5	Cable Tray along with support structure/ HDPE Pipe/ Flame Pipe/ Conduits for cable laying wherever required		
6	Uninterrupted Power Supply at Control Room with minimum 4 hours backup time (As per design concept)	√	
7	Supply of all energy meters including HT Bi directional meter (netmeter), LT Solar Generation meters, associated CT's , PT's as per requirement of EB	√	
8	Supply of metering cubicles(Main and / or Check) HT & LT with CT's and PT's as per requirement of EB	√	
9	Battery and Battery charger at Control Room with 4 hours (As per design concept)	√	
10	AC Earthing as per CEIG & Design requirement	√	
11	Control Room -AC Distribution Board	√	
12	Surge Protection devices and Fuses	√	
13	Rubber Mats for specific kV ratings	√	
14	Fire extinguisher & Fire Alarm in Control room	√	
15	Sand Buckets	√	
16	Termination at HPCL Main LT Panel end	√	
17	Termination of DC and AC cable along with termination kit, suitable lugs	√	
D	**Civil Works**		
1	All civil works related to MMS structure	√	
2	MMS Foundation as per design concept	√	
3	Foundations for AC Panels etc as per design	√	
4	Lighting Arrester Foundation	√	

6	Earth Pit with chamber covers and earthing arrangement	√	
7	Design and Construct Storm water Drainage System for Solar PV Plant	√	
8	Design and Construct Hume pipe at the required peripheral boundary wall crossing wherever required	√	
9	Construction of AC Panel room as required	√	
10	Foundation of Fencing and Gate	√	
11	Soil Excavation and disposing, MV/LV Cable Laying and back filling (inside the Plant boundary)	√	
12	Cross over of different types of cables, Road crossing with hume Pipe	√	
13	Foundation and civil work for outdoor Inverter	√	
14	Foundation for metering panels/ cubicles/ etc as per requirement	√	
15	Cable trench and associate civil work as per design requirement	√	
	Other Plant Works		
1	Detailed Soil Testing & Investigation Reports	√	
2	Approach Road to Plant		√
E	**General Scope**	√	
1	Plant Design and Layout	√	
2	Land area grading as per module mounting structure fixing requirement. Cleaning of land of vegation, Land filing as required.	√	
3	Module cleaning system & Piping networks	√	
4	Plant Illumination	√	
4	Plant Illumination	√	
5	Loading & Unloading of equipment's of Bidders scope of work	√	
6	Hiring Crane/ Hydra for installation of equipment	√	
7	Danger sign plates.	√	
8	Internal Plant road upto Inverter locations , IIP Locations and AC DB location (Murrum Type)	√	
9	Plant commissioning and mandatory spares	√	
10	Responsibility of damaging materials while installation/ testing or commissioning	√	
11	Clearing of scrap after completion of work	√	
12	EPC Contractor Labor License	√	
13	Design and Documentation, submission of detailed drawing, datasheet, GTP, GA, Type Test report, etc. and other necessary documents	√	
14	Spares as per list provided	√	

Expected Solar PV Plant Design:

1. The solar modules will be connected in desired series parallel combination with system voltage of not more than 1000V DC. The DC Power generated by the Solar Modules will be converted to AC Power by Grid Interactive String Inverter/s that will deliver 3 Phase, 415V, 50Hz power output duly synchronized with the incoming Utility power.
2. The system would prioritize the Solar Power over the Utility power during the day. In case of lower solar irradiance, the balance power requirement over and above the power supplied by the Solar PV System will be supplied by the grid. In case of power requirement before sunrise or after sunset or in case failure of the solar PV system the utility power will feed directly to the loads.
3. The respective Grid Interactive Solar PV Plant will be connected to the local utility under the net metering agreement wherein the excess energy generated and not consumed by HPCL will be credited by the utility in the monthly billing. The net metering agreement of HPCL with the local DISCOM will be facilitated by the selected bidder and all necessary approvals, permissions, compliances required by DISCOM, CEIG or any local authority should be taken by selected bidder.
4. In case of failure of grid power, the Inverters having anti-islanding feature will disconnect the supply of the Solar Power from the Solar PV System to avoid reverse feeding into the grid.
5. The system must be designed for maximum safety and durability considering the long life of the solar modules.
6. It is proposed to use Poly Crystalline Technology Solar PV Modules. The Solar Modules should be rated at 325Wp and above at STC. Higher efficiency Solar Modules will be preferred.
7. Suitable tilt angle of the Solar Module Mounting structure must be provided in order to ensure the best output from the Solar PV Plant. Inter-row spacing between Module mounting structure must be maintained so that shadowing of Modules is completely avoided during the Solar Generation period.
8. The selected bidder will also have to inspect and suitably decide the point of evacuation of energy generated from the Solar PV Plant. The evacuation arrangement should confirm with the norms of the local utility and approval for the same should be taken from electrical inspector.
9. The Solar PV Power generating system has to operate in parallel with the grid system which is an infinite electrical system. Any faults not taken care of will damage the Solar PV Plant without affecting the infinite system. Thus the Solar Power Plant has to protect its equipment against any of the possible faults or other disturbances from grid.
10. Very fast microprocessor based Directional and Reverse power flow protection should be provided to ensure complete isolation of the Solar PV Plant from the grid incase of any fault.
11. The basic and detailed engineering of the Solar PV Plant shall aim at achieving high standards of operational performance especially considering the following:
a. Optimum availability of Solar Modules during the day time
b. Ensure proper layout of Solar Modules and structure to prevent shading of Modules.
Selecting the best Grid Interactive String Inverter with high track record, having excellent after sales support and ready availability of spare inverters for quick replacement.

d. Careful logging of operation data / historical information from Data monitoring systems and sending alerts / notifications etc on sms and email for quick rectification of faults.
e. SPV Power plants should be designed to operate satisfactorily in parallel with the Grid only (Solar PV Plants will not run in parallel with DG set) within permissible limits of high voltage and frequency fluctuations.
12. Based on the Solar Insolation data, the Solar PV Power System should be so designed that it shall take into the peak and lowest temperatures and suitably select the cable so that all AC side line losses are below 3%.
13. Selected Bidder should use the Solar Modules and other material that are eligible for subsidy from MNRE or State Nodal Agency, if applicable.
14. If any enclosure or room is needed to house the inverters and other electrical/ electronic equipment's, the same must be communicated in writing to HPCL. The required drawing should be submitted and only after the permission is granted by HPCL the bidder would be permitted to construct the same. All costs pertaining to the enclosure / room will have to be borne by the bidder and the same needs to be included in the offer.
15. The installation practices should be as per industry standards maintaining all safety standards.
16. Excellent workmanship is expected and aesthetic look and qualitative performance should be as per international / national standards only.
17. Wherever there is more than one transformer, the bidder must provide logic control so that the Solar energy can be fed to either one or both transformers. The same will be site specific and should be a part of the Solar PV design.
18. In locations where there is an existing Solar PV Plant installed within the terminal, the selected bidder must ensure that the application for enhancement of the Solar PV Plant under net metering is made to the DISCOM and permissions with all regulatory authorities should be availed with the total plant capacity. In location where net metering scheme is not implemented the selected bidder must make a common application with total capacity to the DISCOM and other regulatory authorities.

Technical Specification of Solar PV Plant

1. **SOLAR PHOTOVOLTAIC MODULES**

a. The solar photovoltaic modules to be used for the project should be of Poly Crystalline technology only.
b. The Solar PV Module should contain high power silicon cells. The Solar cells shall have surface anti-reflective coating to help absorb more light in all weather conditions.
c. The rated capacity of the Solar Modules should be equal to or greater than 325Wp. Solar Modules to be used have to be framed only.
d. Solar Module should be laminated using established polymer (EVA) and Pedlar / Polyester laminate.
e. The solar modules shall have suitable encapsulation and sealing arrangements to protect the Silicon cells from the environment.
f. Module should be PID Free and of positive Tolerance only.
g. Modules should have an efficiency of not less than 16% and the fill factor should be equal to or above 75%.
h. SPV modules should be designed and manufactured to meet the recognized standard, which must have been used extensively with an excellent track record of performance. Higher efficiency Solar PV Modules shall be preferred. Bidders should submit the technical literature with detailed technical specifications of the modules well as the drawings & manuals.
i. The SPV Module should be tested and should have IEC test certificate from any recognized IEC accredited test centres. The Test certificates can be from any NABL/ BIS accrediated Testing / calibration laboratories. The test certificates should have validity of at least 6 months from the date of submission of the tender document.
j. The SPV modules should confirm to the minimum technical specification laid down by MNRE.
k. SPV Modules shall be certified as per IEC 61215, IEC 61730 and IEC 61701 amended up to date or equivalent standards.
l. The PV Modules shall be tested for Salt Mist Corrosion Test as per MNRE requirement.
m. The Solar Modules offered shall have a Power warranty of 25 years. Solar PV modules must be warranted for their output peak watt capacity, which should not be less than 90% of the name plate rated capacity at the end of 10 years and not leass than 80% of the rated name plate capacity at the end of 25 years. All specifications refer to the Standard Test Conditions (STC).
n. The I-V curve of each PV Module with Serial Numbers must be submitted along with the Handover documents.
o. The Solar PV Modules should also be warrantied against manufacturing defects and workmanship for 10 years.
p. Identification and Traceability: Each Solar PV module must have a RF Identification tag. The following information must be mentioned in the RFID used on each of the Solar Module. This can be inside or outside the laminate, but must be able to withstand harsh environmental conditions:
Name of Manufacturer of Solar PV Modyle

Name of the Manufacturer of Solar Cells
Month and year of the manufacturer (Separately for Cell and module)
I-V Curve for the module
Country of Origin (Separately for Cell and module)
Wattage , Im, Vm, and Fill factor for the module
Unique Serial no and Model No of the Module.
Date and year of obtaining IEC PV module qualification certificate.
Name of the test laboratory issuing IEC Certificate
o Other relevant information on traceability of Solar Cell and module as per ISO 9000 series
q. The modules must also confirm to the standards mentioned by the concerned State Nodal Agency.

The approved makes for Solar Modules are: Waaree, Vikram, Emmvee, PV Tech Solar or any other equivalent make having latest IEC certification as per tender requirements specified in clause VII. 1. ix to VII . 1. xii above. Acceptance of other equivalent makes will be at the discretion of HPCL.

2. **TECHNICAL SPECIFICATION FOR INVERTERS**

The Inverter/s used should be robust, intelligent On-grid string inverters manufactured by reputed international companies having sales and service office in India. The inverter/s must conform to the IEC 61683 and IEC 60068-2, IEC 62116, IEC 61727. The typical specifications required are as under:

a. The inverters should be string inverters only with IP65 or IP67 rating for outdoor applications with rated AC Output capacities from 3kW to 75 kW.
b. All inverters should be 3 phase, 415V, 50Hz AC output with LED/LCD display.
c. Minimum Start Voltage should be between 200V to 400 V
d. MPPT Range 350V-800V
e. Maximum Input Voltage: 1000V DC
f. Euro / CEC Efficiency above 97%
g. Frequency: 50Hz +/- 1.5%
h. Power Factor > 0.99
i. THD < 3%
j. Ambient Temperature range: -200 C to + 600 C
k. Warranty: 5 Years Comprehensive extended upto 20 years.
l. Integrated Ground Fault Protection
m. In built DC Surge protection or external in Array Junction Box.
n. Anti Islanding Feature
o. Transformerless
p. Over Voltage/ Under Voltage Protection
q. Auto Shut down in case or Over Heat/ Over Temperature.
r. The inverter/s should be equipped with an inbuild web based data logger or should be compatible with an external datalogger along with appropriate softwares log data and to generate reports/ graphs for AC generation in kWh, Peak daily KW, monthly generation

in kWh, annual generation in kWh and other features.

Approved Makes of the inverter are: SMA, Kaco, ABB, Schnieder, Fronius, Delta, SolarEdge,Sungrow or or any other equivalent make having latest IEC certification as per tenderrequirements specified in clause VII. 2 above. Acceptance of other equivalent makes will be at the discretion of HPCL.

3. **TECHNICAL SPECIFICATION FOR SOLAR MODULE MOUNTING STRUCTURE**

a. Supply of complete solar module mounting structure, hardware etc. shall be suitable for ground mounting as per site requirements along with installation shall be in the scope of selected Bidder. Module mounting structure should be as per MNRE specifications.

b. The structure shall be designed in accordance with the latitude of the place of installation. The array mounting structure shall be designed to allow easy replacement of any module and shall be in line with site requirement. Structure shall be designed for simple mechanical and electrical installation. It shall support SPV modules at a given orientation, absorb and transfer the mechanical loads to the ground properly. Site visit by bidder is recommended for the same.

c. The steel structures shall be fabricated of structural steel as per latest BIS 2062 (amended up to date) galvanised in compliance of BIS 4759 (amended up to date)

d. The support structure is to be Hot Dippled Galvanized steel made from ISI marked M.S angles/ channels or Pre Galvanized extruded sections. The minimum thickness of galvanization for MS or MS extruded sections should be of 70 microns. All fixing fastners and nuts and bolts should be of SS 304 only.

e. The array structure shall be so designed to occupy minimum space without compromising the output from the Solar PV System.

f. The minimum clearance of the lowest part of the module and the ground level shall not be less than 500 mm. However, if the water table in the given location of the Solar PV Plant is higher, the selected bidder is advised to raise the structure height suitably so that the at no instance in event of water logging, the solar PV Modules are submersed in water.

g. The structures are to be pre-fabricated for easy assembly at site. No hot work will be allowed at site.

h. The foundation design should be made by the structural engineer giving due consideration to the weight of the module, the weight of the structure assembly, maximum wind speed of the area, soil condition, seismic factors of the site, as all structural/ Civil considerations for ensuring the safety and durability of the Structure.

i. The structure along with the foundation blocks are to be designed to withstand wind speed up to 160 Km/hr.

j. The design of the structure and foundation should meet IS 800- 2007 Standards. The design calculations, STADD calculations and the wind speed analysis for the foundations & solar mounting structure shall be signed and sealed by the RCC Structural consultant of the supplier and submitted before the despatching the Solar Module mounting structure to site.

k. The selected bidders structural engineer will also certify the installation of the Solar PV Module mounting structure after the installation work is complete. The same must be submitted to HPCL along with the project handing over documents.

l. The foundation pedestals where-ever necessary shall be concrete.

m. The installation, testing & commissioning of SPV structures shall be in Bidders scope. Any

civil/mechanical job for the same shall be done by Bidder. All materials related to mounting of SPV shall be on the Bidders Scope.

4. **TECHNICAL SPECIFICATION - CABLES & ELECTRICAL CONTROLS**

a. All the necessary Solar DC cables / wires shall be supplied shall be of stranded Copper conductor only according to IEC 60228, with XLPO insulation, UV resistant and resistant against water, oil & salt, Halogen free, Low smoke emission and flame retardant features. Positive and Negative Solar DC cables and wires have be be routed throught suitable separate flexible PVC pipes/ Cable trays etc. Solar DC cable / wire maximum temperature rating should be +120 0 C. The solar DC cables should be carry TUV certification.
b. AC cables from Inverter to Inverter Interactive Panel should be 1.1kV grade, 4C stranded copper conductor, of suitable rating as per requirement.
c. 4/ 3.5 core XLPE Copper / Aluminium Armored cable of suitable thickness is to be used from Inverter Interaction Panel to the Main L.T Panel conformig to IS:1554/IEC :227.
d. All connections should be properly made through suitable lug/terminal crimped with use of suitable proper cable glands.
e. The size of cables/wires should be designed considering the line loses, maximum load on line, keeping voltage drop within permissible limit and other related factors. Maximum permissible line losses should be less than 3%.
f. The cables and wires should be ISI marked and confirm to latest BIS standards as required by MNRE for Solar applications. The ambient temperature range of the cables and wires to be used should be from -50 C to + 900 C and above only.
g. All flexible cables to be properly dressed and enclosed suitable in UPVC Pipes and / or G.I Cable trays with covers.
h. Suitable ferrules are to be used to number the cables for easy traceability. The cables are to be terminated in the equipment with copper lugs properly crimped.
i. Flexible pipes and conduits are to be suitably used at corners and at places where there is a possibility of the cables getting cut by abrasion.
j. All cables shall be of low smoke FRLS type & shall be routed through sand filled trenches between Inverters upto the Main LT Panel and existing LT Panels.
Solar DC Cables approved Makes: Polycab, Top Cable Spain, Lapp Germany, Siechem, Aparor any other equivalent reputed brand.
AC cables: Finolex, Polycab, Havell's, Lapp or any equivalent reputed brand.

5. **LIGHTNING, SURGE & OVER VOLTAGE PROTECTION**

a. The SPV power plants shall be provided with lightning & over voltage protection. The main aim in this protection shall be to reduce the over voltage to a tolerable value before it reaches the PV or other sub system components. The source of over voltage can be lightning, atmosphere disturbances etc.
b. Suitable equipments for AC and DC Surge Protection should be provided with the system.
c. The area of the Solar PV Yard/ Array shall be suitable protected against lightning by deploying required number of Lightning Arrestors. Lightning arrestors should be as per

IEC 62305.The protection against induced high-voltages shall be provided by use of metal oxide varistors (MOV's) and suitable earthing so that induced transients find an alternate route to earth.
d. The lightning Masts/ Conductors shall be made as per applicable Indian Standards/ International standards to ensure complete protection of the Solar PV Yard and equipments /components therein.
e. Necessary concrete foundation for securely holding the lightning conductor in position taking into consideration the wind speed in the area. Necessary guy wires should be given to ensure that the lighting conductor remains in position in event of heavy winds.
f. Each Lightning Arrestor must be connect to 2 separate earth pits through suitable size copper cables/wire. The same should be confirm to necessary IS standards.
g. Streamer type lightning protection system along with a counter may also be provided and the relevant IS code will be applicable for its installation.,
h. The supply of lightning protection systems should also be in accordance to the HPCL standards.

6. **EARTHING PROTECTION**

a. The earthing system shall be in strict accordance with IS: 3043 and electricity rules/Acts.
b. The earthing system network / earth mat shall be of interconnected mesh of GI Flats buried in the ground in the plant. Suitable size of GI Flats to be used for the interconnection. The earth conductors shall be free from pitting, laminations, rust, scale and other electrical mechanical defects.
c. Metallic frames of all electrical equipment shall be earthed by 2 separate and distinct connections to the earthing system, each of 100% capacity.
d. Metallic sheaths/ screens and armour of multicore cable shall be earthed at both ends.
e. Neutral connections and metallic conduits / pipes shall not be used for equipment earthing.
f. Connections between earth leads and equipment shall be normally of bolted type.
g. Back filling material to be placed over buried conductors shall be free from stones and harmful mixtures. Back filling shall be placed in layers of 150mm.
h. Minimum spacing between electrodes shall be 2000mm.
i. Necessary test point provision shall be made for bolted isolated joints of each earthing pit for necessary periodic checking of earth resistance.
j. In compliance to Rule 33 and 61 of Indian Electricity Rules , 1956 (as amended to date), all non current carrying metal parts shall be earthed with two separate and distinct earth continuity conductors to an efficient earth electrode.
k. The Solar structure, inverter, lighting arrester should have the separate earth pits. The number of earthpits is to be decided by the Bidder as per the requirements of the electrical inspector /CEIG or any concerned statutory body for the region.
l. The earthing pit shall have to be made as per IS: 3043. All the array structures, equipments & control systems should be compulsorily connected to the earth. The earthing arrangement should also be approved by the electrical inpsector.
m. The approved drawings from electrical inspector/ CEIG must be submitted to HPCL on

completion of the project.
n. Total plant earthing system shall be designed to give an earth resistance of less than 1 ohm all along with earth mesh.

7. **TECHNICAL SPECIFICATION OF ARRAY JUNCTION BOX**

a. The array junction box should be dust, vermin & water proof as per IP65 rating and should be made of FRP/ABS plastic (Test certification is required for IP65 degree of protection).
b. Suitable Fuses/ MCB's should be provided for each string.
c. A DC Surge Protection Device Class II should be provided in the AJB for grounding the surges to protect the inverter.
d. The AJB should have suitable cable entry points fitted with cable glands of appropriate sizes for both incoming and outgoing cables.
e. Suitable markings to be provided on the bus bar for easy identification and cable ferrules shall be fitted at the cable termination points for identification.
f. Necessary Fire Protection / burning behavior in the event of internal faults: Glow wire test in accordance with IEC 60 695-2-11-UL Subject 94 at 960 C, flame retardant &selfextinguishing.
g. Other protection: Temperature Tolerance range: - 40 deg C to + 120 deg C / Chemical Resistance: Acid, Lye, Petrol, Mineral Oil & partially resistant from Benzene. UV behavior: UV stabilized, even after many years there is no sign of brittleness.

8. **AC DISTRIBUTION BOARD & SOLAR LT PANEL**

a. This shall consist of box of suitable powder coated metal casting. Suitable MCB's/ MCCB's of reputed brands are to be used.
b. The cable entry should have proper metallic glands. Aluminium Bus bars of suitable dimensions are to be used.
c. Incomer – Suitable 4 Pole, MDO ACB, energy meter with suitable CT's (in case of Solar Generation Meter as requried by local DISCOM, MFM with Voltage, Current, kWh, KVA etc readings on LED display, indicating lamps for all phases,
d. Outgoing- Suitable 4 pole MCCBs
e. Main bus bar- with suitable current carrying capacity, TPN Electrolytic aluminum bus bar.
f. Protection –IP-21 for indoor mounting, wall or floor mounting depending on site.
g. Separate gland plate for cable glands.
h. Material- CRCA sheet 14/16 gauge
i. Paint- Power coated Siemens grey.
Selected Bidder shall install metering arrangements in accordance with the provisions and practices of the local DISCOM /EB for recording the generation from the Solar PV Plant.
Suggested Makes- Switchgear- ABB/Siemens/ L&T/ reputed equivalent
MCCB- ABB/Siemens/L & T/ reputed equivalent
MCB- ABB/ SIEMENS/ L&T /reputed equivalent
Indicating lamps- Technik/Siemens/ reputed equivalent
MFM- AE/ L&T/reputed equivalent
CTs –reputed as required by DISCOM

Wires/Cables- Universal/RPG/Finolex/Polycab / reputed equivalent
Solar Generation Meters: Secure/L&T or as per DISCOM requirement
Bidirectional Meters: Secure/ L&T or as per DISCOM requirement

9. **REMOTE DATA MONITORING:**

The performance and generation data of the Solar PV Plant is recorded using a data logger. The Remote Monitoring system shall comprise of the following main components:
a. The inverter logs the data and transmits the same to the Data logger. Data Logger can be inbuild or can be externally mounted in an IP 65 enclosure.
b. Data logger gathers information and monitors the performance of the inverter. It also supports measurements from the external sensors. The data can be acquired remotely via a modem.
c. Remote monitoring equipment to measure following weather related parameters:
i) Solar radiation (in plane of array)
ii) Module temperature
iii) Ambient Temperature
iv) Wind Speed
d. PC Data logging software enables automatic long-term storage of measured data from PVPlant.
e. Communication interface The entire system can be operated and monitored via several interfaces (RS232/RS485, LAN Website/ Telephone modem) in addition to the information indicated on the operator panel. Further information can also be acquired remotely through the interfaces mentioned above.
f. The Bidder to provide software interfaces for LAN and LAN cables etc for commissioning of complete data logging /monitoring system.
g.. A dedicated Personal computer with the necessary licensed softwares compatible with the software for data logging must be provided by the bidder. **The PC should be from any of the following brand: Lenovo/HP/ DELL/ equivalent reputed brand.**
h.. HPCL to provide static IP address as per the Bidder's requirement for data communication and remote monitoring of the Solar PV Plant. At places where HPCL cannot provide the static dynamic IP address, the Bidder should provide data monitoring up to the PC provided for monitoring the Solar Plant.
i. The router and the USB data dongle should be secured in a box with a lock for security.
j. Necessary permission from HPCL should be sought by the bidder for any communication requirement.

10. **DETAILED CIVIL AND OTHER NON-ELECTRICAL WORK**

All material, installations, fixtures, accessories etc. to be provided shall be as per the relevant IS specifications. These shall be of best quality and of standard manufacturer as approved by the Engineer-In- Charge (EIC) on site, when there are no standard specifications.
The fresh OPC of 43 grade cement and TMT steel reinforcement bars Fe 415 shall be used confirming to relevant IS specifications of the approved manufacturers of HPCL.
The agency has to keep the full proof records of purchase and consumption along with

original purchase bills of Cement and Steel as per the HPCL procedures and rules. The agency has to provide best workmanship with skilled manpower for all the civil items as per the standard specifications/ best practice as approved by the EIC. The booklet Standard Specifications for Civil Works will be applicable wherever there is dispute in the items of civil works. HPCL will not supply any material for this work.

a. **Topographical Survey:**

Topographical survey shall have to be done by the Successful Bidder of the proposed site at his discretion but not more than 25 mtr intervals with the help of Total Station or any other suitable standard method of survey. All necessary Reduced Levels (RL) as entered in the Field Book have to be submitted along with pre contour layout of the total site. The formation levels of the proposed power plant have to be fixed with reference to High Flood Level of the proposed site (from nearest bridge or culvert etc) . The ground level and plinth level of structures shall be fixed taking into consideration the highest flood level and surrounding ground profiles.

b. Soil Test(if required):

i. Bidder has to carry out detailed Geotechnical investigation to ascertain soil parameters of the proposed site for the use of planning / designing / construction / providing guarantee / warranty of all civil work including but not limited to foundations / piling for module mounting structures, etc. The Bidder shall carry out soil investigation through Government approved / certified soil consultant. These reports shall be furnished to the Company prior to commencing work. All RCC works shall be provided of Minimum M20grade with 340 kg cement/cu.mtr of concrete as per relevant IS specifications as well as soil data considering appropriate earthquake seismic zone, wind velocity, weather effect, soil characteristics etc.
ii. The scope of soil investigation covers execution of complete soil exploration including boring, drilling, collection of undisturbed soil sample where possible, otherwise disturbed soil samples, conducting laboratory test of samples to find out the various parameters mainly related to load bearing capacity, ground water level, settlement, and soil condition and submission of detail reports along with recommendation regarding suitable type of foundations for each bore hole along with recommendation for soil improvement where necessary. Bidder shall provide certificate of foundation design from competent licensed structural engineer in support of the foundation design/Module Mounting Structure proposed by him.

c. Foundations:

The foundations should be designed considering the weight and distribution of the structure and assembly, and a maximum wind speed of 160 km per hour. Seismic factors for the site also have to be considered while making the design of the

foundation.

d. Designing of components:

i. The Bidder shall carry out Shadow Analysis at the site and accordingly design strings and arrays layout considering optimal use of space, material and man- power and submit all the details / design to Company for its review / suggestions / approval.
ii. The Bidder shall obtain and study earthquake and wind velocity data for design of module mounting structure, and considering all parameters related to the weathers conditions like Temperature, humidity, flood, rainfall, ambient air etc

e. Storage, Construction Power and Water:

The Bidder shall also plan for transport and storage of materials at site. The bidder will be provided with Construction Water and Power supply at one point by HPCL free of cost. The Bidder shall estimate the water requirements for cleaning the photovoltaic modules at least once in every week in order to operate the plant at its guaranteed plant performance.

f. Water supply:

All necessary arrangement for pipeline network with valve and pumping assembly for wet cleaning of the solar panels shall be in the scope of the bidders and accordingly the agency has to provide all the necessary equipments, accessories, tool & tackles, booster pumps, Electric panel and pipe line network of GI pipe of Grade B which are required for the same. The successful bidder has to plan pipeline network such that it shall not block the passage between two arrays. Bidder shall have to provide water softener plant as per daily washing requirement of module.

g. Fire Extinguishers:

CO2 fire extinguisher 4.5 kg & DCP type fire extinguisher 9 kg having IS: 2171. 7 IS: 10658 marked shall be provided as per OISD norms. The fire extinguisher shall be suitable for fighting fire of Oils, Solvents, Gases, Paints, Varnishes, Electrical Wiring, Live Machinery Fires, and All Flammable Liquid & Gas.

h. Sand Bucket:

Sand buckets should be ground mounted with at least 24 SWG sheet with bracket fixing conforming to IS 2546. Suitable number of the same should be provided near the IIP's , AC DB , Main Solar LT Panels.

i. Sign Boards:

The sign board containing brief description of various components of the power plant as well as the complete power plant in general shall be installed at appropriate locations of the power plant.
The Signboard shall be made of steel plate of not less than 3 mm. Letters on the board shall be with appropriate illumination arrangements.
The Bidder shall provide to the Company, detailed specifications of the sign boards.

11. **SOLAR MODULE CLEANING FACILITY**

a. The bidder should provide for a system using water for periodic cleaning of Solar Modules.
b. All necessary accessories for removing the soiled modules for dry and wet cleaning must be provided.
c. The selected bidder will have to provide for minimum a number of water outlets close to the Solar module array table.
d. Flexible PVC hose pipes to be provided of sufficient length to cover all modules in the tables.
e. All pipes and fittings should be of CPVC material with suitable PVC valves to adjust the water flow and pressure.
f. Since water is an important resource for cleaning of the Solar Modules a separate arrangement for water storage is required.
g. The water for cleaning of the Solar Modules will be provided by the selected bidder without any extra cost to HPCL until the end of the O&M contract as per applicable terms and conditions.
h. An overhead tank /underground sump shall be constructed as per requirement of storage of water is to be provided.

12. **OTHER FACILITIES FOR INSTALLATION**

a. The bidder will organise for Water, electricity and any material storage facility or coordination room for Site supervisors and engineers during the installation and commissioning phasse.
b. Appropriate space should be left around the entire perimeter of the Solar PV Plant for easy movement of man, machinery. Approach roads within the plant for maintenance of inverters or for any other maintenance required must be provided by the selected bidder.
c. Clear space of 5 m should be maintained along the periphery of the Solar PV Plant.

VII. The bidder has to provide a UPS of 1 kVA Capacity with 4 hours battery back up to operate the remote monitoring system, data loggers and weather monitoring sensors in event of an power outage. Suggested makes of UPS are Emerson, Delta ,Su-kam or equivalent reputed makes. Suggested makes for UPS Batteries are Exide, HBL, Su-kam etc.

VIII. Warranties & Guarantees

a. The selected bidder shall give full warranty that all the equipment/ devices/ instruments/systems/sub- systems/any materials supplied under the CONTRACT shall be new and of first quality according to the specifications and shall be free from defects (even concealed faults, materials & workmanship).
b. If any trouble or defect, originating with the design, material. Workmanship pr operating characteristics of any material arises at any time prior to 5 years, the selected bidder shall, at his own expense and as promptly as possible, make such alterations, repairs and replacements as may necessary to permit the materials to function in accordance with the specifications and to fulfil the foregoing guarantees.
c. The mechnical structures, electrical works and overall workmanship of the Grid Connected Solar PV Plant must be warrantied for 5 years from the date of commissioning of the plant. The date of commissioning that would be considered is the day on which the Net metering arrangement is fully operational and the said agreement with the concerned DISCOM has been signed by HPCL.
d. Warranty / Guarantees for components will be as follows:
Each solar PV module used in the solar power plant, shall be warranted by the manufacturer with free replacement if the output peak wattage capacity under standard test condition (STC) , falls below 90% in first 10 (ten) years and falls below 80% in twenty five years, from the date of successful commissioning of SPV power plant. The Solar Modules shall also be warrantied against manufacturing defects for 10 years from the date of commissioning of the Solar PV plant . The warranty shall be transferred in the name of HPCL after commissioning of the Solar PV Plant.
String Inverters and data monitoring system shall be warrantied for 5 years provided by OEM. The warranty shall be transferred in the name of HPCL after commissioning of the Solar PV Plant.
All other components, equipments like ACDB, Wires, cables, connectors, Module Mounting Structure, foundations, AJB's, Inverter Interaction Panels, Solar LT Panels, metering cubicles etc are warrantied for 5 years from date of commissioning of the Solar PV Plant. The warranty shall be transferred in the name of HPCL after commissioning of the Solar PV Plant
e. At the end of the Operation and Maintenance contract period of 5 years from date of commissioning, the selected bidders liability shall cease.

IX. Inspection, Testing:

i. Successful bidder to provide HPCL the Quality assurance plan (QAP) and drawings for approval before starting manufacturing of the system. Approved QAP shall form the basis for inspection of
equipment/materials. Drawings shall include, SLD of Solar PV System, String design drawings, Earth pit Drawing with calculations, Solar PV Plant Layout drawing showing all

components/equipment locations, Solar Module Mounting Structure GA drawing, Foundation drawing for mounting structure, Solar LT Panel GA drawing with metering arrangement, other foundation drawings, fencing and gate design drawing, ACDB GA drawing and busbar calculations,
LA location drawing with protection radius clearly shown and the calcuations thereof.
ii. Tests certificate from the manufacturer for the quoted material shall be submitted for scrutiny by Third party Inspection agency / HPCL representative and shall also be submitted with material delivery.
iii. Solar PV Plant layout drawing, with earthing and LA system , Electrical Single Line Diagram approved by Electrical Inspector / CEIG should be provided before commencement of installation at site.
iv. All structural designs and foundation drawings should be certified by structural engineer along with a STADD report confirming the stability of the structure for wind speed of 160kmph.

X. Scope of Operation & Maintenance:

The successful bidder will begin the Operation & Maintenance of the Solar PV System immediately after successful commissioning of the Solar PV System as a part of the O&M Contract. The duration of the O&M contract will be 5 years from the date of commissioning of the Solar PV plant.
The scope of the O&M will include the following:
a. O&M of the Solar PV Plant shall be compliant with the grid requirements to achieve committed energy generation.
b. Deputation of qualified and experienced engineer/ technicians till the O&M period at project site on a fulltime basis is expected.
c. Wet Cleaning of the Solar modules at least once in 10 days and additional cleaning may be carried out as per requirement of site conditions.
d. External Cleaning of Inverters once in a month.
e. Tightening of all cable terminals , once in a quarter
f. Regular visual Inspection of cables, ACDB, AJB's communication devices and other equipments.
g. Reporting the daily/ monthly generation from the Solar PV System.
h. Inspection of the structural members used for mounting solar modules for wear and tear once in a month
i. Touch up if required with zinc oxide paint to prevent corrosion.
j. Tightening of the structural members.
k. Repair or replacing the damaged equipments like inverter within 7 days from the date of reporting of event.
l. Replacing the defective solar module within 7 days from the date of reporting of the event.
m. Replacing Cables/ MCB's/ fuses/ MCCB/ Connectors /SPD's/ AJB 's etc that are faulty so that the system remains safe and healthy to operate.
n. Supply and stocking of all spares, consumables and fixtures as required. spares and have to be maintained at the site. Replenishment of the stocked spares should be done within 7 days from consumption from the stock.

o. Providing all necessary testing equipments for routine inspections will be done by the selected bidder. The testing equipments muts be calibrated once a year from the NABL accredited laboratory and the calibration certificate must be kept for ready reference.
p. Coordination with HPCL/ DISCOM as per the requirement for Joint Metering Report (JMR). The site engineer representing the selected bidder shall take a joint meter reading each month in the presence of HPCL representative positively by the 1st of every month. Failure to adhere may result in non-disbursal of O & M charges.
q. Online Performance monitoring and reporting the same to HPCL representatives on a daily basis. Maintaining the visit and event logbook and getting the same authorised by the HPCL maintenance department. The log book should also make note of any event that has occurred due to which the Solar System has underperformed or had stopped.
The event book should also note the corrective action taken, the mention of the equipment or part replaced that should be authorised by the HPCL maintenance team.
r. If any job covered under O&M scope are not carried out by the selected bidder during the O&M period, HPCL shall take appropriate action as deemed fit. HPCL reserves the right to make surprise checks on its own or through its authorised representatives to verify the activities carried under the O&M contract.

XI. List Of Spares & Tools

The selected bidder must maintain the following spares at site that should be included as a free supply with the respective Solar PV Plants. The spares may be used by the selected bidder during the Operation & Maintenance of the Solar PV Plant. The same needs to be replenished by the selected bidder within 15 days on consumption of the same. At the end of the 5 years O&M contract period, the spares provided as free supplies should be available in full quantity to HPCL. All spares should be of the same make and capacity as supplied with the respective Solar PV Plant
List of Spares to be maintained at site by selected bidder.
Solar Modules – 1% of the supplied quantity rounded up to the nearest whole number
Solar Inverters – 2 No of each capacity used in the Plant for Solar PV Plants upto 500kWp and 4 Nos of each capacity used in the Plant for Solar PV Plants above 500kWp upto 1 MWp
Solar DC Cable- 200m for sites below 500kWp and 500 m for sites above 500kWp
Solar MC 4 Connectors- 25 pairs for sites below 500kWp and 50 pairs for sites above 500kWp.
Switchgear (MCB's ,MCCB's) – 10% of the supplied quantity
Lugs – 10% of total quantity of every size used in the project.
Zinc Oxide spray – 5 cans for Solar MMS touch up.
AC SPD- 2 Sets
DC SPD's- 2 Sets
List of Tools to be maintained at site by selected bidder as a part of free supply along with the Solar PV Plant:
Multimeter with AC /DC measuring capability
Earth Resistance tester