SECTION – III

TECHNICAL SPECIFICATIONS

TECHNICAL SPECIFICATIONS

The proposed projects shall be commissioned as per the technical specifications given below. Any shortcomings will lead to cancelation of CFA and SFA in full or part as decided by North Bihar Power Distribution Company Limited. Domestic Modules are to be used failing which it will be assumed that system is not matching the requirement of the scheme and bidder's PBG shall be forfeited. Competent Authority's decision will be final and binding on the bidder.

1. DEFINITION

A Roof Top Solar (RTS) Photo Voltaic (PV) system shall consist of following equipment/components:

1. Solar Photo Voltaic (SPV) modules consisting of required number of Crystalline PV modules
2. Inverter/PCU
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

1. Solar PV modules

1.1. The PV modules and Solar Cell used should be made in India.

1.2. 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 and IEC 62804 (PID). For the PV modules to be used in a highly corrosive atmosphere throughout their lifetime, they must qualify to IEC 61701/IS 61701.

1.3. The rated power of solar PV module shall have maximum tolerance up to +3%.

1.4. 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.

1.5. 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.

1.6. The temperature co-efficient power of the PV module shall be equal to or better than -0.45%/°C.

1.7. Solar PV modules of minimum capacity 250 Wp to be used.

1.8. The PV Module efficiency should be minimum 16%.

1.9. Solar PV modules of minimum fill factor 75%, to be used.

1.10. All electrical parameters at STC shall have to be provided

1.11. 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.

1.12. 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 the module below 1 % per annum.

1.13. 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:

1.14. Defects and/or failures due to manufacturing.

1.15. Defects and/or failures due to quality of materials.

1.16. Nonconformity 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.

1.17. PV modules must be tested and approved by one of the NABL accredited and BIS approved test centres.

1.18. Modules deployed must use a RF identification tag laminated inside the glass. The following information must be mentioned in the RFID used on each module:

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)

iv. Country of origin (separately for solar cells and module)

v. I-V curve for the module Wattage, Im, Vm 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 ISO 14001.

x. Nominal wattage +3%.

xi. Brand Name, if applicable.

1.19. Other details as per IS/IEC 61730-1 clause 11 should be provided at appropriate place. In addition to the above, the following information should also be provided:

i. The actual Power Output Pmax shall be mentioned on the label pasted on the back side of PV Module.
ii. The Maximum system voltage for which the module is suitable to be provided on the back sheet of the module.
iii. Polarity of terminals or leads (colour coding is permissible) on junction Box housing near cable entry or cable and connector.

1.20. Unique Serial No, Model No, Name of Manufacturer, Manufacturing year, Make in India logo and module wattage details should be displayed inside the laminated glass.

2. Inverter/PCU

2.1. Inverters/PCU should comply with applicable IEC/equivalent BIS standard for efficiency measurements and environmental tests as per standard codes IEC 61683/IS 61683, IS 16221 (Part 2), IS 16169 and IEC 60068-2(1,2,14,30) /Equivalent BIS Std.

2.2. Maximum Power Point Tracker (MPPT) shall be integrated in the inverter/PCU to maximize energy drawn from the array. Charge controller (if any) / MPPT units environmental testing should qualify IEC 60068-2(1, 2, 14, 30)/Equivalent BIS standard. The junction boxes/enclosures should be IP 65 or better (for outdoor)/ IP 54or better (indoor) and as per IEC 529 Specifications.

2.3. All inverters/PCUs shall be IEC 61000 compliant for electromagnetic compatibility, harmonics, Surge, etc.

2.4. The PCU/ inverter shall have overloading capacity of minimum 10%.

2.5. Typical technical features of the inverter shall be as follows-

i. Switching devices: IGBT/MOSFET
ii. Control: Microprocessor/DSP
iii. Nominal AC output voltage and frequency: as per CEA/State regulations
iv. Output frequency: 50 Hz
v. Grid Frequency Synchronization range: as per CEA/State Regulations
vi. Ambient temperature considered: -20°C to 60°C
vii. Humidity: 95 % Non-condensing
viii. Protection of Enclosure: IP-54 (Minimum) for indoor and IP-65(Minimum) for outdoor.
ix. Grid Frequency Tolerance range: as per CEA/State regulations
x. Grid Voltage tolerance: as per CEA/State Regulations
xi. No-load losses: Less than 1% of rated power
xii. Inverter efficiency (Min.): >93% (In case of 10 kW or above with in-built galvanic isolation) >97% (In case of 10 kW or above without inbuilt galvanic isolation)
xiii. Inverter efficiency (minimum): > 90% (In case of less than 10 kW)
xiv. THD: < 3%
xv. PF: > 0.9 (lag or lead)

xvi. Should not inject DC power more than 0.5% of full rated output at the interconnection point and comply to IEEE 519.

2.6. The output power factor of inverter should be 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.

2.7. 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:

i. The name or trademark of the manufacturer or supplier;
ii. A model number, name or other means to identify the equipment,
iii. A serial number, code or other marking allowing identification of manufacturing location and the manufacturing batch or date within a twelve-month time period.
iv. Input voltage, type of voltage (a.c. or d.c.), frequency, and maximum continuous current for each input.
v. 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.
vi. The Ingress Protection (IP) rating

2.8. 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.

2.9. In case the consumer is having a *3-ϕ* connection, *1-ϕ*/*3-ϕ* inverter shall be provided by the vendor as per the consumer's requirement and regulations of the State.

2.10. Inverter/PCU shall be capable of complete automatic operation including wake-up, synchronization & shutdown.

2.11. For CFA calculation, minimum of following two shall be considered:

i. Solar PV array capacity in KWp
ii. Inverter Capacity in KW

2.12. Integration of PV Power with Grid & Grid Islanding:

i. The output power from SPV would be fed to the inverters/PCU which converts DC produced by SPV array to AC and feeds it into the main electricity grid after synchronization.
ii. 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, if not available in inverter.

iii. MCB/MCCB or a manual isolation switch, besides 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.

3. 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 three types of materials. They are Hot Dip Galvanized Iron, Aluminium and 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. MMS Aluminium shall be as per AA6063 T6. For Aluminium structures, necessary protection towards rusting need to be provided either by coating or anodization.

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 aluminium 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 as follows (drawings at **Annexure-X**):

i. Ballast structure

a. The mounting structure must be Non-invasive ballast type and any sort of penetration of roof to be avoided.
b. The minimum clearance of the structure from the roof level should be in between 70-150 mm to allow ventilation for cooling, also ease of cleaning and maintenance of panels as well as cleaning of terrace.
c. The structures should be suitably loaded with reinforced concrete blocks of appropriate weight made out of M25 concrete mixture.

ii. Tin shed

a. The structure design should be as per the slope of the tin shed.
b. The inclination angle of structure can be done in two ways-
   b.1. Parallel to the tin shed (flat keeping zero-degree tiling angle), if the slope of shed in Proper south direction
   b.2. With same tilt angle based on the slope of tin shed to get the maximum output.
c. The minimum clearance of the lowest point from the tin shade should be more then 100mm.
d. The base of structure should be connected on the Purlin of tin shed with the proper riveting.
e. All structure member should be of minimum 2 mm thickness.

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

A. Minimum Ground clearance (300MM – 1000 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 module 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 70MM 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 70MM 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 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.

B. Medium Ground clearance (1000MM – 2000 MM) (for reference only)

a. Base Plate – Base plate thickness of the Structure should be Minimum 6MM for this segment.
b. 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 50MM in flange side in Lip section.
c. Rafter - Structure rafter should be minimum 2MM in Lip section / 3MM in C-Channel section. The minimum section should be 70MM in Web side and 40MM in flange side in Lip section.
d. Purlin - Structure purlin should be minimum 2MM in Lip section. The minimum section should be 70MM in Web side and 40MM in flange side in Lip section.
e. Front/back bracing – The section for bracing part should be minimum 2MM thickness.
f. Connection – The structure connection should be bolted 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.

C. Maximum Ground clearance (2000MM – 3000 MM) (for reference only)

a. Base Plate – Base plate thickness of the Structure should be minimum 8 MM for this segment.
b. Column – Structure Column thickness should be minimum 2.6MM in square hollow section (minimum 50x50) or rectangular hollow section (minimum 60x40) or 3MM in C-Channel section.
c. Rafter - Structure rafter should be minimum 2MM in Lip section / 3MM in Channel section. The minimum section should be 80MM in Web side and 50MM in flange side in Lip section.
d. Purlin - Structure purlin should be minimum 2MM in Lip section. The minimum section should be 80MM in Web side and 50MM in flange side in Lip section.

e. Front/back bracing – The section for bracing part should be minimum 3MM thickness.
f. Connection – The structure connection should be bolted 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.

D. Super elevated structure (More than 3000 MM) (for reference only)

D.1. Base structure

a. Base Plate – Base plate thickness of the Structure should be 10MM for this segment.
b. Column – Structure Column minimum thickness should be minimum 2.9MM in square hollow section (minimum 60x60) or rectangular hollow section (minimum 80x40).
c. Rafter - Structure Rafter minimum thickness should be minimum 2.9MM in square hollow section (minimum 60x60) or rectangular hollow section (minimum 80x40).
d. Cross bracing – Bracing for the connection of rafter and column should be of minimum thickness of 4mm L-angle with the help of minimum bolt diameter of 10mm.

D.2. Upper structure of super elevated structure –

a. Base Plate – Base plate thickness of the Structure should be minimum 5MM for this segment.
b. Column – Structure Column should be minimum 2MM in Lip section / 3MM in Channel section. The minimum section should be 70MM in Web side and 40MM in flange side in Lip section.
c. Rafter - Structure rafter should be minimum 2MM in Lip section / 3MM in Channel section. The minimum section should be 70MM in Web side and 40MM in flange side in Lip section.
d. 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.
e. Front/back bracing – The section for bracing part should be minimum 2MM thickness.
f. Connection – The structure connection should be bolted 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.

D.3. If distance between two legs in X-Direction is more than 3M than sag angle/Bar should be provide for purlin to avoid deflection failure. The sag angle should be minimum 2MM thick, and bar should be minimum 12Dia.

D.4. Degree - The Module alignment and tilt angle shell be calculated to provide the maximum annual energy output. This shall be decided on the location of array installation.

D.5. Foundation – Foundation should be as per the roof condition; two types of the foundation can be done- either penetrating the roof or without penetrating the roof.

a. If penetration on the roof is allowed (based on the client requirement) then minimum 12MM diameter anchor fasteners with minimum length 100MM can be used with proper chipping. The minimum RCC size should be 400x400x300 cubic mm. Material grade of foundation should be minimum M20.
b. If penetration on roof is not allowed, then foundation can be done with the help of 'J Bolt' (refer IS 5624 for foundation hardware). Proper Neto bond solution should be used to adhere the Foundation block with the RCC roof. Foundation J - bolt length should be minimum 12MM diameter and length should be minimum 300MM.

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.

4. Metering

4.1. 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.

4.2. The installation of meters including CTs & PTs, wherever applicable, shall be carried out by the respective DISCOMs as per the terms, conditions and procedures laid down by the concerned SERCs/DISCOMs.

5. Array Junction Boxes:

4.1 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 JBs shall be such that input & output termination can be made through suitable cable glands. Suitable markings shall be provided on the bus-bars for easy identification and cable ferrules will be fitted at the cable termination points for identification.

4.2 Copper bus bars/terminal blocks housed in the junction box with suitable termination threads Conforming to IP 65 or better standard and IEC 62208 Hinged door with EPDM rubber gasket to prevent water entry, Single /double compression cable glands should be provided.

4.3 Polyamide glands and MC4 Connectors may also be provided. The rating of the junction box shall be suitable with adequate safety factor to interconnect the Solar PV array.

4.4 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.

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

5 DC Distribution Box (DCDB):

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

5.2 DC Distribution Box are to be provided to receive the DC output from the PV array field.

5.3 DCDBs shall be dust & vermin proof conform having IP 65 or better protection, as per site conditions.

5.4 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.

6 AC Distribution Box (ACDB):

6.1 AC Distribution Panel Board (DPB) shall control the AC power from inverter, and should have necessary surge arrestors, if required. There is interconnection from ACDB to mains at LT Bus bar while in grid tied mode.

6.2 All switches and the circuit breakers, connectors should conform to IEC 60947:2019, part I, II and III/ IS 60947 part I, II and III.

6.3 Theisolators, cabling work should be undertaken as part of the project.

6.4 All the Panel's shall be metal clad, totally enclosed, rigid, floor mounted, air -insulated, cubical type suitable for operation on *1-ϕ/3-ϕ*, 415 or 230 volts, 50 Hz (or voltage levels as per CEA/State regulations).

6.5 The panels shall be designed for minimum expected ambient temperature of 45 degree Celsius, 80 percent humidity and dusty weather.

6.6 All indoor panels will have protection of IP 54 or better, as per site conditions. All outdoor panels will have protection of IP 65 or better, as per site conditions.

6.7 Should conform to Indian Electricity Act and CEA safety regulations (till last amendment).

6.8 All the 415 or 230 volts (or voltage levels as per CEA/State regulations) AC devices / equipment like bus support insulators, circuit breakers, SPDs, Voltage Transformers (VTs) etc., mounted inside the switchgear shall be suitable for continuous operation and satisfactory performance under the following supply conditions.

i. Variation in supply voltage: as per CEA/State regulations
ii. Variation in supply frequency: as per CEA/State regulations

6.9 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.

7 Protections

The system should be provided with all necessary protections like earthing, Lightning, and Surge Protection, as described below:

7.1 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. For 10 KW and above systems, separate three earth pits shall be provided for individual three earthing viz.: DC side earthing, AC side earthing and lightning arrestor earthing.

7.2 **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. Lightning arrestor shall not be installed on the mounting structure.
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 mm^2 copper/ 16 mm^2 aluminum or GI strip bearing size 25*3 mm thick). Separate pipe for running earth wires of Lightning Arrestor shall be used.

7.3 **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.

8 CABLES

8.1 All cables should conform to latest edition of IEC/equivalent BIS Standards alongwith IEC 60227/IS 694, IEC 60502/IS 1554 standards.

8.2 Cables should be flexible and should have good resistance to heat, cold, water, oil, abrasion etc.

8.3 Armoured cable should be used and overall PVC type ‘A’ pressure extruded insulation or XLPE insulation should be there for UV protection.

8.4 Cables should have Multi Strand, annealed high conductivity copper conductor on DC side and copper/FRLS type Aluminium conductor on AC side. For DC cabling, multi-core cables shall not be used.

8.5 Cables should have operating temperature range of -10°C to +80°C and voltage rating of 660/1000 V.

8.6 Sizes of cables between array interconnections, array to junction boxes, junction boxes to Inverter etc. shall be so selected to keep the voltage drop less than 2% (DC Cable losses).

8.7 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%.

8.8 The electric cables for DC systems for rated voltage of 1500 V shall conform to BIS 17293:2020.

8.9 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 is easily identified.

8.10 All cable trays including covers to be provided.

8.11 Thermo-plastic clamps to be used to clamp the cables and conduits, at intervals not exceeding 50 cm.

8.12 Size of neutral wire shall be equal to the size of phase wires, in a three phase system.

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

9 DRAWINGS& MANUALS:

9.1 Operation & Maintenance manual/user manual, Engineering and Electrical Drawings shall be supplied along with the power plant.

9.2 The manual shall include complete system details such as array lay out, schematic of the system, inverter details, working principle etc.

9.3 The Manual should also include all the Dos & Don’ts of Power Plant along with Graphical Representation with indication of proper methodology for cleaning, Operation and Maintenance etc.

9.4 Step by step maintenance and troubleshooting procedures shall also be given in the manuals.

9.5 Vendors should also educate the consumers during their AMC period.

10 Miscellaneous:

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

10.2 Safety measures: Electrical safety of the installation(s) including connectivity with the grid must be taken into account and all the safety rules & regulations applicable as per Electricity Act, 2003 and CEA Safety Regulation 2010 etc. must be followed.

10.3 Shadow analysis: The shadow analysis report with the instrument such as Solar Pathfinder or professional shadow analysis software of each site should be provided and

the consumer should be educated to install the system only in shadow free space. Lower performance of the system due to shadow effect shall be liable for penalty for lower performance.

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

SolarPVModules/Panels	
IEC61215 and IS14286	DesignQualificationandTypeApprovalforCrystallineSiliconTerrestrial Photovoltaic(PV)Modules
IEC 61701:2011	SaltMistCorrosionTestingofPhotovoltaic(PV)Modules
IEC 61853-1:2011/ IS16170-1:2014	Photovoltaic(PV)moduleperformancetestingandenergyrating–: Irradianceandtemperatureperformancemeasurements,andpower Rating.
IEC 62716	Photovoltaic(PV)Modules–Ammonia(NH3)CorrosionTesting (as per the site condition like dairies, toilets etc)
IEC61730-1,2	Photovoltaic(PV)ModuleSafetyQualification– Part1:Requirementsfor Construction,Part2:Requirements for Testing
IEC 62804	Photovoltaic (PV) modules – Test method for detection of potential-induced degradation. IEC 62804-1: Part 1: Crystalline Silicon
SolarPVInverters	
IEC62109or IS: 16221	Safety of power converters for use in photovoltaic power systems – Part1:Generalrequirements, andSafety ofpowerconverters for usein photovoltaicpowersystems Part2:Particularrequirementsforinverters.Safetycompliance(Protection degreeIP65 or betterforoutdoormounting,IP54 or better forindoormounting)
IS/IEC61683latest (asapplicable)	Photovoltaic Systems – Power conditioners: Procedure for MeasuringEfficiency(10%,25%,50%,75%&90-100%LoadingConditions)
IEC 60068-2 /IEC62093 (asapplicable)	EnvironmentalTestingofPVSystem–PowerConditionersandInverters
IEC 62116:2014/ IS16169	Utility-interconnected photovoltaic inverters - Test procedure of islanding prevention measures
Fuses	
IS/IEC60947(Part 1, 2 &3),EN50521	Generalsafetyrequirementsforconnectors,switches,circuitbreakers(AC/DC):

	1)Low-voltageSwitchgearand Control-gear,Part1:Generalrules 2)Low-VoltageSwitchgearandControl-gear,Part2:CircuitBreakers 3)Low-voltageswitchgearandControl-gear,Part3:Switches,disconnectors switch-disconnectorsandfuse-combinationunits 4) EN50521:Connectorsforphotovoltaicsystem-Safetyrequirementsandtests
IEC60269-6:2010	Low-voltagefuses-Part6:Supplementaryrequirementsforfuse-linksforthe protectionofsolarphotovoltaicenergysystems
SolarPVRoofMountingStructure	
IS2062/IS4759/AA6063 T6	Materialforthestructuremounting
SurgeArrestors	
BFC17-102:2011/ NFC 102:2011/ IEC 62305	LighteningProtectionStandard
IEC 60364-5-53/ IS15086-5(SPD) IEC 61643- 11:2011	Electricalinstallationsofbuildings-Part5-53:Selectionanderectionof electricalequipment-Isolation,switchingandcontrol Low-voltagesurgeprotectivedevices-Part11:Surgeprotectivedevices connectedtolow-voltagepowersystems-Requirementsandtest methods
Cables	
IEC 60227/IS 694, IEC60502/IS 1554 (Part 1&2)/IEC69947(as applicable)	GeneraltestandmeasuringmethodforPVC(Polyvinylchloride)insulated cables(forworkingvoltagesuptoandincluding1100V,andUV resistantforoutdoorinstallation)
BSEN 50618	Electriccablesforphotovoltaicsystems (BT(DE/NOT)258),mainlyfor DCCables
Earthing/Lightning	
IEC 62561/IEC 60634 Series(Chemicalearthing) (asapplicable)	IEC 62561-1: Lightning protection system components (LPSC) - Part:Requirementsfor connectioncomponents IEC 62561-2: Lightning protection system components (LPSC) – Part 2:Requirementsfor conductorsandearth electrodes IEC 62561-7: Lightning protection system components (LPSC) - Part 7:Requirementsforearthingenhancingcompounds
JunctionBoxes	
IEC 60529	Junction boxes and solar panel terminal boxes shall be of the thermo-plastictype with IP 65 or better protectionforoutdooruse,andIP54 or better protectionforindooruse