs, VTs etc., mounted inside the switchgear shall be suitable for continuous operation and satisfactory performance under the following supply conditions.
 - a. Variation in supply voltage: $\pm 10\%$ as per CEA/State regulations.
 - b. Variation in supply frequency ± 3 Hz as per CEA/State regulations.

i) The inverter output shall have the necessary rated AC surge arrestors, if required and MCB/ MCCB. RCCB shall be used for successful operation of the PV system, if inverter does

Not have required earth fault/residual current protection.

6. PCU/ARRAY SIZE RATIO:

The recommended the solar PV array capacity in KW shall be in a range of 100%-110% of inverter capacity. i.e if the Inverter Capacity is 5 KW, then the Solar PV array capacity should be from 5 KW to 5.5 KW.

7. Inverter and Remote Monitoring System :-

i. Marking:

All the Inverters should contain the following clear and indelible Marking Label & Warning Label as per IS16221 Part II, clause 5. The equipment shall, as a minimum, be permanently marked with:

- a) The name or trade mark of the manufacturer or supplier;
- b) A model number, name or other means to identify the equipment,
A serial number, code or other marking allowing identification of manufacturing location and the manufacturing batch or date within a twelve month time period.
- c) Input voltage, type of voltage (a.c. or d.c.), frequency, and maximum continuous current for each input.
- d) Output voltage, type of voltage (a.c. or d.c.), frequency, maximum continuous current, and for a.c. outputs, either the power or power factor for each output
- e) The Ingress Protection (IP) rating
- f) As per IS 16221

Marking shall be located adjacent to each fuse or fuse holder, or on the fuse holder, or in another location provided that it is obvious to which fuse the marking applies, giving the fuse current rating and voltage rating for fuses that may be changed at the installed site.

Particulars	Details
Switching devices	IGBT/MOSFET
Control	Microprocessor /DSP
Nominal AC output voltage	For 3-phase/ 1phase :- 415V / 240 V
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	IP-65(Minimum).
Grid Frequency Tolerance range	+ 3 or more
No-load losses	Less than 1% of rated power
Inverter Efficiency(minimum)	(Above 10 kW) Peak Efficiency At least 97%, measure as per IEC 61683 Euro Efficiency At least 96%, measure as per IEC 61683

	(Below 10 kW) Peak Efficiency At least 96%, measure as per IEC 61683 Euro Efficiency At least 95%, measure as per IEC 61683
THD	<3%
PF	>0.9
Communication interface	RS 485 with Modbus
Display type	LCD for data display. LCD / LED for status display
Protections	• Over voltage (both input and output) • Over current (both input and output) • Over/Under grid frequency • Over temperature • Short circuit • Lightening • Surge voltage induced at output due to external source • Anti-islanding
Recommended Alert/Indications	• Inverter ON • Grid ON • Inverter Under / Over Voltage • Inverter Overload • Inverter Over Temperature
Recommended LCD Display on Inverter	• Output power (W) • Daily Energy (Wh) • cumulative energy (Wh) • DC voltage (V) • DC current (A) • AC voltage (V) • AC frequency (Hz) • AC current (A) • Cumulative hours of operation (h).

- a) The inverter shall have an RS-485 interface and support communication of its operational parameters and logs over Modbus protocol. The register mapping/memory mapping of the inverter data shall be made available by the Empanelled Agency from the inverter supplier to the DISCOMs/GUVNL.
- b) Three phase PCU/ inverter shall be used with each power plant system above 6KW and In case of 6 KW or less Capacity single phase/3pahse inverter shall be used as per market availability. In case of capacity addition of existing Solar plant, if the existing inverter is required to be replaced, the cost same is to be borne by consumer up on mutual agreement with Agency and consumer.

- c) 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 sustain fault in feeder line and against the lightning on feeder.
- d) Built-in meter and data logger to monitor plant performance through external computer shall be provided.
- e) 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.
- f) The charge controller (if any) / 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.
- g) The PCU/ inverters should be tested from the MNRE approved test centers /NABL /BIS /IEC accredited testing- calibration laboratories. In case of imported power conditioning units, these should be approved by international test houses. Valid type test report shall be submitted by the empanelled agency before commissioning of the SPV System.
- h) All inverters shall be IEC 61000 compliant for electromagnetic compatibility, harmonics, Surge, etc.
- i) Maximum Power Point Tracker (MPPT) shall be integrated in the PCU/inverter to maximize energy drawn from the array.
- j) The PCU/ Inverter shall have overloading capacity of minimum 10%
- k) The allowable capacity of inverter shall be (+15/-10 %) of registered AC Capacity.

8. INTEGRATION OF PV POWER WITH GRID:

- The output power from SPV would be fed to the inverters which converts DC produced by SPV array to AC and feeds it into the main electricity grid after synchronization.
- 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.
- A manual disconnect 4 pole isolation switch beside automatic disconnection to grid would have to be provided at utility end to isolate the grid connection by the utility personnel to carry out any maintenance. This switch shall be locked by the utility personnel.

9. DATA ACQUISITION SYSTEM / PLANT MONITORING

- i. Data Acquisition System shall be provided for each of the solar PV plant.
- ii. Remote Monitoring and data acquisition through Remote Monitoring System software at the GETCO 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 Empanelled Agency. Provision for interfacing these data on GETCO server and portal in future shall be kept as per requirement.

- iii. Empanelled agency shall ensure that Inverter should have provision of remote monitoring of inverter data through sim card or through Wi-Fi. Required website/mobile app platform, where the user (Consumer) can access the data, should be provided/explained to consumer while installation by Empanelled Agency. The facility of in-built wifi module or communication through sim-card should also be explained to the consumer.

Recurring cost of sim card/Data pack for communication shall be borne by consumers. All the inverter data should be made available to GETCO for monitoring by giving web access by sharing the user ID and password. SIM-card cost, Periodic data charges towards data pack and Internet/Wifi connectivity for maintaining Remote Monitoring System shall be the responsibility of Beneficiary.

10. METERING:

- a) The bi-directional electronic energy meter (0.5S class) shall be installed for the measurement of Import/Export of energy in co-ordination with GETCO.
- b) Reverse power relay shall be provided by bidder (if necessary), as per the local DISCOM requirement.

A Roof Top Solar (RTS) Photo Voltaic (PV) system shall consist of following energy meters:

- i. Net meter: To record import and export units
 - ii. Generation meter: To keep record for total generation of the plant.
- 3.15. The installation of Generation meters including CTs & PTs, wherever applicable, shall be carried out by the Empanelled Vendor as per the terms, conditions and procedures laid down by the concerned GERC/GETCO.

11. POWER CONSUMPTION:

- a) Regarding the generated power consumption, priority need to give for internal consumption first and thereafter any surplus power can be injected in to the grid.

12. PROTECTIONS

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

12.1. LIGHTNING PROTECTION:

- i. The SPV power plants shall be provided with lightning & over voltage protection, if required. The main aim in this protection shall be to reduce the overvoltage 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.
- ii. The entire space occupying the SPV array shall be suitably protected against Lightning by deploying required number of Lightning Arrestors (LAs). Lightning protection should be provided as per NFC17-102:2011/IEC 62305 standard.
- iii. The protection against induced high-voltages shall be provided by the use of Metal Oxide Varistors (MOVs)/Franklin Rod type LA/Early streamer type LA.
- iv. The current carrying cable from lightning arrestor to the earth pit should have sufficient current carrying capacity according to IEC 62305. According to

standard, the minimum requirement for a lightning protection system designed for class of LPS III is a 6 mm² copper/ 16 mm² aluminum or GI strip bearing size 25*3 mm thick). Separate pipe for running earth wires of Lightning Arrestor shall be used.

12.2. SURGE PROTECTION

- i. Internal surge protection, wherever required, shall be provided.
- ii. It will consist of three SPD type-II/MOV type surge arrestors connected from +ve and –ve terminals to earth.

12.3. EARTHING PROTECTION

- i The earthing shall be done in accordance with latest Standards.
- ii. Each array structure of the PV yard, Low Tension (LT) power system, earthing grid for switchyard, all electrical equipment, inverter, all junction boxes, etc. shall be grounded properly as per IS 3043-2018.
- iii. All metal casing/ shielding of the plant shall be thoroughly grounded in accordance with CEA Safety Regulation 2010. In addition, the lightning arrester/masts should also be earthed inside the array field.
- iv. Earth resistance should be as low as possible and shall never be higher than 5 ohms.
- v. separate three earth pits shall be provided for individual three earthing viz.: DC side earthing, AC side earthing and lightning arrester earthing.

12.4. GRID ISLANDING:

- i. 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 immediately. 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 Anti islanding features. In addition to disconnection from the grid (due to islanding protection) disconnection due to under and over voltage conditions shall also be provided.
- ii. A manual disconnect 4 / 2 pole isolation switch (RCCB may also be used) beside automatic disconnection to grid would have to be provided at utility end to isolate the grid connection by the utility personnel to carry out any maintenance.

13. CABLES

Cables of required size to be used in the system shall have the following characteristics:

- i. Shall meet IEC 60227/IS 694, IEC 60502/IS1554 standards
- ii. Temp. Range: –10°C to +80°C.

- iii. Voltage rating 660/1000V
- iv. Excellent resistance to heat, cold, water, oil, abrasion, UV radiation
- v. Flexible
- vi. Sizes of cables between array interconnections, array to junction boxes, junction boxes to Inverter etc. shall be so selected to keep the voltage drop (power loss) of the entire solar system to the minimum. The cables (as per IS) should be insulated with a special grade PVC compound formulated for outdoor use.
- vii. **Cable Routing/ Marking:** All cable/wires are to be routed in a RPVC pipe/ 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.
- viii. The Cable should be so selected that it should be compatible up to the life of the solar PV panels i.e. 25 years.
- ix. The ratings given are approximate. All the cables required for the plant are to be provided by the bidder. Any change in cabling sizes if desired by the bidder/approved after citing appropriate reasons.
- x. 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. Aluminium cable may be used on the AC-side of the PV system.
- xi. The size of each type of DC cable selected shall be based on minimum voltage drop however; the maximum drop shall be limited to 1%.
- xii. The size of each type of AC cable selected shall be based on minimum voltage drop however; the maximum drop shall be limited to 2 %.

14. CONNECTIVITY

The maximum capacity for interconnection with the grid at a specific voltage level shall be as specified in the GERC regulation for Grid connectivity and norms of DISCOM and amended from time to time.

15. DRAWINGS & MANUALS:

- i. Operation & Maintenance manual/user manual, Engineering and Electrical Drawings shall be supplied along with the each power plant. The manual shall include complete system details such as array lay out, schematic of the system, inverter details, working principle etc. Step by step maintenance and troubleshooting procedures shall be given in the manuals and provided to the beneficiary.
- ii. ISI marked (wherever applicable) and reputed makes equipment be used.

16. SOLAR PV SYSTEM ON THE ROOFTOP

The Solar PV system on the rooftop of the premises will be installed for PV capacity permitted by GETCO as per regulation issued by GERC.

17. SAFETY MEASURES:

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 Safety Regulation 2010 etc.

18. DOCUMENTATION:

Operation & Maintenance manual / user manual shall be supplied along with the each power plant. The manual shall include complete system details such as array lay out, schematic of the system, inverter details, working principle etc. Step by step maintenance and troubleshooting procedures shall be given in the manuals and provided to the beneficiary.

19. SHADOW ANALYSIS:

The shadow analysis report with the instrument such as Solar Pathfinder or professional shadow analysis software of each site has to be submitted by Bidder and shall be his responsibility to educate the user to install the system only in shadow free space. Lower performance of the system due to shadow effect shall be the responsibility of the bidder and shall be liable for penalty for lower performance.

Quality Certification, Standards and Testing for Grid-Connected Rooftop Solar PV Systems/Power Plants

Solar PV Modules/Panels	
IEC 61215 and IS 14286	Design Qualification and Type Approval for Crystalline Silicon Terrestrial Photovoltaic (PV) Modules
IEC 61701:2011	Salt Mist Corrosion Testing of Photovoltaic (PV) Modules
IEC 61853- 1:2011 / IS 16170-1:2014	Photovoltaic (PV) module performance testing and energy rating –:Irradiance and temperature performance measurements, and power Rating.
IEC 62716	Photovoltaic (PV) Modules – Ammonia (NH ₃) Corrosion Testing (as per the site condition like dairies, toilets etc)
IEC 61730-1,2	Photovoltaic (PV) Module Safety Qualification – Part 1: Requirementsfor Construction, Part 2: Requirements for Testing
IEC 62804	Photovoltaic (PV) modules – Test method for detection of potential-induced degradation. IEC 62804-1: Part 1: Crystalline Silicon
Solar PV Inverters	
IEC 62109 or IS : 16221	Safety of power converters for use in photovoltaic power systems – Part 1: General requirements, and Safety of power converters for usein photovoltaic power systems Part 2: Particular requirements for inverters. Safety compliance (Protection degree IP 65 or better for outdoor mounting, IP 54 or better for indoor mounting)
IS/IEC 61683 latest	Photovoltaic Systems – Power conditioners: Procedure for

(as applicable)	Measuring Efficiency (10%, 25%, 50%, 75% & 90-100% Loading Conditions)
IEC 60068-2 /IEC 62093 (as applicable)	Environmental Testing of PV System – Power Conditioners and Inverters
IEC 62116:2014/ IS16169	Utility-interconnected photovoltaic inverters - Test procedure of islanding prevention measures
Fuses	
IS/IEC 60947 (Part 1, 2 & 3), EN 50521	General safety requirements for connectors, switches, circuit breakers(AC/DC): 1)Low-voltage Switchgear and Control-gear, Part 1: General rules 2)Low-Voltage Switchgear and Control-gear, Part 2: Circuit Breakers 3)Low-voltage switchgear and Control-gear, Part 3: Switches, disconnectors switch-disconnectors and fuse-combination units 4) EN 50521: Connectors for photovoltaic system-Safety requirements and tests
IEC 60269-6:2010	Low-voltage fuses - Part 6: Supplementary requirements for fuse-links for the protection of solar photovoltaic energy systems
Solar PV Roof Mounting Structure	
IS 2062/IS 4759/AA6063 T6	Material for the structure mounting
Surge Arrestors	
BFC 17-102:2011/ NFC 102:2011/ IEC 62305	Lightening Protection Standard
IEC 60364-5-53/ IS 15086-5 (SPD) IEC 61643- 11:2011	Electrical installations of buildings - Part 5-53: Selection and erection of electrical equipment - Isolation, switching and control Low-voltage surge protective devices - Part 11: Surge protective devices connected to low-voltage power systems - Requirements and test methods
Cables	
IEC 60227/IS 694, IEC 60502/IS 1554 (Part 1 & 2)/ IEC69947 (as applicable)	General test and measuring method for PVC (Polyvinyl chloride) insulated cables (for working voltages up to and including 1100 V, and UV resistant for outdoor installation)
BS EN 50618	Electric cables for photovoltaic systems (BT(DE/NOT)258), mainly for DC Cables
Earthing /Lightning	
IEC 62561/IEC 60634 Series (Chemical earthing) (as applicable)	IEC 62561-1: Lightning protection system components (LPSC) - Part: Requirements for connection components IEC 62561-2: Lightning protection system components (LPSC) – Part 2: Requirements for conductors and earth electrodes IEC 62561-7: Lightning protection system components (LPSC) - Part 7: Requirements for earthing enhancing compounds
Junction Boxes	

IEC 60529	Junction boxes and solar panel terminal boxes shall be of the thermo-plastic type with IP 65 or better protection for outdoor use, and IP 54 or better protection for indoor use
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Guarantee and CMC: -

(a) Guarantee

The Grid connected Solar Photovoltaic System for the project supplied, installed and commissioned shall be guaranteed by the empanelled agency for a minimum period of 5- years from the date of successfully commissioning of the last system, in regard to quality of design, material, workmanship, quality of process/ manufacturing, performance, efficiency, installation, etc.

In the event any defect is found or developed in the system within guarantee period, shall be rectified/replaced by the Empanelled Agency at his own expense promptly.

In case the defects are not rectified within 2 (Two) days of the receipt of the complaint by the Empanelled Agency, GETCO shall have full liberty to rectify such defect or undertake such repairs as may be necessary to restore the system in working condition at the risk and cost of the Empanelled Agency.

The expenditure so incurred by GETCO shall be deducted from EOI applicant's pending claims, security, etc. and if necessary may be recovered in other mode provided under the law. In the event of failure of the complete system, if necessary, the whole system shall be replaced by the Empanelled Agency promptly.

(b) CMC: - Comprehensive Maintenance Contract for 5 years:- (Resolving Complaints related to defects/ non-working / poor performance of the system)

This EOI Document cover Five-year Comprehensive Maintenance Contract under the scope of EOI applicant.

The Five-year comprehensive Maintenance Contract shall include comprehensive on-site guarantee and warranty for all materials and components of the system under the project as mentioned above in para no (a).

During this CMC period the Empanelled Agency has to repair/replace the defective part/s or the material/s or any or all Components of the System to make it in working condition without loss of performance or degradation in efficiency and without compromising safety aspects free of cost within 48 (Fort eight) Hours of time limit as soon as the complaint is received from the GETCO. Also the Empanelled Agency has to undertake regular/periodical preventive maintenance of the system to avoid any future fault in the system and to improve the solar yield.

During the CMC period, the inverter monitoring, monitoring and controlling, shall be done by EOI applicant. Hence necessary reports shall be submitted by the EOI applicant in the soft/hard copies periodically to the concern authority of the GETCO as and when asked.

a) Logging of complain:

The record of each and every complaint received and resolve with down time and up time shall have to be maintained by the Empanelled Agency in register as well as computer based software and shall have to be submitted to GETCO office In each quarter.

b) While doing repairing or rectification work, the Empanelled Agency's technician or any person is not authorized to work on GETCO's electric line of 11 KV and LT having potential danger of electricity.

In case the defects are not rectified within 2 (Two) days from the receipt of the complaint by empaneled agencies than penalty of Rs 200 per day is applicable till the complaint is resolved.

In case of rectification required due to natural disaster i.e. earthquake, Storm, Heavy rain, flood etc, Agency should be completed rectification work within one month after receiving complaint. If after one month plant is not in service with his full capacity, the loss of energy shall be compensated by the agency to GETCO considering previous month generation and prevailing DISCOM tariff during the year.

This penalty shall be payable to GETCO, in case of empaneled agency failed to pay the same, it will be recovered from the PBG or may be recovered in other mode provided under the law. In the event of failure of the complete system, if necessary, the whole system shall be replaced by empaneled agencies within 15 days failing which 0.5% per day plus Taxes (if any) and cess on the particular project value subject to maximum of 10% of the project value plus applicable taxes (if any) and cess to be recovered from the PBG.

(C) Generation Guarantee:

The Capacity utilization factor CUF of the solar power plant shall not be less than 17% on annual basis, during the five CMC period. The Capacity Utilization factor (CUF) shall be maintained at 17% with respect to the AC Capacity of PV system and necessary efforts shall be made to achieve it by the bidder without any claim i.e. weather/climate change or other support not available. In case the system fails to attain the required CUF annually, the system shall be deemed to underperforming. The calculation of the CUF shall be on the generation recorded by the inverter/Solar system AC meter. The shortfall of energy to achieve 17% CUF on the yearly basis shall be compensated by the bidder to GETCO at the rate equivalent to the prevailing DISCOM tariff during the year. Failing which GETCO may invoke the entire performance bank Guarantee.

GUIDELINES FOR AGENCY:

1. It is mandatory for EOI applicant to have valid test report of SPV Modules and grid tie inverters with similar or larger capacity from MNRE approved laboratories.
2. The program implementation guidelines of the MNRE, as declared from time to time, for SPV program shall be applicable and followed at all times.
3. The technical specification, scope of work for which EOI Document is invited are furnished in EOI Document
4. The quantity mentioned in the EOI Document is only indicative and not final. Payment will be done only for the actual quantity executed.
5. Cost of Comprehensive Maintenance during Guarantee and warranty period and Insurance of system for 5 years is required to be included in the quoted prices.
6. The Empanelled Agency shall be responsible for overall project management, system integration and testing to complete all criteria for successful functioning of the Grid connected Solar PV plant, but not limited to the functions laid down in this documents.
7. The above cited requirements are only indicative. The owner reserves the right to requisition any other relevant information and also reserves the right to reject the Bid proposal of any Bidder, if in the Owner's opinion the Qualification data is incomplete and Bidder is not qualified to perform the Contract satisfactorily.