

KERALA AGRICULTURAL UNIVERSITY

COLLEGE OF FORESTRY

KAU (PO), Thrissur - 680 656

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No. COF/GI(1) 398/2018 (i)

Dated: 17 Mar 2018

TENDER NOTICE

Sealed competitive tenders are invited for the supply of the “10 KWP Grid Interactive Roof Top Solar Power Plant With Its Operation & Maintenance For 5 Years”, with the following term and conditions as detailed hereunder, for the Periyar Hostel, College of Forestry, Kerala Agricultural University, Vellanikkara.

Last date & time for receipt of tender : 3.00 pm on 27.03.2018
Date & time of opening of tender : 3.30 pm on 27.03.2018

Terms and conditions

1. The sealed cover containing the tender should be superscribed “**Tender for the Rework of 10KWP Grid Interactive Roof Top Solar Power Plant with its Operation & Maintenance for 5 years**” and should be addressed to the **Dean, College of Forestry, K.A.U. P.O, Thrissur, Kerala-680656.**
2. Tender fee (Non-refundable) of 0.2% of the total cost (rounded to 100, minimum Rs.400, maximum Rs.1500) plus 12% GST extra of tender fee, payable by way of DD drawn in favour of the Dean, College of Forestry, Vellanikkara payable at the SBI, KAU Campus (Branch Code 70670) has to be submitted.
3. Each tender should be accompanied an Earnest Money Deposit (EMD) of 1% of the total cost of the quoted items (subject to minimum of Rs.1500/-) by way of Demand Draft separately and EMD drawn in favour of the Dean, College of Forestry, Vellanikkara payable at the SBI, KAU Campus (Branch Code 70670). Late and incomplete tenders and tenders without Tender fee/EMD will not be accepted.
4. The successful tenderer should execute an agreement in Kerala Stamp Paper worth Rs. (Rupees one hundred only) at the time of supply of items and furnish a security deposit of 5% of the cost of the equipment quoted in the form of term deposit/bank guarantee /DD drawn in favour of Dean, College of Forestry, Vellanikkara payable at the State Bank of India, KAU campus (Branch Code 70670). The format for the agreement can be downloaded from the KAU website forestry.kau.in or www.kau.in/tenders. Firms who are exempted from payment of EMD should furnish copy of the currently valid certificate from the Store Purchase Department, Govt. of Kerala.
5. The cost of the item and rate should be inclusive of all taxes for the supply and installation at this College.
6. The exact specifications, details of make, model, name of manufacturer, warranty details etc. of the item must be clearly specified. Copies of detailed technical literature and illustrated brochures of the units quoted are to be included along with the offer. Details of maintenance service contract offered after expiry of normal warranty, spare parts availability and after-sales-service facilities available should be indicated Offers without these are liable to be rejected.
7. In the case of electricity operated equipment, the circuit diagram will have to be supplied.

8. Offers shall be made CIF Cochin by airfreight for imported instruments and F.O.R. destination for indigenous items. For imported items, charges for insuring up to final inland destination against all risks including total loss for CIF value plus 10% should be included in the insurance charge.
9. Prices quoted should be valid up to three months from the finalization of tender.
10. The decision of the undersigned in finalizing the tenders shall be final and binding.
11. Tenders will be opened on the date and time specified above in the presence of such tenders or their representatives present.
12. If any Bandh/strike/any unexpected holidays occurs on the date of opening of tender, the tender will be opened at the same time on the next working day.
13. On acceptance the supply order will be placed and the invoice should be addressed to The Dean, College of Forestry, Vellanikkara. The payment will be effected only after satisfactory supply, installation of the item at College of Forestry, KAU in working condition and necessary demonstration by authorized service personnel.
14. The successful tenderer should supply the items to College of Forestry, KAU, Vellanikkara within two months from the date of the receipt of the supply order. The Dean, College of Forestry, Vellanikkara reserves the right to remove the defaulted name from the list of suppliers permanently or for a specific period.
15. Tenders insisting payment in advance either full or part for releasing the documents through bank are liable for rejection.
16. List of users giving the exact address of the contact persons and the model number of the units available at these locations, have to be provided. Evidence of exclusive/authorized distributorship from foreign principals should be provided along with the offers for overseas products.
17. The Dean, College of Forestry, Vellanikkara has the right to accept or reject any or all of the offers without assigning any reason.
18. All the rules and regulation applicable to Government Tenders will be applicable to this tender also.

Sd/-

DEAN

TERMS AND CONDITIONS

1. ELIGIBILITY CRITERIA

- Module manufacturers/ Grid Tied Inverter Manufactures, Govt. accredited agencies for electro mechanical works, other firms having adequate similar experience in Solar Installation including EPC firms and MNRE ex channel partners will be eligible to compete in this tender. To substantiate this, necessary documents, certificates shall have to be attached with the proposal.
- The bidder (Manufacturer/authorised representative of manufacturer) should have a service setup in and around central Kerala with Grid Tie inverter manufacturer's on – roll engineer should be positioned.
- The bidder should have installed at least one grid connected solar plant in Central Kerala (work order copy along with performance certificate to be attached)
- The Bidder must have a minimum annual turnover of Rs 1.00 crore (average) over last two years. (*Attach copy of audited balance sheet for, 2015-16 and 2016-17.*)
- The bidder must have adequate technical capacity to design, manufacture, test, supply, erection, and commission the power plant within the given time schedule.
- Furnish a brief write-up, backed with adequate data, explaining the available capacity and experience (both technical and commercial) for the manufacture /procure and supply of the required systems and equipment within the specified time of completion after meeting all their current commitments, If the bidder is an accredited PSU and not a manufacturer of either of the major components
- The products/ systems/ devices quoted in tender should be as per KSEBL Grid standards specifications. (*Do attach copies of recent test certificates from IEC/ other authorized Test Centers of GOI as proof thereof.*)
- All above criteria should be strictly followed.

Supporting documentary evidences to be provided

The Bidder shall furnish all relevant documentary evidences to establish their qualification as desired in eligibility criteria above along with the bid.

The Bidder shall furnish all relevant documentary evidences as mentioned below to establish his experience in Eligibility Criteria above along with the bid to meet Technical Criteria. The certification by the bidder for their own Solar PV power plant will not be acceptable.

- a) Copy of Work Order/ Contract agreement and completion certificate.
- b) Performance Certificate from the user regarding successful operation of the solar PV power plant Project for at least one (01) year.

Financial

- Average Annual Financial Turnover should be in accordance with clause in eligibility criteria given above.
- Net worth of the bidder must be positive as per audited financial statement immediately preceding the current financial year in which bid is submitted.

Note: Following documents should be submitted along with the bid for the above:

- A certificate issued by a Chartered Accountant, certifying the Annual Turnover and nature of business

- Audited Balance sheet and Profit & Loss account.
- If the bidder is a PSU/Limited company with share issued to public, published balance sheet with P&L can be taken into account
- In case of a Company, certified copy of the Memorandum & Articles of Association.
- If manufacturer's authorised representative, an MAF duly signed by OEM should be furnished.

TECHNICAL SPECIFICATION & PLANT DETAILS

2. TECHNICAL SPECIFICATION:

The successful bidder should be undertaken following job: -

- (a) Preparation of Detailed Project Report (DPR) / Project Proposal in compliance with latest provisions of National Solar Mission (NSM) of GoI, launched by Ministry of New & Renewable Energy (MNRE) for technical Evaluation and acceptance by our consultant towards installation of 20 kWp capacity Grid Interactive roof top SPV power plant at southern side roof top of the building or other suitable roof tops
- (b) Design, engineering, manufacture, quality surveillance, testing at manufacturer's works, packing, and supply, erection testing and commissioning and performance testing of 20 kWp grid interactive roof top solar photovoltaic system (GIRTSPVS) with associated components for successful installation at the roof top of suitable building
- (c) Net metering of power with concerned KSEBL department for grid connectivity shall be arranged by the agency.

These systems shall be completed with PV modules, inverter, metering, junction boxes, AC, DC distribution boards and cables, communication interface, and any other equipment necessary for safe and efficient operation of the GIRTSPVS (Grid Interactive Roof Top Solar PV System)

The work shall also include interconnection of GIRTSPVS with the grid.

The scope of supply shall also include comprehensive insurance, storage & In-transit transportation

The civil & structural works for installation of complete system shall also be in scope of supplier.

The scope of work shall also include operation and maintenance of the GIRTSPVS for five years from the date of commissioning, however the prices for the same shall also be separately indicated in the bid

The scope of supply shall also include essential spares necessary for operation, routine maintenance and testing of equipment.

It is not the intent of this specification to specify completely herein all the details of design and construction of equipment. However, the equipment offered shall conform in all respects to high standards of engineering, design and workmanship and be capable of performing in commercial operation up to Bidder's guarantee in a manner acceptable to the purchaser, who will interpret the meaning of drawings, specification and shall have the power to reject any work or materials, which in their judgment are not in full accordance therewith.

COMPLETENESS OF EQUIPMENT

All the fittings and accessories that might not have been mentioned specifically in the specification but are necessary for successful commissioning of the project shall be deemed to be included in the specification and shall be supplied and furnished by the Contractor without any extra charge.

CODES AND STANDARDS

All equipment and accessories shall comply to requirement of standards published by Bureau of Indian Standards (BIS). In case no BIS codes exist the equipments shall meet the requirement of international standard including IEEE/IEC for design and installation of grid connected PV system. The list of standards adopted shall be indicated in the bid.

The SPV Module must be provided with acceptable Test & Certified documents.

The quality of supplied equipment shall meet the guidelines of following standards and codes listed below:

Solar Panel

Type	- Poly Crystalline Silicon
IEC 62804	- PID Resistant
IEC 61701 & IEC 62716	- Salt Mist & Ammonia Corrosion
IEC 61215, IEC 61730,	
UL 1703, IEC 62804	- Approvals & Design Qualification
CE, TUV, UL	
Fire Safety	- Class C (Type 1)
Electrical Safety	- Class II
Application Class	- Class A
Junction Box	- IP 67
Certified Wind Load capacity	- 2400 Pa
ISO 9001:2015,	
ISO 14001:2015 & OHSAS 18001:2007	- Manufacturing facility

SPECIFIC TECHNICAL REQUIREMENTS:

Solar PV system shall consist of following equipment:

- Solar PV modules will have conversion efficiency of 16% or above
- Power Conditioning Unit/ Inverters will have DC to AC efficiency of 98% or above
- MMS according to IS: 875 – 1987 (Part III) & IS: 875 – 1987 (Part-I & II)
- Cables and hardware according to IS & IEC
- DCDB with DC SPD, AJB and DC Disconnect with IP 65/67 enclosure
- ACDB with AC SPD and AC Breaker with IP 65/67 Enclosure
- MCB/Isolator – As per IEC/IS specification with suitable current carrying capacity
- AC Energy meter – Calibrated by KSEBL TMR
- Net meter – Calibrated by TMR
- Earthing kit – compliance to IS specification
- Lightning arrestors ELPS (according to IS/IEC 62305)
- Nut/Bolt – SS as per IS
- PVC pipes and accessories Suitable for a life of 25 years

Mounting Arrangement

- i. Mounting Fixed Type
- ii. Surface azimuth angle of PV Module 0 degree True south
- iii. Tilt angle(slope) of PV Module - At Latitude or as per site requirement

Grid Tie Inverter/ Power Conditioning Unit (PCU)

Number of units – As per string design attached
Rated Capacity Minimum 30KW Grid tied – AC Side
PV voltage range 300 to 1000 V
Dual MPPT tracker – Built in
Integrated DC Disconnect switch
Metering and data logger – built in
IP – 65 Body Shell
Real time LCD with Knock detection from sleep mode to active mode
Output Voltage 3 phase, 415 V AC (+ 5 %)
Frequency 50 Hz
Wake up time 6 AM

Shutdown time 6 PM

Grid Connection Details

Electrical parameters for interconnection	415 V, 3Ph, 50 Hz
Construction Time	1 Months from the date of order

DUTY CYCLE

Average Hours of Operation/day: 8-10 hrs per day
Assured output - 4 units (KWhr)/day /KWp of SPV Plant average in a year
Expected peak output - 5-6 units /KWp/clear sunny day

Supplier shall follow the latest engineering practice; ensure long-term compatibility Requirements and continuity of equipment supply and the safety of the operating staff.

The contractor is required to optimize generation of electricity in terms of kWh generated per kWp of PV capacity installed vis-à-vis available solar irradiation at the site (may be obtained through use of efficient electronics, lower cable losses, maximization of power transfer from PV modules to electronics and the grid, maximization of power generation by enhancing incident radiation by optional methods like seasonally changing tilt angles etc.).

The system shall be designed such that personnel without any background knowledge in Microprocessor-based technologies are able to operate the system. The operator interface shall be intuitive such that operating personnel shall be able to operate the system easily after having received some basic training.

ARRAY STRUCTURE

Structural material shall be corrosion resistant and electrolytic ally compatible with the materials used in the module frame, its fasteners, and nuts and bolts. Galvanizing should meet ASTM A-123 hot dipped galvanizing or equivalent which provides at least spraying thickness of 70 microns on steel as per IS5905, if steel frame is used.

Aluminum frame structures with adequate strength and in accordance with relevant BIS/ international standards can also be used.

Structures shall be supplied complete with all members to be compatible for allowing easy installation at the site.

The structures shall be designed to allow easy replacement of any module. Each panel frame structure will be so fabricated as to be fixed on the ground. The structure should be capable of withstanding a wind load of 200 km/hr after grouting & installation.

The front end of the solar array must be one meter above the Ground. Grouting material for SPV structure shall be as per M20 concrete specification. The structures shall be designed for simple mechanical and electrical installation. There shall be no requirement of welding or complex machinery at the installation site. If prior civil work or support platform is absolutely essential to install the structures, the supplier shall clearly and unambiguously communicate such requirements along with their specifications in the bid. Detailed engineering drawings and instructions for such prior civil work shall be carried out prior to the supply of goods.

The contractor shall specify installation details of the PV modules and the support structures with appropriate diagrams and drawings. Such details shall include, but not limited to the following;

- a. Determination of true south at the site
- b. Array tilt angle to the horizontal, with permitted tolerance
- c. Details with drawings for fixing the modules
- d. Details with drawings of fixing the DCDB, ACDB/AC Energy meter etc..
- e. Interconnection details inside the DBs
- f. Structure installation details and drawings
- g. Electrical grounding (earthing)
- h. Inter-panel/Inter-row distances with allowed tolerances and
- i. Safety precautions to be taken.

The array structure shall support SPV modules at a given orientation and absorb and transfer the mechanical loads to the columns properly. All nuts and bolts shall be of very good quality stainless steel.

The design of mounting structures with fixed tilt shall be provided. The array structure shall be so designed that it occupies minimum space without sacrificing the output from SPV panels due to shadowing, orientation or tilt at the same time.

INVERTER / POWER CONDITIONING UNIT

String inverter configuration with required AC output shall be provided with design. Technical data sheet of the inverter proposed for the project indicating operating modes, protection, efficiency etc. should be provided by the bidder.

Common Technical Specification of the inverter shall be as follows:

- Power Conditioning Unit (PCU), grid interactive in nature, shall consist of MPPT controller, inverter of rating 100 kW, associated control and protection devices etc. all integrated into PCU. It shall provide necessary protections for Grid Synchronization and Data Logging/Monitoring. The PCU should convert DC power produced by SPV modules in to AC power and must synchronize automatically its AC output to the exact AC Voltage and frequency of Grid.
- The bidder may choose the inverter as string as per their Design/ Project Philosophy.
- The DC energy produced has to be utilized to maximum and supplied to the bus for inverting to AC voltage to extract maximum energy from solar array and provides 3-ph, 415V AC/ (+15% to – 10%), 50+/-3 Hz with total harmonic voltage distortion less than 3% to synchronize with local grid . DC voltage ripple content shall be not more than 3%
- The PCU shall be of very high quality having efficiency not less than 97% and shall be capable of running in integrated mode.
- Degree of protection of the outdoor at least IP-65
- Nuts & bolts and the inverter enclosure shall have to be adequately protected taking into consideration the atmosphere and weather prevailing in the area.
- The PCU shall be designed for continuous, reliable power supply as per specification.
- The PCU should be designed to be completely compatible with the SPV array voltage and Grid supply voltage.
- The dimension, weight, foundation details etc. of the PCU shall be clearly indicated in the detailed technical specification.
- The PCU shall be capable of complete automatic operation, including wakeup, synchronization & shut down independently& automatically.
- Both AC & DC lines shall have suitable fuses, Metal Oxide Arrestors/surge arrestors and contactors to allow safe start up and shut down of the system. Fuses used in the DC circuit should be DC rated.
- PCU shall operate in sleeping mode when there will no power connected.

Protections:

- Over voltage both at input & output.
- Over current both at input & output.
- Over/under grid frequency.
- Heat sink over temperature.
- Short circuit.
- Protection against lightening.
- Surge arrestors to protect against Surge voltage induced at output due to external source.
- Anti- Islanding Protection

It should have user friendly LCD display for viewing on line parameters such as:

- Inverter per phase Voltage, current, kW, kVA and frequency,
- Grid Voltage and frequency,
- Inverter (Grid) on Line status,
- PV panel voltage,
- Solar charge current and ambient temperature,
- Individual power stage heat sink and cabinet temperature,
- Solar Radiation (with external pyrometer with in scope)
- Inverter Import export kWh summation
- Solar kWh summation
- Inverter on
- Grid on
- Inverter under voltage/over voltage
- Inverter over load
- Inverter over temperature.
- Current time and date
- Time active
- Time disabled
- Time Idle
- Over frequency, under frequency, ground fault

The PCU shall have arrangement for adjusting DC input current and should trip against sustainable fault downstream and shall not start till the fault is rectified.

A manual disconnect switch beside automatic disconnection to grid would have to be provided at utility end to isolate the grid connection by the utility personal to carry out any maintenance. This switch shall be locked by the utility personal.

The 3 phase PCU shall be from internationally reputed firms, which will incorporate latest Technological advance to provide highly reliable and efficient energy conversion from DC to AC.

PCU shall be capable to synchronize independently & automatically with Discom grid power line frequency to attain synchronization and export power generated by solar plant to grid (when it is operating).

Typical failure analysis report of PCUs and recommended list of critical components shall be provided by the bidder while submitting their offer.

The PCU shall be capable of operating in parallel with the grid utility service and shall be capable of interrupting line fault currents and line to ground fault currents.

The PCU shall be able to withstand an unbalanced load conforming to IEC standard and relevant Indian electricity condition. The PCU shall include appropriate self-protective and self-diagnostic features to protect itself and the PV array from damage in the event of PCU component failure or from parameters – beyond the PCU's safe operating range due to internal or external causes. The self-protective features shall not allow signals from the PCU front panel to cause the PCU to be operated in a manner which may be unsafe or damaging. Faults due to malfunctioning within the PCU, including commutation feature, shall be cleared by the PCU protective devices and not by the existing site utility grid service circuit breaker.

Detailed technical description of the complete unit of offered PCU should be furnished with bid document Following Technical documents of PCU shall be supplied for approval after placement of order.

Detailed technical description of the complete unit

- o Instructions for installation and operation
- o Electrical diagrams of all internal cabling, necessary for installation, maintenance and fault finding.
- o Description of electrical and mechanical characteristics of units.
- o Maintenance and fault finding procedures.

- Safety precautions.
- Data monitoring with detailed description.
- Details of data acquisition
- Factory test reports in details on various parameters.
- Trouble shooting procedures.
- All maintenance requirements and their schedules, including detailed instructions on how to perform each task.
- Detailed schematics of all power instrumentation and control equipment and subsystems along with their interconnection diagrams. Schematics shall indicate wiring diagrams, their numbers and quantities, type and ratings of all components and subsystems.
- A detailed bill of materials which shall list components model numbers, quantities and manufacturer of each supplied item.
- All documents and write ups shall be in English. They shall be clean and legible, and must be checked, signed, approved and dated by a competent representative of the contractor.

The Bidder shall provide data sheet for Power Conditioning Unit along with their offer as per Guaranteed Technical Particular

COMMON TECHNICAL SPECIFICATION:

DC DISTRIBUTION BOARD (DCDB)

DC distribution board shall be provided in between solar array and PCU. It shall have MCCB of suitable rating for connection and disconnection of array section. It shall have DC SPD and array combiner unit (AJB). The DCDB Enclosure shall be suitable for outdoor use with IP 65 standard.

AC DISTRIBUTION BOARD (ACDB)

The AC power output of the inverter shall be fed to the ACDB (metering panel & isolation panel) which also houses energy meter. AC SPD and AC MCB of suitable rating shall have integrated.

Nominal AC output voltage and frequency

415 V, 3 Phases, 50Hz

Accuracy of AC voltage control $\pm 1\%$

Output frequency 50 ± 3 Hz

Accuracy of frequency control ± 3 Hz

Grid Frequency Control range ± 3 Hz

Continuous rating 20 KW inverter

Input Operating voltage range 300 to 1000 V

Nominal Power 20 kW

Standard conformation: IEC 61683

Total Harmonic Distortion less than 3%

Power Control MPPT Dual

Ambient temperature -10 0C to 55 0C

Humidity 95 % non- condensing

Protection of Enclosure IP-65 (minimum)

Grid Voltage tolerance -10 % and + 15 %

Power factor control 0.95 inductive to 0.95 capacitive

No-load losses < 1% of rated power

Inverter efficiency (minimum) 97%

Maximum current ripple 3%

Modifications/ addition if any, in existing L T panel of GRSE Ltd. shall be done at site and covered in scope of Bidder. Also required size cable and other equipment between existing panels to solar AC distribution panel is covered in scope of Bidder.

WIRING:

All instruments and Panel wiring shall be of heat resisting and self-extinguishing type in compliance with IS. Plastic or porcelain cleats of the limited compression type shall be used for holding wiring runs. All wires shall be suitable for bending to meet the terminal studs at right angles. Metal cases of all apparatus mounted on panels shall be separately earthed by means of copper wire or strips.

The following color scheme of the wiring shall be used as per IS: 375.

- a) AC three phase circuits:
- b) No.1 Phase: Red.
- c) No.2 Phase: Yellow.
- d) No.3 Phase: Blue
- e) Neutral Conductor: Black
- f) Connection to Earth: Green
- g) D.C. circuits: Grey

CABLES AND ACCESSORIES

Only copper conductor cables of reputed make shall be used in DC side of plants between interconnection of MODULES, JUNCTION BOX, PCU, LT Interfacing panel/ DC panel and other associated equipments.

The wiring for module inverters connection shall be with hard PVC conduit of renowned make. All Tees, Bends etc., shall also be renowned make.

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

- a) Will meet IS 694/1554 standards
- b) Temp. Range –10 degree centigrade to +80 degree centigrade.
- c) Voltage rating 660/1100V
- d) Excellent resistance to Heat, Fire, oil, cold, water, abrasion, UV radiation.

Flexible Cabling on DC side of the system shall be as short as possible to minimize the voltage drop in the wiring. Components and hardware shall be vandal and theft resistant. All parts shall be corrosion resistant. The system description, general/technical requirements etc. are given for general guidance only.

CABLE ACCESSORIES

- Only terminal cable joints shall be accepted. No cable joints to join two cable ends shall be accepted.
- Cables inside the control room shall be laid in suitable Cable Trays of approved type.
- Cable terminations shall be made with suitable cable lugs & sockets etc., crimped properly and passed through brass compression type cable glands at the entry and exit point of the cubicles. The panels' bottoms should be properly sealed to prevent entry of snakes/lizard etc. inside the panel.
- The terminal end of cables and wires are to be fitted with good quality letter and number ferrules of proper sizes so that the cables can be identified easily.

EARTHING

- Each array structure of the SPV shall be grounded properly. The array structure are to be connected to earth pits as per IS standards. Junction boxes, lighting conduits shall be connected to the main earthing conductor/ electrode.
- Earthing system installation shall be in strict accordance with the latest editions of Indian Electricity Rules, relevant Indian Standards and code of practices and the local statutory authority regulations.
- Neutral points of system metallic enclosures and frame works, not forming part of electric supply shall be connected to main earthing system.
- Necessary Test Point provision shall be made for bolted isolating joints of each earthing pit for periodic checking of earth resistance.
- In compliance to Rule 33 and 61 of Indian Electricity Rules, 1956 (as amended up to date) all non-current carrying metal parts shall be earthed with two separate and distinct earth continuity conductors to an efficient earth electrode.
- Earth resistance of the earth pits shall be tested in presence of the representative of KSEBL Ltd.
- Earthing Layout: The contractor shall submit to Implementation Officer/Engineer-in-Charge. earthing drawings showing the location of earthing conductors, for their approval.

LIGHTNING & OVER VOLTAGE PROTECTION

The SPV Power Plant should be provided with Lightning and over voltage protection connected to proper earth mats. The main aim of over voltage protection is to reduce the over voltage to a tolerable level before it reaches the PV or other subsystem components. The source of over voltage can be lightning or other atmospheric disturbance.

The bidder shall ensure adequate lightning and over voltage protection to provide an acceptable degree of protection as per IS for the array.

The lightning Masts / Conductors shall be made as per applicable Indian Standard/International Standard in order to protect the entire Array Yard/ Shed from Lightning stroke.

Necessary concrete foundation for holding the lightning conductor, in position, to be made after giving due consideration to maximum wind speed and maintenance requirement at site in future.

The lightning masts / conductor shall be earthed through flats and connected to the Earth mats as per applicable Indian Standards with earth pits. Each Lightning Conductor shall be fitted with individual earth pit as per required Standards including accessories, and providing masonry enclosure with cast iron cover plate having locking arrangement, watering pipe using charcoal or coke and salt as per required provisions of IS.

Design calculations and detailed explanations (in 4 sets) shall be provided for approval of **Implementing Officer/Engineer in Charge**, within 15 days of order.

POWER QUALITY REQUIREMENTS:

(i) DC Injection into the grid: The injection of DC power into the grid shall be avoided by using an isolation transformer at the output of the inverter. It is proposed to limit DC injection within 1% of the rated current of the inverter as per IEC 61727. The system shall have to pass the test process of KSEBL.

(ii) Harmonics on AC side

- a. Harmonic distortion is caused principally by non-linear load such as computers, printers, photo copier etc. and can affect the operation of a supply system and can cause overloading of equipments such as capacitors, or even resonance with the system leading to oversteering (excessive voltage & current). Other effects are interference with telephone circuits and broadcasting, metering errors, overheating of rotating machines due to increased iron losses (eddy current effects), overheating of delta connected winding of transformer due to excessive third harmonics or excessive exciting current.
- b. The limits for harmonics shall be as stipulated in the CEA Regulations on grid connectivity which are as follows:
 - Total Voltage harmonic Distortion= 5%
 - Individual Voltage harmonics Distortion=3%
 - Total Current harmonic Distortion=8%

iii. **Voltage Unbalance**-The Voltage Unbalance in the grid shall not exceed 3.0%.

iv. Voltage Fluctuations

- a. The permissible limit of voltage fluctuation for step changes which may occur repetitively is 1.5%.
- b. For occasional fluctuations other than step changes the maximum permissible limits is 3%.
- c. The limits prescribed in (i) and (ii) above shall come into force not later than five years from the date of publication of these regulations in the Official Gazette.

The system shall have to pass the test process of KSEBL.

COMMUNICATION INTERFACE:

(i) The project envisages a communication interface which shall be able to support

- Real time data logging
- Event logging
- Supervisory control
- Operational modes

- Set point editing

(ii) The following parameters shall also be measured and displayed continuously.

- Solar system temperature
- Ambient temperature
- Solar irradiation/isolation
- DC current and Voltages
- DC injection into the grid (one time measurement at the time of installation)
- Efficiency of the inverter
- Solar system efficiency
- Display of I-V curve of the solar system
- Any other parameter considered necessary by supplier of the solar PV system based on prudent practice.

iii. The communication interface shall be an integral part of inverter and shall be suitable to be connected to local computer and also remotely via the Web using either a standard modem or a GSM / WIFI modem. (Optional)

WARRANTY

- The O&M warranty for entire plant shall be 5 years. After 5 years the contractor shall have extend the warranty by means of AMC (Annual Maintenance Contract)
- SPV systems used in solar power plants must be warranted for their output peak watt capacity, which should not be less than 90% at the end of 10 years and 80% at the end of 25 years.

QUALITY ISSUES

Contractor will submit and get finalized detailed comprehensive Standard Field Quality Plan (SFQP) within 30 days from date of issue of the order for bought out items and items manufactured by them. The Standard Field Quality Plan shall relate to the specific and objective erection practices right from storage of equipment till final inspection and testing to be followed for bought out items and items manufactured by Contractor. Accordingly, the Manufacturing Quality Plan shall be submitted broadly under following sub-heads:-

- Raw material/Bought Out items and Components.
- In process inspection and test/checks to establish successful completion/accomplishment of the process.
- Final tests/checks in accordance with relevant national/ international standards/specification.
- The quantum of check for each and every inspection/test items shall be based on an established sampling method and the quantum of check indicated in the SFQP should be designed adequate quality protection.
- In case reference documents/acceptance norms are indicated as per plant standards then the same shall be duly substantiated/properly explained by well-established and proven engineering practices. All submissions will be in English language only.
- Bidder will to allow implementation Officer/Engineer In Charge. to carry out Quality/Audit/Quality surveillance on bidders and our sub-vendor's work with reference to contractual obligations to ensure that the quality management practices/norms as detailed out in the Quality Manual are adhered to. To facilitate this activity, you shall keep GRSE Ltd. informed all progress of work in this contract on monthly basis.
- Contractor will associate/fully witness in each inspection being carried out at their/their sub vendor's works by our authorized inspection engineer(s).
- A detailed 'QAP' for Manufacturing and Inspection shall be submitted by the Bidder for approval of Implementation Officer/Engineer in Charge
- The shop test shall be carried out to prove the performance parameters of the offered model. The testing shall be done in the presence of the Engineer in Charge/ Implementation officer towards inspection of stage manufacturing and testing at works of SPV module and PCU to be made by the agency. The notice of such inspection shall be given well in advance in case of countries outside India and 15 days in India.
- Manufacturer has to submit procedure for Test carried out at their Factory.

DRAWINGS TO BE FURNISHED BY BIDDER AFTER AWARD OF CONTRACT

The Contractor shall furnish the following drawings and obtain approval.

- General arrangement and dimensioned layout

- Schematic drawing showing the requirement of SV panel, Power conditioning Unit(s), Junction Boxes, AC and DC Distribution Boards, meters etc.
- Structural drawing along with foundation details for the structure
- Itemized bill of material for complete SPV plant covering all the components and associated accessories.
- Overall layout showing SPV Plant and SLD
- Format for reports and charts for analysis of various parameters

ERECTION, TESTING & COMMISSIONING

- The installation shall be carried out by an electrical contractor holding a valid license as required by the State Government Authorities.
- The contractor shall provide necessary drawings and documents required by statutory authorities and obtain the approval before taking up erection. It shall be the sole responsibility of the contractor in obtaining safety certificate / approval from local statutory authorities, if required.
- Any modification in the equipment or installation that may be demanded by the inspecting authorities shall be carried out by the contractor at no additional cost.
- In accordance with the specific installation instruction as per the manufacturers drawings or as directed by Engineer in Charge/Implementation Officer, the successful Bidder shall unload, assemble, erect, install test, commission and hand over all electrical equipments included in this contract.
- Erection materials including all consumables, tools, testing instruments or any other equipment required for successful commissioning shall be arranged by the successful Bidder in a timely manner.
- Clearing the site after completion of erection as well as regular clearance of unwanted materials from site.
- All equipment and instruments, indoor and outdoor, shall be marked with Numbers and provided with suitable danger boards as per Indian electricity Rules/code etc. before commissioning.
- The contractor shall touch up the surface with paint of same shade for equipments, which are scratched and / or damaged during transportation and erection before commissioning.
- The contractor shall employ skilled and semi-skilled laborers for erection, testing and commissioning as required. All the electricians, cable jointers, wiremen, welders and others employed shall possess valid certificates / license recognized by competent authorities.
- The contractor shall set up his own facilities at site at allocated place to undertake fabrication/assembly jobs etc.
- The Contractor shall carry out major civil engineering works as called for in scope of work pertaining to electrical equipment's like foundation for modules structures control rooms for Operation staff etc. as per the latest relevant drawings. In doing so if any minor civil works such as foundation bolts, cutting holes in walls, chipping of floor and ceiling etc. making good the same after installation of the equipment arise the same will also be carried out without any extra charges.
- During erection, care is to be taken to see that painting does not peel off at any place and if so, it has to be given a 'Touch-up' after erection by the contract.

PREPARATION OF THE EQUIPMENT FOR TESTING

- After completion of the installation at site and for the preparation of plant commissioning, the contractor shall check all the equipment and installation in accordance with the agreed standards, latest relevant code of practices of Indian Standards and specific instructions furnished by the particular equipment suppliers as well as purchaser.
- Checking required to be made on all equipment and installations at site shall comprise, but not limited to, the following:
 - Physical inspection of Modules for removal of any foreign bodies, external defects, such as damaged, loose connection in Junction Boxes & PCU etc. loose foundation bolts etc.
 - Check for the free movement of mechanism for the circuit – breaker, rotating parts of the rotating machines and devices.
 - Check for tightness of all cable joints and busbar termination ends as well as earth connections in the main earthing network.
 - Check for clearance of live bus bars and connectors from the metal enclosure.
 - Check for proper alignment of all the modules etc.
 - Continuity checks in case of power and control cables.
 - Checking of all mechanical and electrical interlocks including tripping of breakers using manual operation of relay.

- Checking of alarm and annunciation circuits by manual actuation of relevant relays.
- Check and calibrate devices requiring field adjustment/calibration like adjustment of relay setting etc.
- Check for proper connection to earth network of all non-current carrying parts of the equipment and installation.

The relevant tests shall be carried out in accordance with relevant IS of latest issue. The tests which are to be carried out on the equipment shall include, but not be limited to, the following:

Check for completeness of installation

- Each pole to earth insulation resistance test.
- Cables
- Continuity of all the cores, correctness of all connections as per wiring diagram, correctness of polarity and phasing of power cables and proper earth connection of cable glands, cable boxes, armour and metallic sheath, shall be checked.
- Earthing
- Tests to ensure continuity of all earth connections.
- Tests to obtain earth resistance of the complete network by using earth tester. The test values obtained shall be within the limits (less than 3 ohms).

SPECIFICATION FOR TESTING & COMMISSIONING

- The testing and commissioning for all electrical equipment at site shall be according to the procedures listed below:
- All electrical equipment shall be tested, installed and commissioned in accordance with the latest relevant standards and code of practices published by Indian Standards Institution wherever applicable and stipulations made in relevant general specifications.
- The testing of all electrical equipment as well as the system as a whole shall be carried out to ensure that the equipment and its components are in satisfactory condition and will successfully perform its functional operations. The inspection of the equipment shall be carried out to ensure that all materials, workmanship and installations conform to the accepted design, engineering and construction standards, as well as accepted code of practices and stipulations made in the relevant general specifications.
- The contractor in the presence of implementation officer/ Engineer in Charge shall organize all tests using their own calibrated instruments, testing equipment as well as qualified testing personnel (Electrical Inspectorate & KSEBL TMR)
- The results of all tests shall conform to the specification requirements as well as any specific performance data, guaranteed during finalization of the contract and also in with KSEBL test process.

SYSTEM DOCUMENTATION:

It is essential that the owner have complete documentation on the system. System Documentation should include an owner's manual and copies of relevant drawings for whatever system maintenance might be required in the future.

INSTALLATION

PV Installation shall be done by licensed engineer who has adequate experience with installation of the PV system.