

CLAUSE NO.	<div>Technical Specification</div> <div>एनटीपीसी NTPC</div>
	<p>Each PV module deployed must use a RF identification tag which should be able to withstand harsh environment conditions and consist of following information</p> <ul style="list-style-type: none"> • Name of manufacturer of the PV module • Name of manufacturer of solar cells • Month and year of manufacture for each solar cell and module • Wattage, Im, Vm and FF for the module • Unique serial no and model no of the module • Date and year of obtaining IEC PV module qualification Certificate • Name of test lab issuing IEC certificates • Other relevant information on traceability of solar cells and module as per ISO 9001 and ISO 14001 <p>B) MODULE MOUNTING STRUCTURE (MMS):</p> <ul style="list-style-type: none"> • The MMS shall be made of Hot dip GI/Anodized Aluminium material and the structure shall support SPV modules at a given orientation, absorb and transfer the mechanical load to the roof uniformly. There should be no requirement of welding or complex heavy machinery at site. The array structure should be designed in such a way that it will occupy minimum space without sacrificing the output from SPV panels and should be able to withstand heavy winds. • In case MMS is made of hot dip galvanized, the main frames and complete leg assemblies of the array structures shall be made of MS hot dip galvanized. Thickness of the galvanization shall be as per IS-4759. In case the MMS is of Aluminium type, anodic coating of AC25 grade as per IS :1868 is to be done. • The MMS should be designed and fabricated as per site condition. It should be properly earthed and should be designed to withstand Seismic criteria as per IS1893 • The MMS should be able to withstand extreme weather conditions in the area and a wind speed of 200kmph. • All the nuts, bolts and other fasteners used should be of stainless steel (minimum grade SS 304). The nuts and bolts should be tightened using torque wrench. • There should be provision to adjust MMS at 3 angular positions for seasonal tilt adjustment. The locking arrangement for adjusting the angle of the module shall be easily accessible from the roof. • The installation of the mounting structure shall be done without disturbing the roof and its water proofing layer. All civil works including foundation required for erection and commissioning of solar plant shall be in the scope of vendor. <p>D) PCU/ STRING INVERTER :</p> <ul style="list-style-type: none"> • Power Conditioning Unit (PCU)/ String inverter should be provided to convert DC power produced by SPV modules into AC power. It should be grid interactive and DG set interactive if necessary. PCU/inverter output should be compatible with grid frequency. • The string inverter should be a Transformer less with minimum euro efficiency of 97%. The inverter should have a provision of taking auxiliary supply voltage from its output terminals. • IT should have Maximum Peak Power Tracking (MPPT) to extract maximum energy from solar array.
MOUDA SUPER THERMAL POWER PROJECT (2 X 500 MW) + (2 X 660MW)	<div>TECHNICAL SPECIFICATIONS PART-A</div> <div>SECTION-IV</div> <div>PAGE 3 OF 12</div>

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	<div><ul style="list-style-type: none">The PCU/string inverter shall be designed for continuous, reliable power supply as per specifications. It should be capable of complete automatic operation and shall synchronize independently & automatically with the grid supply.The PCU/inverter shall have internal protection against any sustained fault. The dimensions, weight, foundation details shall be included in the detailed technical specifications provided by the bidder.The PCU/inverter shall be capable of complete operation including wakeup, synchronization and shutdown.</div> <div>Inverter Technical details</div> <table><tr><th>S.no</th><th>Parameter</th><th>Specifications</th></tr><tr><td>1</td><td>PCU/inverter AC rating</td><td>As per capacity of PV plant</td></tr><tr><td>2</td><td>Output details</td><td>Pure sine wave, 415V, 3 phase, 50Hz</td></tr><tr><td>3</td><td>Total Harmonic distortion</td><td><3% with resistive load</td></tr><tr><td>4</td><td>Grid frequency synchronization range</td><td>+/- 3 Hz</td></tr><tr><td>5</td><td>Power factor</td><td>0.9 inductive, 0.9 capacitive</td></tr><tr><td>6</td><td>Grid frequency tolerance range</td><td>+/- 3%</td></tr><tr><td>7</td><td>Grid voltage tolerance</td><td>-20 % to +15%</td></tr><tr><td>8</td><td>No load losses</td><td>Less than 1% of rated power</td></tr><tr><td>9</td><td>PCU efficiency</td><td>>95% at nominal voltage and power as per IEC 61683 or equivalent international efficiency standards</td></tr><tr><td>10</td><td>Overloading features</td><td>150 % for 1 min</td></tr><tr><td>11</td><td>cooling</td><td>Forced air cooling with temperature controlled automatic cooler fan</td></tr><tr><td>12</td><td>Operating temperature</td><td>0 to 50 deg C</td></tr><tr><td>13</td><td>Relative humidity</td><td>95%</td></tr><tr><td></td><td>Data monitoring and display controls</td><td>Built in meter and data logger to monitor the performance through external computer shall be provided.</td></tr><tr><td>14</td><td>Protections to be provided</td><td>1) input voltage protection 2) low and high frequency 3) under and over output voltage 4) Grid input under voltage/over voltage with auto recovery 5) DC reverse polarity 6) Anti islanding protection as per standard UL 1741</td></tr><tr><td>15</td><td>Enclosure protection</td><td>IP 54 for indoor and IP65 for outdoor</td></tr><tr><td>16</td><td>Warranty</td><td>Inverter : 5 years</td></tr><tr><td>17</td><td>safety</td><td>IEC 62109 part 1&2</td></tr><tr><td>18</td><td>Environmental Testing</td><td>PCU shall confirm to IEC 60068-2 or EN 50178</td></tr></table>				S.no	Parameter	Specifications	1	PCU/inverter AC rating	As per capacity of PV plant	2	Output details	Pure sine wave, 415V, 3 phase, 50Hz	3	Total Harmonic distortion	<3% with resistive load	4	Grid frequency synchronization range	+/- 3 Hz	5	Power factor	0.9 inductive, 0.9 capacitive	6	Grid frequency tolerance range	+/- 3%	7	Grid voltage tolerance	-20 % to +15%	8	No load losses	Less than 1% of rated power	9	PCU efficiency	>95% at nominal voltage and power as per IEC 61683 or equivalent international efficiency standards	10	Overloading features	150 % for 1 min	11	cooling	Forced air cooling with temperature controlled automatic cooler fan	12	Operating temperature	0 to 50 deg C	13	Relative humidity	95%		Data monitoring and display controls	Built in meter and data logger to monitor the performance through external computer shall be provided.	14	Protections to be provided	1) input voltage protection 2) low and high frequency 3) under and over output voltage 4) Grid input under voltage/over voltage with auto recovery 5) DC reverse polarity 6) Anti islanding protection as per standard UL 1741	15	Enclosure protection	IP 54 for indoor and IP65 for outdoor	16	Warranty	Inverter : 5 years	17	safety	IEC 62109 part 1&2	18	Environmental Testing	PCU shall confirm to IEC 60068-2 or EN 50178
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	<p>E) CABLES, CABLE TRAYS, CONDUITS, PIPES AND ACCESSORIES :</p> <ul style="list-style-type: none"> The cables used in the system should be ISI marked XLPE insulated FRLS armoured copper conductor. Cables of various sizes as per load requirement shall be used for connecting all the modules/ arrays to junction boxes and from junction box to DC distribution box and from DC distribution box to inverter. Copper/ Aluminium cables of appropriate sizes would be provided from inverter for further Ac distribution. Cables for use at the DC-side of PV system shall meet the requirements of TUV standard 2 PfG 1190/5.18 or EN-50618 or other equivalent standard. Copper cables of reputed make shall only be used from PV array to inverter. Aluminium cables can be used for AC power evacuation from inverter. The permissible voltage drop from SPV generator to the inverter shall not be more than 2%. All the required cables shall be in the scope of contractor Cables connecting all monitoring sensors, environmental sensors etc shall be shielded to avoid signal loss. All electronic connections should be properly terminated, soldered and/or sealed from outdoor and indoor elements. Relevant codes and operating manuals must be followed. Cable trays shall be ladder/perforated type as specified completely with matching fittings (like brackets, elbows, bends, reducers, tees, crosses etc), hardware and accessories as required. Cable tray should be ladder type for power and control cables and perforated for instrumentation cables. Cable trays, fittings and accessories shall be fabricated out of rolled mild steel sheets free from flaws such as laminations, rolling marks, pitting etc. These (including hardware) shall be hot dip galvanized as per relevant IS. Thickness of mild steel sheets used for fabrication of cable trays and fittings shall be 2mm thickness. Thickness of side coupler plates shall be 2mm. Suitable GI support system for cable trays has to be provided which shall be able to withstand weight of cable trays, cables and factor of safety of at least 1.5 shall be considered while designing the system. <p>F) ARRAY JUNCTION BOXES :</p> <ul style="list-style-type: none"> Junction boxes shall be dust proof, vermin and water proof and made of FRP/thermos plastic with IP65 protection. The terminals should be connected to copper bus bar arrangement of proper sizes. The junction boxes shall have suitable cable entry and exit points with proper glands and suitable for armoured copper cables. Adequate working space should be provided in JB's for easy accessibility of tools like spanners, screw drivers etc. Suitable identification marking shall be provided on bus bars and cable ferrule should be used at cable termination points. The junction boxes should have suitable arrangement for disconnection of each of the groups, test point for each sub group for quick fault identification, group array isolation, adequate safety loading factor for interconnection of solar PV array. 			
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	<p>INTEGRATION OF PV POWER WITH PCC (Power Control Centre):</p> <ul style="list-style-type: none"> The output power from SPV array should be fed to PCU/ inverter, which converts DC to AC and feeds it to PCC after synchronization. In case of PCC failure/low or high voltages, Solar PV shall be out of synchronization and shall disconnect from the PCC. Once the bus is normalized or synchronization criteria is met, the solar PV system should automatically be synchronized with the PCC and load requirement would be met to the extent of available power. A manual disconnection switch besides the automatic disconnection to the PCC should be provided to isolate the system in case of any maintenance activity. The switch should have locking arrangement. Power generated by solar panels shall be fed to the nearest PCC available. Location of PCC shall be shared with the successful Bidder after finalisation of building locations & design. <p>G) PROTECTIONS :</p> <ul style="list-style-type: none"> The system should be provided with all necessary protections like Earthing, Lightning & Surge and Grid Islanding in accordance with the latest codes & standards and best industry practices. Metallic frame of all electrical equipment shall be earthed by two separate and distinct connections to earthing system, each of 100% capacity. The earth resistance shall be less than 5 ohm as per IS : 3043 code of practice for earthing. GI strip of minimum size 3mm*30mm shall be used for carrying out earthing connections. The GI strip should be connected to earth mat grid. Protection shall comply as per CEA's "Technical standard for connectivity of the distributed generation resources", Regulation 2013 <p>MONITORING OF THE SYSTEM :</p> <ul style="list-style-type: none"> Bidder has to aggregate Data with data storage feature from each Inverter to a Single PC in Control Room. However, irradiance / temperature sensor set can be provided at one of the rooftops. The plant monitoring shall have following, Measurement of Solar PV parameters at PCU / String Inverter level: PCU / String Inverter shall have provision of measuring and displaying actual value of AC & DC Voltage, AC & DC Current, and AC Power & Energy Generated by the Solar PV system. These PCU / String Inverter parameters shall have provision of data logging through Mod Bus (RS-485) protocol. Solar Irradiance: An integrating Pyranometer (Class II or better) shall be provided, with the sensor mounted on a Horizontal plane at a shadow free suitable location near solar arrays. Temperature: Temperature probes for recording the PV Cell temperature shall be provided at one of the modules at shade free location The above data has to be made available at separate terminal by integrating in the LAN network of the package. Bidder can utilize the available mode of data transmission. Any hardware required shall be included in the scope of the bidder. <p>CLEANING OF SOLAR PV PANELS :</p> <ul style="list-style-type: none"> An appropriate Solar PV Module cleaning & water washing system with complete GI pipes, valves, hose pipes, wipers, mops etc. shall be provided for regular cleaning and water washing of the rooftop Solar PV modules.
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	<ul style="list-style-type: none"> Minimum two sets of Microfiber based cleaning tool is to be provided for each rooftop location. The system shall be specifically designed to take care of the harsh & dusty environment of thermal power plants. Drainage for this system shall be arranged by the bidder. Clean water shall be made available at the nearest point from where bidder has to make necessary pumping & treatment, if required, and piping arrangements for water washing of PV modules <p>MAINTENANCE REQUIREMENT:</p> <ul style="list-style-type: none"> Easy access shall be provided for all the components in the SPV plant and grid connecting equipments. Maintenance platform has to be provided on each roof for easy inspection of all the equipments. If special tools are required for maintenance, the bidder has to indicate the same and provide them to NTPC The bidder has to provide operating and maintenance instruction manual to facilitate effective and safe maintenance. <p>INSTALLATION AND COMMISSIONING:</p> <ul style="list-style-type: none"> The bidder has to visit the NTPC Mouda site and make an assessment before submitting the offer. A detailed project execution program with necessary drawings has to be submitted along with the offer. The bidder shall be responsible for arranging all the tools/tackles and manpower for installation and commissioning of complete system. The bidder shall provide all necessary hoists, ladders, scaffoldings, transportation of labour and materials necessary for the proper execution and completion of the work to the satisfaction of NTPC. After completion of installation and commissioning activities, the area shall be cleared of any left out material, scrap etc by the bidder. <p>APPROVAL & CLEARANCES :</p> <ul style="list-style-type: none"> Bidder shall take necessary approvals and clearances from Govt/ statutory bodies wherever applicable in the scope of work and shall submit an affidavit after the completion of work. <p>SUBMISSION OF DRAWINGS, DATA SHEETS AND MANUALS BY SUCCESSFUL BIDDER:</p> <ul style="list-style-type: none"> Successful bidder after obtaining LOI/ PO shall plan a site visit to assess the actual site Conditions at NTPC Mouda and shall submit design drawings and data sheets for approval by NTPC before start of supply and installation. These drawings shall clearly indicate the following: Location and rating of PV arrays Location and details of panels, and other particulars including approved fabrication drawings of panels. Complete wiring diagram as installed and scheduled, showing all the connections in the complete electrical system Routing and particulars of all cables and trays Single line diagram, power schematic, control schematic with detailed bill of materials, showing makes, types and description of all components and accessories. Two sets of hard copies and one set in soft copy of as built drawings, manuals of items used in each system & O&M manual of solar PV plant at each location is to be submitted before completion of trial run. 		
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	<p>INSPECTION OF MATERIAL:</p> <ul style="list-style-type: none">All the material as per BOM shall be supplied along with test certificates and necessary technical documents/datasheets. Material shall be accepted after inspection at NTPC stores/supplier works as applicable. Test certificates duly attested by any authorized person of the agency shall be submitted for scrutiny before supply. <p>TRIAL RUN AND ACCEPTANCE OF SOLAR PV MODULE:</p> <ul style="list-style-type: none">Acceptance of the each solar PV system shall be done after achieving uninterrupted power for thirty consecutive days. A performance datasheet during the period of trial run shall be submitted by agency to NTPC. Any interruption during trial run on account of the system shall restart the trial run counting. <p>OPERATION & MAINTENANCE (O&M)</p> <p>The installer shall be responsible for operation and maintenance of the Roof top Solar PV system for a period of 2 years(from the date of commissioning & operation acceptance of the whole project), during which NTPC will monitor the project for effective performance in line with conditions specified elsewhere in the bid document. During this period, the installer shall be responsible for supply of all spare parts as required from time to time for scheduled and preventive maintenance, major overhauling of the plant, replacement of defective modules, inverters, PCU’s etc and maintaining log sheets for operation detail, deployment of staff for continuous operations and qualified engineer for supervision of O&M work, complaint logging & its attending.</p> <p>Payment for deployed staff during erection, commissioning and O&M period shall meet the local prevalent minimum wages.</p>		
3.2	<p>GENERAL TECHNICAL REQUIREMENTS</p> <ul style="list-style-type: none">The warranty period of 5 years shall commence from the date of successful completion of trial run. Performance guarantee will be as per conditions mentioned in the specification of the module. In case of any deviation observed during performance guarantee, the same shall be intimated to the contractor and shall be rectified by him in a span of 15 days.NTPC shall provide rooftop for installation and single point single phase/ three phase power supply at each installation location which can be used by agency during installation. All other material/requirement for carrying out the job and which is not specifically mentioned elsewhere shall be in the scope of contractor.The installer shall be responsible and take an Insurance Policy for transit-cum storage-cum-erection for all the materials to cover all risks and liabilities for supply of materials on site basis, storage of materials at site, erection, testing and commissioning. The Installer shall also take appropriate Insurance during 2 years O&M period.The installer shall also take insurance for Third Party Liability covering loss of human life, engineers and workmen and also covering the risks of damage to the third party/material/equipment/properties during execution of the Contract. Before		
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5	Bill of Quantity/Schedule of Quantity/ BOQ Item wise description.			
	Item no	Service code	Service Description	
	10.10	ELSPL00GN630	SOLAR PLNT (<>) MATL SUPPLY	
	10.20	ELSPL00GN116	SOLAR PLNT (<>) COMMNG	
6	Quantity variation : NIL			
7	Exclusions: NIL			
	Power & Water Supply and boarding and lodging of employees/ labour / staff Shall be arranged by contractor			
8	List of minimum Tools and Plant: All the T&Ps required for execution o the project shall be arranged by Contractor			
9	Owner's issue material : NIL			
10	Safety : <ul style="list-style-type: none">The contractor should issue safety PPEs such as safety Shoes (Electrical/ Mechanical as per nature of the job), Safety helmet (with ISI mark), Reflective jacket, googles, dust mask etc to all the workers engaged for executing the jobSafety of the personnel deployed is the sole responsibility of the contractor. Contractor shall issue safety PPEs to all the engaged manpower before the start of work. The contractor has to ensure that all the workmen shall use safety PPEs during the execution of work.If any workman sustains minor/ major injury while on job, the contractor shall bear all the expenses towards medical treatment and compensation without any extra cost to NTPC.In case of any dispute, the decision of Engineer-in-charge is final and binding on the contractor.All other terms and conditions not covered here shall be as per GCC of NTPC.			
11	Quality This is indicative List of tests/ checks. The manufacturer is to draw a detailed quality Plan indicating the practice & procedure along-with the relevant supporting documents. Indicative QPs attached for ref.			
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	<div><div>1.1Inverter</div><div><div><div>• Checks on bought out items as per internal standards of the manufacturer</div><div>• In-process checks, as per internal standards of the manufacturer</div><div>• Routine tests as per following on the assembled inverter:<div><div>i. Test to demonstrate automatic / manual synchronization and connections utility service</div><div>ii. Functional check on all protections</div><div>iii. Check on accuracy of all parameters measured by inverter</div><div>iv. Test to demonstrate operation of start-up, stable operation of the inverter, disconnection and shutdown controls and response to other control signals</div></div></div><div>• Following sample tests on one sample of inverter: Heat run test including measurement of phase currents, efficiencies, harmonic content and power factor at four points preferably 25, 50, 75 and 100% of the rated nominal power.</div></div></div><div><div>1.2SPV module</div><div>SPV modules quality plan should include the following:</div><div><div>• Checks on make of bought out items as per TUV certificate of the manufacturer</div><div>• In-process checks as per internal standards of the manufacturer</div><div>• Sample tests as per following:<div><div>i. SPV modules to be checked visually for following defects: (sampling as per General Inspection Level II and AQL 1.5% as per IS 2500 Part 1)<div><div>▪ Scratches on the frame and/or glass</div><div>▪ Excessive or uneven glue marks on glass or frame</div><div>▪ Inconsistent cell colors</div><div>▪ Completeness of module in all respects</div></div></div><div>ii. Performance of SPV module at STC (sampling as per General Inspection Level II and AQL 1.5% as per IS 2500 Part 1)</div><div>iii. IR-HV-IR test (sampling as per Special Inspection Level S-2 and AQL 1.5% as per IS 2500 Part 1)</div><div>iv. Robustness of terminations on 1 sample per offered lot</div><div>v. Mechanical load test on 1 sample per offered lot</div></div></div></div></div></div>			
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12	Defect Liability Period <ul style="list-style-type: none"> Intended installation is expected to have a lifetime of minimum 25 years. The successful bidder shall provide a warranty/defect liability period covering all the PV modules, Inverters, Mechanical structures, distribution boards, meters and over all workmanship of the solar power system for a period of 5 years from date of successful trial run.
13	Price Basis Prices are ...FIRM
14	Cost compensation clause for non-compliance of specifications/scope <i>Refer LD Clause</i>
15	Items not covered in BOQ <i>Not Applicable</i>
16	Work Schedule Time for Completion: ...9..... Months from the date of LOA.
17	Contract Period Extension : NA
18	Payment Terms Payment shall be released on successful submission of invoices as per GCC.
19	Contract Performance Guarantee/ Security Deposit /LD PERFORMANCE GUARENTEE (PG) TEST The performance Guarantee Test (PG Test) shall be carried out after successful completion of Trail run for 1 month. PG Test shall be carried out on any rooftop location by measuring Performance Ratio (PR) and comparing to the Guaranteed PR. The test shall be repeated for each location having different type of inverter and the LD amount shall be extrapolated on pro-rata basis for the complete rooftop installation having the identical inverter model. The mathematical formula for calculating PR is given below: The procedure for PG demonstration test shall be as follow:
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- a. Measuring instruments to record on site data will include a pyranometer with a resolution +/- 1W/m² and sensitivity of 7μV/(W/m²), temperature sensor, signal converter.
- b. Contractor will be responsible to conduct the PR test only after achieving the physical completion and synchronization of the plant and complying the relevant requirements from utility.
- c. The Performance test will be conducted for duration until a total irradiation of 5 kWh/m² has been received at irradiance levels greater than 800 W/m². The operation will be recorded at 15 minute intervals for validating the PR values guaranteed by the contractor. In case of destruction due to any component failure, the test will be repeated.
- d. The PR values shall be computed based on actual energy exported to the grid at the output of isolation/stepup transformer as per SLD.
- e. If Contractor fails to achieve the guaranteed performance levels, the contractor will at its own cost rectify all the defects identified during the test and take necessary steps/efforts to pass the PR test within the stipulated time span. Subsequent to rectification the PR will be restarted.
- f. This measured value of performance ratio shall be compared with "Month wise Target PR " as mentioned in Table-1. The Annual Target PR is 78.30 %

Table 1: Month wise PR

Month	Performance Ratio (%)
January	80.34
February	79.21
March	77.05
April	75.30
May	74.89
June	77.14
July	79.21
August	80.02
September	79.08
October	78.04
November	79.12
December	80.25
Annual	78.30