Thrissur Corporation Electricity Department (TCED)

Request for Proposal

For

Design, Supply, Installation, Testing, Commissioning and O&M of 130 KWp Grid Connected Solar Power Plant at Sakthan

SUMMARY

PART I – BIDDING PROCEDURES AND REQUIREMENTS

Section 1: Request for Proposals (RFP) Notice

This Section includes Request for Proposals.

Section 2: Eligibility and Qualification Requirements

This Section contains information regarding specific eligibility and qualification requirements applicable for prospective bidders to be considered for further evaluation of their proposal.

Section 3: Project Requirements and Specifications

This Section describes the System Requirement, Specifications, Quality Requirements, Standards, Activities and Tasks, Plans, Deliverables, Documentation, and other requirements/ details related to and/or connected with the Project.

Section 4: Project Scope of Work

This Section describes the background information of the Project, Scope, of Work, Operation and Maintenance of equipment, Bill of Materials and other requirements/ details related to and/or connected with the Project.

PART II – CONDITIONS OF CONTRACT AND FORMS

Section 5: Conditions of Contract and Forms

This Section includes standard contract form. It includes General Conditions of Contract ("GCC"), payment method and Special Conditions of Contract ("SCC"). The SCC include clauses specific to this contract to supplement the General Conditions.

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PART I – BIDDING PROCEDURES AND REQUIREMENTS

Section-1: Request for Proposal Notice

"Design, Supply, Installation, Testing and Commissioning of 130 KWp Solar Power Plant at Sakthan"

PROCUREMENT NOTICE

(Single Stage Two-Envelope Bidding Process with e-Procurement)

NATIONAL OPEN COMPETITIVE PROCUREMENT

Contract Title: "Design, Supply, Installation, Testing , Commissioning and O&M of 130 KWp Solar Power Plant at Sakthan''

Request for Proposal (RFP)/ Tender Number: PDS-5568/24

Issued on: 14/08/2024

Thrissur Corporation Electricity Department (hereinafter also referred to as 'Utility' or TCED) invites online Proposals for "Design, Supply, Installation, Testing , Commissioning and O&M of 130 KWp Solar Power Plant at Sakthan". Bidders are advised to note the clauses on Eligibility and Qualification Requirements in Section-2 and Evaluation Criteria in Section-3 of the RFP Document for evaluation of Proposals.

1. Bidding for selection of supplier will be conducted through National open competitive procurement.

2. The RFP Document is available online on https://etenders.kerala.gov.in from [14/08/24] to [05/09/24] on payment of cost of document (Tender Fee) as indicated in the TABLE below. The prospective Bidders would be responsible for downloading the RFP Document and ensuring that any addenda/ corrigendum/ amendment/ clarification thereto available on the website is also downloaded and incorporated.

3. The bidding shall be conducted **under Single Stage Two-Envelope Bidding process with e-Procurement.**

4. Under the Single Stage Two-Envelope Bidding process, the Bidder shall not quote, disclose, or submit its price in the Technical Proposal (First Envelope) or in any other manner, whatsoever, except as part of the Financial Proposal (Second Envelope). In case of any non- compliance in this regard, the Proposal shall be out-

rightly / summarily rejected.

5. Technical proposal shall contain the scanned copies of the following documents which every bidder has to upload.

   i. PartI &II of the tender documents downloaded from the website.

   ii. Agreement in the prescribed format (Annexure I-D)on Govt.of Kerala stamp paper worth Rs.200/--

   iii. Copy of Registration Certificate of the bidder firm.

   iv. Copy of the work orders and certification from the Purchase regarding execution of the order,to prove the experience in executing similar orders, as specified.

   V. Documents to prove the Turnover of the bidder.

   vi. Details of the technical offer, including test certificates issued in the name of the bidder.

   vii. List of Service centres within Kerala with full address and phone nos.(or the required undertaking)

   viii. Summary of Bid Qualification Requirements (Format as in Annexure I-C)

   ix. Declaration by the Bidder (format as in Annexure-II-E)

   x. Statement of Deviations (format as in Annexure-II- F)

   xi. Declaration for Deviations (format as in Annexure-II-G)

   xii. Declaration of Subsidy Claim (format as in Annexure-II-H)

6. Envelop-2: shall contain the Price Schedule as per BOQ in Excel format for this tender to be downloaded from e-tender website, duly digitally signed by the tenderer/authorised signatory of the tenderer**.**

7. The department doesn't take any responsibility for any technical snag or failure that has taken place during document upload.

8. An incomplete and/or ambiguous and/or conditional Proposal and/or Proposal submitted late is liable to be ignored/ summarily rejected.

9. Proposal must be submitted online through the e-Procurement/ e-Tendering process specified in Section 3. Any Proposal or modifications to Proposal received outside the e-Procurement system will not be considered, unless otherwise specified in Section 3. Utility shall not be held liable for any delays due to e-Procurement/ e-Tendering system failure beyond its control. Even though the system will attempt to notify the bidders of any bid updates, Utility shall not be liable for any information not received by the bidder. It is the bidders' responsibility to verify the website for the latest information related to this RFP.

10. Important dates, amounts and other details pertaining to this RFP Notice including submission and opening of proposal, cost of documents/ Tender Fee, address for communication, etc., are given in the TABLE below.

11. If TCED office happens to be closed on the specified date of opening of the Proposals, the Proposals / bids will be opened on the next working day at the same time and venue or as may be notified by TCED.

12. The quotes for the Design, Supply, Installation, Testing & Commissioning including 5 years of warranty (EPC Part), and the quote for the 5-year Operation and Maintenance (O&M part) to be provided by the bidders. The L1 bidder will be selected based on their quotes on the EPC part with 5-year

warranty and the O & M quote will be part of evaluation.

13. Other details can be seen in the RFP document.

TABLE

Other Details

A.	Address for Communication including Contact details: Assistant Secretary, Electricity Department, Thrissur Corporation Thrissur – 680 001 e-mail: astced.lsgd@kerala.gov.in, electricitydepartment@yahoo.co.in
B.	Payment of cost of document/ Tender Fee: **1.** Tender Fee shall be made in the form of A/C payee demand draft in favour of TCED or RTGS payable at Thrissur drawn on any Scheduled Commercial Bank. 2. Tender Fee (or its receipt in case of RTGS payment) and Bid Security must be submitted in physical form in a sealed envelope at address given above, before the Bid Submission Deadline. The sealed envelope shall be clearly marked on the top as "Tender Fee for **"Design, Supply, Installation, Testing, Commissioning and O&M of 130 KWp Solar Power Plant at Sakthan**'' 3. Any Bid not accompanied by a Tender Fee as above shall be rejected by TCED as non- responsive. 4. Tender Fee is non-refundable
C.	Other Payments or Bank Guarantees for the RFP/ Contract shall be as per the terms and conditions defined in this RFP Document

Section-2: Eligibility and Qualification Requirements

BID QUALIFICATION REQUIREMENTS

1. Every tenderer should submit along with his e-tender an Earnest Money Deposit (EMD) unless exempted. This may be done electronically from any of the Nationalized/Scheduled Banks. The EMD of the disqualified tenderers will be returned automatically through e-procurement system. The EMD of the successful tenderers may be adjusted towards the security deposit. No interest shall be paid for the earnest money deposit.
2. An agreement in Rs.200/-worth Kerala stamp paper as per the format given in Annexure I-D must be submitted as a hardcopy to Electricity Department, Thrissur Corporation, Thrissur before the dcadline for submission of e-tender.
3. Bidder must submit valid test certificates of the components (solar PV module and solar inverter)proposed to be supplied/used.Bids without valid IEC test certificates will be rejected. Undertaking from the manufacturers instead of valid IEC Test Certificates shall not be accepted
4. The bidder should have successfully installed solar photovoltaic power plants (Off-Grid and On-Grid)of at least 1MWp aggregate capacity in the last 3 years, out of which at least 500kWp plant should be a Grid connected SPV Power Pant (without Battery).The bidder should complete at least one project out of on grid of capacity 100 KWp or more in as a single project.Copy of work order & bills/certification from the purchaser regarding execution of the order should be submitted as a proof of executing the supply.
5. Annual turnover of the bidder should be at least Rs:500 lakh,in any of the three years in last 5 years. Documentary evidence has to be submitted in the form of certified copies of Audited Statement of Accounts/Profit and Loss Accounts or Sales Tax returns statement or certification from the Statutory Auditor.
6. Vendor should have at least one service centre/authorized service provider in Kerala.Detailed list with address,contact details and proof has to be submitted. If the bidder does not have such facility at the time of tendering, an undertaking agreeing to set up and intimate the same within 15 days of letter of intent should be enclosed.
7. The bidder should submit a valid PV Simulation Report for energy yield Data along with Technical Offer.The PV Power plant should be designed with quality components (PV Modules,Inverters etc.) So as to obtain a minimum Performance Ratio

(PR)of 80% or above during commissioning.TCED will verify the PV Simulation Reports for its authenticity.

8. Electrical Works (Installation, Testing and Commissioning of RMU, HTCable, Transformer, LTDB, LTCable etc.) shall be carried out by a "A Grade Licensed contactor". The Electrical contractor shall have sufficient experience in same works and proof for the experience shall be attached.

Section 3: Project Requirements and Specifications

3.1: System Components- Technical Compliance for System Components

S/N	System Component	Capacity/ rating	Minimum Technical Compliance
1.	Solar panel (MONO PERC Half cut of capacity 640 Wp or above)	As per the required capacity	IS 14286 -Design Qualification and Type Approval for Crystalline Silicon Terrestrial Photovoltaic (PV) Modules
			IEC/IS 61730: Part I& II;
2.	Grid Tied Inverter	As per the required capacity	IS 16221: Part 1 &2- Safety of Power Converters for use in Photovoltaic Power Systems
			IS 16169 - Test Procedure of Islanding Prevention Measures for Utility- Interconnected Photovoltaic Inverters
3.	Module Mounting Structure	As per the required capacity	IS 2062 - Hot Rolled Medium and High Tensile structural Steel
			IS 4759 - Hot-dip Zinc Coatings on structural steel and other products
4.	Cables	As required	IEC 60227 / IS 694
			IEC 60502 / IS 1554 (Pt. I & II)
5.	Switches/ Circuit Breakers	As required	IEC 60947 part I, II, III /IS 60947 PartI, II, III
6.	Connectors		EN 50521
7.	Surge Protection Device		IEC 60364-5-53 / IS 15086-5
8.	Junction Boxes/Enclosures for Inverters/ Charge Controllers	As required	IP 54 (for indoor) or IP 65 / IP 21(for outdoor) as per IEC 529

9.	Energy Meter for Recording Solar Electricity Generated & Two-way meter for Distribution Licensee grid connection		As per CEA Regulations; IEC 60687/ IEC 62052- 11 / IEC62053-22 / IS 14697
10.	Lightning Protection	As required	As per IEC 62305 / IEC 62561
11.	Electrical Grounding (Earthing)	As required	As per IS 3043

3.2.STANDARDS AND REGULATIONS TO BE COMPLIED

The connectivity should be as per

a. Technical Standards for connectivity of the Distributed generation resources, Regulation, 2013.

b. KSERC (Grid interactive Distributed Solar Energy Systems) Regulations, 2014.

c. Central Electricity Authority (Measures relating to Safety and Electric Supply) Regulations, 2023 has to be followed safely and Electricity Supply.

d. Metering should be as per CEA regulation 2006.

e. MNRE guidelines

f. Any amendments thereof will also be applicable.

3.3: SPV MODULES

Only the PV modules with MONO PERC Half cut cells of module capacity 540 Wp or above listed in the ALMM list issued by MNRE from time to time are to be used. However, the specifications for the PV Module are detailed below:

3.3.1 The PV modules must be PID compliant, salt, mist & ammonia resistant and should withstand weather conditions for the project lifecycle.

3.3.2 The back sheet of PV modules shall be with minimum of three layers with outer layer (exposure to ambience) and shall be made of PVDF or PVF. The Back sheets for PV Module with 2 layered or 3 layered Polyester types or the back sheets with Polyester (PET type) at Air side material are not permitted for the empanelment; The minimum thickness of the core layers (without adhesive and inner EVA coated) must be 300 microns. The maximum allowed water vapour transmission rate shall be less than 2 g / m2/day and shall have a Partial Discharge > / = 1500V DC

3.3.3 The front glass shall meet the following specifications:

a. The facing glass must be Tempered, PV grade with Low iron and high transmission.

b. The transmission shall be > 93 %

c. Thickness shall be min 3.2 mm

d. Textured to trap more light

e. The glass shall have an Anti-reflective coating for the better transmission and light absorption.

f. Tempered glass to meet the external load conditions

3.3.4 The encapsulant used for the PV modules should be UV resistant in nature. No yellowing of the encapsulant with prolonged exposure shall occur. The sealant used for edge sealing of PV modules shall have excellent moisture ingress Protection with good electrical insulation and with good adhesion strength. Edge tapes for sealing are not allowed.

3.3.5 Anodized Aluminium module frames of sufficient thickness shall be used which are electrically & chemically compatible with the structural
used for mounting the modules having provision for earthing.

3.3.6 UV resistant junction boxes with minimum three numbers of bypass diodes and two numbers of MC4 connectors or equivalent with appropriate length of 4 sq.mm Cu cable shall be provided. IP67 degree of protection shall be used to avoid degradation during Life.

3.3.7 Shading correction/ bypass diode for optimizing PV out to be incorporated in each solar module or panel level.

3.3.8 Each PV module used in any solar power project must use a RF identification tag (RFID), which must contain the following information. The RFID can be inside or outside the module laminate but must be able to withstand harsh environmental conditions.

a. Name of the manufacturer of PV Module
b. Name of the manufacturer of Solar cells
c. Month and year of the manufacture (separately for solar cells and module) d. Country of origin (separately for solar cell and module)
e. I-V curve for the module.
f. Peak Wattage, IM, VM and FF for the module
g. Unique Serial No. and Model No. of the module
h. Date and year of obtaining IEC PV module qualification certificate i. Name of the test lab issuing IEC certificate
j. Other relevant information on traceability of solar cells and module as per ISO 9000 series

3.3.9 The following details should be provided on the module

a. Name of the manufacture
b. Month and year of manufacture
c. Rated Power at STC
d. VMP, IMP, VOC, Isc

3.3.10 The successful bidder shall arrange an RFID reader to show the RFID details of the modules transported to sites, to the site Engineer in charge up to their satisfaction, which is mandatory for the site acceptance test.

3.3.11 The PV modules must qualify (enclose Test Reports/Certificates from IEC/NABL accredited laboratory) as per relevant IEC standard. The Performance of PV Modules at STC conditions must be tested and approved by one of the IEC/NABL Accredited Testing Laboratories.

3.3.12 PV modules used in solar powerplant/ systems must be warranted for 10 years for their material, manufacturing defects, workmanship. The 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

3.3.13 Original Equipment Manufacturers (OEM) Warrantee of the PV Modules shall be submitted by the successful bidder when the material delivered at site.

3.3.14 The PV modules shall conform to the following standards:

a. IS 14286: Crystalline silicon terrestrial photovoltaic (PV) modules — design qualification and type approval.

b. IEC 61215 / IEC 61646: c-Si (IEC 61215): Crystalline silicon terrestrial photovoltaic (PV) modules - Design qualification and type approval Thin Film (IEC 61646): Design, Qualification & Type Approval.

c. IEC 61730-1: Photovoltaic Module safety qualification- Part 1: Requirements for construction.

d. IEC 61730-2: Photovoltaic Module safety qualification- Part 2: Requirements for testing.

e. IEC 61701: Salt mist corrosion testing of photovoltaic modules

f. IEC 62716: Test Sequences useful to determine the resistance of PV Modules to Ammonia (NH3).

3.3.15 The PV module should have IS14286 qualification certification for solar PV modules (Crystalline silicon terrestrial photovoltaic (PV) modules — design qualification and type approval). The exemption of this certification and other details are described, as per MNRE's Gazette Notification No. S.O. 3449 (E). Dated 13th July, 2018.

3.4: POWER CONDITIONING UNIT (PCU)

The Power Conditioning Unit shall be String Inverter with power exporting facility to the Grid.

General Specifications:

3.4.1 All the Inverters should contain the following clear and indelible Marking Label & Warning Label as per IS 16221 Part II, clause 5. The equipment shall as a minimum, be permanently marked with:

a. The name or trademark of the manufacturer or supplier.

b. A model number, name or other means to identify the equipment.

c. A serial number, code or other markings allowing identification of manufacturing location and the manufacturing batch or date within a three- month time period.

d. Input voltage, type of voltage (A.C. or D.C.), frequency, and maximum continuous current for each input.

e. Output voltage, type of voltage (A.C. or D.C.), frequency, maximum continuous current, and for A.C. outputs, either the power or power factor for each output.

f. The Ingress Protection (IP) rating.

3.4.2 The inverter output shall be 415 VAC, 50 Hz, 3 phase.

3.4.3 The inverter shall include appropriate self-protective and self-diagnostic Feature to protect itself and the PV array from damage in the event of inverter component failure or from parameters beyond the inverter's safe operating range due to internal or external causes.

3.4.4 PCU shall have the dynamic and efficient MPPT algorithm behaviour which finds maximum power point even in low light conditions. The PCU Company should be able to display this feature.

3.4.5 The PCU shall be supplied within-built advanced grid feed-in feature Along with dynamic feed-in control considering self-consumption. The PCU shall also include control functions for optimum feed-in of reactive power and effective power. The amount of reactive power injection and absorption can be controlled depending upon under/over excited systems.

3.4.6 The PCU shall have a provision of external shutdown via remote Signal separately with an in-built floating-point contact or similar option using any minimum interface which is to ensure the emergency stop function in the inverter

3.4.7 The PCU shall have a higher degree of ingress protection of IP 65 to handle robust environment conditions from dust and water ingress under complete outdoor installations.

3.4.8 The data logger should possess the feature of extracting the data externally with open protocols like Modbus TCP/RTU. The manufacturer should provide the Modbus register mapping file to utilize this feature.

3.4.9 The inverter shall have an efficient cooling concept with better power derating feature to handle higher temperatures and ensure the best efficiency. The inverter shall be able to provide full rated output power even at ambient temperatures of 50ºC. The manufacturer to provide the power derating curves to demonstrate the same.

3.4.10 The inverter shall be flexible in terms of the installation and should be capable for installation in a horizontal position facilitating easy installation for site specific requirements.

3.4.11 The inverter shall have an integrated feature of emergency stop to halt the inverter from operation considering safety scenarios.

3.4.12 The PCU manufacturer should have an authorised service centre in Kerala. The details of the service centre along with the spare list must be submitted along with the bid.

3.4.13 PCU should be able to respond smoothly to the voltage fluctuations on the low-tension grid via active & reactive power control/ support. The PCU should be able to respond separately to fulfil below mentioned:

3.4.13.1 Finding out optimisation of the system

3.4.13.2 Optimal power distribution on each phase

3.4.13.3 Prevent PCU from unnecessary disconnections

3.4.14 The PCU Company should have grid connected solar plants running in the country with inverters atleast 7 years from the time of bidding to showcase the service reliability and long-term presence. Also, the PCU should have local presence in the county for atleast last 5 years. The PCU manufacturer may need to provide authentic details to customer if asked to prove the same.

3.4.15 The Technical Specification of On-Grid Inverters are summarized below:

Specifications of Inverters	
Parameters	**Detailed specification**
Nominal voltage	230V/415V
Voltage Band	Between 80% and 110% of V nominal
Nominal Frequency	50 Hz
Operating Frequency Range	47.5 to 50.5 Hz
Waveform	Sine wave
Harmonics	AC side total harmonic current distortion < 3%
Ripple	DC Voltage ripple content shall be not more than 1%
Efficiency	Efficiency shall be >98%
Casing protection levels	Degree of protection: Min IP-65
Operating ambient Temp range	-10 to + 60 degree Celsius
Operation	Completely automatic including wakeup, synchronization (phase locking) and shutdown
MPPT	MPPT range must be suitable to individual array voltages
Protection Class	1
Protections	Over voltage: both input and output Over current: both input and output Over / Under grid frequency Over temperature Short circuit Lightning Surge voltage induced at output due to external source Islanding
Ingress Protection	IP 65
Recommended LED indications	ON Grid ON Under/ Over voltage Overload Over temperature

Recommended LCD Display on front Panel	DC input voltage DC current AC Voltage (all 3 phases) AC current (all 3 phases) Frequency Ambient Temperature Instantaneous power Cumulative output energy Cumulative hours of operation Daily DC energy produced
Communication Interface	RS485/ RS232/Wi-Fi (with or without USB)

3.4.16 The Technical Specification for Interconnection are summarized below:

Sl No	Parameters	Requirements	Reference
1	Overall conditions of service	Reference to regulations	Conditions for Supply of Electricity
2	Overall Grid Standards	Reference to regulations	Central Electricity Authority (Grid standards) Regulations 2010
3	Equipment	Applicable industry standards	IEC/EN standards
4	Safety and Supply	Reference to regulations, (General safety requirements	Central Electricity Authority (Measures of safety and electricity supply) Regulations, 2010 and subsequent amendments
5	Meters	Reference to regulations and additional conditions issued by the commission.	Central Electricity Authority (Installation & operation of meters) regulations 2006 and subsequent amendments

6	Harmonic current	Harmonic current injections from a generating station shall not exceed the limits specified in IEEE 519	IEEE 519 relevant CEA (Technical Standards for connectivity of the distributed generation resource) Regulations 2013 and subsequent amendments
7	Synchronization	Photovoltaic system must be equipped with a grid frequency synchronization device, if the system is using synchronizer inherently built into the inverter, then no separate synchronizer is required	Relevant CEA (Technical Standards for Connectivity of the distributed generation resources) regulations 2013 and subsequent amendments.
8	Voltage	The voltage-operating window should minimize nuisance tripping and should be under operating range of 80% to 110% of the nominal connected voltage. beyond the clearing time of 2 seconds, the Photovoltaic system must isolate itself from the grid	
9	Flicker	Operation of Photovoltaic system should not cause voltage flicker in excess of the limits stated in IEC61000 or other equivalent Indian standards if any	Relevant CEA regulations 2013 and subsequent if any, (Technical standards for connectivity of the distributed generation resource)
10	Frequency	When the distribution system frequency deviates outside the specified limits (50.5 Hz on upper side and 47.5 Hz on lower side) up to 0.2 sec, the Photovoltaic systems shall automatically	

		disconnect from grid and be in island mode.	
11	DC injection	Photovoltaic systemshall not inject DC current greater than 0.5% of full rated output at the interconnection point or 1% rated inverter output current into distribution system under any operating conditions.	
12	Power Factor	While the output of the inverter is greater than 50%, a lagging power factor greater than 0.9 shall be maintained.	
13	Islanding and Disconnection	The photovoltaic system in the event of voltage or frequency variations must island/disconnect itself with the time stipulated as per IEC standards	
14	Overload and overheat	The inverter should have the facility to automatically switch off in case of overload or overheat and should restart when normal conditions are restored	

3.4.17 The Certifications of On-Grid Inverters are summarized below:

Standard	Description
IS/IEC 61683: 1999	Photovoltaic systems - Power conditioners - Procedure for measuring efficiency
IS/IEC 61727: 2004 IEC 61727: 2004	Photovoltaic (PV) systems- Characteristics of the utility interface
IS 16221: Part 1: 2016	Safety of power converters for use in photovoltaic power systems - Part 1: General requirements
IS 16221: Part 2: 2015	Safety of power converters for use in photovoltaic power systems - Part 2: Particular requirements for inverters

IS 16169: 2019	Utility-interconnected photovoltaic inverters - Test procedure of islanding prevention measures
IS 16782: 2018 IEC 62910: 2015	Utility - Interconnected Photovoltaic Inverters Test Procedure for Low Voltage Ride - Through Measurements
IEC/EN 61000-3-3/ 3-11/ 3-5	Electromagnetic compatibility (EMC) - Part 3-11; Limits; Limitation of Voltage Change, Voltage Fluctuations and Flicker in Public Low- Voltage Supply Systems; Rated Current <16A / >16A and <75A / >75A per Phase respectively
IEC/EN 61000-3-2/ -3-12/ -3-4	Electromagnetic compatibility (EMC) - Part 3-12; Limits; Limits for Harmonic Currents produced by equipment connected to the public low voltage systems with Rated Current <16A / >16A and <75A / >75A per Phase respectively
*IEC/EN 61000-6-1 / 6-2	Electromagnetic compatibility (EMC) - Part 6-2: Generic standards - Immunity standard for residential and commercial / industrial environments
*IEC/EN 61000-6-3 / 6-4	Electromagnetic compatibility (EMC) - Part 6-4: Generic standards - Emission standard for residential and commercial / industrial environments
IEC 60068-2-1	Environmental testing - Part 2-1: Tests - Test A: Cold
IEC 60068-2-2	Environmental testing - Part 2-2: Tests - Test B: Dry heat
IEC 60068-2-14	Environmental testing - Part 2-14: Tests - Test N: Change of temperature
IEC 60068-2-30	Environmental testing - Part 2-30: Tests - Test Db:, Damp heat, cyclic (12 h + 12 h cycle)

***Recommended but not mandatory**

3.4.18 : FACTORY TESTING

a. PCU shall be tested prior to shipment and factory test certificate for relevant parameters should be provided with the PCU supplied. TCED officials may be allowed to witness the tests if required.

b. Factory testing shall not only be limited to measurement of phase currents, efficiencies, harmonic content and power factor, but shall also include all other necessary tests/simulation required and requested by TCED Engineers. Tests may be performed at 25, 50, 75 and 100 percent of the rated nominal power.

3.5: REMOTE MONITORING SYSTEM

A dedicated Remote Monitoring System (Hardware and software) for monitoring the plant shall be provided. It is recommended that the following important parameters shall be accessible through the Data Logging Facility.

a) AC Voltage
b) AC Output current
c) Output Power
d) Energy in kWh
e) DC Input Voltage
f) DC Input Current
g) Temperatures (C)

h) Inverter Status

Provision for Internet monitoring and download of historical data shall be incorporated. GSM Modem/Wi Fi modem in case GSM connectivity is used or Wireless Router + modem in case Ethernet connection is being used for remote access must be provided. The data is to be transmitted to TCED server and the successful bidder must undertake all the works required for such deployment including software and arrange for APIs etc.

3.6: ELECTRICAL SAFETY, EARTHING AND PROTECTION

a. All SPV system should comply with Central Electricity Authority (Measures relating to Safety and Electric Supply) Regulations, 2023.

b. Internal Faults: In built protection for internal faults including excess temperature, commutation failure, overload, and cooling fan failure (if fitted) is obligatory.

c. Over Voltage Protection: Over Voltage Protection against atmospheric lightning discharge to the PV array is required. Protection is to be provided against voltage fluctuations in the grid itself and internal faults in the power conditioner, operational errors and switching transients.

d. Earth fault supervision: An integrated earth fault device shall have to be provided to detect eventual earth fault on DC side and shall send message to the supervisory system.

e. Adequate firefighting equipment per site must be provided by the successful bidder at the sites of installation. The fire extinguishers shall be provided in the control room housing inverters as well as on the Roof or site where the PV arrays have been installed. One liquefied CO2 fire extinguisher upright type of capacity min 8 kg having IS: 2171 -7, IS: 10658. A minimum of Two Fire extinguishers to be provided for installation capacity upto 50 kW, and additional fire extinguisher per 25 KW or part of thereof to be provided by the successful bidder.

3.7: TECHNICAL SPECIFICATION FOR 11 kV/433 -250V- 250Kva, OUTDOOR, CABLE ENTRY (HT & LT) TYPE, BEE ENERGY EFFICIENCY LEVEL 1, 3 –PHASE, ALUMINIUM WOUND, DISTRIBUTION TRANSFORMER

3.7.1. SCOPE:

i) This specification covers design, engineering, manufacture, assembly, stage testing, inspection and testing before supply and delivery at site of oil immersed, naturally cooled 3 - phase 11 kV/433 - 250 V normal distribution transformers for outdoor use.

ii) The equipment shall conform in all respects to high standards of engineering, design and workmanship and shall be capable of performing in continuous commercial operation, in a manner acceptable to the purchaser, who will interpret the meanings of drawings and specification and shall have the power to reject any work or material which, in his judgment is not in accordance

therewith.

The offered equipment shall be complete with all components necessary for their effective and trouble free operation. Such components shall be deemed to be within the scope of bidder's supply irrespective of whether those are specifically brought out in this specification and / or the commercial order or not.

iii) The transformer and accessories shall be designed to facilitate operation, inspection, maintenance and repairs. The design shall incorporate every precaution and provision for the safety of equipment as well as staff engaged in operation and maintenance of equipment.

iv) All outdoor apparatus, including bushing insulators with their mountings shall be designed so as to avoid any accumulation of water.

3.7.2. STANDARDS:

The major materials used in the transformer shall conform in all respects to the relevant/specified Indian Standards and international Standards with latest amendments thereof as on bid opening date, unless otherwise specified herein. Some of the applicableIndian Standards are listed as hereunder:

Indian Standards	Title	International Standrds
IS -2026	Specification for Power Transformers	IEC 76
IS 1180 (Part- I): 2014	Outdoor Type Oil Immersed Distribution Transformers upto and including 2500kVA, 33kV-Specification	
IS 12444	Specification for Copper wire rod	ASTM B-49
	Guidelines for Specifications of Energy Efficient Outdoor type Three phase and Single phase Distribution Transformers by Central Electricity Authority	
IS-335	Specification for Transformer/Mineral Oil	IEC Pub296
IS-5	Specification for colors for ready mixed paints	
IS - 104	Ready mixed paint, brushing zinc chromate, priming	
IS-2099	Specification for high voltage porcelain bushing	
IS-649	Testing for steel sheets and strips and magnetic circuits	
IS-3024	Cold rolled grain oriented electrical sheets and strips	
IS -4257	Dimensions for clamping arrangements for bushings	
IS -7421	Specification for Low Voltage bushings	

IS -3347	Specification for Outdoor Bushings	DIN 42531 to 33
IS -5484	Specification for Al tire rods	ASTM B - 233
IS -9335	Specification for Insulating Kraft Paper	IEC 554
IS - 1576	Specification for Insulating Press Board	IEC 641
IS -6600	Guide for loading of oil Immersed Transformers	IEC 76
IS -2362	Determination of water content in oil for porcelain bushing of transformer	
IS -6162	Paper covered Aluminium conductor	
IS -6160	Rectangular Electrical conductor for electrical machines	
IS -5561	Electrical power connector	
IS -6103	Testing of specific resistance of electrical insulating liquids	
IS -6262	Method of test for power factor and dielectric constant of electrical insulating liquids	
IS -6792	Determination of electrical strength of insulating oil	
IS - 10028	Installation and maintenance of transformers.	
	CBIP Manual on Transformer: Publication:317	

3.7.3. SERVICE CONDITIONS:

The Distribution Transformers to be supplied against this Specification shall be suitable for satisfactory continuous operation under the following climatic conditionsas per IS 2026 (Part-I).

i) Location : At various location in the country

ii) Maximum ambient air temperature (^{0}C) : 55

iii) Minimum ambient air temperature(^{0}C) : -5

iv) Maximum average daily ambient air temperature (^{0}C) : 40

v) Maximum yearly weighted average ambient temperature(^{0}C) : 32

vi) Maximum altitude of 1000 meters above mean sea level

vii) Maximum Annual Rainfall (mm) : 5000

viii) Average Annual Rainfall (mm) : 3107

ix) Specified operation range of temperature : 0^0 C to 55^0 C

x) Limit of range of operation of temperature: 10^0 C to 60^0 C

xi) Limit of temperature range for storage and transport: - 10^0 C to 70^0 C

xii) Relative humidity (%) : 50-99

xiii) Average no. of thunderstorm days/annum (Isoceraunic level): 50

xiv) Average number of dust storm days per annum: 5

xv) Average number of rainy days per annum : 120- 140

xvi) No. of months during which tropical monsoon conditions prevail Moderately hot and humid climate, conducive to rust and fungus growth: 5

The equipment shall generally be for use in moderately hot and humid tropical climate, conducive to rust and fungus growth unless otherwise specified.

3.7.4. PRINCIPAL PARAMETERS:

The transformers shall be suitable for outdoor installation with three phase,50Hz,11kV system in which the neutral is effectively earthed and they should be suitable for service with fluctuations in supply voltage upto plus 12.5% to minus 12.5%.

(i) The transformers shall conform to the following specific parameters:

Sl. No.	Item	11kV Distribution Transformers
1	System voltage (Max.)	12 kV
2	Rated Voltage (HV)	11 kV
3	Rated Voltage (LV)	433 -250 V*
4	Frequency	50 Hz +/-5%*
5	No. of Phases	Three
6	Connection HV	Delta
7	Connection LV	Star (Neutral brought out)
8	Vector group	Dyn- 11
9	Type of cooling	ONAN

Audible sound levels (decibels) at rated voltage and frequency for liquid immersed distribution transformers shall be as below (NEMA Standards):

kVA rating	Audible sound levels(decibels)
51-100	51
101-300	55

3.7.5. TECHNICAL REQUIREMENTS:

CORE MATERIAL

- The core shall be stack / wound type of high grade Cold Rolled Grain Oriented steel lamination having low loss and good grain properties, coated with hot oil proof insulation, bolted together and to the frames firmly to prevent vibration or noise. The core shall be stress relieved by annealing under inert atmosphere if required. The complete design of core must ensure permanency of the core loss with continuous working of the transformers. The value of the maximum flux density allowed in the design and grade of lamination used shall be clearly stated in the offer.

- The bidder should offer the core for inspection and approval by the purchaser during manufacturing stage. CRGO steel for core shall be purchased only from the approved vendors.

- The transformers core shall be suitable for over fluxing (due to combined effect of voltage and frequency) up to 12.5% without injurious heating at full load conditions and shall not get saturated. **The bidder shall furnish necessary design data in support of this situation.**

- No-load current up to 200kVA shall not exceed 3% of full load current and will be measured by energising the transformer at rated voltage and frequency. Increase of 12.5% of rated voltage shall not increase the no-load current by 6% of full load current.

AND

- No-load current above 200kVA and upto 2500kVA shall not exceed 2% of full load current and will be measured by energising the transformer at rated voltage and frequency. Increase of 12.5% of rated voltage shall not increase the no-load current by 5% of full load current.

3.7.6. WINDINGS:

Material:

- HV and LV windings shall be wound from Double Paper / Super enamel (SE) covered Aluminum conductor.
- LV winding shall be such that neutral formation will be at top.
- The winding construction of single HV coil wound over LV coil is preferable.
- Inter layer insulation shall be Nomex /Epoxy dotted Kraft Paper.
- Proper bonding of inter layer insulation with the conductor shall be ensured. Test for bonding strength shall be conducted.
- Dimensions of winding coils are very critical. Dimensional tolerances for winding coils shall be within limits as specified in Guaranteed Technical Particulars (GTP Schedule I).
- The core/coil assembly shall be securely held in position to avoid any movement under short circuit conditions.

Joints in the winding shall be avoided. However, if jointing is necessary the joints shall be properly brazed and the resistance of the joints shall be less than that of parent conductor. In case of foil windings, welding of leads to foil can be done within the winding.

3.7.7. TAPPING RANGES AND METHODS:

No tappings required for transformers up to 100 kVA rating.

The tapping shall be as per provisions of IS: 1180 Part-I (2014).

Tap changing shall be carried out by means of an externally operated self-position switch and when the transformer is in de-energised condition. Switch position No.1 shall correspond to the maximum plus tapping. Each tap change shall result in variation of 2.5% in voltage. Arrangement for pad locking shall be provided. Suitable aluminum anodized plate shall be fixed for tap changing switch to know the position number of tap.

3.7.8. OIL:

The insulating oil shall comply with the requirements of IS 335:2018. Use of recycled oil is not acceptable. The specific resistance of the oil shall be as per IS 335:2018.

Oil shall be filtered and tested for break down voltage (BDV) and moisture content before filling.

The oil shall be filled under vacuum.

The design and all materials and processes used in the manufacture of the transformer, shall be such as to reduce to a minimum the risk of the development of acidity in the oil.

3.7.9. INSULATION LEVELS:-

Sl.No.	Voltage (kV)	Impulse Voltage (kV Peak)	Power Frequency Voltage (kV)
1	0.433	-	3
2	11	75	28

3.7.10. LOSSES:

The transformer of HV voltage up to 11kV, the losses shall be as below.

Rating of the Transformer	Total losses (no-load + load losses at 75^0C) at 50% of rated load (watts)	Total losses at 100% of rated load (watts)
100 kVA	475	1650
160 kVA	670	1950
250 kVA	980	2930
315 KVA	1025	3100
500 KVA	1510	4300

The above losses are maximum allowable and there would not be any positive tolerance. Bids with higher losses than the above specified values would be treated as non-responsive. However, the manufacturer can offer losses less than above stated values. Offers with losses lower than the maximum allowable losses will be evaluated on total owning cost basis

in accordance with methodology given in Annexure -I.

3.7.11. TOLERANCES:

No positive tolerance shall be allowed on the losses offered in GTP for both 50%and 100%loading values and for all types of losses.

3.7.12. PERCENTAGE IMPEDANCE:-

The percentage impedance of transformers at 750C for different ratings upto 200kVA shall be as per Table 3 and for ratings beyond 200kVA shall be as per Table 6 of IS 1180(Part- 1):2014.

3.7.13. Temperature rise:

The temperature rise over ambient shall not exceed the limits given below:

- The permissible temperature rise shall be as per IS: 1180 (Part-I):2014.
- The transformer shall be capable of giving continuous rated output without exceeding the specified temperature rise. **Bidder shall submit the calculation sheet in this regard.**

3.7.14. PENALTY FOR NON PERFORMANCE:

• During testing at supplier's works if it is found that the actual measured losses are more than the values quoted by the bidder, the purchaser shall reject the transformer and he shall also have the right to reject the complete lot.

• Purchaser shall reject the entire lot during the test at supplier's works, if the temperature rise exceeds the specified values.

• Purchaser shall reject any transformer during the test at supplier's works, if the impedance values differ from the guaranteed values including tolerance.

3.7.15. INSULATION MATERIAL:

• Electrical grade insulation epoxy dotted Kraft Paper/Nomex and pressboard of standard make or any other superior material subject to approval of the purchaser shall be used.

• All spacers, axial wedges / runners used in windings shall be made of pre-compressed Pressboard-solid, conforming to type B 3.1 of IEC 641-3-2. In case of cross-over coil winding of HV all spacers shall be properly sheared and dovetail punched to ensure proper locking. All axial wedges / runners shall be properly milled to dovetail shape so that they pass through the designed spacers freely. Insulation shearing, cutting, milling and punching operations shall be carried out in such a way, that there should not be any burr and dimensional variations.

3.7.16. TANK:

□□Transformer tank construction shall conform in all respect to clause 15 of IS 1180(Part- 1): 2014.

□□The internal clearance of tank shall be such, that it shall facilitate easy lifting of core with coils from the tank without dismantling LV bushings.

□□All joints of tank and fittings shall be oil tight and no bulging should occur during service.

□□Inside of tank shall be painted with varnish/hot oil resistant paint.

□□The top cover of the tank shall be slightly sloping to drain rain water.

□□The tank plate and the lifting lugs shall be of such strength that the complete transformer filled with oil may be lifted by means of lifting shackle/Hook Type.

□□ □ Manufacturer should carry out all welding operations as per the relevant ASME standards and submit a copy of the welding procedure and welder performance qualification certificates to the customer.

3.7.16.1. PLAIN TANK:

The transformer tank shall be of robust construction, elliptical in shape and shall be built up of electrically tested welded mild steel plates of thickness of 5.0 mm for the bottom and top and not less than 3.15 mm for the sides for distribution transformers of more than 25 kVA and upto and including 100 kVA and 6mm and 4mm respectively above 100kVA. Tolerances as per IS1852 shall be applicable. Under operating conditions the pressure generated inside the tank should not exceed 0.4 kg/ sq. cm positive or negative. There must be sufficient space from the core to the top cover to take care of oil expansion.

Under operating conditions the pressure generated inside the tank should not exceed 0.4kg/sq.cm positive or negative. There must be sufficient space from the core to the top cover to take care of oil expansion. The space above the oil level in the tank shall be filled with dry air or nitrogen conforming to commercial grade of IS 1747 for DT up to 63 kVA. For DT of 63 kVA and above rating, conservator shall be provided.

(i) The tank shall be reinforced by welded flats on all the outside walls on the edge of the tank.
(ii) Permanent deflection: The permanent deflection, when the tank without oil is subjected to a vacuum of 525 mm of mercury for rectangular tank and 760 mm of mercury for round tank, shall not be more than the values as given below: (All figures are in mm)

Horizontal length of flat plate	Permanent deflection
Up to and including750	5.0
751 to 1250	6.5
1251 to 1750	8.0
1751 to 2000	9.0

□The tank shall further be capable of withstanding a pressure and a vacuum as per IS 1180(Part 1): 2014 (Fourth Revision) and subsequent amendments.

□The radiators can be tube type or fin type or pressed steel type to achieve the desired cooling to limit the specified temperature rise.

3.7.17. CONSERVATOR:

- Transformers of rating 63 kVA and above with plain tank construction, the provision of conservator is mandatory.
- Then a conservator is provided, oil gauge and the plain or dehydrating breathing device shall be fitted to the conservator which shall also be provided with a drain plug and a filling hole [32 mm (1¼")] normal size thread with cover. In addition, the cover of the main tank shall be provided with an air release plug.
- The dehydrating agent shall be silica gel. The moisture absorption shall be indicated by a change in the colour of the silica gel crystals which should be easily visible from a distance. Volume of breather shall be suitable for 500g of silica gel conforming to IS

3401 for transformers upto 200 kVA and 1kg for transformers above 200kVA.

- The capacity of a conservator tank shall be designed keeping in view the total quantity of oil and its contraction and expansion due to temperature variations. The total volume of conservator shall be such as to contain 10% quantity of the oil. Normally 3% quantity the oil shall be contained in the conservator.
- The cover of main tank shall be provided with an air release plug to enable air trapped within to be released, unless the conservator is so located as to eliminate the possibility of air being trapped within the main tank.
- The inside diameter of the pipe connecting the conservator to the main tank should be within 20 to 50 mm and it should be projected into the conservator so that its end is approximately 20 mm above the bottom of the conservator so as to create a sump for collection of impurities. The minimum oil level (corresponding to -5 ^{0}C) should be above the sump level.

3.7.18. SURFACE PREPARATION AND PAINTING:

(i) GENERAL

All paints, when applied in a normal full coat, shall be free from runs, sags, wrinkles, patchiness, brush marks or other defects.

All primers shall be well marked into the surface, particularly in areas where painting is evident and the first priming coat shall be applied as soon as possible after cleaning. The paint shall be applied by airless spray according to manufacturer's recommendations. However, where ever airless spray is not possible, conventional spray be used with prior approval of purchaser.

(ii) CLEANING AND SURFACE PREPARATION:

a) After all machining, forming and welding has been completed, all steel work surfaces shall be thoroughly cleaned of rust, scale, welding slag or spatter and other contamination prior to any painting.

b) Steel surfaces shall be prepared by shot blast cleaning (IS9954) to grade Sq. 2.5 of ISO 8501- 1 or chemical cleaning including phosphating of the appropriate quality (IS 3618).

c) Chipping, scraping and steel wire brushing using manual or power driven tools cannot remove firmly adherent mill-scale. These methods shall only be used where blast cleaning is impractical. Manufacturer to clearly explain such areas in his technical offer.

(iii) PROTECTIVE COATING:

As soon as all items have been cleaned and within four hours of the subsequent drying, they shall be given suitable anti-corrosion protection.

(iv) PAINT MATERIAL:

i. Following are the types of paint which may be suitably used for the items to be painted at shop and supply of matching paint to site: Heat resistant paint (Hot oil proof) for inside surface

ii. For external surfaces one coat of thermo setting powder paint or one coat of epoxy primer followed by two coats of synthetic enamel/polyurethene base paint. These paints can be either air drying or stoving.

(v) PAINTING PROCEDURE:

- All prepared steel surfaces should be primed before visible re-rusting occurs or within 4hours, whichever is sooner. Chemical treated steel surfaces shall be primed as soon as the surface is dry and while the surface is still warm.
- there the quality of film is impaired by excess film thickness (wrinkling, mud cracking

or general softness) the supplier shall remove the unsatisfactory paint coating and apply another coating. As a general rule, dry film thickness should not exceed the specified minimum dry film thickness by more than 25%.

(vi) DAMAGED PAINTWORK:

- Any damage occurring to any part of a painting scheme shall be made good to the same standard of corrosion protection and appearance as that was originally applied.
- Any damaged paint work shall be made good as follows:
  - The damaged area, together with an area extending 25 mm around its boundary, shall be cleaned down to bare metal.
  - A priming coat shall be immediately applied, followed by a full paint finish equal to that originally applied and extending 50 mm around the perimeter of the original damage.
  - The repainted surface shall present a smooth surface. This shall be obtained by carefully chamfering the paint edges before and after priming.
  - The paint shade shall be as per Annexure-Paint which is attached herewith.

(vii) DRY FILM THICKNESS:

- To the maximum extent practicable the coats shall be applied as a continuous film of uniform thickness and free of pores. Overspray, skips, runs, sags and drips should be avoided. The different coats may or may not be of the same colour.
- Each coat of paint shall be allowed to harden before the next is applied as per manufacturer's recommendation.
- Particular attention must be paid to full film thickness at the edges.
- The requirements for the dry film thickness (DFT) of paint and the materials to be used shall be as given below:

Sl. No.	Paint type	Area to be painted	No. of coats	Total dry film thickness (min.) (microns)
1.	Thermo setting powder paint	Inside Outside	01 01	30 60
2.	**Liquid paint** a) Epoxy (primer) b) P.U. Paint (Finish coat) c) Hot oil paint/ Varnish	Outside Outside Inside	01 02 01	30 25 each 35/10

The color of the finishing coats shall be dark admiral gray conforming to No. 632of IS-5 of 1961/ No. 541 (Light Brown)

TESTS FOR PAINTED SURFACE:

The painted surface shall be tested for paint thickness.

The painted surface shall pass the cross hatch adhesion test and impact test as acceptance tests and Salt spray test and Hardness test as type test as per the relevant ASTM standards.

Note: Supplier shall guarantee the painting performance requirement for a period of not less than 5 years.

3.7.19. BUSHINGS:

- HV bushings are to be mounted on the top cover of the tank on collars/turrets and not directly on tank cover. The LT bushing shall be mounted on the side of the tank.
- For 11 kV-12 kV class bushings and for 0.433 kV - 1 kV class bushings shall be used.
- Bushing can be of porcelain/epoxy material. Polymer insulator bushings

conforming with relevant IEC can also be used.

- Dimensions of the bushings of the voltage class shall conform to the Standards specified and dimension of clamping arrangement shall be as per IS 4257.
- Minimum external phase to phase and phase to earth clearances of bushing terminals shall be as follows:

Voltage	Clearence	
	Phase to phase	Phase to earth
11 kV	255mm	140 mm
LV	75mm	40mm

- Arcing horns shall be provided on HV bushings.
- Brazing of all interconnections, jumpers from winding to bushing shall have cross section larger than the winding conductor. All the Brazes shall be qualified as per ASME, section–IX.

- The bushings shall be of reputed make supplied by those manufacturers who are having manufacturing and testing facilities for insulators.
- The terminal arrangement shall not require a separate oil chamber not connected to oil in the main tank.

3.7.20. CABLE ENTRY TRANSFORMERS

Tappings +5% to -10% insteps of 2.5% with suitable cable box on HT & LT sides with standard fittings for Cable entry type Transformers

3.7.21.TERMINAL CONNECTORS:

The LV and HV bushing stems shall be provided with suitable terminal connectors as per IS 5082 so as to connect the jumper without disturbing the bushing stem. Connectors shall be with eye bolts so as to receive conductor for HV. Terminal connectors shall be type tested as per IS 5561.

3.7.22. TERMINAL MARKINGS:

High voltage phase windings shall be marked both in the terminal boards inside the tank and on the outside with capital letter 1U, 1V, 1t and low voltage winding for the same phase marked by corresponding small letter 2U, 2V, 2t. The neutral point terminal shall be indicated by the letter 2N. Neutral terminal is to be brought out and connected to local grounding terminal by an earthing strip.

3.7.23. FITTINGS:

The following standard fittings shall be provided :

i. Rating and terminal marking plates, non-detachable.
ii. Earthing terminals with lugs - 2 Nos.
iii. Lifting lugs for main tank and top cover
iv. Terminal connectors on the HV/LV bushings (For bare terminations only). v. Thermometer pocket with cap- 1 No.
vi. Air release device
vii. HV bushings - 3 Nos.
viii. LV bushings -4 Nos.

ix. Pulling lugs

x. Stiffener

xi. Radiators No. and length may be mentioned (asper heat dissipation

calculations)/corrugations.

xii. Arcing horns on HT side - 3 No .

xiii. Prismatic oil level gauge.

xiv. Drain cum sampling valve

xv. One filter valve on upper side of the transformer

xvi. Oil filling hole having p. 1- ¼ '' thread with plug and drain plug on the conservator.

xvii. Silica gel breather

xviii. Base channel 75mmx40mm up to 100kVA and 100mm X 50 mm above 100 kVA, 460 mm long with holes to make them suitable for fixing on a platform or plinth.

xix. Pressure relief device or Explosion vent

xx. Oil level gauge

-5 ˚C and 90˚C marking for non-sealed type Transformers

3.7.24. FASTENERS:

- All bolts, studs, screw threads, pipe threads, bolt heads and nuts shall comply with the appropriate Indian Standards for metric threads, or the technical equivalent.
- Bolts or studs shall not be less than 6 mm in diameter except when used for small wiring terminals.
- All nuts and pins shall be adequately locked.
- therever possible bolts shall be fitted in such a manner that in the event of failure of locking resulting in the nuts working loose and falling off, the bolt will remain in position.
- All bolts/nuts/washers exposed to atmosphere should be as follows.

Size 12 mm or below – Stainless steel

Above 12 mm- steel with suitable finish like electro galvanized with passivation or hot dip galvanized.

- Each bolt or stud shall project at least one thread but not more than three threads through the nut, except when otherwise approved for terminal board studs or relay stems. If bolts and nuts are placed so that they are inaccessible by means of ordinary spanners, special spanners shall be provided.
- The length of the screwed portion of the bolts shall be such that no screw thread may form part of a shear plane between members.
- Taper washers shall be provided where necessary.
- Protective washers of suitable material shall be provided front and back of the securing screws.

3.7.25. OVERLOAD CAPACITY:

24.1 The transformers shall be suitable for loading as per IS 6600.

3.7.26. TESTS:

- All the equipment offered shall be fully type tested by the bidder or his collaborator as per the relevant standards including the additional type tests. The type test must have been conducted on a transformer of same design **during the last five years** at the time of bidding. The bidder shall furnish attested copy of type test reports along with the offer. In case the offered transformer is not type tested, the bidder will conduct the type test as per the relevant standards including the additional type tests at his own cost in CPRI/NABL accredited laboratory in the presence of employers representative(s) without any financial liability to employer in the event of order placed on him.

- Special tests other than type and routine tests, as agreed between purchaser and bidder shall also be carried out as per the relevant standards.
- The requirements of site tests are also given in this clause.
- The test certificates for all routine and type tests for the transformers and also for the bushings and transformer oil shall be submitted with the bid.
- The procedure for testing shall be in accordance with IS1180 (Part- 1): 2014 / 2026 as the case may be except for temperature rise test.

- Dispatch of each of the completely assembled transformers shall be subjected to the routine tests at the manufacturer's works.

3.7.27. ROUTINE TESTS:

- Ratio, polarity, phase sequence and vector group.
- No Load current and losses at service voltage and normal frequency.
- Load losses at rated current and normal frequency.
- The test certificates for all routine and type tests for the transformers and also for the bushings and transformer oil shall be submitted after the receipt of order.
- Impedance voltage test.
- Resistance of windings at each tap, cold (at or near the test bed temperature). ➢Insulation resistance.
- Induced over voltage withstand test.
- Separate source voltage withstand test.
- Neutral current measurement-The value of zero sequence current in the neutral of the star winding shall not be more than 2% of the full load current.
- Oil samples (one sample per lot) to comply with IS 1866.
- Measurement of no load losses and magnetizing current at rated frequency and 90%, 100%and110% rated voltage.

- Pressure and vacuum test for checking the deflection on one transformer of each type in every inspection.

3.7.28. TYPE TESTS TO BE CONDUCTED ON ONE UNIT:

In addition to the tests mentioned in clause 26 following tests shall be conducted:

- Temperature rise test for determining the maximum temperature rise after continuous full load run. The ambient temperature and time of test should be stated in the test certificate.
- Impulse voltage test: with chopped wave of IS 2026 part-III. BIL for 11 kV shall be 75 kVpeak.
- Short circuit withstand test: Thermal and dynamic ability.
- Air Pressure Test: As per IS – 1180 (Part- 1):2014.
- Magnetic Balance Test.
- Un-balanced current test: The value of unbalanced current indicated by the ammeter shall not be more than 2% of the full load current.
- Noise-level measurement.
- Measurement of zero-phase sequence impedance.
- Measurement of Harmonics of no-load current.

Transformer tank shall be subjected to specified vacuum. The tank designed for vacuum shall be tested as per IS 1180 (Part 1): 2014 (Fourth Revision) and subsequent amendments. The permanent deflection of flat plates after the vacuum has been released shall not

exceed the values specified below:

Horizontal length of flat plate (in mm)	Permanent deflection (in mm)
Upto and including 750	5.0
751 to 1250	6.5
1251 to 1750	8.0
1751 to 2000	9.0

- Transformer tank together with its radiator and other fittings shall be subjected to pressure as per IS 1180 (Part 1): 2014 (Fourth Revision) and subsequent amendments. The permanent deflection of the flat plates after the excess pressure has been released, shall not exceed the figures for vacuum test.
- Pressure relief device test: The pressure relief device shall be subject to increasing fluid pressure. It shall operate before reaching the test pressure as specified in the above class. The operating pressure shall be recorded. The device shall seal-off after the excess pressure has been released.
- **Short Circuit Test and Impulse Voltage Withstand Tests**: The purchaser intends to procure transformers designed and successfully tested for short circuit and impulse test. In case the transformers proposed for supply against the order are not exactly as per the tested design, the supplier shall be required to carry out the short circuit test and impulse voltage withstand test at their own cost in the presence of the representative of the purchaser.
- The supply shall be accepted only after such test is done successfully, as it confirms on successful withstand of short circuit and healthiness of the active parts thereafter on un- tanking after a short circuit test.
- Apart from dynamic ability test, the transformers shall also be required to withstand thermal ability test or thermal withstand ability will have to be established by way of calculations.

- It may also be noted that the purchaser reserves the right to conduct short circuit test and impulse voltage withstand test in accordance with the IS, afresh on each ordered rating at purchaser cost, even if the transformers of the same rating and similar design are already tested. This test shall be carried out on a transformer to be selected by the purchaser either at the manufacturer's works when they are offered in a lot for supply or randomly from the supplies already made to purchaser's stores. The findings and conclusions of these tests shall be binding on the supplier.

3.7.29. TESTS AT SITE

The purchaser will conduct the following test on receipt of transformers in their store. The utility shall arrange all equipment, tools & tackle and manpower for the testing. The bidder will depute his representative to witness the same. All such test shall be conducted by utility not later than 10 days from receipt of transformers.

i) Megger Test
ii) Ratio test

3.7.30. INSPECTION:

a. In respect of raw material such as core stampings, winding conductors, insulating paper and oil, supplier shall use materials manufactured/supplied by standard manufacturers and furnish the manufacturers' test certificate as well as the proof of purchase from these manufacturers (excise gate pass) for information of the purchaser. The bidder shall furnish following documents along with their offer in respect of the raw materials:

i. Invoice of supplier.
ii. Mill's certificate.
iii. Packing list.
iv. Bill of landing.
v. Bill of entry certificate by custom.

3.7.31. CIVIL WORKS:

3.7.31.1: Transformer Plinth:

Construct Transformer plinth of size 1.5x1.5x1.5m on 1.8x1.8x0.75m basement inclusive of cost of all materials. [Excavation1.8x1.8x0.75m, Random Rubble in CM(1:6) 1.8x1.8x0.75m + 1.5x1.5x1.5m,concrete (1:2:4, 20mm) 1.5x1.5x0.10 m, plaster CM (1:3) 12mm, 1.5x1.5m, Pointing CM (1:3) 1.5x1.5mx 4 sides].

3.7.31.2: Transformer Fencing:

Provide Transformer fencing to a height of 1.8 m aboveground level using MS Angle frames of size ISA 50x50x6mm for outer frame, 2 runs of 40 x 6 MS flat for horizontal brasing and grills with MS rods 8mm Dia @ 10cm c/c for verticals, providing gate with locking arrangements, providing danger board & name board, embedding the legs in cement concrete 1:2:4, footing of size 30cmx30cmx50cm, painting with synthetic enamel paint two coats over one coat of iron primer etc. complete, incl cost of transportation.

3.7.31.3: Transformer Yard Metaling:

Cleaning and levelling of transformer yard/RMU, spreading 40 mm broken stone in yard for a thickness of 10 cm above bed of 10 cm thick 6 mm broken stone, after constructing a curb wall of height 20cm aboveground and 10cm below level including cost of all materials and charges for conveying, spreading, consolidating etc.

3.8 : RMU

3.8.1. Scope

3.8.1.1. The RMU to be supplied against this specification are required for outdoor vital installations where continuity of service is very important. Design, materials and manufacture of the equipment shall, therefore, be of highest quality to ensure continuous and trouble-free service over the years. The RMU offered shall be easy to install ,reliable to operate, safe and easy to operate and complete with all parts necessary for their effective and trouble-free operation.

3.8.1.2. The scope including the specifications and the schedules mentioned herein covers only the major items. Any item or work not included in this specification and the schedules which are necessary for the satisfactory performance of the outdoor ring main units in the tropical seashore area shall be deemed to be included as part of the specifications, irrespective of whether they are specifically indicated herein. Tenderers may seek clarification in case needed before quoting.

3.8.1.3. In general, the scope of work covers design, engineering, manufacture, assembly, stage testing, inspection, FAT and testing before supply and delivery at site, storing, erection, installation, testing, commissioning, integration with the existing SCADA-DMS over IEC 104 protocol and handing over of outdoor type 11kV, Ring main units with various

combinations with SF6 insulated / arc-quenching Load Break Switches and vacuum / SF6 breakers along with FRTU and accessories such as cable termination kits, terminal protectors, spares etc. complete .

3.8.1.4. RMUs shall originally be designed, engineered and manufactured in a fully integrated outdoor module, which would meet the relevant standards for outdoor application.

3.8.2 General

3.8.2.1. The RMU shall meet the criteria for compact, metal-enclosed switchgear and shall be in accordance with IEC 60298

3.8.2.2. All RMUs shall be provided with motorised operation facility using internal battery with charger fed from internal power supply. RMU shall be extensible on LHS or RHS as per requirement. The equipment shall be mounted on base channels with anchor bolt holes for installation in a concrete plinth suitable for the general foundation drawing as per Annexure attached. Construction of foundation is not included in the scope of bidder

3.8.2.3. Switchgear (Load Break Switch, Vacuum Circuit breakers etc.) and control gear (CTs, PTs, relays etc.) shall be mounted on the same Kiosk. Bus bars shall be air insulated with PVC insulation/sleeves on electrostatic powder coating. The bus bars should be of electrolytic high grade copper with permissible limits of current density. Size of the bus bars and current density should be specified in the offer. The bus bars conductor shall conform to IS 8084 and 3427 and shall be rated for 630 A. It shall withstand the mechanical stresses of the rated short circuit current.

3.8.2.4. A cable test rod has to be provided which can be fixed on the terminations to facilitate testing. Termination boots/Protectors should have a proper opening to facilitate the same. The opening should be covered by means of removable protection cap, boots used in terminations must have this facility.

3.8.2.5. Indoor RMU installed inside the separate outdoor enclosure shall not be acceptable. RMU and metering panel shall be of louvers free design .

3.8.2.6. In view of the space constraints in the city, the maximum width of the panels shall be 750 mm for breaker panel, 500 mm for load break switch panel and 800 mm for metering cubicle. The maximum depth of the panels shall be 800 mm and suitable for 600 mm wide cable trench. The height shall not exceed 1500 mm and 2000mm with bus bar voltage transformer.

3.8.2.7. Each RMU shall be identified by an appropriately sized label, which clearly indicates the functional units and their electrical characteristics.

3.8.2.8. The switchgear and RMUs shall be designed so that the position of the different devices is visible to the operator on the front of the switchboard and operations are visible as well.

3.8.2.9. In accordance with the standards, the RMUs shall be designed so as to prevent access to all live parts during operation.

3.8.3 Standards

3.8.3.1. The equipment shall conform in all respects with the requirements of the latest editions of the IEC standards /IS stated below except where specified otherwise.

SL.NO	Indian Standard	Title	International & Internationally recognized standard
1	IS/13118:1991	High Voltage Alternating Current Circuit Breaker	IEC-60056, 62271-100, 62271-200
2	IS/9920:1981, 1982	High Voltage Switches	IEC - 60265
3	IS: 2099	Dimensions of Indoor & Outdoor post insulators with voltages >1000 volts	IEC - 60273
4	IS/9921	Alternative current disconnector and earthing switches	IEC - 60129, 62271 - 102
5	IS 12729:1988	General requirements for switchgear and control gear for voltages exceeding 1000V	IEC - 60298
6	IS 13947 (Part- 1)	Degrees of protection provided by enclosures for low voltage switchgear and control gear.	IEC - 60529
7	IS/2705: 1992	Current Transformers	IEC - 60185
8	Equivalent IS	Monitoring and Control	IEC - 60801
9	Equivalent IS	Common clauses for High Voltage switchgear and control gear standards	IEC - 60694, 62271 - 1
10	IS 13118	HV/AC Circuit Breaker	BS 5311
11	Equivalent IS	HV Switches	BS 5463
12		Filling of SF6 Gas in RMU	IEC 60376
13		Circuit Breaker phase protection	IEC 60255-3
14	IS 3156	Voltage Transformer	IEC 60044-2
15	IS: 3231	Electric Relays for power system	IEC 60255

3.8.4. Conflict of standards

3.8.4.1. Equipment conforming to other internationally accepted standards, which ensure equal or higher quality than the standards mentioned above would also, are acceptable. In case the Bidders who wish to offer equipments conforming to such other standards, salient points of difference between the standards adopted and the specific standards shall be clearly brought out in relevant schedule. Four copies of such standards with authentic English translations shall be furnished along with the offer. In case of conflict the order of precedence shall be (i) IS (ii) IEC (iii) Other standards.

3.8.5. Environmental Conditions

3.8.5.1. All equipments to be supplied against this tender shall be suitable for satisfactory continuous operation under tropical conditions as specified below:

1.	Maximum ambient temperature	50^0C
2.	Minimum ambient temperature	10^0C
3.	Approximate variation of ambient temperature over a period of 24 hours	15^0C
4.	Maximum Relative humidity	100 %
5.	Maximum annual rainfall	4500 mm
6.	Maximum wind pressure	130 kg/ m2

3.8.5.2. All parts of the work shall be protected against corrosion under service conditions. Except where otherwise specified all ferrous parts shall be galvanized. The protection shall also prevent corrosion during transport and handling.

3.8.6. General Technical Requirements:

Network	Three phases - Three wires
Rated Voltage kV	12
Service Voltage kV	11
System Frequency-Hz	50
Bus bar Rating - A	630
IP Rating	IP 67 for SF6 breaker tank IP 54 for outdoor enclosures
Internal Arc test	BFLR 20 kA for 1 sec
Lightning Impulse withstand Voltage	75 kV
Power Frequency withstand voltage	28 kV rms - 1 min
Rated Normal Current Load Break Switch Circuit - breaker	 630 A 630 A
Rated Short time current withstand (3 sec) For Ring switch and Earthing switch	20 kA
Rated breaking capacity of Breaker	20 kA for 3 sec
Rated Short circuit making capacity of line switches and earthing switches	50 kA peak at Rated Voltage.
Number of operations at rated short circuit current online switches, earthing switches and CB	5 closing operations for switches and 25 for breaker

3.8.7. RMU Enclosure

3.8.7.1. The RMU enclosure must be metallic and tropicalised with canopy roof with IP54 standards. The metallic enclosure shall be made of high tensile steel of thickness not less than 2.5 mm and shall be grid/short blasted thermally sprayed with Zinc alloy, phosphate and subsequently painted with marine paint, the overall paint layer

thickness shall be not less than 150 microns. The equipment should also be designed to prevent ingress of vermin, accidental contact with live parts and to minimize the ingress of dust and dirt. The use of materials, which may be liable to attack by termites and other insects is not permitted. Relevant IE rules for clearance shall be applicable. The enclosure shall be type tested for weather proof at EREDA/CPRI. Heating coil and required lighting shall be provided. One 3 pin plug point with MCB shall be provided inside the metering panel. Manufacturer shall provide test report to prove salt spray withstand for at least 500 hours on material components used to build the switchgear. Removable lifting lugs are to be fitted on the top of each panel. Bolts and nuts used shall conform to ISO Standards (metric) and shall be rust protected. Nuts and bolts for pressure parts shall be best quality stainless steel conforming to IS.

3.8.8. Switchgear and bus bar

3.8.8.1. SF6 gas is the preferred dielectric medium. SF6 gas used for the filling of the RMU shall be in accordance with IEC 60376. Absorption material shall be provided in the tank to absorb the moisture from the SF6 gas and to regenerate the SF6 gas following arc interruption.

3.8.8.2. The switchgear and bus bar shall be contained in a robotically welded stainless steel enclosure as per IS, filled with SF6 gas, so as to protect against adverse environmental and climatic conditions. The enclosure should meet the "sealed pressure system" criterion in accordance with the IEC 60298 standard (i.e. a system for which no handling of gas is required throughout the 30 years of service life), so that refilling is not required. In addition, manufacturer shall confirm that maximum leakage rate is lower than 0.1% per year.

3.8.8.3. The switchgear chamber shall be protected against adverse environmental and climatic conditions like flooding, high humidity, high temperature etc. by providing IP67 degree of protection in accordance with recommendation IEC 60529. The active parts of the switchgear shall be maintenance-free

3.8.8.4. Temperature compensated SF6 gas pressure indication system shall be provided in RMUs for giving early warning of pressure loss. All live parts except for the cable connection shall be insulated with SF6 enclosure. The tank shall be made of stainless steel conforming to IP 67 degree of protection.

3.8.8.5. Temperature independent gas pressure gauge marked with **green** (safe) and **red** (not safe) zones shall be provided. The safe operating zone shall correspond to a temperature range of –10º C to+55º The unit shall continue to work safely even if the gas pressure inside the tank goes down to the atmospheric pressure

3.8.9. Load Break Switches

3.8.9.1. They shall be maintenance-free, capable of breaking in low pressure SF6 gas. The position of the power contacts and earthing contacts shall be clearly visible on the

front of the switchboard with the help of mechanical indicator. The position indicator shall provide positive contact indication in accordance with IEC 60265-1 standard. In addition, manufacturer shall prove reliability of indication in accordance with IEC 60129.

3.8.9.2. The operating mechanism shall be spring operated mechanism with operating handle for ON/OFF and earth positions with arrangement for padlocking in each position. Also independent manual operations with mechanically operated indicator shall be possible.

3.8.9.3. The earth switch shall be naturally interlocked to prevent the main and earth switch being switched 'ON" at the same time. The selection of the main and earth switch shall be through the facia, which shall be allowed to move only if the main or earth switch is in the off position.

3.8.9.4. Closing and opening operation of the load break switch from remote shall be possible. For facilitating the operation of RMU with SCADA, Shunt trip kit is to be provided. Spring charging mechanism of the Breaker should be motorized for Local electrical charging. The LBS shall be provided with suitable motor to have the facility for remote on/off. It should be feasible to retrofit the motor at site. Reverse polarity protection shall be given for motors

3.8.9.5. Each load break switch shall be of the triple pole, simultaneously operated with quick break contacts and with integral earthing arrangement. The rated current of isolator shall be 630Amps continuous at Maximum Ambient temperatures. No De-rating shall be allowed. For clarity, the isolator at an Ambient temperature of 50^0 C means that isolator rating should be 630A at ambient temperature of 50^0 C.

3.8.9.6. The relevant type test report to prove the temperature rise is below 55^0 C shall be submitted by the bidder with the offer.

3.8.9.7. Earthing of the cable shall be either through a three-position switch of a separate snap action type Earth Switch. The switches shall be fully mounted and inspected in the factory. Manual opening and closing shall be driven by a fast-acting mechanism, independent of operator action.

3.8.9.8. The switch and earthing switch operating mechanism shall have a mechanical endurance of at least 1500 operations.

3.8.10 Circuit Breakers

3.8.10.1. The circuit breakers shall be of the maintenance-free, Vacuum/SF6 gas type. The position of the power and earthing contacts shall be clearly visible on the front of the switchboard. The position indicator shall provide positive contact indication in accordance with IEC 60265-1 standard. In addition, manufacturer shall prove reliability of indication in accordance with IEC 60129.

Rated voltage	kV	12
Rated normal current of feeders	A	630
Rated short-time withstand current		20kA, 3 s
Rated peak withstand current	kA	50
Rated short-circuit breaking current	kA	20
Rated short-circuit making current	kA	50
Number of mechanical operating cycles for disconnector		1000
Number of mechanical operating cycles for earth switch		1000
Number of mechanical operating cycles for circuit-breaker		10 000
Rated operating sequence		O - 0.3 s - CO - 3min - CO
Number of short-circuit breaking operations	n	25

3.8.10.2. The circuit breakers shall have at least 2 positions: open-disconnected & closed and shall be constructed in such a way that interlocking system prevents all undesired operations. The earth switch shall be mechanically interlocked with the breaker to prevent any unauthorized operation.

3.8.10.3. Earthing of circuit breaker shall be by means of a switch with same fault level capacity of the breaker.

3.8.10.4. Operating mechanism shall be fast acting and independent of the operator action when operating manually and shall indicate the following positions:

- Circuit breaker ON and OFF
- Off-Load Isolator ON and OFF
- Earthing ON and OFF

3.8.10.5. The circuit breaker panel shall be equipped with an off-load isolator switch, and it shall be fully interlocked with the circuit breaker when the breaker is in ON condition. They shall be fully mounted and factory inspected.

3.8.10.6. An operating mechanism to manually close the circuit breaker shall be provided. It shall be fitted with a local system for manual tripping by an integrated push button. There will be no automatic re- closing.

3.8.11 RELAYS

3.8.11.1. The integrated protection unit of the circuit breaker shall be achieved with a communicable- type, self-powered numerical relay. The phase protection shall have two separately adjustable settings:

- The low setting with IDMT in compliance with the IEC 60255-3 standard with selectable standard inverse, very inverse and extremely inverse type curves.
- The high setting shall be of the definite time type.

Setting range:

- IDMT: 20% to 125% for over current and 5% to 50% for earth fault
- High set: 100-3000% over current and 100- 1200% for earth fault.
- Parameter change capability shall be password protected.

3.8.11.2. The relay's auxiliary contacts shall be provided for hardwiring to the FRTU. The relay shall also have interface with the FRTU via an RS 232/485 port in order to send, as a minimum, real-time readings using the MODBUS protocol.

3.8.11.3. The relays should have the provision to show separate indications for over current and earth fault on each outgoing vacuum/SF6 breaker module for indication of Trip on Fault

3.8.12. Voltage indicator Device and Phase comparators

3.8.12.1. The live status of the cable terminated in the RMU shall be indicated by suitable voltage indicator device mounted on the front panel of the RMU to indicate whether or not there is voltage in the cables. The voltage indicator shall satisfy the requirements of IEC 61243/5. It is should have "cable live status" output for SCADA usage.

3.8.12.2. Three inlets in compliance with IEC 61958 standard shall be provided to check the synchronization of phases. Verification of correct terminal-phase connections shall be possible by means of a phase comparison test unit.

3.8.13. Fault Current indication System

3.8.13.1. The Fault current indicators capable of sensing both over current and earth fault shall be provided in all RMUs. Fault current indicators should have automatic reset facility. In case of a momentary fault in which the fault sensor picks up, but the breaker does not trip, then after 2 seconds the system shall automatically reset and shall revert to the monitoring mode. Subsequent to an actual fault, the system shall reset automatically as soon as the supply is re - established after isolating the faulty portion. Fault current indication system in RMUs shall have local/remote reset facility and compatible for SCADA applications. One potential-free output contacts shall be hardwired to FRTU.

The fault sensing devices should function properly irrespective of the soil Resistivity of the location.

They shall confirm to the following standards:

IEC 68-2-6,IEC 68-2-9 & IEC 529	:	Mechanical Test
IEC 950	:	Electrical Security
IEC 1000-4 and IEC 1000-6	:	EMI/RFI
IEC 1000-4-2	:	Air Discharges

3.8.13.2. They shall be provided with bright LED's/flag Indicators, which shall be clearly visible all the time. It should be possible to test these indicators at site through "Test" push button

3.8.14. Bus bar sectionalisers with Load Break Switch

3.8.14.1. The load break switch of the Bus bar sectionalizers shall berated for 11kV, 630A, and 20kAfor 3 secs. The sectionaliser LBS shall also be housed in a SF6 Insulated stainless steel enclosure conforming to IP67 Degrees of protection and shall be with motorized mechanism. All other specifications applicable to LBS are applicable to The sectionalizers shall be provided with all the necessary electrical and mechanical interlocks required for proper functioning with the Incomers.

3.8.15. Earthing

3.8.15.1. The cables shall be earthed by an earthing switch with short-circuit making capacity, in compliance with IEC60129 standard. The earthing switch can only be operated when the main Load Break Switch/Circuit Breaker is open. The earthing switch shall be fitted with its own operating mechanism and manual closing shall be driven by a fast acting mechanism, independent of operator action. Mechanical interlocking systems shall prevent access to the operating shaft to avoid all operator errors such as closing the earthing switch when the load switches are closed.

3.8.15.2. All ring main units (RMUs) shall have earth bar with a sectional area of not less than120 sq.mm. Copper run along the whole of metal enclosed switch structure, each end being connected to the main earthing system where metal cases are used on instruments these shall be connected to this bar by conductors of not less than 16sq.mm section. There shall be continuity between the metallic parts of the switchboard and Armour of cables so that there is no electric field pattern in the surrounding air, thereby ensuring the safety of people. All the power cables shall be suitably glanded to the equipment while termination.

3.8.16. HV Bushings

3.8.16.1. The bushing should be conveniently located for working with cables specified, and allow for the termination of cables in accordance with the instruction of Manufacturers. Bottom entry of cable and termination at front end shall be provided

3.8.16.2. The profiles of the cable connection bushings shall be in compliance with EN-50181/DIN-47636 standards.

3.8.17. Cable termination

3.8.17.1. Cable termination for Load Break Switches and Circuit Breakers shall be of bolted connection on cable bushing with Heat Shrinkable suitable for 3Core x 300sq.mm XLPE cable, using single hole cable lugs suitable for bolt size of M16. Plug-in type termination shall not be used.

3.8.17.2. Cable compartments shall be dry-type inside and suitable for accepting three core Aluminum XLPE insulated cables of outside diameter of 70- 100 mm. Each cable box shall have a bottom plate and cable clamp. Bottom plate shall be in two halves with cable entry hole of 110 mm diameter equipped with rubber bushing. Cable clamp shall be detachable semi-circular halves suitable to hold the cable inside the cable box without cable glands.

3.8.17.3. Cable bushings shall be complete with brass fasteners (nuts, bolts and washers).

3.8.17.4. The cable connection compartments must be fitted with front covers to the front. The front covers must be integrated in the comprehensive interrogator interlocking system. Termination access from the rear is not acceptable.

3.8.17.5. Vertical distance from the top of cable clamp to the center line of cable bushings shall be suitable for all type of terminations. The clearances shall be sufficient for cable handling for termination applications. The cable doors should be removable/detachable type so as to facilitate easy connection of cables and not to allow any hindrance to the maintenance staff while doing maintenance. The design of the cable compartments shall be such that their covers with sidewalls shall be removed to have full access during cable termination. Removal and installation of cable compartment covers shall be with minimum number of bolts.

3.8.17.6. The cable connection compartment shall be arc resistant as per IEC 62271-200amended up- to-date. The internal arc fault test on cable box shall be carried out for 11 kV system for 20 kA for 1 second. The clearance between phase to phase and phase to earth shall be as per IEC 61243 – 5 amended up-to- date. No insulating material on metal surface of the cable box is allowed to ensure arc proof resistance in the cable connection compartment.

3.8.17.7. Necessary Right angle Boot should be supplied to the cable terminations. Compound filled cable boxes are not acceptable. The cable termination and gland arrangements shall be appropriate for the type and style of cables used at the time. Cable bushing shall be complete with brass fasteners (nuts, bolts and washers).

3.8.17.8. Cable clamps shall be non Ferro-magnetic suitable for 3 core XLPE cables. Cable shall be terminated by properly glanding in the base plate of the RMU. The cable brackets inside the cable connecting compartments must be vertically and horizontally adjustable.

3.8.17.9. Internal wiring in cable boxes shall be covered with heat resistant tape/tube, to protect it against flame temperature of gas torch during the cable termination.

3.8.17.10. 3 Nos. ring type, single core CTs shall be provided in each incoming load break switch for metering purposes. A similar arrangement shall be provided in each circuit breaker cable compartment to mount a 3 Nos. single-core, ring type for CT for protection purposes. Enough space and provision should be provided in the cable compartment and cable terminations to accommodate ring type CT's.

3.8.18. Metering and protection equipments

3.8.18.1. The RMU shall be provided with current and voltage transformers. The rating of the instrument transformers for measuring and protection purposes shall be determined according to the technical requirements, but shall not be less than 125% of the overall computed (design) burden of the connected apparatus and conductors. However, the transformer shall not be loaded less than 60 % of rated burden.

3.8.18.2. CURRENT TRANSFORMERS(CT)

CTs for Protection:

Material: **Epoxy resin cast**

Ratio: **100-50/1 A**

Accuracy Class : **5 P10**

3.8.18.3. The RMU's other CTs / sensors, e.g., those used by Fault Passage Indicators (FPIs), shall be supplied by the FPI manufacturer. These CTs/sensors shall be an integral part of the FPI's design to ensure that they properly match the requirements of the FPI.

3.8.19. Auxiliary supply

3.8.19.1. The RMU shall not require any external auxiliary AC power supply for operation and control. This power supply shall be obtained from a cast resin insulated transformer connected to bus- bar side with secondary output 230 V AC. The VA rating shall be adequate for status indications, auxiliary power for protective relays, contactors for control and monitoring of ring switches ,space heaters, lighting and circuit breaker panels and rectifier for battery charger etc.. The

auxiliary power transformer shall be equipped with surge protection devices in accordance with IEC 62305.

3.8.20. Battery

3.8.20.1. The Battery should be of reputed make with superior dry fit technology, maintenance free suitable for Automation of RMU. Battery shall be of minimum 26 AH typically. The compartment inside the RMU panel to accommodate battery and battery charger shall havea minimum height of 50 cm.

Following shall be the features of the battery:-

a. 24V Dry/Gel/VRLA type maintenance free batteries.
b. Maintenance free (no topping up during the whole service life.
c. 12 year designed life.
d. Very low gassing due to internal gas recombination.
e. Shelf life up to 2 years
f. Short recharging time.
g. Completely recyclable.
h. Should have capacity for at least 5 Switching operations without charging in the event of supply failure.
i. To prevent deep discharge of the batteries on loss of AC power source, the all circuitry fed by the batteries shall be automatically disconnected following a user- adjustable time period or when the battery voltage falls below a preset value.
j. If the battery voltage falls below the preset value, the time to fully recharge all batteries shall not exceed twenty-four (24) hours.

3.8.21. Battery Charger

3.8.21.1. 24V on line Rectifier cum battery charger of sufficient capacity to drive motors and SCADA equipments with voltage regulation of + / - 5% or less on full load. The battery charger shall be fully temperature compensated. Battery charger, offered shall be suitable for Dry fit batteries with the following technical features

a. Industrial DIN RAIL mounted battery charger.
b. Input Voltage 230 VAC.
c. Output voltage (as per requirement for the battery above).
d. Wide output adjustment range.
e. Series and parallel use should be possible.
f. System Healthy and Power Fail indicators to be provided.

3.8.22. Safety & Pressure Release Device

3.8.22.1. Internal faults in any compartment such as arcing to earth, unsuccessful breaking operation, shall not affect the operators standing in front of the switchgear

assembly. All design arrangements to avoid such risks shall betaken.

3.8.22.2. Any accidental overpressure inside the sealed chamber shall be limited by the opening of a pressure-release device in such a way that the released gas shall not affect the operator or anyone else in the vicinity of RMU. Manufacturer shall provide type test report to prove compliance with IEC 60298. The degree of safety of persons against hazardous approach to live parts and moving parts shall be provided strictly as per latest safety standards. Proper sealing for the safety against entrance of small animals/insects/rodents into the compartment shall be provided. Internal Arc classification (IAC) shall be B FLR 20 kA/s.

3.8.23. Operation Position indicators

3.8.23.1. All operating positions shall be on the front of the unit and position of each of the switches shall be displayed on a mimic diagram. Clear indicators showing 'ON', OFF' and 'Earth' shall be provided on polycarbonate or metal painted labels not less than 15 mm in height and 1.5 mm thick (sticker type labels are not acceptable).

3.8.23.2. Indicator windows shall not be less than 15 mm in diameter and shall be covered with transparent UV resistant material with adequate mechanical strength.

Indicator	Letters	Background
ON	White	Red
OFF	White	Green
Earth	Black	Yellow

3.8.24. Interlocks

3.8.24.1. RMU installation is intended in public places and hence all possible interlocks to prevent wrong operation shall be provided. In general, the following interlocks are mandatory.

3.8.24.2. Mechanical type interlocks shall forbid access to the switchgear compartment if the following conditions are not fulfilled.

i. The switching device (load break switch / circuit breaker) is in the open position.

ii. The earthing switch is in the closed position.

iii. Any conducting parts, which extend outside the compartment, are earthed.

3.8.24.3. Opening of door or cover shall not be possible unless the earthing switch is

closed(as per IEC 298 clause 5.102.4). However it must be possible to open the Earthing switch when the door is opened for cable testing.

3.8.24.4. Operation of load break/circuit breaker switch shall not be possible when the

i) Cable compartment is open.
ii) Load breaks switch/circuit breaker is padlocked.
iii) Earthing switch is in the "closed" position.
iv) Cable test cover is open
v) Test plug is inserted

3.8.24.5. Operation of the 'Earth ON / Earth OFF' mechanism of earth switch shall not be possible unless the 'ON/OFF' mechanism of ring switch is in the 'OFF' position.

3.8.24.6. Operation of an Earthing switch shall not be possible when the Load break Switch/circuit breaker is in the "**closed"** position.

3.8.25. Padlocking facilities

3.8.25.1. Pad locking facility shall be provided for the circuit breakers and earthing switches in the openor closed position by 1 to 3 padlocks 6 to 8mm in diameter

3.8.26. Operating lever

3.8.26.1. An anti-reflex mechanism on the operating lever shall prevent any attempts to reopen immediately after closing of the switch or earthing switch. All manual operations will be carried out on the front of the switchboard. The effort exerted on the lever by the operator should not be more than 250N for the switch and the circuit breaker. The maximum height of the mechanism operating access shall not exceed 1.5 m.

3.8.27. Front plate

3.8.27.1. The front plate shall have an IP2X degree of protection. The front shall include a clear mimic diagram, which indicates the different functions. The position indicators shall give a true reflection of the position of the main contacts. They shall be clearly visible to the operator. The lever operating direction shall be clearly indicated in the mimic diagram. Motor replacement should be possible without removal of mimic.

3.8.27.2. The manufacturer's name and rating plate shall include the switchboard's main electrical characteristics.

3.8.28. Control wiring and Connections.

3.8.28.1. All Control wiring shall be 2.5sq.mm. minimum, stranded copper having 600V flame retardant insulation. CT wiring shall be of 4 Sqmm.minimum. All wires should be properly ferruledand numbered as per international standards. Connections to the external circuits shall be brought out to suitably rated pressure type terminal blocks complete with cable identification and wire markers at all connection points.

- Terminal blocks shall be provided in LV compartment for SCADA connectivity and to accommodate FRTU. Terminal blocks shall have provision for disconnection(isolation) with full depth insulating barriers made from moulded self -extinguishing material . Terminal blocks shall be appropriately sized and rated for the electrical capacity of the circuit and wire used. Not more than 2 wires shall be connected to any terminal .Required number of TBs shall be provided for common shield termination for each cable .
- All terminal blocks shall be suitably arranged for easy identification of its usages such as PT circuit, CT circuit, analog inputs, status inputs, control outputs, auxiliary power supply circuits, communication signals etc. TBs for CT circuits shall have features for CT shorting (On CT side) and disconnection (from load side) to facilitate testing by current injection. Similarly TBs for PT circuit shall have feature for disconnection to facilitate voltageinjection for testing .

3.8.29. RMU-FRTU Connectors

3.8.29.1. Potential free contacts for the following status signals shall be made available.

- CB Close/Open
- LBS Close/Open
- LBS & CB Earth switch Close/Open
- Spring charge status indication(LBS/CB)
- SF6 gas pressure low
- O/C Operated
- E/F operated
- Local/Remote
- Common Power supply healthy
- Motor MCB healthy status
- Battery charger fail
- RMU door Open
- CB trip coil healthy
- FPI Control - For remote resetting for SCADA
- Live cable status and Phase comparator output (ref 12.1 & 12.2)

For ease of installation and maintenance, the interconnection between the RMU and the FRTU, in a separate enclosure shall be supported by having heavy-duty terminal blocks with screw type terminals shall be provided by the supplier for necessary cable terminations. In using a terminal block, no more than two cables or wires

shall be connected to any of its individual terminals.

- Making strips shall be used to identify all external connection blocks. Marking tags shall be read horizontally. All terminals to which battery or other high voltages are connected shall be provided with fireproof covers.

- All individual status input, AC voltage input, and control output points shall be isolatable without the need to remove wiring by means of individual terminal blocks of the removable link type. In order to avoid open circuits on the secondary side of CTs, termination blocks with by- pass bridges shall be provided for all AC current inputs.

- Terminal blocks shall comply with IEC 60947-7-1 (2009): Low-voltage Switchgear and Control Gear, Part 7-1: Ancillary Equipment, Terminal Blocks for Copper Conductors.

3.8.30. SCADA FEATURES

3.8.30.1. The SCADA functions include

- Remote control for Load Break Switches and circuit breakers
- Position indicator for Load Break Switches, Circuit Breakers and Earthing Switches
- Remote monitoring and Control of fault indication system on all individual limbs for all phases and also separation to be there for current/earth fault.
- Monitoring of SF6 gas pressure
- Remote monitoring of voltage and current
- Remote Energy Auditing

3.8.31. TECHNICAL SPECIFICATION OF FRTU

3.8.31.1. General:

3.8.31.1.1. The Feeder Remote Terminal Unit (FRTU) shall be integral part of Ring Main Units (RMUs). FRTU shall be used for control of switching devices such as breaker, isolator inside RMU panel, sectionalizer etc from Master station(s). The supplied FRTUs shall be interfaced with the RMUs, FPI, communication equipment, and power supply distribution boards; for which all the interface cables, TBs, wires, lugs, glands etc. shall be supplied, installed & terminated by the supplier.

3.8.31.1.2. The FRTU should be enabled for communication to any Front-End Processor of any vendor and should be capable of being integrated to any SCADA-DMS system of any vendor over IEC 104 protocol

3.8.31.1.3. The FRTU shall be housed in a control cabinet that is mounted with the RMU panel with proper locking.

3.8.31.2. Design Standards:

3.8.31.2.1. The FRTUs shall be designed in accordance with applicable International Electro-Technical Commission (IEC), Institute of Electrical and Electronics Engineer (IEEE), American National Standards Institute (ANSI), and National Equipment Manufacturers association (NEMA) standards, unless otherwise specified in this Technical specification. In all cases the provisions of the latest edition or revision of the applicable standards in effect shall apply.

3.8.31.3. FRTU Functions:

3.8.31.3.1. All functional capability described herein shall be provided by the supplier even if a function is not initially implemented.

3.8.31.3.2. As a minimum, the FRTU shall be capable of performing the following functions:

a. Receiving and processing digital commands from the master station(s). Data transmission rates -2400 to 115200 bps for Serial ports for MODBUS. and 100mbps for TCP/IP Ethernet ports

b. Use of IEC 60870-5-104/101 protocol to communicate with the Master station(s)

c. Use of MODBUS over RS485 interface, to communicate with the MFTs.

d. Have required number of communication ports for simultaneous communication with Master station(s), MFTs and FRTU configuration & maintenance tool.

e. FRTU shall have the capability of automatic start-up and initialisation following restoration of power after an outage without need of manual intervention.

f. Remote database downloading of FRTU from master station from SCADA/DMS control centre

g. Internal battery backup to hold data in SOE buffer memory & also maintaining the time & date.

h. As the SCADA/DMS system will use public domain such as Fiber/cellular etc, therefore it mandatory to guard the data/ equipment from intrusion/damage/breach of security & shall have SSL/VPN based security.

i. Communication with at least two master stations simultaneously on IEC 60870-5-104 /101

j. FRTU should be remotely accessible and user should be able to perform monitoring and diagnosis from a centralised location.

k. Inbuilt logics for breaker/isolator open/close functions.

3.8.31.3.3. Further FRTU should have provision for providing additional I/O modules and communication cards for future expansion.

3.8.31.4. Communication ports:

3.8.31.4.1. The FRTUs shall have following communication ports to communicate with

master station MFTs and configuration & maintenance terminal.

3.8.31.4.2. FRTU shall have two TCP/IP Ethernet port for communication with Master station(s) using IEC 60870-5-104 protocol and 1No.Rs232 serial port in case of IEC60870-101

3.8.31.4.3. FRTU shall have 1No. of RS 485 port for communication with MFTs to be connected in daisy chain using MODBUS protocol. The MFT will act as slave to the FRTU. The FRTU shall transmit these values to the master station in the frame of IEC 60870-5-104/101 protocol

3.8.31.4.4. FRTU shall have one port of serial/Ethernet for connecting the portable configuration (Local Display HMI) and maintenance tool for FRTU.

3.8.31.4.5. Sufficient number of communication ports shall be provided in the FRTU to be able to meet future requirements. The FRTU shall support the use of a different communication data exchange rate (bits per second) and scanning cycle on each port & different database for each master station.

3.8.31.5. Status input:

3.8.31.5.1. FRTU shall be capable of accepting isolated dry (potential free) contact status inputs. The FRTU shall provide necessary sensing voltage, current, optical isolation and de-bounce filtering independently for each status input. The sensing voltage shall not exceed 24 Vdc/220VAC.

3.8.31.5.2. The FRTU shall accept two types of status inputs i.e. Single point Status inputs and Double point status inputs.

3.8.31.5.3. To take care of status contact chattering, a time period for each point and the allowable number of operations per time period shall be defined. If the allowable number of operations exceed with in this time period, the status change shall not be accepted as valid

3.8.31.5.4. Single point status input will be from a normally-open (NO) or normally-closed (NC) contact which is represented by 1-bit in the protocol message.

3.8.31.5.5. The Double point status input will be from two complementary contacts (one NO and one NC) which is represented by 2-bits in the protocol message. A switching device status is valid only when one contact is closed and the other contact is open. Invalid states shall be reported when both contacts are open or both contacts are closed.

3.8.31.6. Sequence of Events (SOE) feature:

3.8.31.6.1. To analyse the chronology or sequence of events occurring in the power system, time tagging ofdata is required which shall be achieved through SOE

feature of FRTU. The FRTU shall have an internal clock with the stability of 100ppm or better. The FRTU time shall be set from time synchronization messages received from master station using IEC 60870-5- 104 protocol. SOE time resolution shall be 10 ms or better

3.8.31.6.2. The FRTU shall maintain a clock and shall time-stamp the digital status data. Any digital status input data point in the FRTU shall be assignable as an SOE point. Each time a SOE status indication point changes the state, the FRTU shall time-tag the change and store in SOE buffer within the FRTU. A minimum of 5000 events can be stored in the SOE buffer. SOE shall be transferred to Master Station as per IEC 60870-5-104 protocol. SOE buffer shall be maintained by FRTU on power supply interruption.

3.8.31.7. Control Outputs:

3.8.31.7.1. The FRTU shall provide the capability for a master station to select and change the state of digital output points. These control outputs shall be used to control power system devices such as Circuit breakers, isolator, reset, relay disable/enable and other two-state devices, which shall be supported by the FRTU.

3.8.31.7.2. Each control output shall consist of one set of potential free NO contact. The output contacts shall be rated for at least 0.2 Amp. at 24 Vdc. These output contact shall be used to drive heavy duty relays. In case Control output module of FRTU does not provide potential free control of this rating, then separate control output relays shall be provided by the supplier. These relay coils shall be shunted with diodes to suppress inductive transients associated with energizing and de-energizing of the relay coils & shall conform to the relevant IEC requirements.

3.8.31.8. Heavy duty control output relays:

3.8.31.8.1. The control output contact from the FRTU shall be used for initiating heavy duty relays for trip/close of switching devices. The supplier shall provide heavy duty relay switch are in DIN rail mounting with aux voltage (coil voltage) on 24 V DC .Each control output relays shall consist of at least 2 NO contacts. The output contacts shall be rated for at least 10 Amps Continuous at 220Vdc and shall provide arc suppression to permit interruptions of an inductive load. Relay coils (24 V DC supply) shall be shunted with diodes to suppress inductive transients associated with energizing and de-energizing of the relay coils. The relays shall conform to the IEC255-1-00,IEC255-5 and IEC- 60810 requirements.

3.8.31.9. Input DC Power Supply:

3.8.31.9.1. The FRTU will be powered from a 24 V DC power supply system. The RTU shall not place additional ground on the input power source. The characteristics of the input DC power supply shall be

Nominal voltage of 24 Vdc with variation between 20.4 and 28.8V dc (i.e. 24(+20%/-15%)

3.8.31.9.2. The FRTU shall have adequate protection against reversed polarity, over current and under voltage conditions, to prevent the FRTU internal logic from being damaged and becoming unstable causing mal-operation.

3.8.31.10. Environmental Requirements:

3.8.31.10.1. The FRTU will be installed in inside RMU Panel or in open environment with no temperature or humidity control. The FRTUs shall be capable of operating in ambient temperature from 0 to +70 degree C with rate of temperature change of 20degree C/hour and relative humidity less than 95%, non-condensing.

3.8.31.11. FRTU Type Test Requirements

Test No.	Test Name	EUT Status	Test Level	Power Supply Points		I/O Points	Passing Criteria
				CM	DM	CM	
1	Surge Immunity Test	ON	Level-3	2 kV	1 kV	2 kV	A
2	Electrical Fast Transient BurstTest	ON	Level-3	2 kV		1 kV	A
3	Damped Oscillatory Wave	ON	Level-3	2.5 kV	1 kV	2.5 kV	A
4	Electrostatic Discharge Test	ON	Level-3	+/- 6 kV in Contact discharge mode or +/- 8 kV in Air discharge mode			A
5	Radiated Electromagnetic Field Test	ON	Level-3	10 V/m electric field strength			A
6	Damped Oscillatory Magnetic Field Test	ON	Level-3	30 A/mat 1MHz of magnetic field strength			A

7	Power frequency magnetic fieldTest	ON	Level-3	30 A/m of magnetic field strength(Continuous duration sine wave)	A
8	Power frequency voltage withstand Test	OFF	-	1 kV RMS for 1 min	No break down or flashover shall occur
9	1.2/50µs impulse voltage withstand Test	OFF		2 kV p	No break down or flashover shall occur
10	Insulation Resistance Test	OFF	-	Measure Insulation resistance using500 V DC Megger before &after Power Frequency & Impulse voltage withstand tests	As per manufacturer's Standard
11	Dry Heattest	ON	-	Continuous operation at 550C for16 hrs	
12	Damp Heat Test	ON	-	at 95% RH and 400C	

3.8.32 TESTS

Routine Tests shall be conducted on the Ring Main Units in accordance with the latest versions of IEC/IS. Each completely wired Ring Main Unit shall be tested to ensure that all of its protective, control and interlock systems are satisfactorily functioning in the manner as required. QA/QC assured reports also may be furnished along with supply. The Bidder shall indicate tests recommended to be carried out at site during installation and commissioning to ensure satisfactorily functioning in the equipment supplied.

3.8.32.1. Type Tests

3.8.32.1.1. The Ring Main Units shall be fully type tested as per the relevant standards including the type tests mentioned below. The type tests must have been conducted on 11kV Ring Main Units of same type from recognized NABL

accredited test laboratories not earlier than 2002(5 years from the date of opening of bid). The bidder shall furnish two sets of type test reports as per relevant standards along with the bid. Bids without the following type test reports will be treated as non-responsive .

3.8.32.1.2. According to this specification and IEC recommendations, the following type test certificates shall be supplied:

Impulse withstand test,

Temperature - rise test,

Short-time withstand current test,

Mechanical operation test,

Checking of degree of protection,

Switch, circuit breaker, earthing switch-making capacity.

Switch, circuit breaker breaking capacity.

Internal arc withstand

Checking of partial discharge on complete unit

Salt spray withstand test

3.8.32.1.3. In addition, for switches, test reports on rated breaking and making capacity shall be supplied. For earthing switches, test reports on making capacity, short-time withstand current and peak short-circuit current shall be supplied.

3.8.32.2. Routine Tests

3.8.32.2.1. The supplier shall carry out all acceptance and routine tests stipulated in the relevant standards in presence of TCED's representative during FAT. The Contractor shall give at least fifteen (15) days advance notice for witnessing the tests.

3.8.32.2.2. The routine tests carried out by the manufacturer shall be backed by test reports signed by the factory's quality control department. They shall include the following:

Conformity with drawings and diagrams,

Measurement of closing and opening speeds,

Measurement of operating torque,

Checking of filling pressure,

Checking of gas-tightness,

Checking of partial discharges on individual components,

Dielectric testing.

Measurement of main circuit resistance

Measurement of the time travel characteristics of breakers.

3.8.32.2.3. Copies of certified reports of all tests carried out at works shall be furnished. The equipment shall be dispatched from works, only after receipt of KSEB's written approval of the test reports.

3.8.32.2.4. TCED reserves the right to insist for witnessing the acceptance/routine testing of the bought out items to pass tests

3.8.32.3. Test during manufacture

The Bidder shall furnish details of tests carried out during the process of manufacture and end inspection by the bidder to ensure the desired quality of the equipment to be supplied.

3.8.32.4. Additional Tests:

3.8.32.4.1. The TCED reserves the right of having at contractors expenses any other tests(s) of reasonable nature carried out at Bidders premises, at site, or in any other place in addition to the aforesaid type, acceptance and routine tests, to satisfy themselves that the material comply with the specifications.

3.8.32.4.2. In case of failure in any type test, the supplier is required to modify the design of the material and the material shall be type tested again for the modified design, without any extra cost to TCED. No delivery extension shall be given for this additional testing.

3.8.32.4.3. The entire cost of testing for the acceptance and routine tests and tests during manufacture shall be treated as included in the quoted unit price.

3.8.32.5. Test Reports:

3.8.32.5.1. Record of routine test reports shall be maintained by the Bidder at his works for periodic inspection by the KSEB's representative.

3.8.32.5.2. The Bidder shall maintain test certificates for QA/QC of tests conducted during manufacture. These shall be produced for verification as and when desired by the TCED representative during the FAT and along with delivery.

3.8.32.6. Test Facilities:

3.8.32.6.1. The tests shall be carried out as per relevant IEC/IS and test certificates shall be furnished for approval. The Bidder shall indicate the details of the equipment available with him for carrying out the various tests as per relevant Standards. The Bidder shall indicate the sources of all materials. The bidder shall indicate the name of the supplier and make of vacuum interrupters meters relays, conductor, insulating oil, electrical steel laminations constructional steel etc.

3.8.32.6.2. Tests as per applicable standards should be carried out in respect of porcelain bushings, galvanization, relays and meters

3.8.33. Mandatory Spares & Tools:

3.8.33.1. Comprehensive list of manufacturer's recommended spare parts shall be furnished along with the bid. The quantities offered should be adequate for the initial 5 years of operation. Firm price and delivery period shall be quoted for each item.

1. List of recommended special maintenance Tools and Tackles together with their individual prices shall be furnished along with the bid. Torque wrench also to be included along with the list of tools

2. SF6 Gas Cylinders of 50 Kg capacity 2 Nos
3. SF6 gas filling equipment with every lot of 50 Nos. RMUs.
4. Vacuum pump 3 Nos.
5. Spare 11kV Bushings- 10 Nos. with every lot of 100 Nos. RMUs
6. List of recommended special maintenance Tools & Tackles for the equipment to be supplied against this specification together with their individual prices shall be furnished along with the bid.

3.8.34. DOCUMENTATION:

All drawings shall conform to International Standards Organization (ISO) 'A' series of drawings sheet/India Standards Specifications IS:656. All drawings shall be in ink and suitable for microfilming and a soft copy of the drawings. All dimensions and data shall be in S.I. Units.

3.8.35. LIST OF DRAWINGS AND DOCUMENTS:

3.8.35.1. The bidder shall furnish four sets of following drawings and documents along with his offer.

1. Completely filled-in technical schedules
2. Typical general arrangement drawings/ wiring diagrams
3. Type Test Certificates
4. Quality Assurance Plan
5. Experience List
6. Foundation fixing drawings
7. General outline drawing showing plan, elevation and end view dimensions, assembly and Constructional drawings of the equipment.
8. Name plate & schematic drawings.
9. Operation manuals, leafless literature etc.
10. The successful Bidder shall, within 2 weeks of placement of order, submit three sets of final versions of all the above said drawings for TCED's approval. The TCED shall communicate his comments/approval on the drawings to the supplier within four weeks. The supplier shall, if necessary, modify the drawings and resubmit three copies of the modified drawings for their approval. The supplier shall within two weeks, submit 5 prints and two good quality copies of the approved drawings for TCED's use.

3.8.35.2. The supplier for distribution before commencement of supply shall submit two sets of the type test reports, duly approved by TCED. Adequate copies of acceptance and routine test certificates, duly approved by TCED, shall accompany the dispatch consignment.

3.8.35.3. The manufacturing of the equipment shall be strictly in accordance with the approved drawings and no deviation shall be permitted without the written approval of the TCED. All manufacturing and fabrication work in connection with the equipment prior to the approval of the drawing shall be at the supplier's risk.

3.8.35.4. One set of nicely printed bound volumes of operation, maintenance and erection manuals and approved drawings in English language shall be supplied along with each circuit breaker, in addition to the five sets to be sent directly to TCED.

3.8.35.5. Approval of drawings/work by TCED shall not relieve the supplier of his responsibility and liability for ensuing correctness and correct interpretation of the drawings for meeting the requirements of the latest revision of application standards, rules and codes of practices. The equipment shall conform in all respects to high standards of engineering, design, workmanship and latest revisions of relevant standards at the time of ordering and purchaser shall have to power to reject any work or materials which, in his judgment is not in full accordance therewith.

3.8.36. PACKING & FORWARDING

The material shall be packed properly as per standard to eliminate the chances of damages during transit and while handling at site. The manufacturer should adopt suitable marks in terms of labeling, strip marking and stamping etc.

3.8.37. TRAINING

All successful tenderers for switchgear shall provide training facilities to Engineers & line staff. The training shall be for not less than 3 man days. Syllabus and other details of the training shall be finalized in consultation with the Owner Charges for training shall be borne by the contractor & should be included in the quoted rate.

3.8.38. RMU INSTALLATION.

RMU Installation consists of foundation, base plates, fixing anchor bolts, loading & unloading, handling, erection, alignment and allied works for the installation of Data Acquisition compatible Extensible type Ring Main Units with terminal protector boots & extension modules, actuators for remote operations, communicable FPIs, CTs, PTs & relay contacts for SCADA, giving power & control wiring and connections, providing terminal protector, interconnecting RMU bus bar and control cables, providing metered LT supply from nearest LT pole, providing 2 nos pipe earthing, cable mounting & terminations, giving connections after ascertaining proper phase sequence, providing location name & warning boards, burying cables & refilling, conducting all pre commissioning tests as required, complete, except cost of conveyance

3.8.39. RMU FOUNDATION.

RMU Shall be erected on 200x900x1200 mm "C" shaped concrete pedestal on 150mm PCC and the top of the pedestal shall be 300mm above from the finished GL.

SCHEDULE OF GUARANTEED TECHNICAL PARTICULARS OF RING MAIN UNITS

Sl no	Description	KSEB Requirement	As per tender offered
I	**GENERAL**		
1.	Design	Metal enclosed high tensile steel	
2.	Type	Outdoor	
3.	Extensibility	Both sides as per requirement	

4.	Motorized &SCADA Compatible	Yes	
5.	Type and designation		
6.	Rated voltage	12 kV	
7.	No. of poles	3	
8.	Rated short-duration power-frequency withstand voltage	28 kV RMS - 1 min	
9.	Rated impulse withstand voltage	75 kV	
10.	Rated frequency	50 Hz	
11.	Rated normal current		
a)	For ring-main feeders	630 A	
b)	For bus bar	630 A	
c)	For circuit breaker feeder	630 A	
12.	Rated short-time withstand current	20 kA, 3 sec	
13.	Rated peak withstand current	50 kA	
14.	Rated short-circuit making ct.		
a)	For ring-main feeders	50kA	
b)	For circuit breaker feeder	50kA	
15	Degree of protection		
a)	For gas filled switchgear vessel	IP67	
b)	For switchgear enclosure	IP 54	
c)	For low-voltage compartment	IP 54	
16.	Internal arc test	BFLR 20 kA, 1 sec	
17.	No. of tanks		
18.	Type of insulation	SF6	
19.	Quantity of SF6 gas in the complete switch	Sufficient for minimum 30 years of operation without refilling	
20.	Total length of break per pole		
21.	Type of arcing contacts and arc control device		
22.	Steady hydraulic test press. tank can withstand for one minute without distortion		
23.	Weight of switch complete with operating mechanism		
24.	Maximum temp. rise of contacts at normal rating		

	and frequency		
25.	Method of closing	Manual independent spring charged and motorised	
26.	Minimum clearance in in SF6		
	i)Between poles		
	ii)Between live parts and earth		
	iii)Between fixed and moving contact in the open position		
II	**CIRCUIT BREAKER**		
1.	Type	Fixed	
2.	Insulation medium	SF6	
3.	Interruption medium	Vacuum	
4.	Rated voltage	11 kV	
5.	Maximum operating voltage	12 kV	
6.	Rated frequency	50 Hz	
7.	Rated current of CB	630 A	
8.	Rated short circuit level(1 s)	20 kA	
9.	Rated making current	50 kA	
10.	Re-striking voltage ratio		
11.	Duty cycle(Rated operating sequence)		
12.	Making time		
13.	Opening time		
14.	Arc duration		
15	Total Breaking Time		
16.	Operating mechanism	Spring charged	
17.	Main contacts	Silver plated	
18.	Protective E/F &O/C relay as per Clause 11	Yes	
19.	Provision of isolator switch	Yes	
III	**EARTHING SWITCH**		
1.	Rated short circuit making ct.	50 kA	
2.	Number of operating cycles, mechanical	1500	

3.	Number of short circuit making operations	5	
IV	**CABLE COMPARTMENTS**		
1.	Type of cable box	Air insulated	
2.	Cable termination access	Front	
3.	Phase to phase clearance	.The clearance between ph. to ph. and ph. to E shall be as per IEC 61243-5 amended up to date	
4.	Phase to earth clearance		
5.	Phase to earth over insulated surface (creepage distance)		
6.	Type of cable termination ;suited	Heat shrink	
7	Cable compartment with bottom plate and cable clamp	Yes	
8	To accept cable with 70-100 mm diameter	Yes	
9	Bottom plate in two halves with 110 mm hole	Yes	
10	Fasteners supplied with bushing	Yes	
11	Bolt size for cable termination	M16	
12	Clearance between clamp and bushing	Suitable for all types of cable and terminations	
V	**ACCESSORIES**		
1.	Ground bar 25x5 mm M 12 stud		
2.	Voltage indicator lamp	Yes	
3.	Phase comparators	Yes	
4.	Fault Pass Indicators	Yes	
5.	Cable testing facility	Yes	
6.	Voltage transformer as per clause 18.2	Yes	

7.	Current transformers rated as per clause 18.1	Yes	
8.	Terminal blocks of meter relay testing and SCADA provided	Yes	
9.	Indicating meters	Nil	
10.	over pressure release	Yes	
11.	Name plate	Yes	
12.	Circuit labels	Yes	
13.	KSEB monogram	Yes	
14.	Danger plate	Yes	
15.	Operating handle	Anti-reflex type	
16.	Max. height of operating access	1.5 m	
17.	Max physical effort required to operate any mechanism	250 N	
18.	Cable testing facility	Yes	
19.	Interlocks as per Clause 24	Yes	
20.	Provision of gas pressure gauge	Yes	
21.	Position indicator in accordance with IEC 60265-1	Yes	
22.	Auxiliary supply as per clause 19	Yes	
23.	Padlocking facility	Yes	
VI	**CUBICLE**		
1	Maximum height	1500mm	
2	Maximum height with metering panel		
3	Max width of CB panel	750 mm	
4	Max width of LBS panel	500 mm	
5	Max width of metering cubicle	800mm	
6	Depth suitable for 600 mm cable trench	800mm	
7	Paint finish method		
8	Finish colour	Polyurethane powder coated D A Grey	
VII	**BUS BAR**		
1.	Material and grade		
2.	a. Cross sectional area mm^2		

	b. Size mm		
3.	Continuous current		
	. Standard		
4.	Short time current for 1		
	sec.(kA rms)		
5.	Minimum clearance from Busbar connection		
.	Phase to phase (mm)		
.	Phase to earth(mm)		
6.	SF6 gas pressure		
7.	Reference standard		
8.	Max.temp.rise over ambient (^{0}C)		
9.	Busbar provided with		
.	Insulation sleeve	Busbars shall be housed in SF6 and need not be sleeved	
	. Phase barriers		
	. Cast resin shrouds for joints		
10.	Busbar connection		
.	Silver plate		
	. with anti oxide grease		
11.	Busbar support spacing(mm)		
12.	Bus support insulators		
.	Make		
	. Type		
	. Reference standard		
	. Voltage class(kV)		
	. Min. creepage distance(mm)		
	. Cantilever strength (kg/mm)		
	. net weight		
VIII	**BATTERY AND CHARGER**		
	Type ofbattery		

	Designed life	12 years	
	Shelf life	2 years	
	Recharging time	short	
	Ah	42 minimum	
	Make of battery charger		
	Rated voltage of charger	24v	
IX	**FRTU**		
	General Hardware Specification • Processor • Memory		
	Power Consumption		
	Input Voltage	24 V	
	No of Digital Input Signals supported		
	No of Digital Output Signals supported		
	No of Analog Input Signals supported		
	Max .No of Digital Input Signals supported		
	Max. No of Digital Output Signals supported		
	Data Transmission Rate	- 2400 to 115200 bps for Serial ports for MODBUS 100 mbps for TCP/IP Ethernet ports	
	Protocol supported	IEC 60870-5-104/101 MODBUS	
	Port	RS 485 RS 232 Ethernet	
	Operating temperature range	0 to +70 degree C	
	Simultaneous communication to multi master	At least two Master	

		station	
	Security	SSL/VPN	
	Minimum SOE buffer storage capacity	5000 events	
	Remote download database to FRTU	Yes	
	Status input scanning frequency	1 millisecond	

3.9 : Technical Specification of L.T. Distribution Box suitable for 315 kVA Distribution Transformer.

3.9.1. SCOPE:

This Specification covers the design, manufacture, testing at works and supply of Distribution Boxes made out of **CRCA MS** for controlling the L.T. feeders from the L.T. side of Distribution Transformers. The system shall be A.C. 3 phase, 4 wire, 433 V, 50 HZ with effectively grounded neutral.

3.9.2. SERVICE CONDITIONS:

The equipment to be supplied against this specification shall be suitable for satisfactory continuous operation under the tropical conditions as specified by employer which is as hereunder;

1. Max. Ambient temperature : 50 degree centigrade
2. Min. Ambient temperature : 5 degree centigrade
3. Daily average Ambient temperature : 30 degree centigrade
4. Max. Humidity : 100%
5. Average number of Thunder storm days : 50 per annum
6. Average number of storm per annul : 55 per annum
7. Max. rain fall per annul : 4500mm (approx.)
8. Average rain fall per annul : 3000mm (approx.)
9. Limits of variation of ambient temperature
10. Over a period of 24 hours : 15 degree peak
11. Wind pressure : 150 kg/sq. meter
12. Altitude : up to1000m above MSL

Moderately hot and humid tropical climate conductive to rust and fungus growth

3.9.3. Applicable Standards:

1 IS :13947/ (Part 3) (amended upto date) for Isolator (Switch Disconnector)

2 IS: 8623 (amended upto date) for enclosure Box & for degree of protection provided by enclosures of electrical equipments.

3 IS: 4237, IS:8623 (amended upto date) - for general requirement of L.T. switchgears.

4 IS 13703 (Part I & II amended upto date) for HRC Fuse Base and HRC Fuse Link.

5 IS: 5 /2007 - Colours of Ready Mixed paints and Enamels.

6 IS: 13871/1993 (amended upto date) - Powder coatings - specifications

7 IS : 6005/1998 (amended upto date) - Code of Practice for phosphating of iron and steel.

8 IS: 13411/1992 (amended upto date) - Glass Reinforced Polyester Dough Moulding Compounds

3.9.4. MANUFACTURE / CONSTRUCTION OF BOXES:

1.1 Distribution Boxes shall have Isolator (Switch Disconnector) and HRC fuse base with links on incoming circuit and on outgoing circuits with necessary interconnecting Bus Bars/ Links.

1.2 Standard General Arrangement of Isolators, HRC fuse base with links, Neutral Links, Bus Bars, Cable termination arrangement etc inside the Box is shown in the enclosed drawings.

3.9.5. INCOMING CIRCUIT -

3.9.5.1 Isolator (Switch Disconnector) -

Each distribution box shall have one triple pole Isolator (Switch Disconnector), conforming to relevant latest IS. The supplier shall indicate makes and types of offered isolator in GTP. The supplier shall submit Type Test Report (Report of within 5 Years) of the Isolator as specified in Cl. No. 12.3 (II) for approval of Employer before commencement of supply. The Switch disconnector to be provided in the Distribution Box will be as per TCED specification.

The Isolator should be front operated triple pole type. The casing of Isolator shall be of non-tracking, heat resistant insulating material of Dough Maudling Compound (DMC) of D_3 Grade as per IS:13411 (amended up to date), no separate enclosure is required. Isolator Base should withstand the breaking capacity of 80 kA. To extinguish the arc immediately in isolators, in each phase arc-chutes with minimum 12 strips shall be provided.

The isolator should be front operated triple pole type. The isolator shall be robust in construction and easy for operation. The handle of the isolator should be detachable easily for security purpose while working on L.T. circuits.

The characteristics of Isolator shall be as follows:

S.No	Characteristics	
1.	Basic uninterrupted duty	700 A
2.	Mechanism	Manual quick make quick break
3.	Standard applicable	IS : 13947 amended upto date
4.	Utilization category	AC -23 A
5.	Mechanical Endurance	As per IS 13497 amended upto date
6.	Electrical Endurance	As per IS: 13947 amended upto date
7.	Rated Duty	Uninterrupted
8	Making /Breaking capacity	Not less than requirement of AC -23 A category
9.	Two seconds rating	8 KA
10.	Rated insulation voltage	660 V

The terminal connector strips of the isolator shall be projecting out of isolator of 80 mm (minimum) in length on cable connection side and 60mm (minimum) on HRC fuse base side. The cross section of the strips on outside of the isolator shall be provided as 50x6 mm.

The material of isolator strips shall be EC grade tin-plated copper. The terminal strips shall be continuous from the point of contact separation inside the Isolator with cross section as mentioned above throughout the length. Gap of 50mm shall be maintained between each terminal throughout the length.

3.9.5.2 HRC FUSE

HRC Fuse of suitable capacity shall be provided between outgoing terminal of Switch Disconnector (Isolator) and incoming Busbar to facilitate electrical breaking of the circuit. Each Distribution Box shall have 3 Nos. of HRC Fuse Base with HRC Fuse Links (Blade type Contacts).

(i) HRC FUSE BASE

The base of the HRC Fuse shall be of non-tracking, heat resistant insulating material of Dough Moulding Compound (DMC) of D_3 Grade as per IS:13411/1992. The Fuse Base shall be sturdy in construction.

HRC Fuse Base & fuse link should have withstand the breaking capacity of 80 kA and HRC Fuse base shall be 630A .

(ii) HRC FUSE LINK

The HRC Fuse Links shall be sturdy in construction of "Din Type". Breaking Capacity shall be 80 kA. For fault indication red pop up indicator should come out instantly on fusing. Manufacturer's name, current rating, breaking capacity and type shall be marked on HRC fuse link. HRC Fuse link Current rating shall be 450 Amp

The supplier shall submit Type Test Report of the HRC fuse base and HRC fuse link as specified in Cl. No. 12.3 (III) for approval of TCED before commencement of supply. The HRC fuse base with links to be provided in the Distribution Box will be as per TCED approval given in the detailed purchase order.

3.9.6 : OUTGOING CIRCUITS:

The distribution box shall have 6 nos of HRC Fuse Units to protect outgoing circuits. HRC Fuse Units shall be of reputed make. The HRC Fuse Units to be provided in the Distribution Box will be as per TCED approval. HRC Fuse base shall be 630A and HRC Fuse shall be 315A . An additional cut out fuse of 100 Ashall be provided for Street main control

3.9.7 : BUSBARS AND CONNECTIONS:

The Incomer feeder should be on right side of the distribution box and all outgoing feeders will be on left side of the distribution box, with phase sequence RYB to be maintained. The phase busbars, incoming droppers and feeder droppers from busbars shall be of EC Grade Aluminium. The phase bus bar strips shall be of size 50X15 mm, Feeder droppers shall be of size 50X15 mm and Incomer dropper size of 50X15 mm, All busbars and droppers shall be properly drilled and de-burred. Each bus bar shall be of one single strip without any joint. Busbars shall be provided with durable PVC insulating sleeves of standard colour code for different phases. Corrugated/Spring & Plain washers shall be used for Nut-Bolt connections. Busbars shall be mounted on suitable size support insulators which should be tightened from inside. i.e. once fitted, should not be able to removed.

Minimum clearances and other clearances shall be as per requirement of IS: 4237amended up to date.

3.9.8 : ENCLOSURE:

3.9.8.1 The Box & Doors shall be made up of CRCAMS sheet of 2mm thickness.

3.9.8.2 The manufacturing process of Box shall be Deep Drawn / Sheet Bending Process.

3.9.8.3 The rounding of corners and slope on top of the distribution boxes shall be provided.

3.9.8.4 The welding process of distribution boxes shall be done by MIG (Metal Inert Gas) welding and workmanship/finishing should be good enough.

3.9.8.5 For Deep Drawn/ Sheet Bending Process Box: The general clear dimensions of 315 KVA Distribution Box shall be 1100 x1030 x 350 (LX H X W)mm. The centre height of distribution box on front side shall be 1000 mm

3.9.8.6 The Base and doors of enclosure shall be individually in one piece

without any welding, except for fixing of the accessories like hinges, clamps, mounting clamps, bolts etc. All boxes shall have two doors as shown in the drawing fixed on right & left side of the box with four hinges provided from inside of box. On closing of doors, right door shall rest on the left door. Hinges shall not be visible and approachable after closing the box. Base and doors shall have flange / collars as shown in drawing. Collar of Base and doors shall overlap by 10mm. Rubber gasket of suitable size shall be provided in between base and doors, such that it provides proper sealing between the door and base of box to avoid penetration of dust & ingress of water. Degree of protection shall be IP- 33 as per IS-8623 (amended up to date). Rubber Gasket shall be fixed with suitable adhesive. Four hinges on each side shall be provided from inside of the box to fix the doors. Hinges shall be minimum 50 mm in length & made from 2mm thick sheet. Hinge stainless steel pin diameter shall be 4mm. The hinges shall not be visible from outside.

3.9.8.7 Isolator and all HRC fuse base with link shall be housed inside the enclosure. Live parts such as Bus bars and droppers etc should be covered by hylam sheet. Isolator operating handle shall be accessible only after opening of the doors.

3.9.8.8 Four set of Louvers (two sets on each side) of suitable size shall be provided as shown in drawing. Thelouvers shall be provided such that heat dissipation is proper. The perforated sheet of 20 SWG with 2.5 mm holes shall be welded from inside of the louvers.

3.9.8.9 Mounting of components inside the enclosure shall allow free air circulation keeping the required clearances.

3.9.8.10 LED indicating lamps in RYB for Mains and outgoing circuits should be provided on the Doors.

3.9.8.11 Locking Arrangement to the Box:

The doors shall be closed with a push fit locking arrangement such that on pressing/pushing the right door, the distribution box gets locked from inside from top & bottom. This arrangement shall be operational for opening of the door with a handle provided outside the door. Handle shall be removable type only. A Nylon washer shall be provided between the handle and door to avoid penetration of water. One central lock with brass levers shall be provided inside the door. Key way shall be provided on the door for operating the central lock from outside. Key way shall be provided with cover.

3.9.8.12 A suitable cable termination arrangement with support insulators shall be provided on Isolators and Link Disconnectors. The bimetallic lugs of adequate size should be provided. Clearances, Creepages and convenience in making connections shall be ensured.EC grade Aluminium Neutral Busbar of 1200 x 40 x 15mm for capable of carrying for full load current. Neutral Busbar shall be isolated with respect to body. The bimetallic lugs of adequate size, should be provided. Neutral Busbar should be provided at the bottom in the enclosure.

3.9.8.13 Bolts of M10 mm and 35 mm length with 2 Nos. plain washer and two Nos. nut are to be provided on both the sides for earthing of the distribution box. Earthing bolt is to be fixed on U-structure (Earth Clamp) welded on both sides of the distribution box. Thickness of earth clamp shall be 2mm. The top surface of the earth clamp shall be properly Zinc plated. Earthing nut bolt and washer should be zinc plated. There should be no powder coating on top surface of the earthing clamps.

3.9.8.14 Three bottom plates shall be provided for incoming and outgoing cables. Bottom plate of size 125mm x 125mm fixed with four screws from inside shall be provided for incoming and outgoing cables. Bottom plates shall be provided with suitable holes and rubber

glands for the cables. Rubber glands shall be made such that internal diameter of glands provided for cables should be closed with the rubber film of minimum 1mm thickness. Cable will go through the glands by cutting the film of the glands. Bottom plates shall also be provided with cable clamps.

3.9.8.15 Necessary fixing arrangement shall be provided at the back of the enclosure to ensure proper fixing on double pole structure by means of suitable clamps at 4 places.

3.9.8.16 Danger marking shall be provided in red color on the right door of the distribution box. Marking shall be scratch proof and properly readable.

3.9.8.17 All the components inside the Box shall be mounted on CRCA MS strips of 2mm thickness. The mounting strips shall be provided with required bends or ribs to give the extra strength and shall be powder coated or zinc plated.

3.9.8.18 All joints of current carrying parts shall be bolted with 8.8 grade High Tensile MS Nuts & Bolts, Corrugated/spring & Plain Washers. The nuts & bolts should be of hexagonal type. All the nuts, bolts & washers should be properly zinc plated.

3.9.8.19 Each distribution box shall be supplied with proper packing in five ply - corrugated box.

3.9.8.20 Name plate having details such as Month & year of manufacturing, Sr.No, and rating of Distribution box shall be riveted on the Distribution box door. Name of Manufacturer shall be duly embossed on the door of the distribution box. The name plate should be of stainless steel of thickness 1 mm.

3.9.8.21 Incoming and outgoing circuit should be duly highlighted with paint by stencil printing.

3.9.8.22 Adequate slope on the top of box shall be provided to drain out rainwater from the top.

3.9.8.23 Good-quality plastic sticker leaflet should be pasted inside of distribution box door. The matter of instruction leaflet shall be provided. All the instructions in leaflet should be in English/Malayalam languages.

3.9.9 : CABLE TERMINATION:

Adequate size of Bimetallic lugs shall be provided for 4 core, LT XLPE cable on incoming side 300sq.mm and out going side 150 sq.mm

3.9.10 : CABLE LUG :

Bimetallic lug should be made for electrolytic grade aluminum. Each lug should be copper coated by electrolytic process and rich layer of tin should be mounted through out the lug to protect from Galvanic Corrosion. The lugs shall be such that the rich layer of tin should not peel of during operation. Individual lot should be pre filled with conductive inhibition compound and lug should be duly capped to prevent oozing of compound. The ductility of material should be such that flow ability of material be adequate to flow into the strand of the conductor and withstand on crimping pressure of 8500PSI. The cut cross section of the joints shall be homogeneous.

3.9.11 : FINISHING OF DISTRIBUTION BOX:

The outer side and inside surface of the box shall be properly Pre-treated /Phosphated in seven tank process as per IS: 6005 and shall be applied powder coating of minimum 40 micron thickness. The Color shade of light Admiralty gray (as per TCED requirement) as per IS: 5/2007 (Colours of Ready Mixed paints and Enamels) shall be applied inside & outside surface of the box or as per state practice. Powder coating shall be suitable for outdoor use, conforming IS: 13871 (amended up to date) - Powder coatings. The process facility shall be in-house to ensure proper quality for outdoor application.

3.9.12: TESTS & TEST CERTIFICATES:

In case of bought out items, routine and acceptance tests as per relevant IS and

this specification shall be carried out at the original manufacturers' works.

a) Routine Test (Carried out on all boxes):

1 Overall Dimensions Checking.
2 Insulation Resistance Tests.
3 High Voltage Test at 2500 V, 50 HzAC for one minute.
4. Operation Test on Isolator/ HRC fuse base and fuse links.

b) Acceptance Tests (one complete Distribution Box):

Following tests shall be carried out as per acceptance tests in addition to routine tests.

i) Temperature rise test.

Temperature rise test will be carried out as per the procedure given below:

For temperature rise test, a distribution box with all assembly of cut out fuse/ Isolator / HRC fuse base with link shall be kept in an enclosure such that the temperature outside the box shall be maintained at 50 ° C. 20% more current than transformer secondary capacity shall be kept in incoming circuit keeping outgoing circuits short, till the temperature stabilizes and maximum temperature rise should be recorded.

C) TYPE TESTS :

C.1 COMPLETE BOX:

a. Temperature rise test:- The temperature rise test should be carried out as per IS: 8623

1. High voltage test shall be carried out as per IS:8623 amended up to date.
2. Short Time Withstand Current Test on Distribution Box shall be carried out as per IS 8623 or latest version.
3. The Distribution Box should be subjected to Short Time Withstand Current Test for 8 KA for 2 second, all the circuits independently.
4. Degree of protection for **IP- 33** on complete box shall be carried out as per IS: 13947/1993 or the latest version thereof.

C.2 ISOLATOR (SWITCH DISCONNECTOR):

All type tests on Isolator (Switch Disconnector) as per IS: 13947 (Part III) amended up to date shall be carried out.

C.3 HRC fuses base and HRC fuse links :

All type tests on HRC fuses and HRC fuse links IS 13703 (Part I & II amended up to date) for HRC Fuse Base and HRC fuse link shall be carried out.

3.9.13: TYPE - TEST CERTIFICATES:

The Distribution Box, Isolator (Switch Disconnector), HRC fuse, HRC Fuse Link and cut out fuse shall be fully type tested as per relevant IS and this specification. The Supplier shall furnish detailed type test reports before commencement of supply. Type Test Certificate shall not be more than 5 Years old from Date of supply. The detailed Type Test Reports shall be furnished with relevant IS oscillogram and certified Drawings of the equipment tested. All the type tests shall be carried out from laboratories accredited by National Accreditation Board of Testing And Calibration Laboratories (NABL), Department of science & technology , Govt. of India to prove that the complete Box, Isolator, HRC fuse, meet the requirements of the specification. The Manufacturer should also furnish certificate from laboratories that laboratories are having all the requisite test facility available in house. The type test Reports conducted in manufacturers own laboratory and certified by testing institute shall not be acceptable. The Supplier

should furnish the particulars giving specific required details of Distribution Boxes, Isolator.

3.9.14: TESTING & MANUFACTURING FACILITIES :

Supplier must be an indigenous manufacturer. The Supplier must clearly indicate what testing facilities are available in the works of manufacturer and whether the facilities are adequate to carry out all Routine & Acceptance Tests. These facilities should be available to Employer's Engineers, if deputed to carry out or witness the tests in the manufacturer's works. The supplier must have all the in-house testing facilities to carry out the acceptance tests on the Box. The supplier shall furnish detailed process of manufacturing & Powder coating

3.10 : CABLING PRACTICE

Cabling is required for wiring from AC output of inverter/PCU to the Grid Interconnection point. It includes the DC cabling from Solar Array to AJB and from AJB to inverter input.

3.10.1 All cables of appropriate size to be used in the system shall have the following

characteristic:

a. Shall conform to IEC 60227 / IS 694 & IEC 60502 / IS 1554 standards.

b. Temperature Range: -10 degree Celsius to +80 degree Celsius

c. Voltage rating: 660/1000V

d. Excellent resistance to heat, cold, water, oil, abrasion, UV radiation

e. Flexible

3.10.2 Sizes of cables between any array interconnections, array to junction boxes, junction box to inverter etc. shall be so selected to keep the voltage drop (power loss) of the entire solar system to the minimum (2%).

3.10.3 For the DC cabling, XLPE or XLPO insulated and sheathed, UV stabilized single core flexible copper cables shall be used; multi-core cables shall not be used. The Connectors being used must comply - IS 16781: 2018 | IEC 62852 : 2014 - Connectors for DC Application in Photovoltaic Systems Safety Requirements and Tests

3.10.4 XLPE insulated Aluminium cable of suitable area of cross section can be used in the AC side subject to a minimum area of cross section of 10 sq.mm. Outdoor AC cables shall have a UV -stabilized outer sheath IS/IEC 69947.

3.10.5 All LT XLPE cables shall conform to IS: 7098 part I&II.

3.10.6 The total voltage drop on the cable segments from the solar PV modules to the solar grid inverter shall not exceed 2.0%.

3.10.7 The total voltage drop on the cable segments from the solar grid inverter to the building distribution board shall not exceed 2.0%

3.10.8 The electric cables for DC systems for rated voltage of 1500 V shall conform to BIS 17293:2020

3.10.9 The DC cables from the SPV module array shall run through a UV-

Stabilized PVC conduit pipe / HDPE Double Wall Corrugated (DWC) conduits of adequate diameter with a minimum wall thickness of 1.5mmand suitably tagged and marked with proper manner by good quality ferule or by other means so that the cable is easily identified.

3.10.10 Cables and wires used for the interconnection of solar PV modules shall be provide with solar PV connectors (MC4) and couples.

3.10.11 All cables and conduit pipes shall be clamped to the rooftop, walls and ceilings with thermo-plastic clamps at intervals not exceeding 50cm; the minimum DC cables size shall be 4.0mm2 copper; the minimum AC cable size shall be 4.0mm2 copper. In three phase systems, the size of the neutral wire size shall be equal to the size of the phase wires. Conduits for taking outdoor cables shall be UV
treated.

3.10.12 Cable Marking: All cable/wires are to be marked in proper manner by good quality ferule or by other means so that the cable can be easily identified. The
following colour code shall be used for cable wires

a. DC positive: red (the outer PVC sheath can be black with a red line marking
b. DC negative: black
c. AC single phase: Phase: red; Neutral: black
d. AC three phase: phases: red, yellow, blue; neutral: black
e. Earth wires: green.

3.10.13 Cables and conduits that have to pass through walls or ceilings shall be taken through PVC pipe sleeve.

3.10.14 Cable conductors shall be terminated with tinned copper end ferrules to prevent fraying and breaking of individual wire strands. The termination of the DC and AC cables at the Solar Grid Inverter shall be done as per instructions of the manufacturer, which in most cases will include the use of special connectors.

3.10.15 All cables and connectors used for installation of solar field must be of solar grade which can withstand harsh environment conditions including high temperatures, UV radiation, rain, humidity, dirt, salt, burial and attack by moss and microbes for 25 years and voltages as per latest IEC standards. DC cables used from solar modules to array junction box shall solar grade copper (Cu) with XLPO insulation and rated for 1.1 kV as per relevant standards only.

3.10.16 Bending radii for cables shall be as per manufactures recommendations and IS: 1255.

3.10.17 For laying/termination of cables latest BIS/IEC Codes/ standards shall be followed.

3.11 : FACTORY TESTING

a. PCU shall be tested prior to shipment and factory test certificate for relevant parameters should be provided with the PCU supplied. TCED officials may be allowed to witness the tests if required.

b. Factory testing shall not only be limited to measurement of phase currents, efficiencies, harmonic content and power factor, but shall also include all other necessary tests/simulation required and requested by TCED Engineers. Tests may be performed at 25, 50, 75 and 100 percent of the rated nominal power.

3.12 : ARRAY SUPPORT STRUCTURE

a. Photovoltaic arrays must be mounted on a stable, durable structure that can support the array and withstand wind, rain, and other adverse conditions. The modules will be fixed on structures with fixed arrangement.

b. The module mounting structures shall have adequate strength and appropriate design suitable to the locations, which can withstand the load and high wind velocities. Stationary structures shall support PV modules at a given orientation, absorb and transfer the mechanical loads to the surface properly.

c. Wherever required, suitable number of PV panel structures shall be provided. Structures shall be of flat-plate design using minimum size of C (75 x 40 x 5 mm) or L (55 x 55 x 5mm) or I (60x 40x 4mm) sections or higher dimensions for respective sections.

d. Each structure with fixed tilt should have a tilt angle as per the site conditions to take maximum insolation which will be approximately equal to the latitude of the location facing true South with a North - South orientation. The tilt angle can vary from 9 degree to 12 degree based on the location's latitude in Kerala

e. The PV module mounting structure shall have a capacity to withstand a wind velocity of 150 km/hr unless specified for dedicated requirements.

f. Suitable fastening arrangement such as grouting and calming should be provided to secure the installation against the specific wind speed. The PV array structure design shall be appropriate with a factor of safety of min 1.5.

g. The materials used for structures shall be Hot dip Galvanized Mild Steel conformed to IS 2062:1992 or aluminium of suitable grade minimum alloy 6063 or better.

h. The minimum thickness of galvanization for hot dip Galvanized Mild Steel should be atleast 80 microns as per IS 4759. The galvanisation thickness will be checked during inspection and the vendor is to arrange the

equipment needed for the same at the site.

i. The Bolts, Nuts, fasteners, and clamps used for panel mounting shall be of Stainless Steel SS 304.

j. Structures shall be supplied complete with all members to be compatible for allowing easy installation at the site. Additional Structures/Frames for required vfor the installation of modules if any need to be provided by the bidder.

k. The structures shall be designed to allow easy replacement of any module, repairing and cleaning of any module. No Welding is allowed on the mounting structure. Adequate spacing shall be provided between two panel frames and rows of panels to facilitate personnel protection, ease of installation, replacement, cleaning of panels and electrical maintenance

l. Aluminium structures used shall be protected against rusting either by coating or anodization. Aluminium frames should be avoided for installations in coastal areas.

m. The structure shall be designed to withstand operating environmental conditions for a period of minimum 25 years. And shall be free from corrosion while installation.

n. Screw fasteners shall use existing mounting holes provided by module

manufacturer. No additional holes shall be drilled on module frames

o. The total load of the structure (when installed with PV modules) on the roof should be less than 60 kg/m^2

p. Minimum distance between the lower level of PV Module and the ground shall be 0.6m from the ground level.

q. The PV Panel area shall be accessible for cleaning and for any repair work.

r. Sufficient gap needs to be provided between the rows to avoid falling of shadow of one row on the next row. Seismic factors for the site will be considered while making the design of the foundation.

s. Adequate spacing shall be provided between any two modules secured on PV panel for improved wind resistance.

t. Installation of structure for solar PV mounting should not tamper with the water proofing of the roofs.

3.12.1 The Rooftop Structures maybe classified in three broad categories as follows (drawings in Format-II-J). The bidders are required to quote the rates for each separately in the financial bid:

i. Ballast structure

a. The mounting structure must be Non-invasive ballast type and any sort of penetration of roof to be avoided.

b. The minimum clearance of the structure from the roof level should

be in between 70-150 mm to allow ventilation for cooling, also ease of cleaning and maintenance of panels as well as cleaning of terrace.

c. The structures should be suitably loaded with reinforced concrete blocks of appropriate weight made out of M25 concrete mixture.

ii. Tin shed

a. The structure design should be as per the slope of the tin shed.

b. The inclination angle of structure can be done in two ways

b.1. Parallel to the tin shed (flat keeping zero-degree tiling angle), if the slope of shed in Proper South Direction.

b.2. With same tilt angle based on the slope of tin shed to get the maximum output.

c. The minimum clearance of the lowest point from the tin shade should be more than 100 mm.

d. The base of structure should be connected on the Purlin of tin shed with the proper riveting. All structure member should be of minimum 2mm thickness.

iii. RCC Elevated structure: It can be divided into further three categories

A. Minimum Ground clearance (300mm - 1000 mm)

a. The structure shall be designed to allow easy replacement of any module and shall be in line with site requirement. The gap between modules should be minimum 30mm.

b. Base Plate - Base plate thickness of the Structure should be 5mm for this segment.

c. Column - Structure Column should be minimum 2mm in Lip section / 3mm in C- Channel section. The minimum section should be 70mm in Web side and 40mm in flange side in Lip section.

d. Rafter - Structure rafter should be minimum 2mm in Lip section / 3mm in C- Channel section. The minimum section should be 70mm in Web site (y-axis) and 40mm in flange side (x-axis).

e. Purlin - Structure purlin should be minimum 2mm in Lip section. The minimum section should be 60mm in Web side 40mm in flange Lip section.

f. Front/back bracing - The section for bracing part should be minimum 2mm thickness.

g. Connection - The structure connection should be bolted completely. Leg to rafter should be connected with minimum 12 diameter bolt. Rafter and purlin should be connected with minimum 10 diameter bolt. Module mounting fasteners should be SS-304 only and remaining fasteners either SS-304 or HDG 8.8 Grade.

h. For single portrait structure the minimum ground clearance should be 500mm.

B. Medium Ground clearance (1000mm - 2000 mm)

a. Base Plate - Base plate thickness of the Structure should be Minimum 6MM for this segment.

b. Column - Structure Column should be minimum 2mm in Lip section / 3mm in C- Channel section. The minimum section should be 80mm in Web side and 50mm in flange side in Lip section.

c. Rafter - Structure rafter should be minimum 2mm in Lip section / 3mm in C- Channel section. The minimum section should be 70mm in Web side and 40mm in flange side in Lip section.

d. Purlin - Structure purlin should be minimum 2mm in Lip section. The minimum section should be 70mm in Web side and 40mm in flange side in Lip section.

e. Front/back bracing - The section for bracing part should be minimum 2mm thickness.

f. Connection - The structure connection should be bolted completely. Leg torafter should be connected with minimum 12 diameter bolt. Rafter and purlin should be connected with minimum 10 diameter bolt. Module mounting fasteners should be SS-304 only and remaining fasteners either SS-304 or HDG 8.8 Grade.

C. Maximum Ground clearance (2000mm - 3000 mm)

a. Base Plate - Base plate thickness of the Structure should be minimum 8mm for the segment.

b. Column - Structure Column thickness should be minimum 2.6MM in square hollow section (minimum 50x50) or rectangular hollow section (minimum 60x40) or 3MM in C-Channel section.

c. Rafter - Structure rafter should be minimum 2MM in Lip section / 3MM in Channel section. The minimum section should be 80MM in Web side and 50MM in flange side in Lip section.

d. Purlin - Structure purlin should be minimum 2MM in Lip section. The minimum section should be 80mm in Web side and 50mm in flange side in Lip section.

e. Front/back bracing - The section for bracing part should be minimum 3mm thickness.

f. Connection - The structure connection should be bolted completely. Leg to rafter should be connected with minimum 12 diameter bolt. Rafter and purlin should be connected with minimum 10 diameter bolt. Module mounting fasteners should be SS-304 only and remaining fasteners either SS-304 or HDG 8.8 Grade.

D. Super elevated structure (More than 3000 mm)

i. Base structure

b. Base Plate - Base plate thickness of the Structure should be 10mm for this segment.

c. Column - Structure Column minimum thickness should be minimum 2.9mm in square hollow section (minimum 60x60) or rectangular hollow section (minimum 80x40).

d. Rafter - Structure Rafter minimum thickness should be minimum 2.9mm in square hollow section (minimum 60x60) or rectangular hollow section (minimum 80x40)

e. Cross bracing - Bracing for the connection of rafter and column should be of minimum thickness of 4mm L-angle with the help of minimum bolt diameter of 10mm.

ii. Upper structure of super elevated structure

a. Base Plate - Base plate thickness of the Structure should be minimum 5mm for this segment.

b. Column - Structure Column should be minimum 2mm in Lip section / 3mm in Channel section. The minimum section should be 70mm in Web side and 40mm in flange side in Lip section.

c. Rafter - Structure rafter should be minimum 2mm in Lip section / 3mm in Channel section. The minimum section should be 70mm in Web side and 40mm in flange side in Lip section.

d. Purlin - Structure purlin should be minimum 2mm in Lip section. The minimum section should be 60MM in Web side and 40MM in flange side in Lip section.

e. Front/back bracing – The section for bracing part should be minimum 2mm thickness.

f. Connection – The structure connection should be bolted completely. Leg to rafter should be connected with minimum 12 diameter bolt. Rafter and purlin should be connected with minimum 10 diameter bolt. Module mounting fasteners should be SS-304 only and remaining fasteners either SS-304 or HDG 8.8 Grade.

iii. If distance between two legs in X-Direction is more than 3M than sag angle/Bar should be provide for purlin to avoid deflection failure. The sag angle should be minimum 2mm thick, and bar should be minimum 12Dia.

iv. Degree - The Module alignment and tilt angle shell be calculated to provide the maximum annual energy output. This shall be decided on the location of array installation.

v. Foundation – Foundation should be as per the roof condition; two types of the foundation can be done- either penetrating the roof or without penetrating the roof.

a) If penetration on the roof is allowed (based on the client requirement) then minimum 12MM diameter anchor fasteners with

minimum length 100MM can be used with proper chipping. The minimum RCC size should be 400x400x300 cubic mm. Material grade of foundation should be minimum M20.

b) If penetration on roof is not allowed, then foundation can be done with the help of 'J Bolt' (refer IS 5624 for foundation hardware). Proper Neto bond solution should be used to adhere the Foundation block with the RCC roof. Foundation J - bolt length should be minimum 12MM diameter and length should be minimum 300MM.

3.13: SURGE PROTECTION

The system should have installed with Surge Protection Device (SPD) for higher withstand of the continuous PV-DC voltage during earth fault condition. SPD shall have safe disconnection and short circuit interruption arrangements through integrated DC in-built bypass fuse (parallel) which should get tripped driving failure mode of MOV, extinguishing DC arc safely to protect the installation against fire hazards. The SPD should be provided in the AC Distribution Box as well. Type 2 SPD having maximum Discharge Current (8/20 μs) of value 40 kA with a minimum response time less than 25ns.

3.14 : EARTHING

The Solar PV Plant should have a dedicated earthing system. The Earthing for array and LT power shall be made as per the provisions of **IS:3043-2018** "Code of practice for earthing (Second Revision)," that governs the earthing practices of a PV system and **IS732:2019** "Code of practice for electrical wiring installations (Fourth Revision)

3.14.2 Earthing System shall connect all non-current carrying metal receptacles, electrical boxes, appliance frames, chassis and PV module mounting structures in one long run. The earth strips should not be bolted. Earthing GI strips shall be interconnected by proper welding. Exothermic / Aluminothermic welding are only allowed for jointing earth electrode.

3.14.3 The earthing conductor should be rated for 1.56 times the maximum short circuit current of the PV array. The factor 1.56 considers 25 percent as a safety factor and 25 percent as albedo factor to protect from any unaccounted external reflection onto the PV modules increasing its current

3.14.4 In any case, the cross-section area or the earthing conductor for PV equipment should not be less than 6 mm^2 if copper, 10 mm^2 if aluminium or 70 mm^2 if hot- dipped galvanized iron. For the earthing of lightning arrestor, cross-section of the earthing conductor should not be less than 16 mm^2 of copper or 70 mm^2 if hot-dipped galvanized iron. Copper bonded Earth electrodes of minimum thickness of 250 microns and diameter of 14.2mm and length of 3m must be used incompliance with the National Building Code of India 2016. The complete Earthing system shall be mechanically & electrically connected to provide independent return to earth.

3.14.5 Masonry enclosure with the earth pit of size not less than 400mm X 400 mm(depth) complete with cemented brick work (1:6) of minimum 150mm width duly plastered with cement mortar (inside) shall be provided. In case FRP based Earth chambers are used, the same must be certified by NABL accredited laboratory for Compression Test/Weight Holding Capacity. Hinged inspection covers of size not less than 300mm X 300mm with locking arrangement shall be provided. Suitable handle shall be provided on the cover by means of welding a rod on top of the cover for future maintenance.

3.14.6 Minimum required gap shall be provided in between earth pits as per relevant standard. Body earthing shall be provided in inverter each panel frame, module mounting structures, kiosk and in any other item as required.

3.14.7 Earth pit shall be constructed as per IS: 3043-2018. Electrodes shall be embedded below permanent moisture level. Earth pits shall be treated with salt and charcoal if average resistance of soil is more than 20-ohm meter. The use of Earth enhancing compounds of adequate quantity is to be used in case the earth value is high in compliance with IEC 62561-7:2011

3.14.8 There shall be adequate number of interconnected earth pits provided in each location and minimum required gap shall be provided in between earth pits as per relevant standard. The interconnection is to be done using Copper conductors of minimum 25 mmx 3 mm or HDGI conductor of minimum 25mm x 6mm.

3.14.9 Earth resistance shall not be more than 5 ohms. Earthing system must be interconnected through GI strip to arrive equipotential bonding. The size of the HDGI earth strip must be minimum 25mm X 6mm and the coating thickness of minimum 80 microns is to be maintained.

3.14.10 In compliance to Rule 11& 61 Of Indian Electricity Rules,1956(as amended up to date), all non-current carrying metal parts shall be Earthing with two separate and distinct earth continuity conductors to an efficient earth electrode.

3.14.11 The equipment grounding wire shall be connected to earth strip by proper fixing arrangement. Each strip shall be continued up to at least 500mm from the equipment.

3.14.12 Necessary provisions shall be made for bolted isolating joints of each earthing pit for periodic checking of earth resistance.

3.14.13 The frame of inverter cabinet shall be connected with the earthing bus bar through the earthing terminals using flexible braided copper wire; all metal casing and shielding of the plant, each array structure of the photovoltaic yard, equipment, inverters and control systems shall be earthed through proper earthing.

3.14.14 Earthing system shall connect all non-current carrying metal receptacles, electrical boxes, appliance frames, chassis and photovoltaic module mounting structures in one long run and the earth strips shall be interconnected by proper welding and shall not be bolted;

3.14.15 For each earth pit, a necessary test point shall be provided.

3.13.16 Total no of Earth pits required for solar plants shall be as per the Electrical Inspectorate norms.

3.15 : LIGHTNING PROTECTION FOR PV ARRAY

The SPV power plant should be provided with lightning and over voltage protection. The source of over voltage can be lightning or other atmospheric disturbance. The lightning conductors shall be made as per applicable Indian Standards in order to protect the entire array yard from lightning stroke.

The design and specification shall conform to IS/IEC 62305, "Protection against lightning" govern all lightning protection-related practices of a PV system.

- The entire space occupying SPV array shall be suitably protected against lightning by deploying required number of lightning arresters. Lightning protection should be provided as per IS/ IEC 62305.
- Lightning system shall comprise of air terminations, down conductors, test links, earth electrode etc. as per approved drawings.
- The protection against induced high voltages shall be provided by the use of surge protection devices (SPDs) and the earthing terminal of the SPD shall be connected to the earth through the earthing system.
- Separate pipe for running earth wires of Lightning Arrestor shall be used.
- The Vendor / Company shall submit the drawings and detailed specifications of the PV array lightning protection equipment to Employer for approval before installation of system.

3.16 : AC DISTRIBUTION PANEL BOARD

a. AC Distribution Board (ACDB) shall control the AC power from inverter and should have necessary surge arrestors.

b. An ACDB panel shall be provided in between PCU and Utility grid. It shall have MCB/MCCB/ACB or circuit breaker of suitable rating for connection and disconnection of PCU from grid.

c. The connection between ACDB and Utility grid shall be of standard cable/ Conductor with suitable termination. It shall have provision to measure grid voltage, current and power.

d. The incomer shall be selected at required rating. The ACDB enclosure shall be of good protection and suitable for mounting on the trenches / on wall.

e. All the 415 V AC or 230 V AC devices/equipment like bus support insulators, circuit breakers, SFU isolators (if applicable), SPD, etc. mounted inside the switch gear shall be suitable for continuous operation.

f. Switches/ circuit breakers/ connectors meeting general requirements and safety s as per IS 60947 measurements a per IS 60947 PartI, II, III and IEC

60947 part I, II and III.

g. Junction boxes, enclosures, panels for inverters/ Controllers shall meet IP 65 (for indoor) as per IEC 529. The use of PVC enclosures is not permitted.

h. All combiner boxes shall be provided with suitable surge protective device with arc extinguishing capability as per the relevant standards to avoid any risk of fire.

3.17 : DC DISTRIBUTION BOARD

a. DC bus/ cable which can handle the current and the voltage of inverter output safely with necessary surge arresters per the relevant IS standards.

b. Polyamide glands and MC4 Connectors may also be p rovided. The rating of the junction box shall be suitable with adequate safety factor to interconnect the Solar PV array.

c. DC panel should be equipped with an adequate capacity indoor DC circuit breaker along with control circuit, protection relays, fuses, annunciations and
remote operating and controlling facility from the main control facility.

d. DCDB shall have sheet from enclosure of dust and vermin proof, the busbar/ cables are to be made of copper of desired size. DCDB shall be fabricated to comply with IP 65 protection. The PVC enclosures is not permitted.

e. All combiner box shall be provided with suitable surge protective device with arc extinguishing capability as per the relevant standards to avoid any risk of fire

3.18 : CABLES, SWITCHES AND GENERAL REQUIREMENTS

a. PVC insulated copper cables with current rating suitable for AC and DC asper the National Electric Code, and meeting:

i. General Test and Measuring Method as per IEC 60189/ IS 694
ii. PVC insulated cables for working voltages up to 1100 V and UV resistant for outdoor installation as per IEC 60502/ IS 1554 (Pt. I & II).

b. Cable Marking: All cable/wires are to be marked in proper manner by good quality ferule or by other means so that the cable can be easily identified.

c. Switches/ circuit breakers/ connectors meeting general requirements and safety measurements as per IS 60947 PartI, II, III and EN 50521 for AC/DC.

d. All indoor panels will have protection of IP 54 or better, as per site conditions. All outdoor panels will have protection of IP 65 or better, as per site condition.

3.19 : AC/DC WIRING

Before submitting the tender, actual measurement of cables required for wiring from AC output of inverter/PCU to load point should be calculated and this work is also included in the tender. The actual cable required from module to DC distribution board and DC distribution board to inverter input should be calculated and this work should be done as apart of Solar Power Plant installation. Separate drawings for exclusively for the AC/DC Wiring should be provided.

3.20 : CIVIL WORKS

While installing solar power pants on rooftops, the physical condition of the rooftop, chances of shading, chances water level rise in the rooftop during raining due improper drainage in the roof-top should betaken into consideration.

a. PV array shall be installed in the terrace space free from any obstruction and/or shadow and to minimize effects of shadows due to adjacent PV panel rows.

b. PV array shall be oriented in the south direction in order to maximize annual energy yield of the plant.

c. The solar PV array must be installed on the rooftop in such a way that there is sufficient space on the rooftop for maintenance etc.

d. There should not be any damage what so ever to the rooftop due to setting up of the solar power plant so that on a later day there is leakage of rainwater, etc. from the rooftop.

e. Some civil works are inevitable for erecting the footings for the module mounting structure as discussed in Module Mounting Structure section. The rooftop may be given a suitable grading plaster with suitable leak proof compound so as to render the roof entirely leak proof.

f. Ample clearance shall be provided in the layout of the inverter and DC/AC distribution boxes for adequate cooling and ease of maintenance.

g. While cabling the array, care must be taken such that no loose cables lie on the rooftop.

h. The rooftop should look clean and tidy after installation of the array.

i. Neatness, tidiness and aesthetics must be observed while installing the systems.

j. RCC Works - All RCC works shall be as per IS 456 and the materials used viz. Cement reinforcement, steel etc. shall be as per relevant IS standards. Reinforcement shall be high strength TMT Fe 415 or Fe 500 conforming to IS: 1786-1985.

k. Brick Works (If any) - All brick works shall be using 1st class bricks of approved quality as per IS 3102.

l. Plastering - Plastering in cement mortar 1:5, 1:6 and 1:3 shall be applied to all.

m. Display of mandatory items- Single Line Diagram and layout diagram of modules and interconnection at installation site shall be provided near the inverter.

n. For painting on concrete, masonry and plastered surface IS: 2395 shall be followed. For distempering IS 427 shall be followed referred. For synthetic enamel painting IS 428 shall be followed. For cement painting IS 5410 shall be followed.

o. All Civil works required for the installation of the PV Plant and other civil and electrical work in evacuation infrastructure, wherever necessary, shall be within the scope of the bidder

p. The layout of Inverter accommodation shall be designed to enable adequate heat dissipation and availability. Mount within the existing infrastructure available in consultation with the Site in charge. String Inverters may be installed with Canopy type structure over it to protect it from frequent monsoon and weather changes.

Section 4: Project Scope of Work

4.1. Definition

Solar PV power plant system comprises of C-Si (Crystalline Silicon)/ Thin Film Solar PV modules with intelligent Inverter having MPPT technology and Anti-Islanding feature and associated power electronics, which feeds generated AC power to the Grid. Other than PV Modules and Inverter/Inverters, the system consists of Module Mounting Structures, appropriate DC and AC Cables, Array Junction Boxes (AJB) / String Combiner Boxes (SCB), AC and DC Distribution Box, Lightning Arrester, Earthing Systems, RMU, HT Cable, Transformer, LT DB, LT Cable etc. The system should be capable for exporting the generated AC power to the Grid, whenever the Grid is available with all System Protection facilities.

4.2. Scope of Work

4.2.1 The scope includes the Design, Supply, Installation, Testing and Commissioning of Rooftop On-Grid SPV power plants. All the necessary approvals from Electrical Inspectorate, feasibility study, necessary civil work, Mounting of Module Structures, PV Module Installation, Inverter Installation, DC/AC Cabling and interconnections, Installation of Lightning Arresters, Earthing System, RMU, HT Cable, Transformer, LT DB, LT Cable, Panel Board etc. as per the standards, arranging all the necessary inspections from Electrical Inspectorate as part of Pre- Commissioning, if any, Commissioning of the PV Power Plant, are coming under the scope of the bidder.

4.2.2 The additional costs for site specific cabling works, earthing, mounting structure modifications etc are under the scope of the bidder.

4.2.3 It is mandatory that the bidders are to visit the sites and quote the rates considering all the requirements as mentioned in this tender document. No requests for revision of rates will be entertained. In case, the successful bidder is not undertaking the specific work, the work will be cancelled and d isciplinary proceedings will be initiated against the bidder and all payments due will be withheld. Hence, Bidders are requested to visit the site before quoting and the rate for successful commissioning in all aspects is to be quoted.

4.2.4 The rate quoted should be all inclusive including delivery of materials, the cost of materials and labour for the civil works, Installation and Commissioning, 5-yearWarranty, fee for approval from the Electrical Inspectorate if any, Solar Meter, Remote monitoring facility, Insurance, GST and all other expenses deemed necessary for the proper implementation of the conditions and specification in-corporate in the tender.

4.2.5 The Operation and Maintenance of the Powerplant for the whole period of warranty will be duty of the vendor. The rates for O&M per year need

to be quoted in the BoQ file provided. This rates if acceptable, will be awarded, if not, the vendors are required to undertake the work at the rates followed/ approved by the Kerala State Electricity Regulatory Commission.

4.2.6 The Component wise split up of the costs in percentage for each capacity is to be included as part of the technical bid (included as format A).

4.2.7 Any other work required for the successful commissioning of the po power plant which are not mentioned in this document and are required as per prevailing laws & regulations in the country.

4.2.8 The capacity of the plant mentioned in the document may vary +/- 15% according to the actual design as per the site condition and payment may also vary accordingly.

4.3. SCHEDULE OF SUPPLY

4.3.1 The items should be delivered and installed at the sites of constructions for which work order shall be given and specified by TCED, under prior intimation to TCED.

4.3.2 The successful bidder should complete the Supply, Installation, Testing and Commissioning of Solar Power Plant.

4.3.3 If the successful bidder fails to deliver the materials within the days mentioned below(from the date of award of contract), the order stands cancelled and TCED will award the work to the next bidder and penalty as decided by TCED will be levied.

#	Capacity of Solar Plant in kW	Material Delivery (Days)	Completion Period (Days)
1	<= 100	30	60
2	>100	45	75

4.3.4 For any delay in Installation and Commissioning beyond the period mentioned above (from the date of award of contract), the TCED will charge penalty of 0.5% of the order value/week or part thereof, subject to the cost not exceeding 10% of the total cost.

4.3.5 Order will be cancelled if the delay of service is more than this time period and work will be issued to the second lowest bidder

4.3.6 Bidders are to submit their quotes only after visiting the site and the details of additional works required for the successful commissioning of the power plant is to be mentioned in the technical bid. No additional amount for any works will be provided under any circumstance, even if the site requires additional work other than quoted by the bidder. Hence, special care must be taken while submitting the bids.

4.3.7 Supply of the SPV module must be from the ALMM list issued by MNRE from time to time. The test certificates and reports of the inverters being used for the project must be submitted along with the bid. TCED reserves the right to reject the bid based on the non-conformity of the inverter being supplied.

4.3.8 The successful bidder shall submit the detailed BoM and the timeline

for completion along with the agreement and security deposit. This timeline must be followed and no extension of time for completing the installation will be granted. Although, time extension may be granted for things beyond the control of the bidder.

4.3.9 In case of no valid reason, extension of time of completion that can be granted at a time shall be 25% of the original time. The maximum extension that can be granted for a work shall be limited to half the original time of completion.

4.3.10 When the contract period has to be extended wholly or partly due to default on the part of the bidder, the Agreement Authority may sanction extension of time after imposing fine as mentioned below;

Period	Rate of Fine
First Extension	1% of the PAC subject to a minimum of Rs. 1000/- and maximum of Rs. 50,000/-.
Second Extension	2% of the PAC subject to a minimum of Rs. 2000/- and maximum of Rs. 1,00,000/-

4.4 : WARRANTY

a. 5 years' warranty should be provided by the supplier for the system and components, or part of the system has to be provided as per the special conditions of the contract.

b. PV modules used in solar power plants/ systems must be warranted for their output peak watt capacity, which should not be less than 90 % at the end of 10years and 80% at the end of 25 years

c. The Warranty Card to be supplied with the system must contain the details of the all the components supplied including serial numbers accompanied with the OEM warranty card

4.5 : OPERATION AND MAINTENANCE

4.5.1 For the optimal operation of a PV plant, maintenance must be carried out on a regular basis. All the components should be kept clean. It should be ensured that all the components are fastened well at their due place. The O&M Charges for 5-year period is to be quoted by the bidders

4.5.2 The service personnel should visit the installations at least once a month for preventive maintenance even if no faults are reported. Reports of these preventive maintenance visits and generation data should be submitted to the TCED office on a monthly basis.

4.5.3 Maintenance guidelines for various components viz. solar panels, inverter, wiring etc. are discussed below:

4.5.3.1 SOLAR PV PANELS

Although the cleaning frequency for the panels will vary from site to site depending on soil, it is recommended that

a) The panels are cleaned at least once every thirty days.

b) Use water and a soft sponge or cloth for cleaning.

c) Do not use detergent or any abrasive material for panel cleaning.

d) Iso-propyl alcohol maybe used to remove oil or grease stains.

e) Do not spray water on the panel if the panel glass is cracked or the back side is perforated.

f) Wipe water from module as soon as possible.

g) Use proper safety belts while cleaning modules at inclined roofs etc.

h) The modules should not be cleaned when they are excessively hot. Early morning is particularly goodtime for module cleaning.

i) Check if there are any shade problems due to vegetation or new building and report the same to TCED.

j) Ensure that the module terminal connections are not exposed while cleaning; this poses a risk of electric shock..

k) Never use panels for any unintended use, e. g. drying clothes, chips etc. Ensure that monkeys or other animals do not damage the panels.

4.5.3.2 CABLES AND CONNECTION BOXES

a) Check the connections for corrosion and tightness.

b) Check the connection box to make sure that the wires are tight, and the water seals are not damaged.

c) There should be no vermin inside the box.

d) Check the cable insulating sheath for cracks, breaks or burns. If the insulation is damaged, replace the wire.

e) If the wire is outside the building, use wire with weather-resistant insulation.

f) Make sure that the wire is clamped properly and that it should not rub against any sharp edges or corners.

g) If some wire needs to be changed, make sure it is of proper rating and type.

4.5.3.3 INVERTER

a) The inverter should be installed in a clean, dry, and ventilated area.

b) Remove any excess dust in heat sinks and ventilations. This should only be done with a dry cloth or brush.

c) Check that vermin have not infested the inverter. Typical signs of this include spider webs on ventilation grills or wasps' nests in heat sinks.

d) Check functionality, e.g., automatic disconnection upon loss of grid power supply, at least once a month.

e) Verify the state of DC/AC surge arrestors, cable connections, and circuit breakers.

4.5.3.4 Inspection and Maintenance Schedule

Component	Activity	Description	Interval
PV Module	Cleaning	• Clean PV modules with plain water or mild dishwashing detergent. • Do not use brushes, any types of solvents, abrasives, or harsh detergents.	Monthly or as per site conditions
PV Array	Inspection	• Check the PV modules and rack for any damage. • Note down location and serial number of damaged modules.	Annual
	Inspection	• Determine if any new objects, such as vegetation growth, are causing shading of the array and move them if possible.	Half Yearly
	Vermin Removal	• Remove bird nests or vermin from array and rack area.	Half Yearly
Junction Boxes	Inspection	• Inspect electrical boxes for corrosion or intrusion of water or insects. Seal boxes if required. • Check position of switches and breakers. • Check operation of all protection devices.	Annual
Wiring	Inspection	• Inspect cabling for signs of cracks, defects; lose connections, overheating, arcing, short or open circuits, and ground faults.	Annual
Inverter	Inspection Service	• Observe instantaneous operational indicators on the faceplate of the inverter to ensure that the amount of power being generated is typical of the conditions. • Inspect Inverter housing or shelter for physical maintenance, if required.	Monthly
Plant	Monitoring	• Operation and Performance Monitoring	Monthly
Spare Parts	Management	• Manage inventory of spare parts.	As needed

4.5.3.5 The faulty system or components should be replaced/ repaired within 7 days of fault reporting. The servicing should be carried out at the site of installation. If any of the components are to be taken out from the site for repair, a standby must be provided to ensure un-interrupted power generation and the systems functions smoothly.

4.5.3.6 Any Delay in servicing beyond 7 days of fault reporting would attract penalty at the rate fixed by TCED and further actions will be

initiated against the agency.

4.5.3.7 A designated contact Telephone Number and address should be submitted for reporting faults during the O&M period of 5 years.

4.6 : PERFORMANCE RATIO TEST (PR TEST)

The Plant should run minimum two weeks without any major equipment failure to start the PR test. The EPC Contractor shall submit two copies of O&M manual with soft copy before the start of PR Test. Depending on the requirement, capacity and suitable Pyranometer shall be installed at locations suggested by TCED or else METEONORM data shall be considered for calculating PR.

i. The PR test shall be conducted at site by the Contractor in presence of the TCED officials as per IEC61724. The PR test procedure shall be submitted by the Contractor for review and approval. Any special equipment, instrumentation tools and tackles required for the successful completion of the performance test shall be arranged by the Contractor at his own cost.

ii. The procedure for PR demonstration tests hall be as follows:

The Weather monitoring station installed in the plant shall be in working condition for minimum 2 weeks and all the parameters shall be available for analysis and verification. The test report for the calibration shall be submitted by the Contractor for approval. After the successful verification of the initial parameters by TCED, PR test shall be conducted. The Following factors shall be excluded for calculation;

- Generation loss due to grid outage.
- Irradiance below 250 W/m2
- The measured global solar radiation of the period of the outage of the power evacuation systemshall be excluded to calculate average global solar radiation for the period of PR test. PR is to be calculated as per the below formula:

Performance Ratio of the solar plant for a period of time =
***Energy measured* (*kWh*) / (*Irradiance* (*kWh*/m^2) *on the panel x Active area of PV module* (m^2) *x PVmodule efficiency* (%)**

The EPC Contractor shall demonstrate minimum PR of 93% (measured at output of the inverter/solar meter level) in the initial PR test within 7 consecutive days. If the contractor fails to prove the desired performance ratio at the time of completion and during any of the consecutive years of defect liability period, he will be given a second chance to demonstrate the PR within another 7 consecutive days. Still if it is not achieved, the same shall be demonstrated within another 7 consecutive days and still if it is not achieved, EPC contractor shall improve the quality of the plant by replacement of module/other components with all suitable modification requirements on balance of systems at his own cost to achieve the performance ratio. After obtaining Energisation Approval from Electrical Inspectorate and

demonstration of minimum specified PR, the solar plant shall be commissioned which shall be the date of completion of the project.

4.7 : DATE OF COMMISSIONING

After the Inspection and approval of the Electrical Inspectorate, date of Energisation to the Grid will be considered as the official Date of Commissioning (DoC) of the project. To ensure PR, the bidder will be allowed EPC contractor shall improve the quality of the plant by replacement of any components with all suitable modification requirements on balance of systems at this own cost to achieve the performance ratio.

4.8 : OPERATION MANUAL

An Operation, Instruction and Maintenance Manual, should be provided with the system. The following minimum details must be provided in the manual.

i. About solar powerplant – its components and expected performance.
ii. DO's and DON'T's
iii. Cleaning of Solar PV Modules in regular intervals
iv. Clear instructions on regular maintenance and troubleshooting of solar power plant
v. AS built Drawings for the Installation
vi. OEM Warrantee Certificates of Inverters, PV Modules, Batteries etc.
vii. Specification of PV Plant
viii. Data Sheets of major equipment like PV Module, Inverter etc.
ix. Name and address of the E.P.C Contractor and the contract person in case of non-functionality of the solar powerplant.

4.9 : BILL OF MATERIAL

The bidder should provide the bill of material mentioning the quantity of each of the item consisting in the system, along with the offer in the format as show below for each capacity:

SN	Item	Make (If any)	Model & Individual Capacity(If any)	Qty (Nos)	Rating/Capa city
1.	PV Module				
2.	PCU/Inverter				
3.	DC Cables				
4.	AC Cables				
5.	AJB/SCB				
6.	Module Mounting Structure (MMS)				
7.	ACDB				

8.	Lightning Arrester				
9.	Earthing System Details and No. of Earth pits				
10.	Data Acquisition System				

4.10 : SITE INSPECTON

It is recommended that the bidders visit all the sites listed here for the physical verification and for correctly estimating the quantity, especially related to structure and cabling, before submitting the bids. Bidder must include all the AC/DC wiring cost, replacement of instrument transformers, panel boards etc only after visiting the proposed site. The quoted amount will be for all the site-specific works and no additional amount will be allotted for any sort of works.

The site-specific requirement of ladders for accessing PV modules, pathway facility (with minimum 75cm in width) along with handrails and guard rails in case of sheet roofs are under the scope of the bidder. The Fabrication of Permanent Ladder should be of GI (min14 SWG), coated with Epoxy steel primer with rung spacing not be more than 10 inches and rung width of min 50 inches. Side Handrails / Grab Bars welded/ Hinged (to avoid shade on panels) on both sides for safety purpose with an extension of Min 50 inches above the landing or access level. The pathway can be either of GI or FRP material and shall include handrails of minimum seventy-five centimeter in width for safety without causing shade on the PV module and Guardrails to prevent accidental falls from the sheet roofs.

4.11 : CLEANING

The bidder shall provide permanent arrangement for module washing in the SPV Plant. Waterlines maybe drawn to feed water from the available resources. Contractor has to provide additional facility including pipeline, motor for pumping to the additional overhead tank, if required.

4.12 : DISPLAY BOARD

The vendor has to display a board of size at the project site of size minimum 60 cm x 30 cm including the following details.

- Plant Name, Capacity, Location, Type of Renewable Energy plant (solar), Date of commissioning etc. The details of the scheme as specified in the work order.

4.13 : INSURANCE

a. The power plant must be insured at every stage of operation - from Material dispatch, storage, completion of installation and till 5 years after commissioning. The insurance coverage on handing over of the system must include all conditions of **Standard Fire and Special Perils Policy (Material Damage)**.

b. The insurance premium for the 5 years of warranty is to be paid by the

bidder. Only the system components are to be insured. On handing over of the system, the original insurance policy is to be handed over to the

authorised person at the site of installation and a copy to TCED Office. The annual premium payment receipt must be handed to the authorised person at the site of installation.

4.14 : POWER QUALITY TEST

a. Harmonic distortion at the point of coupling to utility grid shall be as per IEEE 519-2022. Test report for THD and individual harmonics (3Rd, 5th and 7th) for current and voltage shall be submitted for energisation approval of the plant. DC component shall also be tested and maintained as per standard or other applicable standards

4.15: Financial Proposal

Financial Proposal for Supply , Installation and Commissioning of HT Cable, RMU, Transformer, LT DB, LT Cable and LT Panel Board				
S.No.	**Name of Article**	**Quantity**	**Unit**	**Remarks**
	Materials			
1	Supply of 11kV 63A , 20KA, Motor operated, compact outdoor, extensible, CCV+ FRTU as per standards and specification mentioned in the standard bid document.	1	No	MP
2	Cost of providing earthing for RMU & Tx	5	No	Ann:69
3	250 Kva 11 Kv/433V 50 Hz ONAN, Cable Relay (Cable box on both HT/LT Side)	1	No	
4	GI 11M HT Steel post	1	No	
5	DTR Meter Box	1	No	
6	CT's 400/5A	4	No	
7	SMC Box	1	No	
8	X-arm 4x3 ^1/2	2	No	
9	LT Shackle 4x4 ^1/2 LT	4	No	
10	LT Cable 185 Sq.mm, 3.5	120	m	MP
11	GI Pipe 2.5"	12	m	
12	BC Wiren No.6	10	Kg	
13	ACSR Rabbit	250	m	
14	Crimping socket-Cu 185	10	No	
15	1 Phase meter 5-30 A for Street light	1	No	
16	Nut & Bolt (Various)	1	LS	
17	3x4, 100 /5, TOD, LCD CT Meter for DTR	1	No	
18	Timer switch	1	No	
19	Fuse unit 100A	2	No	
20	Contactor	1	No	
21	3x300 Sq.mm, HT 11kV UG Cable	100	m	
22	Cable End Kit indoor 300sq mm	4	No	

23	Cable End Kit 4x300 LT	2		
24	UG Cable 4x300 sq mm LT XLPE	25	m	MP
	Labour Part			
25	Cost of construction of foundation , erection, conveyance &Alignment of RMU.	1	No	
26	Cost of labour (RMU)	1	No	Anne: 69
27	Cost of Transportation (RMU)	1	No	
28	Construction of transformer plinth	1	No	Ann:65
29	Cost of Labour (Transformer)	1	No	
30	Cost of Transportation(Transformer)	1	No	
31	RMU+ Transformer yard metalling	16.5	sq.m	
32	RMU+ Transformer fencing	40	sq.m	
33	HDD Work including HDPE Pipe (11kV XLPE UG Cable laying work)	79	m	
34	Laying HT 11kV UG Cable excluding excavation	21	m	
35	Excavation of cable trench	21	m	
36	Doing one cable end termination using cable jointing kit	6	No	
37	Installing one number LT Distribution box suitable for 250kVA Transformer to be mounted on 2"B class GI pipe at a level of 1M above floor level with necessary frame work	1	No	
	Panel Board			

1	Main LT Panel Board MSB size 1900×1400×250 mm: Supply, fabrication, erection, testing and commissioning the following floor mounted free standing cubicle type fully compartmentalised (Busbar chamber, 4Nos SFU chamber, 1No three phase Energy meter chamber, 9 Nos. single phase Energy meter chamber; dust tight vermin proof LT panel boards fabricated out of 14 SWG CRCA sheet and powder coated as per IS standards. The Board shall be completed with phase indication lamps in the incoming. suitably rated TPN Aluminium Busbars and earth bus of adequate capacity double earth connection to all switches, internal rigid connection etc. Incomer;-250A TPN SFU with HRC fuse and Rotary handle-2Nos. TPN AI. Busbar as per ISS. Outgoing:-125A SFU with HRC fuse and rotary handle 2 Nos..63A 4 pole isolator 1No.40 A DP Isolator 9Ncs and 63A Kit kat fuse unit 3 Nos. and 32A kit kat fuse unit 9 Nos)	1	No	
2	Distribution Pane l Board of appro. size 1900 X1400X 250 mm:- Supply, fabrication, erection, testing and commissioning the following floor mounted free standing cuticle type fully compartmentalised (Busbar chamber.8Nos Single phase Energy meter chamber, 5Nos three phase Energy meter chamber and 1 No. Three phase SFU chamber) dust tight, vermin proof LT panel boards fabricated out of 14SWG CRCA sheet and powder coated as per IS standards. The Board shall be completed with phase indication lamps in the incoming suitably rated TPN Aluminium Busbars and earth bus oi adequate capacity, double earth connection to all switches, internal rigid connection etc (Incomer-125A TPN SFU with HRC fuse and Rotary handle -1No, TPN Al. Busbar as per ISS, Outgoing:-63A 4 pole Isolator 5Nos, 40 A DP isolator 8Nos and 63A Kit kat fuse unit 15 Nos. and 32A kit kat fuse unit 8 Nos	2	No	
3	Shifting and fixing three phase Energy meter from existing new panel and giving complete connections, testing and commissioning etc.as required	11	No	

4	Shifting and fixing single phase Energy meter from existing new panel and giving complete connections, testing and commissioning etc.as required	25	No	
5	Dismantling transporting to department store of existing Panel board as per the direction of department staff etc complete	3	No	
6	All the Statutory payment remitted by the contractor in connection with inspection fees to Electrical Inspectorate and other departments if any	1	LS	
	LT Distribution Board			
1	Supply, Install, Testing and commissioning of LT Distribution Box suitable for 250 KVA Distribution Board.	1	LS	

PART II – CONDITIONS OF CONTRACT AND FORMS

Section 5: Conditions of Contract and Forms

5.1 General Conditions

The tenders should be submitted online at www.etenders.kerala.gov.in

The tenders should be as per the prescribed form which should be downloaded from the e-tender wcbsite.The cost of tender forms should be paid online, and once paid will not be refunded.Tender forms are not transferable.Tenders that are not in the prescribed form are liable to be rejected.

Intending tenderers should submit their tenders on or before the due date and time mentioned in the tender abstract. Late tender will not be accepted.

The rates quoted should be only in Indian Currency. Tenders in any other currency are liable to rejection. The rates quoted should be for the unit specified in the schedule attached.

The tenderer shall submit a copy of PAN card of the authorised signatory along with tender.

Tenders subject to conditions will not be considered.They are liable to be rejected on that sole ground.

The tenders will be opened on the specified day and time in the Office of the Assistant Secretary, Electricity Department,Thrissur Corporation.The bidders or the bidder's representatives with proper authorization issued by the bidder may be present at the time of opening of tenders.

Every tenderer should send along with his tender an Earnest Money Deposit. This may be paid online at the e-tenders website.

If any tenderer withdraws from his tender before the expiry of the period fixed for keeping the rates firm for acceptance,the Earnest Money if any, deposited by him,will be forfeited.

(a) The tenderer shall clearly specify whether the articles offered bear Bureau of Indian Standards mark/IEC Certification or not. In such cases, they shall produce copies of certification mark along with their tender in support of it.

(b) Tenders shall clearly specify whether the goods are offered from indigenous sources or from imported stocks in India or from foreign sources to be imported under a license.

The final acceptancc/rejection of the tenders rests entirely with the Assistant Secretary,Electricity Department,Thrissur Corporation who does not bind themselves to accept the lowest or any tender.

In the case of materials of technical nature,the successful tenderer should be prepared to guarantee satisfactory performance for a period of guarantee under a definite penalty.

Communication of acceptance of the e-tender normally constitutes a concluded contract. Nevertheless the successful tenderer shall also execute an agreement for the due fulfillment of the contract within the period to be specified in the letter of acceptance. The contractor shall have to pay all stamp duty, Lawyer's charges and other expenses incidental to the execution of the agrecment. Failure to execute the agreement within the period specified will entail the penalties set out below:

(a) The successful tenderer shall before signing the agreement and within the period specificd in the letter of acceptance of his tender, deposit a sum equivalent to 5% of the value of the contract as security for the satisfactory fulfillment of the contract less the amount of earnest money deposited by him along with his tender. The amount of security may be deposited in the manner of Demand Draft or Bank Guarantee in favour of the Assistant Secretary, Electricity Department,Thrissur Corporation payable at Thrissur, Kerala from any of the nationalized/Scheduled Banks. If the successful tenderer fails to deposit the security and execute the agreement as stated above, the earnest money deposited by him will be forfeited to Electricity Department, Thrissur Corporation and contract arranged elsewhere at the defaulter's risk and any loss incurred by Electricity Department, Thrissur Corporation on account of the purchase will be recovered from the defaulter who will however not be entitled to any gain accruing thereby.

(b) Incases where a successful tenderer, after having made partial supply and installation fails to fulfill the contracts in full,all or any of the materials not supplied/installed may at the discretion of Electricity Department, Thrissur Corporation be installed by means of another tender/quotation or by negotiation or from the next higher tenderer who had offered to supply already, and the loss if any caused to Electricity Department,Thrissur Corporation shall thereby together with such sums as may be fixed by Electricity Department, Thrissur Corporation towards damages be recovered from the defaulting tenderer.

(c) If the contractor fails to install within the time/period(s) specified in the contract, Electricity department,Thrissur Corporation shall without prejudice to its other remedies under the contract, deduct from the contract prices, as liquidated damages, a sum equivalent to 2%of the delivered price of the delayed stores or unperformed services for each month of delay until actual delivery or performance, up to a maximum deduction of 10% of the contract price. Once the maximum is reached, the purchaser may consider tcrmination of the contract at the risk and cost of the contractor.

The sccurity deposit shall, subject to the conditions specified herein be returned to the contractor within thrce months after the expiration of the contract but in the event of any dispute arising between Electricity Department, Thrissur Corporation and the contractor,Electricity Department, Thrissur Corporation shall be cntitled to deduct out of the deposits or the balance thereof,until such dispute is determined the amount of such damages, costs, charges and expenses as may be claimed. The same may also be deducted from any other sum which may be due at any time from Electricity Department,Thrissur Corporation to the contractor. In all cases where there are guarantee for the goods supplied,the security deposit will be released only after the expiry of the guarantee period.

(a) All payments to the contractors will be made by the Assistant Secretary, Electricity Department,Thrissur Corporation in due course

i. by the cheques on District Treasury or State Bank of India.

ii. in the case of supplied from abroad,by drafts as maybe arranged between the contracting parties.

(b) All incidental expenses incurred by Electricity Department,Thrissur Corporation for making payments outside the State in which the claim arises shall be borne by the contractor.

Payments will be made only after the required technical verification and based on the inspection Report by TCED officials.

The contractor shall not assign or make over the contract on the benefits or burdens thereof to any other person or body corporate.The contractor shall not underlet or sublet to any person or persons or body corporate the execution of the contract or any part thereof without the consent in writing of the purchasing officer who shall have absolute power to refuse such consent or to rescind such consent (if given)at any time if he is not satisfied with the manner in which the contract is being executed and no allowance or compensation shall be made to the contractor or the subcontractor upon such rescission.Provided always that if such consent be given at any time, the contractor shall not be relieved from any obligation,duty or

responsibility under this contract.

In case the contractor becomes insolvent or goes in to liquidation,or makes or proposes to make any assignment for the benefit of his creditors or proposes any composition with his creditors for the settlement of his debts, carries on his business or the contract under inspection on behalf of or his

creditors or in case any receiving order(s)for the administration of his estate

are made against him or in case the contractor shall commit any act of insolvency or in case in which under any clause or clauses any act of insolvency or in casc in which under any clause(s)of this contract the contractor shall have rendered himself liable to damages amounting to the whole of his sccurity deposits,the contract shall,thereupon,after notice given by the Purchasing Officer to the contractor,be determined and Electricity Department,Thrissur Corporation may complete the contract in such time and manner and by such persons as Electricity Department, Thrissur Corporation shall think fit.But such determination of the contract shall be without any prejudice to any right or remedy of Electricity Depart, Thrissur Corporation against the contractor or his sureties in respect of any breach of contract committed by the contractor.All expenses and damages caused to Electricity Department,Thrissur Corporation by any breach of contract by the contractor shall be paid by the contract or to Electricity Department,Thrissur Corporation and may be recovered from him under the provision of the Revenue Recovery Act in force in the State.

In case the contractor fails to supply and installation of the SPV Power Plant within the time provided for the same,or in case the contractor commits ay breach of any of the covenants,stipulations and agreements herein contained,and on his part to be observed and performed,then and in any such case,it shall be lawful for Electricity Department,Thrissur Corporation(if they shall think fit to do so)to arrange for the purchase of the said articles and things from elsewhere of on behalf of Electricity Department,Thrissur Corporation by an order in writing under the hand of the Assistant Secretary put an end to this contract and in case Electricity Department,Thrissur Corporation shall have incurred sustained or been put to any costs,damages or expenses by reason of such purchase or by reason of this contract having been so put an end to or in case any difference in price, compensation, loss, costs, damages, expenses or other moneys shall then or any time during the continuance of this contract be payable by the contractor to Electricity Department, Thrissur Corporation under and by virtue of this contract, it shall be lawful for Electricity Department,Thrissur Corporation from and out of any moneys for the time being payable or owing to the contract or from Electricity Department, Thrissur Corporation under or by virtue of this contractor otherwise to pay and reimburse to Electricity Department, Thrissur Corporation all such costs, damages and expenses they may have sustained, incurred or been put to by reason of the purchase made elsewhere or by reason of this contract having been so put an end to as aforesaid and also all such difference in price, compensation, loss, costs, damages, expenses and other moneys as shall for the time being payable by the contractor aforesaid.

Any some of money due and payable to the contractor(including security deposit returnable to him) under this contract may be appropriated by The Assistant Secretary or any other person authorised by Electricity Department, Thrissur Corporation and set off against any claim of Electricity Department, Thrissur Corporation for the payment of a sum of money araising out of or under any other contract made by the contractor or with Electricity Department, Thrissur Corporation or any other person authorised by Electricity Department, Thrissur Corporation. Any sum of money due and payable to the successful tenderer or contract or from Electricity Department, Thrissur Corporation shall be adjusted against any sum of money due to Electricity Department, Thrissur Corporation from his under any other contracts.

Eyery notice hereby required or authorised to be given may be given to the contractor personally or left at his residence or last known place of abode or business, or mny be handed over to his agent personally, or may be addressed to the contract or by post at his usual or least known place of abode or businessman is so addressed and posted, shall be deemed to have been seryed on the contractor on the date on which in the ordinary rouse of post, a letter so addressed and posted would reach his place of abode or business.

The tenderer shall undertake the installation of the PV Power Plant according to the specified cngineering standards and specifications.

No representation for cnhancement of rate once accepted will be considered.

The prices quoted should be inclusive all taxes, duties, cesses etc. which are or may become payable by the contractor under existng or future law or rules of the country of origin/supply or delivery during the course of execution of the contract.

The tenderer wvi in variaby furnish the required certificates with their bills for payment —

*Certifed that the goods which GST has been charged have not been exempted under the GST Rules made there under and the charges on account of sales tax on these goods are correct under the provisions of there relevant Act or the rules

made there under certified further that we … (or our Branch or

Agent).....(Address) are registered as dealers in the State of under Registration No……for purposes of sales tax.'

Special conditions, if any, of the tenderers attached with the ternders will not be applcabe to the contract unless they are expressly accepted in writing by the purchaser,

The tenderer should send along wit his tender an agreement executed and signed in Kerala Stamp Paper of value Rs.200/-. A specimen form of agreement is given Annexure I-D to this tender. Tenders without the agreementin stamped paper will be rejected outright.

Conditions in the technical document, technical specifications and special conditions of this tender document would over ride these general conditions, wherever applicable.

Electricity Department,Thrissur Corporation,by notice sent to the contractor,may terminate the contract,in whole or in part,at any time for its conveniencc.The notice of termination shall specify that termination is for Electricity Department,Thrissur Corporation's convenience,the extent to which performance of the contractor under the contract is terminated,and the date upon which such tcrmination becomes effective.

Envelope-1 shall be opened at the time and date announced in the tender notice.

Envelope-2 containing price Bid will not be opened at the time of opening Envelope -1. Envelope -2 will be opened later, the date of which will be intimated to the qualified tenderers, and this information would also be available on the e-tenders website.

In case any difference or dispute arises in connection with the contract, all legal proceedings relating to the matter shall be instituted in the Court within whose jurisdiction the Assistant Secretary, Electricity Department, Thrissur Corporation voluntarily resides.

The courts situated at the place where the Head Quarters of Electricity Department, Thrissur Corporation is situated viz, Thrissur alone will have jurisdiction to entertain civil suits and all other legal pertaining to this contract.

5.2 PAYMENT METHOD

5.2.1 No Advance payment will be given. All the documents submitted should be certified by the TCED officer.

5.2.2 The terms of payment shall be:

5.2.2.1 EPC Payment

i. Upon delivery of major components (PV Modules, Inverter etc) at the respective sites, 60 % of the contract value will be released as first part payment. The supplier shall submit the invoice for the materials (including serial numbers and delivery challan) duly certified by the TCED Officer along with report regarding the supply of materials

ii. On completion of the installation of power plant and filing application for testing, 20% of the contract value shall be released as second part payment. The supplier shall submit the invoice for the materials supplied and all documents related including the Project Completion Report to the completion of the work certified by the TCED officer shall be submitted for the release of the amount. The PCR submitted will be used for conducting the pre-commissioning tests.

iii. On commissioning of the grid connected system, 10% of the remaining contract value will be released. All documents related to the completion of the work including commissioning report shall be submitted for the release
of the amount.

iv. The balance 10% shall be retained as performance security and will be released in equal parts of 2% after each year of operation with the acceptable PR value considering 1% yearly degradation. This period will be considered only from the date of commissioning. This can be released against a bank guarantee of equivalent amount valid for 5 years.

v. The security deposit of 3% furnished along with the contract agreements hall be released on successful completion of supply, installation and commissioning.

vi. The capacity of the plant mentioned in the document may vary +/- 20% according to the actual design as per the site condition and the payment will be considered according to the final measurement.

5.2.2.2 O&M Payment

i. The O&M charges shall be released after completion of every 6 months of the O&M period. The start of O&M period will be considered from the scheduled date of operation.

ii. The preventive maintenance reports along with receipt of premium of insurance and generation reports are to be submitted for the release of O&M payments.

iii. The payment shall be released after the inspection by the authorized personnel of TCED on annual basis.

5.2.3 Income tax, contribution to workers' welfare fund and other statutory deductions shall be made from the payment as per prevailing norms.

5.3. Special Conditions

Each Bidder should submit only one (1)bid.Any bidder who submits/participates in more than one bid for the work shall be disqualified.

The tenders will be opened in the presence of bidders present at the date and time advised in the Bidding Document.If the due date for receiving and opening the tender happens to be declared holiday,then the tender will be received and opened on the very next day,for which no prior intimation will be given.

If the bidder has NOT submitted the requisite EMD OR Agreement,OR if the price bids are included in Envelope -A or Envelope -B,OR if Envelope-C is not submitted along with the tender,such tenders will be summarily rejected.

During the technical evaluation period,Thrissur Corporation may seek more clarifications/details from any or all of the tenderers,if found necessary.

The price bids of technically qualified terndererers only will be opened and the L_1 bidder will be awarded the work of supply and installation of items after fulfilling all the requirements.

5.4. Service and maintenance

The faulty system or components should be replaced/repaired within 10 days of fault reporting.The servicing should be carried out at the site of installation.The service personnel should visit the installations at least once in a month for preventive maintenance even if no faults are reported. Delay in servicing beyond 10 days of fault reporting would attract penalty at the rate of Rs.10,000/-per fortnight or part thereof.

Designated contact Telephone Number ,Email and Address for communication should be submitted for reporting faults during the warranty period.

ANNEXURE I-C : SUMMARY OF BID QUALIFICATION REQUIREMENTS

1	Name of the bidder	
2	Address in full	
3	Contact Details Mobile Land Phone Fax E mail	
4	Name and Designation of the authorised signatory	
5	Details of EMD submitted along with the bid in favour of Assistant Secretary Electricity Department,Thrissur Corporation.	
6	Total Number and capacity of solar power plants installed so far	Number of systems:
		Total capacity:
		(Proof to be enclosed and flagged as Annexure……page no……)
7	Annual turnover of the firm during last three years (Rs.)	
		(Proof to be enclosed and flagged as Annexure……page no……)
8	No.of service centres/Authorised service providers in Kerala	
9	Agreement submitted in stamp paper(YES/NO);	

ANNEXURE I-D : AGREEMENT

ARTICLES OF AGREEMENT executed on this the …… day of ……Two thousand and ……between the Electricity Department,Thrissur Corporation of the one part and Sri…… ……Name and address of the tenderer)hereinafter referred to as"the Bounden")of the other part.WHEREAS in response to the Notification No……dated……the bounden has submitted to Electricity Department,Thrissur Corporation an e-lender for the Supply,Installation &Commissioning of a total of 160kWp Grid Connected SPV power plant at Thrissur Municipal Corporation Buildings,Thrissur,in Thrissur Corporation,Thrissur District specified therein subject to the terms and conditions contained in the said e-tender.

AND WHEREAS the bounden has furnished to Electricity Department,Thrissur Corporation a sum of Rs……as Eamest Money Deposit for execution of an agreement undertaking the due fulfllment of the contract in case his e-tender is accepted by Electricity Department,Thrissur Corporation.NOW THESE PRESENTS WITNESS and it is hereby mutually agreed as follows:-

In case the etender submited by the bounden is accepted by Electricity Department,Thrissur Corporation and the contract for ……is awarded to the bounden, the bounden shall within fifteen days of acceptance of his e-tender,execute an agreement with Electricity Department,Thrissur Corporation incorporating all the terms and conditions under which Electricity Department,Thrissur Corporation accepts his e-tender.

In case the bounden fails to execute the agreement as aforesaid incorporating the terms and conditions governing the contract,Electricity Department,Thrissur Corporation shall have power and authority to recover ffom the bounden any loss or damage caused to Electricity Department,Thrissur Corporation by such breach as may be deternined by Electricity Department,Thrissur Corporation by appropriating the moneys inclusive of Earmest Money Deposited by the bounden and if the Earnest Money is found to be inadequate the deficit amount may be recovered from the bounden and his properties movable and immovable in the manner hereinafter contained.

All sums found due to Electricity Department,Thrissur Corporation under or by virue of this agreement shall be recoverable from the bounden and his properties movable and immovable under the provisions of the Revenue Recovery Act for the time being in force as though such sums are arrears of land revenue and in such other manner as Electricity Department,Thrissur Corporation may deem fit.

In witness whereof Sri ……Name and Designation) for and on behalf of the Electricity Department,Thrissur Corporation and Sri. … … … … … … … … … ……the bounden have hereunto set their hands the day and year shown against theirrespective signature.

Signed by Sri……

(Date)……

in the presence of witnesses

Signed by Sri……

(Date)……

in the presence of witnesses

ANNEXURE II-C : BIDDER'S TECHNICAL INFORMATION SUMMARY

(To be filled in by bidder, Use copies, for each model offered)

1.	Name of the bidder as in registration certificate	
2.	Address in full	
3.	Contact Details Mobile Land Phone Fax No. Email Address	
4.	Name of the authorised signatory	
5.	Designation of the authorised signatory	
6.	Whether the bidder is a bonafide manufacturer/integrator of the item tendered ?	

7.Details of main components in the systems offered and the test certificates

S/N	Criteria	PV Module	Inverter
1.	Make offered		
2	Model offered		
3	Lab from which Test certificate obtained		
4	Test Certificate No.		
5	Date of Test Certificate		
6	Standards to which it complies, as per test certificate		
7.	Copy of test certificate enclosed at page No…(of this tender submission)		

I have read the General Tender Terms &Conditions for e-Procurement,General Conditions Special Conditions and Bidder's Technical Information summary of this e-tender and hereby agree to participate in the e-tender strictly adhering to the conditions and the details furnished along with bid are true and correct.

Signature of authorised signatory with

Date:

Name:

Designation:

ANNEXURE II-D : FORMAT FOR WARRANTY CARD TO BE

SUPPLIED WITH EACH SOLAR SYSTEM

1.Name &Address of the Bidder/Bidder of the System

2.Name &Address of Purchasing Agency

3.Data of supply of the system

4.Details of PV Module(s)supplied in the system

Make

Model

Serial No.(s).

Wattage of the PV Module(s)under STC

Warranty valid up to

5.Details of BOS items(Inverter etc)

System Make

Model

Serial No.(s)

Warranty valied up to

6.Designation&Address of the person to be contractor for claiming Warranty obligations

ANNEXURE II-E : DECLARATION BY THE BIDDER

Tender Notification No.PDS- for Design, Supply,Installation Testing & Commissioning of a ……kW Grid Connected SPV power plant at…….. Thrissur Corporation,Thrissur District.

Tender notification Date

To

The Assistant Secretary

Electricity Department,Thrissur Corporation.

We,the undersigned,declare that:

1.We have examined and have no reservations to the Bidding Document,

including Addenda No……

2.We offer to supply in conformity with the Bidding Document and in accordance with the delivery schedule.

3.Our Bid shall be valid for a period of 6 months from the date fixed as deadline for the submission of tenders in accordance with the Bidding Document,and it shall remain binding upon us and may be accepted at any time before the expiration of that period;

4.If our Bid is accepted,we commit to submit a Security Deposit in the amount of 5 percent of the Contract Price for the due performance of the Contract,;

5.We are not participating,as Bidders,in more than one Bid in this bidding process;

6.Our fim,its affliates or subsidiaries,including any subcontractors or contractors for any part of the Contract,has not been declared ineligible by the TCED or Government of Kerala;

7.We understand that this Bid,together with your written acceptance thereof included in your notification of award,shall constitute a binding contract between us,until a formal Contract is prepared and executed.

8.Our firm has obtained the certifications ffom MNRE or NABL approved Test laboratories that the goods and services are satisfying the technical

criteria specified in the bid.

Signature:

Name:

Date :

ANNEXURE II-F : STATEMENT OF DEVIATIONS

Name of Work: Design, Supply,Installation, Testing & Commissioning of a …….KW Grid Connected SPV power plant at …… in Thrissur Corporation,Thrissur District

c-Tender No.:PDS-

Name and Address:

To,

The Assistant Secretary,

Electricity Department,

Thrissur Corporation,Thrissur

Dear Sir

Sub:-Deviations from bid conditions relating to bit No……for the Design, Supply,Installation, Testing & Commissioning of a …..kW Grid Connected SPV power plant at ……. in Thrissur Corporation, Thrissur District

In respect of whatever has been stated to the contrary any where else in our offer, only the following are the deviations and variations from the exception to the specifications and documents for the subject e-Tender No.PDS- ……. These deviations and variations are exhaustive ,except these deviations.The entire supply and installation will be effected as per your bid specifications and documents.Further 1/We agree that additional conditions,if any found in the offer other than those stated below,except those petaining to any rebatcs offered /reductions in cost to the Electricity Department, Thrissur Corporation shall not be given effect to.I/We also certify that the financial

implication of these deviations if to be withdrawn has been furnished.

Signature of the Tenderer

ANNEXURE II-G : DECLARATION FOR DEVIATION

From.

To,

The Assistant Secretary

Electricity Department,

Thrissur Corporation,Thrissur.

Dear Sir.

Sub:-**Bid for Design, Supply,Installation, Testing & Commissioning of a …. kW Grid Connected SPV power plant at …….. in Thrissur Corporation, Thrissur District**

Ref:-Bid No……

This has reference to your above referrer bid.As required therein we are pleased to submit our price bid for the above bid in a separate sealed cover,We have also submitted the pre-qualification bid in a separate sealed cover.

We declare that we are qualified to participate in the above-referred bid inline with your qualification requirements stipulated in the "Bid documents".We further declare that we have brought out all our deviations to the conditions of contract stipulated in your bid documents indicating therein the cost for withdrawing the conditions in case you for such withdrawal will be limited to the amount mentioned against each deviation separately.

It is understood that the deviations to the conditions of the bid documents as have been brought out are exhaustive.

We agree and declare that irrespective of whatever has been stated elsewhere in the bid documents only those deviations that have been specifically brought out in Annexure-II to Part II hold good.

I/We have enclosed … …proof of having deposited an amount of Rs…… towards Earnest Money Deposit,in a separate sealed cover.

Thanking You

Yours faithfully,

(Signature of Bidder):

Date:

ANNEXURE II-H : DECLARATION ON SUBSIDY CLAIM

Tender Notification No.:PDS-

Design, Supply,Installation, Testing &Commissioning of a …… kW Grid Connected SPV power plant at …….in Thrissur Corporation, Thrissur District.

To

The Assistant Secretary

Electricity Department,

Thrissur Corporation,Thrissur.

I hereby declare that we will not apply directly to MNRE for claiming the subsidy for this SPV project with 150 kW capacity and proposed to be installed at Thrissur Corporation,Thrissur District.

Signature of Bidder:

Name :

Date :

Office Seal

ANNEXURE II-J : ENGINEERING DRAWING OF STRUCTURE

The bidder should submit and get the necessary approval of the following detailed Engineering Drawings before the execution of the project:

i. Single Line Diagram of the PV Power Plant
ii. Detailed Plot Plan for the Deployment of PV Array.
iii. Schematic Diagram.
iv. Module Mounting Structure (Plan & Elevation).

The succcessful bidder should submit the soft copy of the Solar Radiation Data that

They have used for PV System Simulation of the Solar PV Power Plant.