and the Rules made there under the statutory modification thereof for the time being in force shall be deemed to apply for the Arbitration proceeding under this clause.

27 Jurisdiction in Legal Proceeding

The only courts at Panchkula shall have the exclusive jurisdiction.

28 Blacklisting of the Firms

The contractor will be blacklisted,

1. If the Enlisted firm backs out of the work at any stage, the firm will be issued two 15 days notices to commence the work failing which no further notices will be issued and the firm will be straightway Blacklisted, without prejudice to other terms and conditions of the contract.
2. If the firm Indulge in fraudulent and illegal practices such as forgery, cheating or any civil/criminal wrongdoing or any grave misconduct of similar nature which has a direct impact on the contract and the Nigam. In such case no notice of default will be issued and the firm will be straightway blacklisted in addition to initiating the legal proceedings etc., without prejudice to the other terms and conditions of the contract.
3. The Performance Bank Guarantee of the Blacklisted firms will be forfeited and the firm shall have no claim whatsoever on the same.
4. Period of Blacklisting shall be five years and all power utilities in the country & MNRE shall be intimated about the same

SECTION – IV: TECHNICAL SPECIFICATIONS

DETAILED TECHNICAL SPECIFICATIONS

(Grid Connected Solar Rooftop Photo Voltaic (SPV) power plant**)**

The projects shall be installed and commissioned as per the technical specifications given below.

DEFINITION

A Grid Connected Solar Rooftop Photo Voltaic (SPV) power plant consists of SPV array, Module Mounting Structure, Inverter/Power Conditioning Unit (PCU) consisting of Maximum Power Point Tracker (MPPT), and Controls & Protections, interconnect cables and switches. PV Array is mounted on a suitable structure. Grid connected SPV power plant should be designed with necessary features to supplement the grid power during day time. Components and parts used in the SPV power plants including the PV modules, metallic structures, cables, junction box, switches, inverters/PCUs etc., should conform to the BIS or IEC or international specifications, wherever 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 cells.
- Grid interactive Inverter with Remote Monitoring System
- Mounting structures
- Junction Boxes.
- Earthing and lightening protections.
- IR/UV protected PVC Cables, pipes and accessories

SOLAR PHOTOVOLTAIC MODULES:

(i) Only domestic manufactured Solar Panels with domestic manufactured Solar cells are to be used in the system.

(ii) The efficiency of the PV modules should be minimum 16% and fill

factor should be more than 70%.

(iii) Modules of mono/poly crystalline type can be used.

(iv) The PV modules used must qualify to the latest edition of IEC PV module qualification test or equivalent BIS standards Crystalline Silicon Solar Cell Modules. In addition, the modules must conform to IEC 61730 Part-1 - requirements for construction & Part 2 – requirements for testing, for safety qualification or equivalent IS. a) For the PV modules to be used in a highly corrosive atmosphere throughout their lifetime, they must qualify to IEC 61701. Certificate for module qualification from IEC or equivalent to be submitted as part of the bid offer. Self-undertaking from manufacturer / supplier that the modules being supplied are as per above. The Potential Induced Degradation (PID) test for solar modules will be mandatory. It should be valid during the operational period.

(v) Module shall consists of Solar Cell of minimum 5 Bus Bar technology. At the time of supply the supplier shall submit the certificate from the manufacturer of the module certifying that he has supplied the modules to ..... (name of supplier) strictly manufactured as per BOM of IEC certificate mentioning the technology of the solar cell (as per Annexure-E).

(vi) The modules of the manufacturers who are having OEM and co-certification will not be considered as qualified modules.

(vii) The total solar PV array capacity should not be less than allocated capacity (kWp) and should comprise of solar crystalline modules of minimum 300 Wp (with 72 cells) and above wattage for the project above 5 kWp and of minimum 250 Wp (with 60 cells) and above wattage for the project upto 5kWp. Module capacity less than minimum of these wattage shall not be accepted.

(viii) Protective devices against surges at the DC side shall be provided.

Low voltage drop bypass diodes shall be provided.

(ix) PV modules must be tested and approved by one of the IEC authorized test centres and shall meet the latest higher side specifications prescribed by MNRE/HAREDA/UHBVNL.

(x) The module frame shall be made of corrosion resistant materials, preferably having anodized aluminum.

(xi) The bidder shall carefully design & accommodate requisite numbers of the modules to achieve the rated power in his bid.

(xii) Other general requirement for the PV modules and subsystems shall be the Following:

a) The rated output power of any supplied module shall have tolerance of plus 3% or above.

b) The peak-power point voltage and the peak-power point current of any supplied 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.

c) The module shall be provided with a junction box with weather proof lid of sealed type and IP-65 rated.

d) I-V curves at STC shall be provided with the module.

(xiii) The module should have the following minimum information laminated inside the module.

- Made in India (to be subscribed in words)
- Company name /logo
- Model number (it should indicate the voltage and rated wattage of the module)
- Serial number
- Year of make

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 (5) years from the date of commissioning of the system

(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.

ARRAY STRUCTURE (MODULE MOUNTING STRUCTURE)

Module mounting structure (MMS) should be of anodised aluminium or Hot Dipped Galvanised Iron (HDGI), of prescribed Specifications given below, for mounting of SPV modules at site. The panel frame structure should be capable of withstanding a minimum wind speed load of 150 KM per hour, after grouting and installation. MMS should be sturdy & designed to assist SPV Modules to render maximum output. The hardware (fasteners) used for installation of SPV Modules & MMS should be of suitable Stainless Steel (SS 304). Each MMS should be with minimum four legs grouted on pedestals of minimum 300X300X250 mm

with anchoring/ chipping & chemical sealing of foundation based on RCC roof. Foundation bolts of stainless /GI steel should be at least 300 mm long.

Its size should be with reference to the specifications of the selected make SPV modules. Anti Theft Nut Bolts of SS (with washers) should be used for mounting modules for better theft proofing.

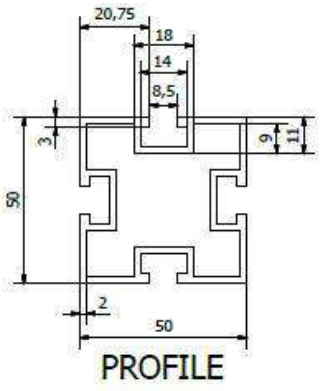
4.1 Aluminium structure should meet the following minimum specifications:

A. Structure Assembly Main Components:

1. Purlin
2. Leg & Base Plate
3. Rafter (with cleat)

B. Component Details:

1. Purlin/Rafter (Design is indicative)



- Cross section Length: 50mm, Cross section Width: 50mm, Thickness: 02mm
- Component Length – As per PV modules table designed

- Tolerance: ±5%

Cleat:

- Cross sectional length – 135mm, Cross sectional width – 50mm, Thickness – 5mm
- Tolerance: ±5%

2. Leg & Base Plate

(a) Base Plate:

- Cross sectional Length: 75mm, Cross sectional Height: 75mm, Thickness: 5mm
- Component Length: 150mm with two holes on base area for fixing of J Bolts
- Tolerance: ±5%

(b) Leg attached to base plate

- Cross sectional length – 50mm, Cross sectional width – 50mm, Thickness – 5mm
- Component Length – 3808mm ((or as per site requirement of tilt angle and may vary with the required height of structure) with two holes on bottom area for fixing with base plate and one hole on top are for fixing of Rafter
- Tolerance: ±5%

4.2 Hot Dipped Galvanised Iron (HDGI) structure should meet the following minimum specifications:

Rafter	: 60mmX60mmX3.2mm or 60mmX45mmX15mmX2.6mm
Purlin	: 90mmX45mmX15mmX2.6mm
Vertical Post	: 60mmX60mmX3.2mm or 60mmX45mmX15mmX2.6mm

Base Plate : 200mmX200mmX8mm

Top Plate : 176mmX176mmX8mm

4.3 Foundation:

The CC foundation shall have to be designed on the basis of the weight of the structure with module and minimum wind speed of the site, i.e. 150 Km/hour. Normally, each MMS should be with minimum four legs grouted on pedestals of proper size. However, for sheds CC work will not be required.The structure shall be grouted with fasteners with chemical sealing to withstand the required wind velocity. Angle of inclination shall be between 15^0 to 30^0,however,maybe changed as per site requirement.

- CC Pillar size shall be: 300X300
- For Pillars: Cement: Concrete: Sand Ratio :: 1:2:3
- Screws shall be Grouted in the Slab of roof up to depth of 50 mm.
- Lengths of rafter/Purlin may be changed as per site requirement.

Sufficient numbers of vertical post shall be provided so that the structure may not bent.

SPECIFICATIONS FOR INVERTER/POWER CONDITIONING UNIT (PCU)

As SPV array produce direct current electricity, it is necessary to convert this direct current into alternating current and adjust the voltage levels to match the grid voltage. Conversion shall be achieved using an electronic Inverter and the associated control and protection devices. All these components of the system are termed the “Inverter”. In addition, the inverter 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:-

Specifications of Inverter	
Parameters	Detailed Specifications
Switching devices	IGBT
Capacity	The Rated Capacity of the Inverter shall not be less than the solar PV array capacity.
Control	Microprocessor /DSP
Nominal Voltage	230V / 415V as the case may be
Voltage range	Single Phase: Shall work from 180 Volts to 270 Volts; Three Phase: Shall work from 180 Volts to 270 Volts per phase
Operating frequency/ range	50 Hz(47to52 Hz)
Grid Frequency Synchronization range	± 3 Hz or more (shall also compatible for Synchronization with DG Set)
Waveform	Sine Wave
Harmonics	AC side total harmonic current distortion<5%
Ripple	DC voltage ripple on tent shall not be more than 1%.
Efficiency	1. The inverters should be tested as per IEC standards/ as per latest MNRE Specification. The following criteria should be followed : 2. The benchmarking efficiency criteria for the Grid tied (central/string) inverter • At nominal voltage and full load is >95% • For load >25% is >92%. 3. The benchmarking efficiency criteria for Grid Tied PCU of capacity < 5KW: >85%and for capacity ≥ 5KW: ≥90% 4. No load losses should not be more than 5%.
Losses	Maximumlossesinsleepmode:2Wper5kW Maximumlossesinstand-bymode:10W
Casing protection levels	Degree of protection: MinimumIP-21 and 22for indoor useandIP65 certification for outdoor use
Temperature	Shouldwithstandfrom-10to+50 degCelsius
Humidity	Shouldwithstandupto95%(relative humidity)
Operation	Completely automatic including wake up, synchronization

	(phase-locking)and shutdown
MPPT	Maximum power point tracker shall be integrated in the inverter to maximize energy drawn from the array. MPPT range must be suitable to individual array voltages in power packs
Protections	Mains Under / Over Voltage
	Overcurrent
	Over / Under grid frequency
	Over temperature
	Short circuit
	Lightening
	Surge voltage induced at output due to external source
	Anti Islanding (for grid synch. mode)
	Battery Under Voltage and Over Voltage
System Monitoring Parameters	Inverter/PCU voltage & current Mains Voltage, Current & Frequency PV Voltage, Amps & KWH System Mimic & Faults
Recommended LCD Display on Front Panel	Accurate displays on the front panel:
	DC input voltage
	DC current
	AC Voltage (all 3 phases, in case of 3 phase)
	AC current (all 3 phases in case of 3 phase)
	Ambient temperature
	Instantaneous & cumulative output power
	Daily DC energy produced
	Battery Voltage (in case of Hybrid PCU)
Communication interface	RS 485 / RS 232 PCU shall also house MPPT (Maximum Power Point Tracker), an interface between Solar PV array to the power conditioning unit/inverter should also be DG set interactive.
Power Factor	> 0.9

THD	<3%
Test Certificates	The inverter should be tested from the MNRE approved test centres / NABL /BIS /IEC accredited/authorised testing- calibration laboratories. In case of imported power conditioning units, these should be approved by international test houses.

a) Three phase 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 as per site requirement. The inverter of single phase shall be installed if grid supply is of single phase and that of three phase shall be installed if grid supply is of three phase.

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

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

d) Built-in meter and data logger to monitor plant performance through external computer shall be provided (Providing Computer is not part of DNIT & is in the scope of user).

e) **Anti-islanding (Protection against Islanding of grid):** The inverter/PCU shall have anti islanding protection in conformity to IEEE 1547/UL 1741/ IEC 62116/IS16169 or equivalent BIS standard.

f) Successful Bidders/Supplier shall be responsible for galvanic isolation of solar roof top power plant (>100kWp) with electrical grid or LT panel.

g) In Inverter/PCU, there shall be a direct current isolation provided at the output by means of a suitable isolating transformer. If

Isolation Transformer is not incorporated with Inverter, there shall be a separate Isolation Transformer of suitable rating provided at the output side of inverter units for capacity more than 100 kW.

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

i) The inverter should comply with applicable IEC/ equivalent BIS standard for efficiency measurements and environmental tests as per standard codes IS/IEC 61683 and IEC 60068-2 (1,2,14,30)/ Equivalent BIS Std./EN50530,IEC 61727 (all clauses except clause 5.2.2). in case of clause 5.2.2, it should withstand the over/under frequency in the range 47 to 52 Hz.

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

INTEGRATION OF PV POWER WITH GRID:

(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. In case of grid failure, or low or high voltage, solar PV system shall be out of synchronization and shall be disconnected from the grid. 4 pole isolation of inverter output with respect to the grid connection need to be provided. Solar Generation Meter(s) and bidirectional energy meter, as per HERC Net

Metering Regulations should also be installed in the campus/building of beneficiary.

(ii) The solar generation meter and Bi-directional meter along with CT/PT (if required) with Surge Protection Device (SPD) should be of 0.2S accuracy class is in the scope of bidder. For LT connection the accuracy shall be as per requirement of DISCOMs.

(iii) CEA guideline 2013 for interconnecting solar power with Grid shall be followed.

(iv) Certification of Islanding protection in the inverter from the manufacturer of the equipment shall be mandatory. This shall be arranged by the supplier from the manufacturer.

(v) Technical Standards for Interconnection:

S.No.	Parameters	Requirements	Reference
1.	Overall Conditions of Service	Reference to regulations	Conditions for Supply of Electricity of Distribution Licensees
2.	OverallGrid Standards	Reference to regulations	Central Electricity Authority (Grid Standards) Regulations 2010
3.	Equipment	Applicable industry standards	IEC standards/IS
4.	Safetyand Supply	Reference to regulations, Chapter III (General Safety Requirements)	Central Electricity Authority (Measures of Safety and Electricity Supply) Regulations, 2010 and subsequent amendments
5.	Meters	Reference to regulations and additional conditions issued by the Commission.	Central Electricity Authority (Installation & Operation of Meters) regulations 2006 and subsequent amendments
6.	Harmonic Current	Harmonic current injections from a generating station shall not exceed the limits specified in IEEE 519	IEEE 519 relevant CEA (Technical Standards for Connectivity of the distributed generation resource) regulations 2013 and subsequent amendments

7.	Synchronization	Photovoltaic system must be equipped with a grid frequency synchronization device, if the system is using synchronizer inherently built into the inverter than no separate synchronizer is required.	Relevant CEA (Technical Standards for Connectivity of the distributed generation resources) regulations 2013 and subsequent amendments.
8.	Voltage	The voltage-operating window should minimize nuisance tripping and should be under operating range of 80% to 110% of the nominal connected voltage. beyond a clearing time of 2 seconds, the Photovoltaic system must isolate itself from the grid.	
9.	Flicker	Operation of Photovoltaic system shouldn't cause voltage flicker in excess of the limits stated in IEC 61000 or other equivalent Indian standards, if any	Relevant CEA regulations 2013 and subsequent if any, (Technical Standards for Connectivity of the distributed generation resource)
10.	Frequency	When the Distribution system frequency deviates outside the specified conditions (52 Hz on upper side and 47 Hz on lower side up to 0.2 sec), the Photovoltaic system shouldn't energize the grid and should shift to island mode.	
11.	DCInjection	Photovoltaic system should not inject DC power more than 0.5% of full rated output at the interconnection point. or 1% of rated inverter output current into	