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SOLAR BUYER'S GUIDE

Standard Equipment Lists
Connection Diagrams
Standard Technical Specifications
Enquiry & Selection Criteria

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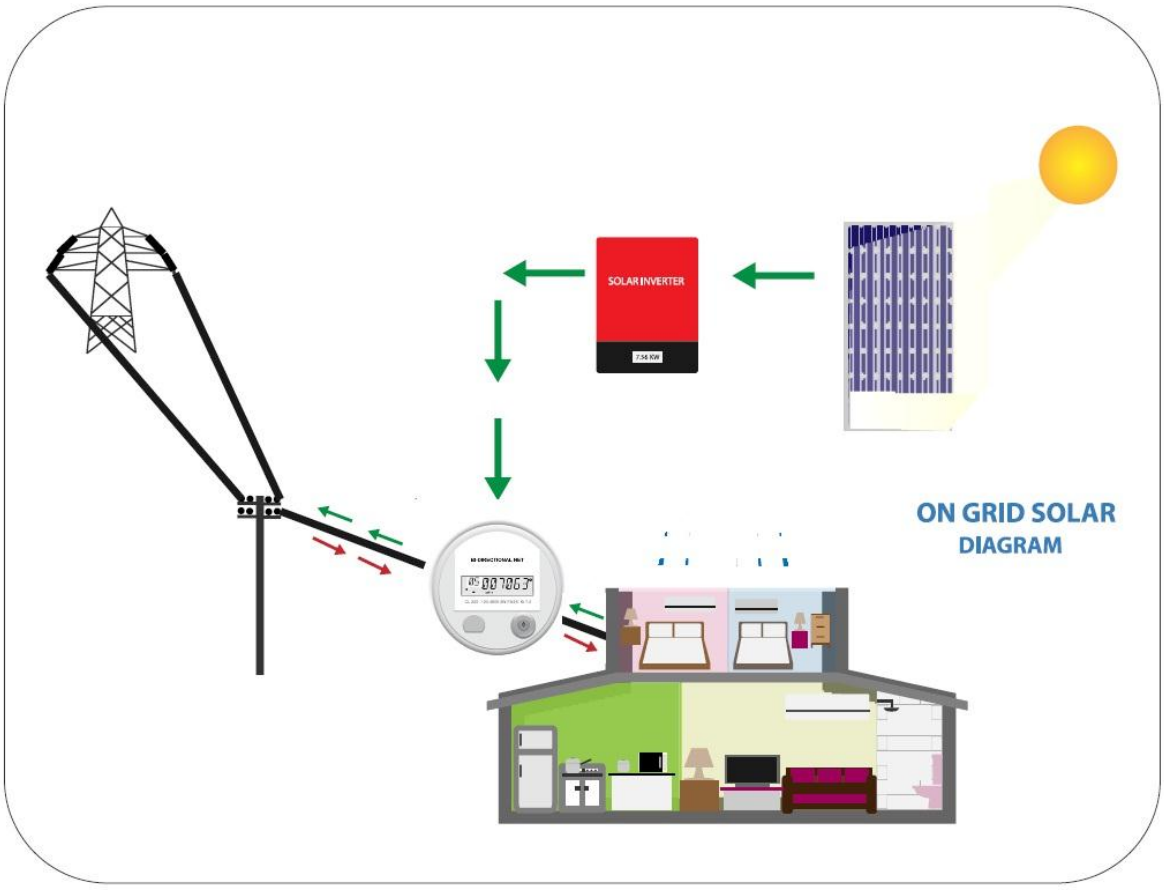
STANDARD EQUIPMENT LIST : ON GRID WITH NET METER

ITEM	Make
Modules	Sunpower /Tata Power Solar /Emvee /Jinko /Trina / Waaree / REC Solar/ Yingli / Renesola/Canadian Solar
Inverters	SMA / Emerson / Schneider /ABB /Delta /Zever Solar /Kaco /Consul Neowatt/ Hitachi
Solar Panel Structure	Hot Dip Galvanised with atleast 80 micron thick coating
AC, comm etc. cables	Polycab/Havells/Finolex make, 4C, multiple runs
DC cables	LAPP/Polycab make, TuV approved, Copper conductor, sheathed, atleast 4sqmm for module interconnection
LT panels & Switchgear	one nos-switchgear from SIEMENS/ABB/L&T/SCHNEIDER & Meters-RISHBH,Landis+Gyr
Pyranometer	kipp zonen
Wind sensor	Testo, Lutron
Temperature sensors	Delta, Steca
Earthing strip and earthing electrodes	Cu bonded electrode
MC4 connectors	bizlink, amphenol
Junction Boxes	Hensel, Sintex
Miscellaneous items	Cable trench, ferrules, SCADA, lugs, fastners, sleeves
Galvanum Sheet	Galvanised with az210 coating
Approvals / Permits	

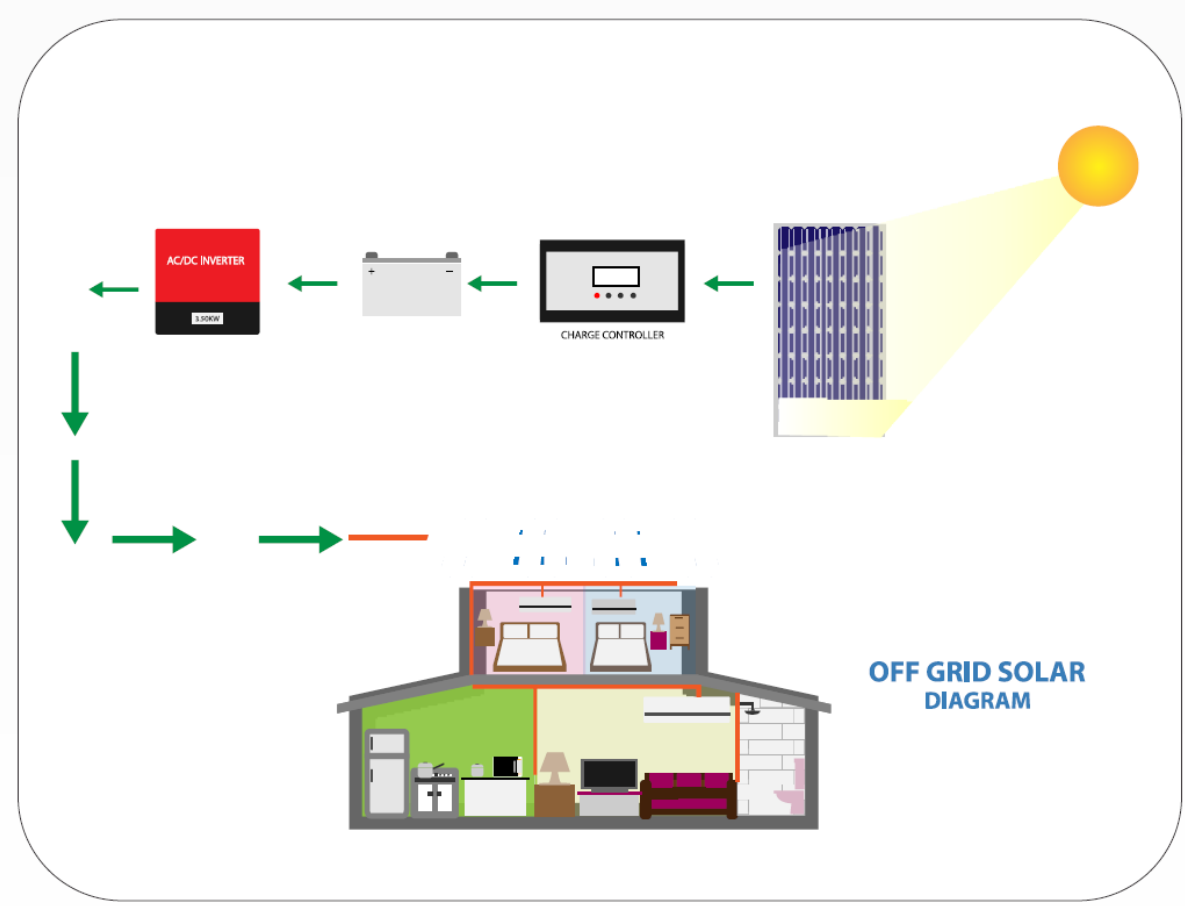
CONNECTION DIAGRAM: ON GRID WITH NET METER



STANDARD EQUIPMENT LIST : OFF GRID WITH BATTERY

ITEM	Make
Modules	Sunpower /Tata Power Solar /Emvee /Jinko /Trina / Waaree / REC Solar/ Yingli / Renesola/Canadian Solar
Inverters	SMA / Emerson / Schneider /ABB /Delta /Zever Solar /Kaco /Consul Neowatt/ Hitachi
Solar Panel Structure & Battery Rack	Hot Dip Galvanised with atleast 80 micron thick coating
Solar Battery	Exide/Amaron/Southern/HBL/Okaya/Luminous (C10 & 5 yrs warrantee)
AC, comm etc. cables	Polycab/Havells/Finolex make, 4C, multiple runs
DC cables	LAPP/Polycab make, TuV approved, Copper conductor, sheathed, atleast 4sqmm for module interconnection
LT panels & Switchgear	one nos-switchgear from SIEMENS/ABB/L&T/SCHNEIDER & Meters-RISHBH,Landis+Gyr
Pyranometer	kipp zonen
Wind sensor	Testo, Lutron
Temperature sensors	Delta, Steca
Earthing strip and earthing electrodes	Cu bonded electrode
MC4 connectors	bizlink, amphenol
Junction Boxes	Hensel, Sintex
Miscellaneous items	Cable trench, ferrules, SCADA, lugs, fastners, sleeves
Approvals / Permits	

CONNECTION DIAGRAM: OFF GRID WITH BATTERY



STANDARD TECHNICAL SPECIFICATIONS

The proposed projects shall be commissioned according to the technical specifications given below.

1. DEFINITION

A Grid Tied Solar Rooftop Photo Voltaic (SPV) power plant consists of SPV array, Modu le Mounting Structure, Power Conditioning Unit (PCU) consisting of Maximum Power Po int Tracker (MPPT), Inverter, and Controls & Protections, interconnect cables and switc hes. 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 d uring day time. Components and parts used in the SPV power plants including the PV modules, metallic structures, cables, junction box, switches, PCUs etc., should conform to the BIS or IEC or international specifications, wherever such specifications are availa ble and applicable.

Solar PV system shall consist of following equipments/components.

- Solar PV modules consisting of required number of **Crystalline** PV modules.
- Grid interactive Power Conditioning Unit with Remote Monitoring System
- Mounting structures
- Junction Boxes.
- Earthing and lightening protections.
- IR/UV protected PVC Cables, pipes and accessories

A Off Grid Solar Rooftop Photo Voltaic (SPV) power plant consists of SPV array, Module Mounting Structure, Power Conditioning Unit (PCU) consisting of Maximum Po wer Point Tracker (MPPT), Inverter, battery, battery monting rack and Controls & Protec tions, interconnect cables and switches. PV Array is mounted on a suitable structure. Off Grid SPV system is with battery and should be designed with necessary features to supplement the grid power during day and night time. Components and parts used in SPV power plants including the PV modules, metallic structures, cables, junction box,

switches, PCUs etc., should conform to the BIS or IEC or international specifications, w herever such specifications are available and applicable.

Solar PV system shall consist of following equipments/components.

- Solar PV modules consisting of required number of **Crystalline** PV modules.
- Off Grid Power Conditioning Unit with Remote Monitoring System
- Battery Bank
- Mounting structures- Solar Panels & Battery
- Junction Boxes.
- Earthing and lightening protections.
- IR/UV protected PVC Cables, pipes and accessories

1.1 SOLAR PHOTOVOLTAIC MODULES:

1.1.1. The PV modules used should be made in India.

1.1.2 The PV modules used must qualify to the latest edition of IEC PV module qualifi cation test or equivalent BIS standards Crystalline Silicon Solar Cell Modules IEC 61 215/IS14286. In addition, the modules must conform to IEC 61730 Part-2- requireme nts for construction & Part 2 – requirements for testing, for safety qualification or equ ivalent IS.

a) For the PV modules to be used in a highly corrosive atmosphere throughout their l ifetime, they must qualify to IEC 61701/IS 61701

b) The total solar PV array capacity should not be less than allocated capacity (kWp) a nd should comprise of solar crystalline modules of minimum **250** Wp and abov e wattage. Module capacity less than minimum **250** watts should not be accepted

c) Protective devices against surges at the PV module shall be provided. Low voltage d rop bypass diodes shall be provided.

d) PV modules must be tested and approved by one of the IEC authorized test centers. The module frame shall be made of corrosion resistant materials, prefe-rably having anodized aluminum.

e) The bidder shall carefully design & accommodate requisite numbers of the modules t o achieve the rated power in his bid. /owners shall allow only minor changes at the ti me of execution.

f) Other general requirement for the PV modules & subsystems shall be the Following:

I. The rated output power of any supplied module shall have tolerance of +/-3%.

II. The peak-power point voltage and the peak-power point current of anysupplied module and/or any module string (series connected modules) shall not vary by more than 2 (two) per cent from the respective arithmetic means for all modules and/or for all module strings, as the case may be.

III. The module shall be provided with a junction box with either provision of external screw terminal connection or sealed type and with arrangement for provision of by-pass diode. The box shall have hinged, weather proof lid with captive screws and cable gland entry points or may be of sealed type and IP-65 rated.

IV. IV curves at STC should be provided by bidder.

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, Im, Vm 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

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 sale to the original customer ("Customer")

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 pro cesses. If the solar Module(s) fails to conform to this warranty, the manufacturer w ill 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 ye ars period of the full rated original output.

2. ARRAY STRUCTURE

2.1. Hot dip galvanized MS mounting structures may be used for mounting the module s/ panels/arrays. Each structure should have angle of inclination as per the site co nditions to take maximum insolation. However to accommodate more capacity the angle inclination may be reduced until the plant meets the specified performance r atio requirements.

2.2. The Mounting structure shall be so designed to withstand the speed for the wind z one of the location where a PV system is proposed to be installed (like Delhi-wind speed of 150 kM/ hour). It may be ensured that the design has been certified by a recognized Lab/ Institution in this regard and submit wind loading calculation sheet to . Suitable fastening arrangement such as grouting and calming should be provi ded to secure the installation against the specific wind speed.

2.3. The mounting structure steel shall be as per latest IS 2062: 1992 and galvanizatio n of the mounting structure shall be in compliance of latest IS 4759.

2.4. Structural material shall be corrosion resistant and electrolytically compatible with t he materials used in the module frame, its fasteners, nuts and bolts. Aluminium str uctures also can be used which can withstand the wind speed of respective wind zone. Necessary protection towards rusting need to be provided either by coating or anodization.

2.5. The fasteners used should be made up of stainless steel. The structures shall be designed to allow easy replacement of any module. The array structure shall be so designed that it will occupy minimum space without sacrificing the output from the SPV panels

g) Regarding civil structures the bidder need to take care of the load baring capacity

of the roof and need arrange suitable structures based on the quality of roof. The t otal load of the structure (when installed with PV modules) on the terrace should b e less than 60 kg/m^2.

h) The minimum clearance of the structure from the roof level should be 300 mm.

3. JUNCTION BOXES (JBs)

3.1. 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/c ables must be terminated through cable lugs. The JBs shall be such that input & o utput termination can be made through suitable cable glands.

3.2. Copper bus bars/terminal blocks housed in the junction box with suitable terminati on threads Conforming to IP65 standard and IEC 62208 Hinged door with EPDM r ubber gasket to prevent water entry. Single / double compression cable glands. Pr ovision of earthings. It should be placed at 5 feet height or above for ease of acces sibility.

3.3. 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.

3.4. Suitable markings shall be provided on the bus bar for easy identification and the c able ferrules must be fitted at the cable termination points for identification

4. DC DISTRIBUTION BOARD:

4.1. DC Distribution panel to receive the DC output from the array field.

4.2. 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 MC Bs/MCCB shall be provided for controlling the DC power output to the PCU along with necessary surge arrestors.

5. AC DISTRIBUTION PANEL BOARD:

5.1. 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.

5.2. All switches and the circuit breakers, connectors should conform to IEC 60947, par

t I, II and III/ IS60947 part I, II and III.

5.3. The changeover switches, cabling work should be undertaken by the bidder as par t of the project.

5.4. All the Panel□s shall be metal clad, totally enclosed, rigid, floor mounted, air - insul ated, 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 de gree 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.

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, SPDs, VTs etc., mounted inside the switchgear shall be suitable for conti nuous operation and satisfactory performance under the following supply conditions

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

6. PCU/ARRAY SIZE RATIO:

6.1. The combined wattage of all inverters should not be less than rated capacity of power plant under STC.

6.2. Maximum power point tracker shall be integrated in the PCU/inverter to maxi mize energy drawn from the array.

7. PCU/ Inverter:

As SPV array produce direct current electricity, it is necessary to convert this direct current into alternating current and adjust the voltage levels to match the grid voltage. Conversion shall be achieved using an electronic Inverter and the associated control and protection devices. All these components of the system are termed the " Power Conditioning Unit (PCU)". In addition, the PCU shall also house MPPT (Maximum Power Point Tracker), an interface between Solar PV array & the Inverter, to the power conditioning unit/inverter should also be DG set interactive. If necessary. Inverter output should be compatible with the grid frequency. 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
  (In case single phase inverters are offered, suitable arrangement for balancing the phases must be made.)
- 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-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)
- THD : < 3%
- PF : > 0.9

a) Three phase PCU/ inverter shall be used with each power plant system (10kW and /or above) but In case of less than 10kW single phase inverter can be used.

b) PCU/inverter shall be capable of complete automatic operation including wake-up, synchronization & shutdown.

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 an y sustainable fault in feeder line and against the lightning on feeder.

d) Built-in meter and data logger to monitor plant performance through external comp uter shall be provided.

e) The power conditioning units / inverters should comply with applicable IEC/ equival ent BIS standard for efficiency measurements and environmental tests as per stan dard 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 IE C 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 centres / NABL /BIS /IEC accredited testing- calibration laboratories. In case of imported power co nditioning units, these should be approved by international test houses.

8. BATTERY

Charging C/10

AH Efficiency > 95%

WH Efficiency > 85%

Self Discharge <0.5 % per week at 27 C

Design float life 20 years design life at 27ºC

Design cycle life 5200 Cycles at 20% depth of discharge at 27 ºC

Applicable standards IEC 60896 – 21 & 22, IEC 61427,DIN 43539 P5

9. INTEGRATION OF PV POWER WITH GRID

The output power from SPV would be fed to the inverters which converts DC produ ced by SPV array to AC and feeds it into the main electricity grid after synchronizat ion. In case of grid failure, or low or high voltage, solar PV system shall be out of s ynchronization and shall be disconnected from the grid. Once the DG set comes in to service PV system shall again be synchronized with DG supply and load require ment would be met to the extent of availability of power. 4 pole isolation of inverter

output with respect to the grid/ DG power connection need to be provided.

10. DATA ACQUISITION SYSTEM / PLANT MONITORING

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

ii. 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.

iii. Solar Irradiance: An integrating Pyranometer / Solar cell based irradiation sensor (along with calibration certificate) provided, with the sensor mounted in the plane of the array. Readout integrated with data logging system.

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

v. The following parameters are accessible via the operating interface display in real time separately for solar power plant:

   a. AC Voltage.
   b. AC Output current.
   c. Output Power
   d. Power factor.
   e. DC Input Voltage.
   f. DC Input Current.
   g. Time Active.
   h. Time disabled.
   i. Time Idle.
   j. Power produced
   k. Protective function limits (Viz-AC Over voltage, AC Under voltage, Over frequency, Under frequency ground fault, PV starting voltage, PV stopping voltage.

vi. 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.

vii. PV array energy production: Digital Energy Meters to log the actual value of AC/ D C voltage, Current & Energy generated by the PV system provided. Energy meter along with CT/PT should be of 0.5 accuracy class.

viii. Computerized DC String/Array monitoring and AC output monitoring shall be provi ded as part of the inverter and/or string/array combiner box or separately.

ix. String and array DC Voltage, Current and Power, Inverter AC output voltage and c urrent (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.

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

xi. The data shall be recorded in a common work sheet chronologically date wise. Th e data file shall be MS Excel compatible. The data shall be represented in both ta bular and graphical form.

xii. All instantaneous data shall be shown on the computer screen.

xiii. Software shall be provided for USB download and analysis of DC and AC paramet ric data for individual plant.

xiv. Provision for Internet monitoring and download of data shall be also incorporated.

xv. Remote Server and Software for centralized Internet monitoring system shall be al so provided for download and analysis of cumulative data of all the plants and the data of the solar radiation and temperature monitoring system.

xvi. Ambient / Solar PV module back surface temperature shall be also monitored on c ontinuous basis.

xvii. 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.

xviii. Remote Monitoring and data acquisition through Remote Monitoring System softw are 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 fo r interfacing these data on server and portal in future shall be kept.

11. TRANSFORMER “IF REQUIRED” & METERING:

10.1.1. Dry/oil type relevant kVA, 11kV/415V, 50 Hz Step up along with all protections , switchgears, Vacuum circuit breakers, cables etc. along with required civil work.

10.1.2. The bidirectional electronic energy meter (0.5 S class) shall be installed fo r the measurement of import/Export of energy.

10.1.3. The bidder must take approval/NOC from the Concerned DISCOM for the connectivity, technical feasibility, and synchronization of SPV plant with distribution network and submit the same to before commissioning of SPV plant.

d) Reverse power relay shall be provided by bidder (if necessary), as per the loca l DISCOM requirement.

11. POWER CONSUMPTION:

11.1. Regarding the generated power consumption, priority need to give for inte rnal consumption first and thereafter any excess power can be exported to grid . Finalization of tariff is not under the purview of or MNRE. Decisions of appro priate authority like DISCOM, state regulator may follow.

12. PROTECTIONS

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

12.1 LIGHTNING PROTECTION

The SPV power plants shall be provided with lightning &overvoltage protection. T he main aim in this protection shall be to reduce the over voltage to a tolerable va lue before it reaches the PV or other sub system components. The source of ove r voltage can be lightning, atmosphere disturbances etc The entire space occupyi ng the SPV array shall be suitably protected against Lightning by deploying requi red number of Lightning Arrestors. Lightning protection should be provided as per IEC 62305standard. The protection against induced high-voltages shall be provi ded by the use of metal oxide varistors (MOVs) and suitable earthing such that in duced transients find an alternate route to earth.

12.2. **SURGE PROTECTION**

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

12.3. **EARTHING PROTECTION**

i. Each array structure of the PV yard should be grounded/ earthed properly as per I S:3043-1987. In addition the lighting arrester/masts should also be earthed inside t he array field. Earth Resistance shall be tested in presence of the representative of Department/ as and when required after earthing by calibrated earth tester. PCU, ACDB and DCDB should also be earthed properly.

ii. 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.

12.4. **GRID ISLANDING:**

i. In the event of a power failure on the electric grid, it is required that any independ ent 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 se ctions 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.

ii. A manual disconnect 4pole 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

13. **CABLES**

Cables of appropriate size to be used in the system shall have the following characte ristics:

i. Shall meet IEC 60227/IS 694, IEC 60502/IS1554 standards

ii. Temp. Range: –10^{o}C to +80^{o}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 bo xes 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 GI cable tray and suita bly 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. 25years.

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

x. Multi Strand, Annealed high conductivity copper conductor PVC type 'A pressure extruded insulation or XLPE insulation. Overall PVC/XLPE insulation for UV protecti on 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/X LPE insulated cables for working Voltage up to and including 1100 V ,UV resistant for outdoor installation IS /IEC 69947.

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 sha ll be as specified in the Distribution Code/Supply Code of the State and amended from time to time. Following criteria have been suggested for selection of voltage level in the distribution system for ready reference of the solar suppliers.

Plant Capacity	Connecting voltage
Above 10kW and up to 100 kW	415V – three phase as per DISCOM rules

i. The maximum permissible capacity for rooftop shall be 1 MW for a single net metering point.

ii. Utilities may have voltage levels other than above, DISCOMS may be consulted before finalization of the voltage level and specification be made accordingly.

iii. For large PV system (Above 100 kW) for commercial installation having large load, the solar power can be generated at low voltage levels and stepped up to 11 kV level through the step up transformer. The transformers and associated switchgear would require to be provided by the SPV bidders.

15. **TOOLS & TACKLES AND SPARES:**

i. 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 / owner.

ii. 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

16. **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 signage shall be provided one each at battery –cum-control room, solar array area and main entry from administrative block. Text of the signage may be finalized in consultation with / owner.

17. **FIRE EXTINGUISHERS:**

The firefighting system for the proposed power plant for fire protection shall be consi sting of:

a) Portable fire extinguishers in the control room for fire caused by electrical short circuits
b) Sand buckets in the control room
c) The installation of Fire Extinguishers should confirm to TAC regulations and BI S standards. The fire extinguishers shall be provided in the control room housin g PCUs as well as on the Roof or site where the PV arrays have been installed.

18. **DRAWINGS & MANUALS:**

18.4. Two sets of Engineering, electrical drawings and Installation and O&M ma nuals are to be supplied. Bidders shall provide complete technical data sheets for each equipment giving details of the specifications along with make/makes in the irbid along with basic design of the power plant and power evacuation, synchroniz ation along with protection equipment.

18.5. Approved ISI and reputed makes for equipment be used.

18.6. For complete electro-mechanical works, bidders shall supply complete design, de tails and drawings for approval to /owners before progressing with the installation work

19. **PLANNING AND DESIGNING:**

i. The bidder should carry out Shadow Analysis at the site and accordingly design stri ngs & arrays layout considering optimal usage of space, material and labor. The bi dder should submit the array layout drawings along with Shadow Analysis Report to /Owner for approval.

ii. reserves the right to modify the landscaping design, Layout and specification of s ub-systems and components at any stage as per local site conditions/requirement

iii. The bidder shall submit preliminary drawing for approval & based on any modifica tion or recommendation, if any. The bidder submit three sets and soft copy in CD of final drawing for formal approval to proceed with construction work.

20. **DRAWINGS TO BE FURNISHED BY BIDDER AFTER AWARD OF CONTRACT**

i. The Contractor shall furnish the following drawings Award/Intent and obtain approv al
ii. General arrangement and dimensioned layout
iii. Schematic drawing showing the requirement of SV panel, Power conditioning Unit(s)/ inverter, Junction Boxes, AC and DC Distribution Boards, meters etc.
iv. Structural drawing along with foundation details for the structure.
v. Itemized bill of material for complete SV plant covering all the components and ass ociated accessories.
vi. Layout of solar Power Array
vii. Shadow analysis of the roof

21. **SOLAR PV SYSTEM ON THE ROOFTOP FOR MEETING THE ANNUAL ENERG Y REQUIREMENT**

The Solar PV system on the rooftop of the selected buildings will be installed for mee ting upto 90% of the annual energy requirements depending upon the area of rooftop available and the remaining energy requirement of the office buildings will be met by drawing power from grid at commercial tariff of DISCOMs.

22. **SAFETY MEASURES:**

The bidder shall take entire responsibility for electrical safety of the installation(s) incl uding connectivity with the grid and follow all the safety rules & regulations applicabl e as per Electricity Act, 2003 and CEA guidelines etc.

ENQUIRY AND SELECTION CRITERIA

ENQUIRY FORMAT

Typical enquiry form must seek quotations in the following sections.

- General Terms & Conditions to the supplier
- Technical specifications
- Specifications of the load
- Specifications of the SPV system
  - SPV modules
  - Battery
  - Inverter
  - Charge controller
  - Scope of Civil Works
  - Scope of Operations & Maintenance
- Commercial Details
  - Cost of the SPV System
  - Cost of Civil works
  - Cost of Operations & Maintenance
  - Summary of Costs
- Annexure (if any)

EVALUATION

The quotations received in response to enquiry have to be evaluated in detail. If the quotations are not meeting the techno-commercial criteria, those will have to be reje cted. The following points have to be considered while evaluating the quotations.

- Are all the General Terms & Conditions satisfied by the supplier
- Is system technically correct
- Are the commercial aspects and calculations correct

Once the bidder has been qualified in all the respects mentioned above, the commercial details have to be recorded for evaluation purpose.

NEGOTIATION

After successful evaluation of quotations, the discussions have to take place with the successful parties for negotiation and finalization of the order. The following points n eed to be considered during the discussion phase.

1. Credibility of the company: Is the company credible for negotiation is the first point we need to look at. The credibility of the company is assessed in terms of

- Financial strength of the company:The aggregate turnover and the profitability of the company during the last three years
- Organizational strength of the company: The organizational strength of the company can be assessed in terms of
  - Existing Infrastructure of the company
  - Organizational mission and quality policy
  - Managerial strength of the company
  - Technical strength of the company

2. Technical parameters: This is another important parameter to be considered while negotiating.

This is based on the technical specification of the components used for the system. The following are the various attributes to be reckoned:

- Modules: Are the modules proposed for the system complying with the standards like IEC or Any other International standards
- Inverters: Are the Inverters proposed for the system complying with the standards like IEC or Any other International standards. Is the Inverter field proven?
- Battery: Are the Batteries proposed for the system complying with the standar ds like IEC or Any other International standards. Are these batteries from ren ewed make?
- Warranty/Guarantee: The period of warrantee/guarantee offered by the supplier for all the system components is also an important parameter.
- Track Record: Has the company got track record in installing the similar system so far. If so, Are those systems running without any major faults?

3. Financial parameters: This is the most important parameter of interest during the n egotiation period. This is based on the pricing offered by the supplier with respect to each component and also system as a whole. The following are the various attribute s conducive for this.

- Price: Is the price quoted by the supplier at par with the technical performance offered.
- Payment Terms: Has the supplier agreed for the payment terms given by us or any modification required in that regard.

Once the discussions and negotiations are held with all the parties, they are short listed by ranks and order is finalized with the party offering both techno-commercial benefits.

FINALIZATION

After finalization of the party, the order has to be released incorporating the minutes of the discussions. The following points need to be incorporated in the order.

- System design parameters: Any deviation between the enquiry specifications and final offer shall be taken of.
- Cost estimates: The revised cost estimates finalized during the discussion phase shall be incorporated in the final order.

INSPECTION OF GOODS RECIEVED

Once the order has been placed, the supplier starts supplying the components of the system.A quality check has to be performed even though the components have been tested by the respective agency.

The following are various attributes to be considered during the inspection of goods.

1. Items complying with general standards: Are all the items/components supplied matching the standards specified like
   a. Design standards
   b. Safety standards etc.
2. Acceptance test standards: Once the components are satisfying the general st andards, the components have to be examined for acceptance standards. The following are few categories of acceptance standards that need to be considered.

Type test: Type testing is to check whether the component is meeting the

rated conditions specified in the standards to which the component is affiliated.

Routine test: Routine test is testing the components for its voltage, current & test whether the component is satisfying the I-V curve etc.

System performance test:Testing the overall system performance after integrating all the components is as System performance test.

3. Acceptance test standards: Inference against all the standards used to test various components of the system and the overall system performance testing have to be reported properly.

PARAMETERS TO BE CHECKED DURING INSTALLATION

The following factors are to be considered during the installation.

1. Mounting structures: How the structures are mounted? What is the material u sed for that? What is the angle considered? What is the soil condition? What are the tools used?
2. Protective measures taken: What are the protection measures taken for vario us components and system? Are they in line with the protection standards
3. Grounding and Cabling: Weather suitable grounding mechanism has been ad opted or not. Are all the cabling done as per standard techniques
4. Training to the operator: Has the supplier trained the operator properly to han dle the system carefully
5. Operation & Maintenance manual: Whether the operation & maintenance manual has been handed over to the operator or not.