GOVERNMENT OF MIZORAM
POWER AND ELECTRICITY DEPARTMENT
MIZORAM : AIZAWL

TENDER DOCUMENT

NOTICE INVITING TENDER NO 3 OF 2017-2018

(Vide No. **996/1/17-E-in-C(PD)/9**)

Name of work : **Construction of 2x2.5MVA, 33/11kV Sub-Station at P&E Complex at Saiha.**

2017

Office of the Engineer-in-Chief, P&E Deptt : Aizawl, Mizoram

CONTENT

SECTION - I
INSTRUCTION TO TENDERERS

1 DEFINITION OF TERMS

In the Contract, the following expressions shall, unless the context otherwise requires, have the meanings, hereby respectively assigned to them.

The '**Contract**' means the Documents duly signed by both the Parties, forming formal Agreement executed between Power & Electricity Department, Govt. of Mizoram, Aizawl and the Tenderer.

'**Contract Price**' shall mean the total sum of financial involvement named in or calculated in accordance with the provisions of the Contract Price.

'**Equipment/Materials**' shall mean and include all Machinery, Apparatus, Materials etc to be provided/supplied under the Contract by the Tenderer

'**F.O.T Price**' shall mean the cost of equipment/materials up to destinations as specified in the Contract. The cost should include GST, Freight, Insurance, any Charges up to destination.

'**General Conditions**' shall mean these General Conditions of Contract.

'**Month**' shall mean a Calendar Month.

'**Owner**' means the Power & Electricity Department, Govt. of Mizoram, Aizawl.

'**Project'** refers to that mentioned under the headings of the Tender Specifications.

'**Purchaser**' shall mean the Engineer-in-Chief, Power & Electricity Department, Govt. of Mizoram, Aizawl.

'**Purchaser's Representatives**' shall mean any Person or Consulting Firm appointed and remunerated by the Purchaser to Supervise, Inspect, Test and Examine Workmanship on the Survey, Supply and erection works.

'**The Tenderer**' shall mean the Tenderer whose Bid has been accepted by the Purchaser and shall include the Tenderer's Executors, Administrators, Successors and permitted assigns approved by Engineer-in-Chief, Power & Electricity Department, Mizoram, Aizawl.

'**The Engineer/Engineer in charge**' shall mean the Engineer appointed by the Purchaser/Owner for the purpose of this Contract.

'**Specification**' shall mean the specification annexed to or issued with the General Conditions and shall include the Schedules and Drawings attached thereto as well as samples and patterns, if any.

'**Ton**' or '**Tonne**' used in these specifications shall mean Metric Ton, unless otherwise specified.

'Plant' is any integral part of the works, which has mechanical, electrical, electronic or chemical or biological functions.

'**Contract Documents**' shall mean the following documents which shall be deemed to form an integral part of this Contract.

i) Contract Agreement, Instructions to Tenderers and all conditions of contract.
ii) Tenderer's proposal including the letters or clarifications there to between the Tenderer and the Purchaser prior to award of Contract and
iii) Equipment Specifications and Drawings. In the event of any conflict between the above mentioned documents, the Contract Agreement shall prevail.

'**Works**' means the materials and equipments to be supplied and the work to be executed as defined and set out in the specifications and includes all extra Work, Additions, Deletions, Substitutions and Variations ordered by the Engineer in accordance with the provisions of the Contract.

"**Tenderer**' means the Person, Firm or Corporation tendering for the works and His/Its Executors or Administrators or Successors or Assigns.

'**Site**' means the land on, under, in or through which the works are to be executed or carried out or such lands as may be agreed between the Owner and the Tenderer as being reasonable and necessary for the carrying out of the work.

'**Sub Contractors**' used here refer to a Party or Parties having a direct contract with the Tenderer and to whom any part of the Contract has been sublet by the Tenderer with the consent in writing of the Engineer-in-Chief.

'**Labourer**' shall mean all categories of labour engaged by the Tenderer, his Sub-Tenderers and his piece workers for work in connection with the execution of the work covered by the specifications. All these labourers will be deemed to be employed primarily by the Tenderer.

'**Fiscal Year**' shall mean a year beginning on 1st April and ending on 31st March in the succeeding year.

'**Security Deposit**' shall mean all deposits whether in Government Securities, Fixed Deposit Receipts or Bank Guarantees from Nationalized Banks of India, amounts deducted from interim payments or in any other form as specified by the Purchaser pledged to the Owner for due performance of the Contract and shall be adjusted in case of compensations or penalties and which may stand for future either in part or whole as the situation demands.

Letter of Intent means the letter from the Engineer-in-Chief conveying his intention to accept the Bid subject to reservations as may have been stated therein.

Letter of Award/Instruction to Commence means the letter from the Engineer-in-Chief notifying the formal acceptance of the Bid subject to the terms and conditions finally arrived at after conduction/negotiation (if any).

'**Manufacturer**' used herein refers to the party proposing to design, fabricate and manufacture as specified complete or in part.

'**Authorised Representative**' of the Owner shall mean any Authorised Officer of the Owner from the level of Junior Engineer and above.

2 Qualifying Requirement

Qualification of a bidder will be based on meeting the minimum criteria specified in below regarding the bidder's technical and financial position as demonstrated by the bidder's responses in Application.

i) Average Annual Financial Turn over during the immediate last three (3) consecutive financial years should be 100% of the estimated cost for the works.

ii) The bidder shall provide evidence satisfactory to the Owner of their capability and adequacy of resources to carry out the Contract effectively. Accordingly, bids shall include the following information:

(a) Copies of original documents defining the constitutions or legal status, place of registration and principal place of business; written power of attorney of the signatory of the "Applicant" to commit the plant.

(b) Firm's credentials including its past experience in executing similar type or works and also the list of ongoing projects.

(c) List of plant, machinery, manufacturing and testing facilities

(d) List of manpower with qualification and designations

(e) Quality assurance system with designated quality officer and Nos. of safety officer with PPE (personal protective equipment)

(f) A Statement from banker indicating various fund based/non fund based limits sanctioned to the bidder and the extent of utilization as on date. Such statement should have been issued not earlier than three months prior to the date of submission of 'Application'. Wherever necessary P&E Deptt. may make queries with the bidder's bankers;

(g) The complete annual reports together with Audited statement of accounts of the company for last three years preceding the date of submission of the 'Application'.

The Owner may assess the capacity and capability of the Bidder in Qualification Stage, to successfully execute the scope of work covered under the package within stipulated completion period. This assessment shall include

(i) Document verification

(ii) Details of works executed, works in hand, anticipated in future & balance capacity available for the present scope of work

(iii) Details of plant and machinery, manufacturing/testing facilities, safety equipments, manpower and financial resources

(v) Details of quality system in place

(vi) Past experience and performance

(vii) Customer feedback

(viii) Banker's feedback etc.

P&E Department reserves the right to waive minor deviations if they do not materially affect the capability of the Bidder to perform the contract.

3 Instruction to Bidder

3.1.0: Bid documents can be obtained from Executive Engineer (Design & Monitoring), Office of The Engineer-in-Chief, Power & Electricity Department, Aizawl, e-mail - encdesigncell@gmail.com during working hours against formal request on payment of the cost of Bid Documents by way of Demand Draft from any Reputed Bank in favour of Engineer-in-Chief, Power & Electricity Dept. Payable at 'SBI Dawrpui Branch, Aizawl.'

3.2.0: Notwithstanding anything stated above, P&E Dept. reserves the right to assess the bidder's capability and capacity to perform the contract should the circumstances warrant such assessment necessary in its overall interest.

3.3.0: IT IS IMPERATIVE/MUST FOR EACH BIDDER TO SATISFY HIMSELF COMPLETELY OF ALL LOCAL CONDITIONS AND ASSESS ANY PROBLEMS RELATING TO THE MEANS OF ACCESS TO THE SITE. RIGHT OF WAY SHALL BE THE JOINT RESPONSIBILITY OF SUCCESSFUL BIDDER AND THE DEPARTMENT. A BIDDER SHALL BE DEEMED TO HAVE FULL KNOWLEDGE OF THE SITE (WHETHER HE INSPECTS OR NOT) ONCE THEY SUBMIT THE BID.

3.4.0: P&E Dept. reserves the right to accept or reject any or all the bids without assigning any reason whatsoever. P&E Dept. also reserves the right to pre-pone/postpone the above dates, split and distribute the work among more than one bidder without assigning any reason whatsoever. The bid documents are non-transferable and the cost of bid documents non refundable under any circumstances. P&E Dept. shall not be held responsible for any delay, loss, damage or non-receipt of request for issue of bid documents or bids sent by post.

3.5.0 This NIT in window form as published in newspapers may also be seen on the official website: www.tender.mizoram.gov.in. In case of any discrepancy between the documents downloaded from the website by the prospective bidder and the bidding documents (Hard copy) issued by P&E Dept. Officials, the latter shall prevail.

3.6.0 The tenderer must have documentary proof of license for construction of 33kV level or above within the Mizoram State issue by Electrical Inspectorate, Government of Mizoram.

3.7.0. The successful bidder should submit GTP of materials & Tools for approval .

4 Earnest Money :

The Tenderer shall have to furnish Earnest Money for Rs. 9.4 lakh (Rupees nine Lakhs forty thousand) only in the form of Bank Draft/Deposit at call from a nationalized bank pledged in favour of the Engineer-in-Chief, Power & Electricity Department in a separate cover super-scribing the Tender Specification, Number and Date of opening failing which the Tender will not be opened. Tribal Tenderers are allowed to submit Earnest Money for half the above amount. Manufacturers registered with NSIC, DGT&D and also SSI unit is exempted for payment of Earnest Money provided Registration Certificate is enclosed.

5 Validity

Tender should be kept valid for a period of 30(thirty) Calendar months from the date of opening of Tenders. Validity less than 30(thirty) Calendar months will be liable for rejection.

6 Examination of the Documents

The Tenderer shall examine General Conditions of Contract and Specifications to satisfy himself about all the Terms & Conditions and circumstances affecting the Contract Price. He shall quote price(s) according to his own views on these matters and understand that no additional allowances except as otherwise provided therein will be levied. The Purchaser shall not be responsible for any misunderstanding or incorrect information obtained by the Tenderer other than information given to the Tenderer in writing by the Purchaser. The Tenderer shall give his/her signature with seal in each and every page of the Tender Document as an indication of his/her acceptance of the Terms and Conditions of the Tender.

In the Tender, no overwriting is allowed. Dated initial should be given by the Tenderer to all corrections, if any, and the Seal stamped on each. Rates should be quoted both in figures and in words as far as practicable.

5.1. Non-Tribal Tenderers should submit the following alongwith their Tenders:

1) Authorised Dealer must submit an Authorised Dealership Certificate issued by Manufacturers.
2) ISI/BIS Certificate.
3) Documents showing past experience.

5.2. Tribal Tenderers should submit :

1) House Tax Payee Certificate
2) Authorised Dealer must submit an Authorised Dealership Certificate issued by Manufacturers.
3) ISI/BIS Certificate which ever applicable.
4) Documents showing past experience.

7 Patent Rights, etc

The Tenderer shall indemnify the Purchaser against all Claims, Actions, Suits and Proceedings for the infringement or alleged infringement of any patent design or copy right protected either in the Country of origin or in India by the use of any equipment supplied by the Tenderer, but such indemnity shall not cover any use of equipment other than for the purpose indicated by or reasonably to be inferred from the specifications.

8 Reservation

The Owner reserves the right to accept or reject, partly or wholly, or all the tenders without assigning any reason thereof. Further, the Owner is not bound to select the lowest Tenderer to execute the work. Tenderers who do not accept General Conditions will be automatically rejected.

9 Variations - Additions and Omission

i) The Tenderer shall not modify the materials and equipment except directed in writing by the Purchaser.

ii) The Purchaser shall have the right to alter, amend, omit or otherwise vary the equipment by notice in writing to the Tenderer. The Tenderer shall carry out such variations except when said variations result on cost excess of 15% of the Contract Price, in which case the approval of the Purchaser shall be obtained. The amount of such variations shall be determined in accordance with the rate specified in the Contract so far as they may apply and where such rates are not available. These will be mutually agreed between the Purchaser and the Tenderer.

iii) If the Purchaser shall make variations in any part of the materials and equipment, a reasonable notice shall be given in writing to the Tenderer. In such cases where equipment has already been manufactured or is under manufacture, the Purchaser may consider payment of additional sum to the Tenderer. If in the opinion of the Tenderer such variation is likely to prevent or prejudice the Tenderer from fulfilling any of his obligations under the contract, he shall notify the Purchaser thereof in writing and the Purchaser shall decide whether or not the variation shall be carried out.

10 Pre-bid meeting :

The intending bidder or his official representative is invited to attend a pre-bid meeting which will take place at the address, venue, time and date as indicated in the NIT. The purpose of meeting will be to clarify issues and to answer questions on any matter that may be raised at that stage. The intending bidder is requested to submit any questions in writing to the owner not late than one week before the meeting. Minutes of meeting, including the text of the question raised and the response given will be transmitted to the purchaser of the bidding documents. Non-attendance at the pre-bid meeting will not be a cause for disqualification of the bidder.

11 Special Instruction to Bidder :

Please read following instructions carefully before submitting your bid.

1. All the drawings, i.e. elevation, side view, plan, cross sectional view etc., in Soft Copy and manuals in PDF format, for offered item shall be submitted. Also the hard copies as per specification shall be submitted.

2. The bidder shall submit Quality Assurance Plan for manufacturing process and Field Quality Plan with the technical bid.

3. The bidder shall have to submit all the required type test reports for the offered item. However, in the event of partial submission or reports older than specified limit, bidder must submit his confirmation for those type test reports to be submitted in the event of an order, without affecting delivery schedule, before commencement of supply, free of cost. In absence of this confirmation, the evaluation shall be carried out accordingly as non submission of type test reports.

4. The bidder must fill up all the point of GTP for offered items.

5. All the points other than GTP, which are asked to confirm in technical specifications must be submitted separately with the bid.

6. Please note that the evaluation will be carried out on the strength of content of bid only. No further correspondence will be made.

7. One tender per tenderer (i.e. only one tender should be submitted by each tenderer).

8. The bidder should indicate manufacturing capacity by submitting latest updated certificate of a Chartered Engineer (CE).

SECTION - II
GENERAL CONDITIONS OF CONTRACT

1. Scope of the Work

Bidders are requested to visit the site before participating in the tender. Scope of work of the Contract includes Engineering, Supply, Erection, Testing and Commissioning of all materials & equipment such as –

1.1. Sub-Station :

i) 33/11kV Power Transformer (with concrete foundation)
ii) 33/0.4kV, 100 kVA Station Transformer (with concrete foundation)
iii) 33kV outdoor type Vacuum Circuit Breaker, Current Transformer, Potential Transformer, Isolator, Surge Arrestor (with concrete foundation)
iv) G.I. Sub-Station Structure for Bus-bar, Gantry and mounting of outdoor equipments (with concrete foundation)
v) 33kV Indoor C&R panel and 11kV indoor Switchgear containing Busbar, VCB, CT, PT, Control & relay Panel with multi functional Meter.
vi) 11kV outdoor Switchyard containing Isolator, Surge arrestor alongwith supporting structure. (with concrete foundation)
vi) Distribution Box for both AC & DC
vii) Bus-bar, Conductors, Insulators, Hardware fitting and Clamps & Connector etc.
viii) Battery & Battery charger
ix) XLPE HT cable, Power Cables & its jointing kits, Control Cables & its termination
x) Earthing system
xi) Fire Fighting equipment
xii) Boundary wall
xiii) Site surfacing including anti-weeds treatment.
xiv) Switchyard illumination.
xv) Concrete Cable trench and drainage system.
xvi) Switch yard gravelling.
xvii) Fixing of danger plate, Bay marking & colour coding etc
xviii) Excavation of soil for foundation works for the structure & transformer platform
xix) Leveling of sub-station area.
xx) Construction of control room building

Important Note: *Wherever the source is from an existing 33 KV or Grid sub-station to the proposed 33/11 KV s/s, care is to be taken for construction of bays at the existing s/s end for matching with the existing system. The dismantling works if any involved are also to be taken care as per the direction of the Engineer in Charge.*

The specification covers design, engineering, manufacture, assembly, type tests, inspection and testing at manufacturer's works, packing, forwarding and delivery F.O.R destination stores of single phase, single unit Potential Transformers for instrumentation, protection and metering services in solidly grounded 33/11KV S/S.

The scope is on the basis of a single/Joint venture Bidder's responsibility, completely covering supply and erection of all the equipment specified

under the accompanying Technical Specifications including other services. It will include the following:

a) A tentative BOQ has been made on Preliminary investigation / survey. However, the Contractor will make detail survey and will supply the materials as per detailed survey/investigation.
b) Providing Engineering drawings related to foundation details, structural details of both line & Sub-station work.
c) Providing Equipment data, Operational manual.
d) Preparation of Cable Schedule (in shape of a booklet) etc for the Owner's approval.
e) Packing and transportation from the manufacturer's works to the site.
f) Loading, unloading and transportation as required.
g) Receipt, storage, preservation and conservation of equipment at the site including insurance.
h) Erection, testing and commissioning of all the equipment.
i) Performance and guarantee tests on completion of commissioning.

The following items of work are specifically excluded from the Contractors scope of work unless otherwise specifically brought out.

a) Sub-station site selection
b) Land acquisition for sub-station

The scope of work shall also include all work incidentals for successful operation and commissioning and handing over of works whether specifically mentioned or not. In general, works are to be carried out by the Contractor in accordance with the stipulations in Conditions of Contract.

2. Manner of Execution

The Project will be executed on turnkey basis.

3. Price

Firm rates for materials should be quoted FOT Destination. Rate should be inclusive of all taxes, duties, insurance, freight, handling charges, etc. For erection, firm rates should be quoted inclusive of all taxes.

4. Terms of Payment

i) 10% of the total Contract Price shall be paid as mobilization advance against Bank Guarantee of the same amount within 15 days from signing of the Contract Agreement. Balance payment may be as per work done. The advance so paid shall be adjusted by deducting not less than 10% (Ten percent) from each bill to be paid to the Contractor on pro rata basis until the advance amount is adjusted.

ii) 80% of the cost of materials and tools will be paid to the Contractor after receipt of the materials & tools at site in good conditions to the satisfaction of the Engineer. The payment will be made after the materials & tools have been duly verified by the site Engineer and

certification to that effect. Balance 20% will be paid after completion of the work.

iii) 80% Payment for the Works shall be done for works done as per actual measurement on the basis of R.A. Bills to be raised against final construction. Balance 20% Payment shall be made after successful commissioning of the Project.

5. Mode of Payment

Payments shall be made promptly by the Owner at the receipt of the Tenderer's invoice, complete in all respects and supported by the requisite documents and fulfillment of stipulated conditions, if any. All the payment shall be released to the Contractor directly.

All invoices under the Contract shall be raised by the Tenderer on "the Owner" and all payments shall be made to the Contractor by the Owner.

6. Target Date of Completion

The work should be completed within 12 months from the date of signing the contract.

7. Extension of Time

If the supply of equipment or erection work is delayed due to any reasons, the Tenderer shall without delay give notice to the Purchaser in writing of his claim for an extension of time within 30 days of Scheduled Date of Delivery/Completion. The Purchaser on receipt of such notice may agree to extend the Contract Completion Date as may be reasonable but with Liquidated Damages. However, in the case of Force Majeure or in any such cases beyond the control of the Tenderer and are accepted as such by the Purchaser, the Completion Date may be extended without Liquidated Damages.

8. Defect Liability Period

"Defect Liability Period" means 12 calendar months after taking over of the Project by the Owner.

The Contract shall not be considered completed until a Defects Liability Certificate shall have been signed by the Engineer-in-Charge and delivered to the Contractor stating the date on which the Contractor shall have completed his obligations to execute and complete the Works and remedy any defects there in to the Engineer's satisfaction. The Defects Liability Certificate shall be given by the Engineer within 28 days after the expiration of the Defects Liability Period, or, if different defects liability periods shall become applicable to different sections or parts of the

Permanent Works, the expiration of the latest such period, or as soon thereafter as any works instructed, pursuant to relevant clauses of this Chapter have been completed to the satisfaction of the Engineer-in-Charge.

Notwithstanding the issue of the Defects Liability Certificate, the Tenderer and the Owner shall remain liable for the fulfillment of any obligation incurred under the provisions of the Contract prior to the issue of the Defects Liability Certificate which remains unperformed at the time such Defect Liability Certificate is issued and for the purposes of determining the nature and extent of any such obligation, the Contract shall be deemed to remain in force between the parties.

If it appears to the Engineer or his Representative at any time during construction or reconstructions or prior to the expiry of the Defects Liability Period, as specified or 12 (twelve) calendar months from the certified date of final completion of entire work covered under the Contract, that any work has been executed with unsound, imperfect, or unskilled workmanship or that any materials or articles provided by the Tenderer for execution of the work are unsound or of a quality inferior to that contracted for, or otherwise not in accordance with the Contract or that any defect, shrinkage or other faults in the work arising out of defective or improper materials or workmanship, the Tenderer shall upon receipt of a notice in writing on that behalf from the Engineer, forthwith rectify or remove or reconstruct the works so specified in whole or in part as the case may be and/or remove that material/articles so specified and provide other proper and suitable materials at his own expense.

9. Completion of the work

The work shall be completed to the entire satisfaction of the Engineer and in accordance with the time mentioned in the Contract. As soon as the work under the Contract is substantially completed as a whole, the Tenderer shall give notice of such substantial completion to the Engineer along with an understanding to complete any outstanding work during the Defects Liability Period. The Engineer, within 30 days or receipt of such notice, shall inspect the work and shall satisfy himself that the Work(s) has been substantially completed in accordance with the provisions of the Contract and then issue to the Contractor a Certificate of Completion indicating the date of completion. Should the Engineer notice that there are defects in the works or the works are not considered to be substantially completed, he shall issue a notice in writing to the Tenderer to rectify/replace the defective work or any part there of or complete the work, as the case may be, within such time as may be notified and after the Tenderer has complied with as aforesaid and gives notice of completion, the

Engineer shall inspect the work and issue the Completion Certificate in the same manner as the aforesaid.

No Certificate of Completion shall be issued and no work shall be considered to be completed unless the Tenderer shall have removed from the work site and/or premises all his belongings/temporary arrangements made/brought by him for the purpose of execution of the work and cleared the site and/or premises in all respects and made the whole of the site and/or premises fit for immediate occupation/use to the satisfaction of the Engineer. If the Tenderer fails to comply with the above mentioned requirements on or before the date of completion of the work, the Engineer may, as he thinks fit, at the risk and cost of the Tenderer, fulfill such requirements and remove/dispose off the Tenderer's belongings/temporary arrangements as aforesaid and the Tenderer shall have no claim in this respect except for any sum realized by the sale of the Tenderer's belongings/temporary arrangements, less the cost of fulfilling the said requirements and any other amount that may be due from the Tenderer, should the expenditure on the aforesaid account exceed the amount by sale of such Tenderer's belongings/ temporary arrangements then the Tenderer shall, on the demand of the Engineer, pay the amount of such excess expenditure.

10. Taking over

i) The work shall be taken over from the Tenderer by the Owner after successfully commissioned.

(ii) The issuance of a Taking over Certificate shall in no way relieve the Tenderer of his responsibility for the satisfactory operation of the equipment in terms of the specifications.

11. Insurance of Equipment

The materials and equipment shall be fully insured by the Tenderer against damage, lost, pilferage etc in transit. Insurance Document should be sent along with evidence of dispatch.

12. Replacement

If the materials/equipments or any portion thereof is damaged or lost before taking over of the work by the Owner, the replacement of such materials/equipment shall be effected by the Tenderer within a specified time to avoid unnecessary delay in the commissioning of the materials and equipment. The replacement of materials/equipment damaged shall be made free of cost by the Tenderer.

13. Rejection

In the event that any portion of the works carried out by the Tenderer is found below standard or otherwise not in conformity with the requirements

of the Contract Specifications, the Purchaser shall request the Tenderer in writing to rectify the same. The Tenderer on receipt of such notification shall rectify the work free of cost to the Purchaser. If the Tenderer fails to do so, the Purchaser may:

a) at its option replace or rectify such defective work and recover the extra cost so involved from the Tenderer plus 15% of the defective work

b) terminate the Contract.

14. Inspection & Testing During Manufacture

i) The Purchaser's representative shall be entitled at all reasonable times during manufacture to inspect, examine and test on the Tenderer's premises the material, manpower and workmanship of all equipment to be supplied under this Contract by the Tenderer and if part of the said equipment is being manufactured on other premise, the Tenderer shall obtain for the Purchaser's representative permission to, inspect, examine, and test as if the equipment were being manufactured on the Tenderer's premises. Such inspection, examination and testing shall not release the Tenderer from his obligations under this Contract.

ii) The Tenderer shall give the Purchaser's Representative thirty (30) days notice in writing of the date and the place at which the materials and equipment will be ready for testing.

iii) Inspection and Testing will be at the cost of Tenderer including providing assistance for labour, materials, electricity, fuel and instrument as may be required or as may be reasonably demanded by the Purchaser's Representative to carry out such tests efficiently.

iv) When the equipment has passed the specified tests, the Purchaser's Representative shall furnish a Certificate to his effect in writing to the Tenderer. The Tenderer shall provide reasonable copies of the Test Certificates to the Purchaser.

15. Guarantee

The Tenderer shall provide cover of Guarantee to the materials and equipment supplied for a period of 12 (twelve) months from the date of commissioning of the materials/equipments. During the period of Guarantee the Tenderer shall remedy, at his expense, all defects in design, materials and workmanship that may develop under normal use of the materials and equipment upon written notice from the Purchaser who shall indicate in what respect the equipment is fault. The provision of this Clause including the cost of transport shall be implemented within the period specified by the Purchaser at the Tenderer's expense.

16. Force Majeure

The term '**Force Majeure**' shall herein mean Riots (other than among the Tenderers Employees), Civil Commotion (to the extent not Insurable), War (whether declared or not), Invasion, Act of Foreign Enemies, Hostilities, Civil War, Rebellion, Revolution, Insurrection, Military or Usurped Power, Damage from Aircraft, Nuclear Fission, such as Earthquake (above 7 Magnitude on Richter Scale), Lightning, Unprecedented Floods, Fires not caused by Tenderer's negligence and other such causes over which the Tenderer has no control and are accepted as such by the Purchaser, whose decision shall be final and binding.

In the event of either party being rendered unable by Force Majeure to perform any obligation required to be performed by them under this Contract, the relative obligation of the Party effected by such Force majeure shall be treated as suspended for the period during which such Force Majeure cause lasts, provided the Party alleging that it has been rendered unable as aforesaid, thereby shall notify within 10 days of the alleged beginning and ending thereof giving full particulars and satisfactory evidence in support of such cause. The Purchaser shall verify the facts and grant such extension or as the case may be as fact justify.

17. Payment due from the Tenderer

All cost and damages for which the Tenderer is liable to the Purchaser including a recovery of advance will be deducted by the Purchaser from any money due to the Tenderer under the Contract.

If for any unavoidable reasons, payment is delayed, the Tenderer shall neither charge any interest for the delay in payment nor the Tenderer shall stop the contract work on account of this.

18. Performance Bond or Bank Guarantee for Security

At the time of signing the Contract, the Tenderer shall provide the Purchaser with Security Deposit for a Performance Bond or a Performance Bank Guarantee for an amount of 5% (five percent) of the total accepted value of the works. This Bond or Guarantee will be released at the end of the Guarantee Period and on written request by the Tenderer. Form of Bank Guarantee attached.

19. Delay in Completion

If the Tenderer shall fail to complete the work within the time specified in the Contract Agreement or extension of time without Liquidated Damage, the Purchaser shall recover from the Tenderer as liquidated damages a sum of one half of one percent (0.5 %) of the Balance Contract Value, for

each week (7 days) of delay from the expiry of Scheduled Date of Completion. The total Liquidated Damages shall not exceed 10% (ten percent) of the balance contract value to be finalized by the purchaser.

20. Tenderer's Default & Liability

i) The Purchaser may upon written notice of default to the Tenderer terminate the Contract in circumstances detailed here under:

a) If in the judgement of the Purchaser, the Tenderer fails to complete the work within the time specified in the contract agreement or within the period for which extension has been granted by the Purchaser to the Tenderer.

b) If in the judgement of the Purchaser, the Tenderer fails to comply with any of the other provisions of the Contract.

ii) In the event the Purchaser terminates the Contract in whole or in parts as provided in Clause 21.0, the Purchaser reserves the right to purchase upon such terms and in such a manner as he may deem appropriate, materials and equipment similar to that terminated and the Tenderer will be liable to the Purchaser for any additional costs for delay as defined in Clause 21.0 of the General Conditions until such reasonable time as may be required for the final supply of equipment.

iii) If the Contract is terminated as provided in Clause 16.0 the Purchaser in addition to any other rights provided in this Article may require the Tenderer to transfer title and deliver to the Purchaser under any of the following cases in the manner and as directed by the Purchaser:

a) Any completed materials and equipment

b) Such partially completed materials and equipment, Drawings, Information and Contract Rights {hereinafter called Manufacturing Material} as the Tenderer has specifically produced or acquired for the performance of the contract as terminated. The purchaser shall pay to the Tenderer the Contract Price for completed materials and equipment delivered to and accepted by the Purchaser and for manufacturing material delivered and accepted.

iv) In the event the Purchaser does not terminate the Contract as provided in Clause 16.0 the Tenderer shall continue the performance of the Contract, in which case he shall be liable to the Purchaser for liquidated damages for delay as set out in Clause 14.0 until the equipment is accepted.

21. Termination of the Contract

i) If the Tenderer finds it impracticable to continue operation or if owing to Force Majeure reasons or to any cause beyond his control, the Purchaser finds it impossible to continue operation then prompt notification in writing shall be given by the party affected to the other.

ii) If the delay or difficulties so caused cannot be expected to cease or become avoidable or if in operations cannot be resumed within 6(six) months then either parties shall have the rights to terminate the Contract upon 10(ten) days written notice to the other. In the event of such termination of the Contract, payment to the Tenderer will be made as follows :

a) The Tenderer shall be paid for all materials and equipment approved by the Purchaser's representative and for any other legitimate expenses due to him.

b) If the Purchaser Terminates the Contract owing to Force Majeure or due to any cause beyond his control, the Tenderer shall additionally be paid for any work done during the said 6 (six) months period including any financial commitment made for the proper performance of the Contract and which are not reasonably defrayed by payments under (a) above.

c) The Purchaser shall also release all Bond and Guarantees at its disposal except in cases where the total amount for payment made to the Tenderer exceeds the final amount due to him in which case the Tenderer shall refund the excess amount within 60(sixty) days after termination and the Purchaser thereafter shall release all Bonds and Guarantees. Should the Tenderer fail to refund the amounts received in excess within the said period, such amounts shall be deducted from the Bonds or Guarantee provided.

iii) On Termination of the Contract for any cause the Tenderer shall see to the orderly suspension and termination of operations, with due consideration to the interest of the Purchaser with respect to completion, safeguarding or storing of equipment produced for the performance of the contract and the salvage and resale thereof.

22. The Engineer shall, on such Termination of the Contract, have Powers

i) To take possession of the site of Work under the Contract as well as the Land/Premises allotted to the Tenderer for his preliminary, enabling and Works and

ii) To take possession of any Materials, Constructional Plant, Equipment, Implements, Stores, Structures etc thereon.

The Engineer shall also have powers to carry out the incomplete Work by any means or through any other Agency or by himself at the risk and cost of the Tenderer. In such a case, the value of the Work done through such agencies shall be credited to the Tenderer at his Contract prices and the Tenderer shall pay the excess amount, if any incurred in completing the Work as aforesaid as stipulated herein.

22.1. On termination of the Contract in full or in part, the Engineer may direct that a part or whole of such Sub-Station, Equipment and Materials, Structures be removed from the site of the Work as well as from the land/premises allotted to the Tenderer for his preliminary, enabling and ancillary Works, within a stipulated period. If the Tenderer shall fail to do so within the period specified in a notice in writing by the Engineer, the Engineer may cause them to be sold, the net proceeds of such sale to the credit of which shall be released after completion of Works and settlement of amounts under the Contract.

22.2. If the expenses incurred or to be incurred by the Department for carrying out and completing the incomplete Work or part of the same, as certified by the Engineer, are in excess of the value of the Work credited/to be credited to the Tenderer, the difference shall be paid by the Tenderer to the Department. If the Tenderer fails to pay such an amount, as aforesaid, within thirty days of receipt of notice in writing from the Engineer, the Engineer shall be empowered to recover such amount from any sums due to the Tenderer on any account under this or any other Contract or from his Security Deposit or otherwise.

22.3. Also, the Engineer shall have the right to sale any or all of the Tenderer's unused materials, constructional plant, equipment, implements, temporary building/structures etc. and apply the proceeds of sale thereof towards the satisfaction of any sums due from the Tenderer under the Contract and if thereafter there maybe any balance outstanding from the Tenderer, the Engineer shall have powers to recover the same in accordance with the provisions of the Contract.

22.4. All decisions/actions of the Engineer under this clause as aforesaid shall be conclusive and binding on the Tenderer.

23. Bankruptcy

If the Tenderer shall become Bankrupt or have a receiving order made against him or compound with his Creditors, or being a Corporation commence to be wound up, not being a voluntary winding up for the purpose only of amalgamation or reconstruction, or carry on its business under a receiver for the benefit of its Creditors or any of them the Purchaser shall be at liberty:-

a) to Terminate the Contract forthwith by notice in writing to the Tenderer or to be liquidator or receiver or to any person in whom the Contract may become vested and to act in the manner provided in Clause 20.0 as though the last mentioned notice has been the notice referred to in such Article and the materials and equipment has been taken out of the Tenderer's hand.

b) to give such liquidator, receiver, or other person the option of carrying out the contract subject to his providing a guarantee for the due and faithful performance of the contract upto an amount to be determined by the Purchaser.

24. Contingent Fees

The Tenderer warrants that he has not employed any person to solicit or secure the contract upon any agreement for a Commission, Percentage, Brokerage or Contingent Fee, broach of this warranty shall give the Purchaser the right to cancel the Contract or to take any other measure as the Purchaser may deem fit. The warranty does not apply to commissions payable by the Tenderer to Established/Commercial or Selling Agent for the purpose of securing business.

25. Non-Assignment

The Tenderer shall not assign or transfer the contract or any part thereof without the prior approval of the Purchaser.

26. Certificate not to Affect Rights of the Purchaser of the Tenderer

The issuance of any certificate by the Purchaser or any extension of time granted by the Purchaser shall not prejudice the rights of the Purchaser in terms of the contract nor will this relieve the Tenderer of his obligations for due performance of the Contract.

27. Settlement of disputes

i) Except as otherwise specifically provided in the Contract, all disputes concerning question of fact arising under the Contract shall be decided

by the Purchaser subject to a written appeal by the Tenderer to the Purchaser, these decisions shall be final to the Parties hereto.

ii) Any disputes or differences including those considered as such by only one of the Parties arising out of or in connection with this Contract shall be to the extent possible settled amicably between the Parties. If amicable settlement cannot be reached then all disputes issues shall be settled by Arbitration.

28. Arbitration

i) If at any time, any question, disputes or difference whatsoever shall arise between the Tenderer and the Purchaser upon or in relation to or in connection with this Contract, either of the Parties may give to the other notice in writing of the existence of such a question dispute or difference and the same shall be referred to two Arbitrators, one to be nominated by the Purchaser and the other to be nominated by the Tenderer or in case of such arbitration not agreeing, then to an Umpire to be appointed by the Arbitrator in writing, before proceeding with the reference and the decision of the Arbitrator or in the event of their not agreeing of the Umpire appointed by them, shall be final and binding on the Parties and the provision of the Indian Arbitration and Conciliation Act, 1996 and of the Rules there under and any statutory modifications thereof shall be deemed to apply and be incorporated in this Contract. Such a notice of the existence of any question, dispute or difference in connection with this contract shall be served by either party within 90 days of the issue of the Taking Over Certificate by the Purchaser, failing which all rights and claims under this Contract shall be deemed to have been forfeited and absolutely barred.

ii) Upon every or any such reference, the cost of and incidental to the reference and award respectively, shall be at discretion of the Arbitrators or in the event of their not agreeing of the Umpire appointed by them who, may determine the amount thereof or direct the same to be fixed as between solicitor and client, or as between Party, and Party shall direct by whom and to whom and in what manner the same shall be borne and paid.

iii) The work under this Contract shall, if reasonably possible, continue during arbitration proceedings, and no payments due from or payable by the Purchaser shall be withheld on account of such proceedings except to the extent which may be in dispute.

29. Jurisdiction

No legal proceedings shall be taken to enforce any claim and no suit rising out of any conflict shall be instituted except in a court of competent jurisdiction located within **MIZORAM**.

30. Language and Measure

All Documents pertaining to the Contract including Specifications, Schedule, Notice, Correspondence, Operating and Maintenance Instructions, Drawings, or any other writings shall be in English Language. The Metric System of measurement shall be used exclusively in this Contract.

31. Correspondence

i) Any notice to the Tenderer under terms of the Contract shall be served by registered mail or by hand at the Tenderer's principal place of business.

ii) Any notice to the Purchaser shall be served at the Purchaser's Principal office in the same manner.

32. Consignee and Paying Authority

Name of Work	**Paying Authority**	**Consignee**
Construction of 2x2.5MVA, 33/11kV Sub-Station at Saiha	Executive Engineer, Saiha Power Division	Sub-Divisional Officer, Saiha Power Sub-Division

33. Legal Addresses of the Parties

The addresses of the Parties to the Contract are as follows :

Purchaser : The Engineer-in-Chief,
Power & Electricity Department
Govt. of Mizoram, Aizawl.

Tenderer : _____

SECTION - III
TECHNICAL SPECIFICATION

A. TECHNICAL SPECIFICATION OF CIVIL WORKS

1. GENERAL

The provisions of this section of specification shall only be applicable to the extent of scope of works indicated in Bid Proposal Sheet (BPS). The intent of specification covers the following:

1.1 Design, engineering, and construction of all civil works at sub-station. All civil works shall also satisfy the general technical requirements specified in other Sections of this Specification and as detailed below. They shall be designed to the required service conditions/loads as specified elsewhere in this Specification or implied as per National/ International Standards.

1.2 All civil works shall be carried out as per applicable Indian Laws, Standards and Codes. All materials shall be of best quality conforming to relevant Indian Standards and Codes.

1.3 The Contractor shall furnish all design, drawings, labour, tools, equipment, materials, temporary works, constructional plant and machinery, fuel supply, transportation and all other incidental items not shown or specified but as may be required for complete performance of the Works in accordance with approved drawings, specifications and direction of Employer.

1.4 The work shall be carried out according to the design/drawings to be developed by the Contractor and approved by the owner based on Tender Drawings Supplied to the Contractor by the Owner. For all buildings, structures, foundations etc. necessary layout and details shall be developed by the Contractor keeping in view the functional requirement of the substation facilities and providing enough space and access for operation, use and maintenance based on the input provided by the Owner. Certain minimum requirements are indicated in this specification for guidance purposes only.

1.5 In case of R&M of existing substations, Contactor shall visit site to ascertain the amount of repair and strengthening of structures and foundations, dismantling and new construction of structures and foundations works are to be done before quoting. Contractor must furnish the design and drawings in support of the activities mentioned above that are to be carried out in the R&M of existing substation site.

1.6 The rate quoted by the bidder for all type of civil work shall be firm irrespective of the type of terrain and depth of filling. However, the Contractor shall quote according to the complete requirements.

2. GEOTECHNICAL INVESTIGATION

2.1 The Contractor shall perform a detailed soil investigation to arrive at sufficiently accurate, general as well as specific information about the soil profile and the necessary soil parameters of the site. So that

the foundation of the various structures can be designed and constructed safely and rationally.

2.2 A report to the effect will be submitted by the Contractor for Owner's specific approval giving details regarding data proposed to be utilized for civil structures design.

2.3 The Contractor should visit the site to ascertain the soil parameters before submitting the bid. The topography is uneven steeply sloping at few places requiring cutting and filling operations including slope stability and protection measures (if slopes encountered). Any variation in soil data shall not constitute a valid reason for any additional cost & shall not affect the terms & condition of the Contract. Tests must be conducted under all the critical locations i.e. Control Room Building. Tower locations, transformer etc.

3. SCOPE OF WORK

The scope of works for all Civil and structural works shall include preparation of Civil designs and approval thereof, supply of all approved materials, labour, plant and equipments, fixtures, fitting, erection, testing and all temporary and permanent works necessary for the satisfactory completion of the job in all respects including clearing and cleaning the site. The Contractor shall complete all these works so that each substation is handed over to the employer ready to use.

Brief scope of work for each substations/Sites is as given below :

a) Check survey of substation areas and its surrounding upto main road, soil investigation, assessment of local conditions and requirements and collection of necessary data for establishing the parameters for design of various switchyard including control building and its super structure foundations as per site conditions.

b) Site leveling at various substation areas for Control Room, Switchyard and Roads to the extent as marked in the respective plot plan and providing gates, fencing, supply, fabrication and erection of infrastructure facilities etc.

c) Supply of steel structures for substation. Foundations for steel structures and electrical and mechanical equipment.

d) Crushed rock surfacing.

e) Drainage and sewerage system.

f) Water supply and plumbing system including bore well survey / investigation, drilling and installation of tube/borewell with provision of pumping arrangement and storage tanks. Alternate arrangement shall be made from available local authority water supply scheme or any assured private well in case of failure of bore well within a one km. distance.

g) Control building.

h) Miscellaneous civil works for lighting, earthing etc.

i) All other necessary works required for the completion of the job.

3.1. Electrical Resistivity Test

This test shall be conducted to determine the Electrical resistivity of soil required for designing safe grounding system for the entire station area. The specifications for the equipments and other accessories required for performing electrical resistivity test, the test procedure, and reporting of field observations shall confirm to IS: 3043. The test shall be conducted using Wagner's four electrode method as specified in IS: 1892, Appendix-B2. Unless otherwise specified at each test location, the test shall be conducted along two perpendicular lines parallel to the coordinate axis. On each line a minimum of 8 to 10 readings shall be taken by changing the spacing of the electrodes from an initial small value of 0.5 m upto a distance of 10.0 m.

3.2. Water Sample

Representative samples of ground water shall be taken when ground water is first encountered before the addition of water to aid drilling of boreholes. The samples shall be of sufficient quantity for chemical analysis to be carried out and shall be stored in airtight containers.

3.3. Back Filling of Bore Holes

On completion of each hole, the Contractor shall backfill all bore holes as directed by the Owner. The backfill material can be the excavated material and shall be compacted properly.

3.4. Laboratory Test

1. The laboratory tests shall be carried out progressively during the field work after sufficient number of samples has reached the laboratory in order that the test results of the initial bore holes can be made use of in planning the later stages of the field investigation and quantum of laboratory tests.

2. All samples brought from field, whether disturbed or undisturbed shall be extracted/prepared and examined by competent technical personnel, and the test shall be carried out as per the procedures laid out in the relevant I.S. Codes.

The following laboratory tests shall be carried out

a) Visual and Engineering Classification
b) Natural moisture content, bulk density and specific gravity.
c) Swell pressure and free swell index determination for expensive soil only.
d) Consolidated un-drained test with pore pressure measurement. Chemical tests on soil and water to determine the carbonates, sulphates, nitrates, chlorides, Ph value, and organic matter and any other chemical harmful to the concrete foundation.
e) C.B.R value

f) Rock quality designation (RQD), RMR in case of rock is encountered

4. SITE PREPARATION

The contractor shall be responsible for proper leveling of switchyard site as per layout and levels of switchyard finalized during detailed engineering stage. The Contractor at his own cost shall make the layout and levels of all structure etc from the general grids of the plot and benchmarks set by the Contractor and approved by the Owner. The Contractor shall give all help in instruments, materials and personnel to the Owner for checking the detailed layout and shall be solely responsible for the correctness of the layout and levels. Site leveling shall be in the scope of the contractor. Bidder may decide the level of the sites. However, the level shall be such that it is 300 mm higher than the highest flood level (HFL) of the site. If HFL is not available, then nearby road level shall be assumed as HFL.

Whenever for bay extension works the existing substation are to be modified or strengthen, contractor should keep same as existing sub-station so that all the necessary arrangements are to be carried out in this regard by the contractor.

Earth Works:

This specification covers the general requirements of earthwork in excavation in different soils and strata including rock, site grading, filling in areas, including bringing excavated approved material from borrow pits, filling back around foundations and in plinths including consolidation, conveyance and disposal of surplus unwanted spoils as directed by Engineer and all operations covered within the intent and purpose of this specification.

The Contractor shall prepare the necessary detailed drawing for earthwork and submit the same to the Engineer for approval. The earthwork shall commence only after obtaining approval from the Engineer to these drawings.

Contractor shall furnish all tools, plants, instruments, qualified supervisory personnel, labour, materials, any temporary works, consumables etc. Whether or not such items are specifically stated herein, for completion of the job in accordance with specification requirements.

Contractor shall carry out the survey of the site before excavation and set properly all lines and establish levels for various works such earthwork in excavation for grading, basement, foundations, plinth filling, roads, drains, cable trenches, pipelines etc. Such survey shall be carried out by taking accurate cross sections of the area perpendicular to established reference/ grid lines at 5 m. intervals or nearer as determined by Engineer based on ground profile. These shall be checked by Engineer and thereafter properly recorded.

The excavation shall be done to correct lines and levels in all types of strata such as soil, soft murrum, hard murrum, soft rock, hard rock etc. This shall also include, where required, proper shoring to maintain excavations and also the furnishing, erecting and maintaining of adequate barricades around excavated areas and warning lamps at night for ensuring safety.

The area to be excavated/ filled shall be cleared of fences, plants, logs, stumps, bush, vegetation, rubbish, slush etc. and other objectionable matter. If any roots or stumps of trees are met during excavation, they shall also be removed. The materials so removed shall be disposed off as directed by Engineer. Where earth fill is intended, the area shall be stripped of all loose/ soft patches, top soil containing objectionable mass/ materials before fill commences. All precious objects/relics objects of antiquity etc. which may be found in or upon the site shall be property of Employer.

All excavation work shall be carried out by the Contractor by mechanical equipments unless in the opinion of Engineer, the work involved and time schedule permits manual work.

Excavation for permanent work shall be taken out to such widths, lengths, depths and profiles as are shown on to the drawings or such other lines and grades as may be specified by the Engineer. Rough excavation shall be carried out to a depth 150 mm above the final level. The balance shall be excavated with special care. Soft pockets shall be removed even below the final level and extra excavation filled up as directed by Engineer. The final excavation if so instructed by engineer shall be carried out just prior to laying the mud-mat.

Contractor may, for facility of work or similar other reasons excavate, and also backfill later, if so approved by Engineer, at his own cost, outside the lines shown on the drawings or directed by Engineer. Should any excavation be taken below the specified elevations, Contractor shall fill it up with concrete of the same class as in foundation resting thereon, upto the required elevation. No extra claim shall be made by Contractor on this count.

All excavations shall be done to minimum dimension required for safety and working facility. Contractor shall obtain prior approval of Engineer in each individual case for the method he proposes to adopt for excavation, including dimensions, side slopes, dewater disposal etc. This approval, however, shall not in any relieve Contractor to his responsibility for any subsequent loss or damages. It shall be the responsibility of the Contractor to take every precaution to prevent slips.

Excavation shall be carried out tools, tackles and equipment. Blasting or other methods may be resorted to the case of hard rock; however not without the specified permission of Engineer.

Specific permission of Engineer will have to be taken by Contractor for blasting rock and he shall also obtain valid blasting license from the authorities concern. All loose or loosened rock in the sides shall be remained by barring, wedging etc.

All excavations shall be kept free of water. Grading the vicinity of excavations shall be controlled to prevent surface water running into excavated areas. Contractor shall remove by pumping or other means approved by Engineer, any water inclusive of rainwater and subsoil water accumulated in excavation and keep all excavations dewatered until the foundation work is completed and backfilled.

All fill material will be subject to Engineer's approval. If any material is rejected by Engineer, Contractor shall remove the same forthwith from the site at no extra cost to the Employer. Surplus fill material shall be deposited / disposed off as directed by Engineer after the fill work is completed.

No earthfill shall commence until surface water discharge and streams have been properly intercepted or otherwise dealt with as directed by Engineer.

To the extent available, selected surplus spoils from excavated materials shall be used as back fill. Fill material shall be free from clods, salts, sulphates, organic or foreign material.

If any selected fill material is required to be borrowed, contractor shall make arrangements for bringing such material from outside borrow pits. The material and source site be subject to prior approval of Engineer. The approved borrow pit area shall be cleared of all bushes, roots of trees, plants, rubbish etc. Top soil containing salts / sulphate and other foreign materials or shall be removed. The materials so removed shall be burnt or disposed off as directed by Engineer.

As soon as the work in foundations has been accepted, the spaces around the foundations, structures, pits, trenches etc. shall be cleared of all debris, and filled with earth in layers not exceeding 150 mm. Each layer shall be watered, rammed and properly consolidated before the succeeding one is laid. Each layer shall be consolidated to the satisfaction of Engineer. The required maximum dry density shall 94%.

Plinth filling shall be carried out with approved material as described hereinbefore in layers not exceeding 150 mm watered and compacted with mechanical compaction machine. Engineer may however, permit manual compaction by hard tampers in case he is satisfied that mechanical compacting is not possible. When filling reaches the finished level the surface shall be flooded with water, unless otherwise directed for atleast 24 hours allowed to dry and then the surface again compacted as specified above to avoid settlements at a later stage. The finished level of the filling shall be trimmed to the level/ slopes specified. Any temporary work required to contain the fill under flooded conditions shall be Contractor's account.

Where specified, compaction of the plinth fill shall be carried out by means of 10 tonnes rollers (smooth wheeled, sheep-foot or wobbly wheeled rollers). A smaller weight roller). A smaller weight roller may be used only if permitted by Engineer. As rolling proceeds water sprinkling shall be done to assist consolidation.

The thickness of each unconsolidated fill layer can in this case be upto a maximum of 300 mm. Engineer will determine the thickness of the layers in which fill has to be consolidated depending on the fill material and equipment used.

Rolling shall commence from the outer edge and progress towards the center and continue until compaction is upto the satisfaction of Engineer, but in no case less than 10 passes of the roller will be accepted for each layer.

The compacted surface shall be properly shaped, trimmed and consolidated to an even and uniform gradient. All soft spots shall be excavated and filled and consolidated.

At some locations/areas it may not be possible to use rollers because of space restrictions etc. Contractor shall then be permitted to use pneumatic tampers, rammers etc. and he shall ensure proper compaction.

In case site is infected by termite, pre-anti termite measures shall invariably be adopted.

Stone filling and antiweeds treatment :

Before taking up stone rolling, antiweeds treatment shall be applied in the switchyard area where stone filling is to be done and the area shall be thoroughly de-weeded including removal of the roots. The recommendation of local

agriculture/horticulture department shall be sought where ever feasible while choosing the type of chemical to be used. Nevertheless the effectiveness of chemical shall bedemonstrated by the contractor in a test area of size 10 meterx 10 meter (approx..). The final approval based on the result shall be given by Engineer-in-charge. Antiweed treatment shall be procured from reputed manufacturer. The dosage and application of chemical shall be strictly as per the manufacturer's recommendation. The contractor shall be requested to maintain the area free of weed for a period of one year from the date of application of the first dose of the chemical.

The material to be used for stone filling/ site surfacing shall be uncrushed/ crushed/ broken stone of 20 mm nominal size (single sized) conforming to table 2 of IS: 383- 1970. Hardness, flakiness shall be as required for wearing courses are given below.

(a) Sieve analysis limits/Gradation

Sieve size	% passing by weight
40mm	100
20mm	85-100
10mm	0-20
4.75mm	0-5

(b) Hardness
Abrasion value (IS: 2386 part-IV) not more than 40%
Impact value (IS: 2386 part-IV) not more than 30%

(c) Flakiness Index
As per (IS: 2386 part-IV) and maximum value is 25.

After all the structures/equipments are erected, the surface of the switchyard area shall be maintained, rolled/compacted to the lines and grades as decided by Engineer-in-Charge. De-weeding including removal of roots shall be done before rolling is commenced. Engineer-in-Charge shall decide final formation level so as to ensure that the site appears uniform. The final formation level shall however be very close to the formation level indicated in the drawing using half-ton roller with suitable water sprinkling arrangement to form a smooth and compact surface.

A base layer of uncrushed/crushed/broken stone of 20 mm nominal size (single sized) shall be spread and rolled/compacted by using half ton roller with 4 to 5 passes and water sprinkling to form a minimum 50 mm layer on the finished ground level of the specified switchyard area excluding roads, drains, cable trench and tower and equipment foundations as indicated in the drawing.

Over the base layer of site surfacing material, a final surface course of minimum 50 mm thickness of 20 mm nominal size (single sized) broken stone as specified above shall be spread and compacted by light roller using half tones steel roller (width 30" and 24" dia meter) with water sprinkling as directed by the Engineer-in-Charge. The water shall be sprinkled in such a way that bulking does not take place.

In areas that are considered by the Engineer-in-Charge to be too congested with foundations and structures for proper rolling of the site surfacing material by normal rolling equipments, the material shall be compacted by hand, if necessary. Due care shall be exercised so as not to damage any foundation structures or equipment during rolling compaction.

Drainage:

1. Adequate site drainage system shall be provided by the Contractor in a substation. In case of bay extension of existing substation, drainage layout shall be prepared by the contractor in such a way that it should satisfy the technical parameters stated below while designing the drainage system so that flow of water of the existing part of substation remain uninterrupted and the same should be approved by the owner. The technical parameters stated below also to be taken into account while designing the drainage system for new substation as well.
The Contractor shall obtain rainfall data and design the storm water drainage system, (culverts, ditches, drains etc.) to accommodate run off due to the most intense rainfall that is likely to occur over the catchments area in one hour period on an average of once in ten years. The surface of the site shall be sloped to prevent the ponding of water.

2. The maximum velocity for pipe drains and open drains shall be limited to 2.4m/sec and 1.8m/sec respectively. However, minimum non-silting velocity of 0.6m/sec shall be ensured. Longitudinal bed slope shall not be milder than 1 in 1000.

3. The drains shall be constructed using Brick masonry except at road crossings etc. where RCC pipe shall be used. The RCC pipe for drains and culverts shall be as per IS:456 and IS:783.

4. The Contractor shall ensure that water drains are away from the site area and shall prevent damage to adjacent property by this water. Adequate protection shall be given to site surfaces, roads, ditches, culverts, etc. to prevent erosion of material by water.

5. The drainage system shall be adequate without the use of cable/pipe trenches. (Pipe drains shall be provided in areas of switchyard where movement of crane will be necessary in operating phase of the substation).

6. For pipe drains, concrete pipe of class NP2 shall be used. However, for road crossings etc. higher strength pipe of class NP3 shall be provided. For rail crossings, pipes conforming to railway loading standards or at least NP4 class shall be provided. Manholes shall be provided at every 30m interval, at connection points and at every change of alignment.

7. Open surface drains for new Sub-Station shall be provided with brick masonry in 1:6 (1 cement: 6 coarse sand) cement mortar with 12 mm thick, 1:4 (1 cement: 4 sand) cement plaster inside and exposed surface of drains as per approved drawing. For bay extension at existing substations, prevailing practice of the respective substation shall be adopted.

8. Pipe drains shall be connected through manholes at an interval of max. 30m. Effluents shall be suitably treated by the Contractor to meet all the prevalent statutory requirements and local pollution control norms and treated effluents shall be conveyed to the storm water drainage system at a suitable location for its final disposal.

9. Invert of the drainage system shall be decided in such a way that the water can easily be discharged above the High Flood Level (HFL) outside substation boundary at suitable location upto a maximum 50M beyond boundary wall of substation or actual whichever occurs earlier and approved by Owner.

10. All internal site drainage system, including the final connection/disposal to owner acceptance points shall be part of Supplier's scope including all required civil works. The Contractor shall connect his drain(s) at one or more points to outfall points as feasible at site.

5. FOUNDATION WORKS :

The foundation for all the substations gantry and equipment support structures specification to be designed shall be the responsibility of the Contractor. All designs and details shall be subject to the prior approval of the Engineer. The substation foundation top level for gantries and equipment support shall be 300mm above switchyard level.

The Contractor shall supply installation drawings giving full erection particulars for approval to the Engineer. Safety factor of foundation for uplifting force shall not be less than 2. The safe allowable bearing stress of founding stratum may be assumed to be 15 to 20 tonnes/ Sq.m. which shall be verified during field exploration.

The weight of earth may be assumed to be 1.6 tonne/ Cu.m. The angle of repose shall be reckoned as 15 degree. The seismic coefficient shall be taken as 0.2. All the data shall be verified by the Contractor at site after necessary geotechnical investigations are made before final detail designs are undertaken.

The above information has been given to bidder in good faith. It shall be the responsibility of the Contractor to ascertain these values after carrying out necessary geotechnical investigation.

Transformer Foundation :

The Contractor shall provide a road system integrated with the transformer foundation to enable installation and the replacement of any failed unit by the spare unit located at the site. This system shall enable the removal of any failed unit from its foundation to the nearest road.

If existing/failed transformer is required to be replaced by new one in augmentation/bay extension works of existing substations then the foundation supporting that equipment shall be strengthen by modifying the foundation itself or the foundation shall be dismantle and recast new foundation as per site conditions. However, contractor must furnish the design calculation

incorporating all those changes so that safety of the structure and foundation remain adequate.

Similarly all types of equipment foundations with /without supporting structures shall be treated in similar manner as stated for transformer foundations.

Contractor must access the amount of work involve for augmentation/bay extension of existing substations while quoting.

Equipment/Steel Structure Foundation:

The foundations shall be designed such that the upper structures shall be securely supported. Any unbalanced displacement that may cause harmful effect to the upper structures shall not be allowed. The safety factors for all types of stability of the foundations shall not be less than 2.0.

The foundations shall be designed so that the upper equipment shall be securely supported. The effect of vibration of the equipment impact load when in operation and turnover force due to abnormal condition of equipment shall be considered in foundation design. The safety factor for stability of the foundations shall not be less than 2.0.

Detailed calculations for each type of foundation shall be submitted for approval of the Engineer. Such details shall show the following requirements.

i) Detailed calculations of loads acting on foundation under different load conditions.
ii) Calculated safety factor for each type of stability and condition.
iii) Maximum stresses in concrete and in steel reinforcement at any critical section.

Details drawing of Foundation:

Details of each type of foundation submitted for the Engineer's approval shall be as shown on the approved design drawings and shall conform to the requirements described hereafter. No change shall be made without the written approval of the Engineer. The details drawings shall at least include:

a) Detailed dimensions of foundation
b) Details of setting dimensions of foundation
c) Details of placing of all reinforcing steel which shall conform to the latest IS Specification.
d) Details of type, size and length of each reinforcing steel including details of bar bending.

6. GRAVELLING OF SWITCHYARD :

The work shall consist of crushed rock, spread uniformly on the whole switchyard in two layers in accordance with lines, grades and cross-section and as directed by the Engineer. The approved crushed rock shall be laid in stone aggregate of size below 90mm thick and not less than 175mm dept. The finish metal layer top should not be less than 175mm above switchyard level.

7. SUBSTATION STEEL STRUCTURES:

Hot dip galvanized or M.S. lattice structures as per site requirement of self supporting type are to be used for substation gantries, beams and equipment

support structures in various switchyards covered in this specification. The structural drawing of towers, gantries and equipment supporting structures shall be spared to the successful Bidder. The bidder shall fabricate proto of each type of structure and offer the same for inspection and testing, if required, by the representation of Employer before taking up mass production.

The Contractor shall supply and erect all materials deliver the same to site, provide all labour, erect plant and equipment, fixtures, fittings, and all temporary and permanent works necessary for satisfactory completion of the job in all respects.

Materials:

All material for rolled shapes and plates shall be hot rolled structural mild steel and/ or high strength structural steel and shall conform to IS: 2062 for structural steel. All structural members shall be galvanized after fabrication as per site requirement.

All connection bolts, U-bolts nuts washers (flat spring washers, beveled, washers), fillers and filler plates shall conform to relevant IS standard. All items shall be galvanized for G.I. structures.

Step bolts shall conform to relevant IS Code shall be galvanized for G.I. structures.

All anchor bolts shall conform to relevant IS code and shall be galvanized for G.I. structures. The minimum diameter of anchor bolt shall be 16 millimeters.

All pieces must be straight, true to detail drawings and free from flaws, twists and other defects. All clipping backcuts, grinding, bends, holes, etc. must be true to detail drawings and free of burrs. No additional splices than those indicated on the approved drawings permitted in members of the structure.

All identical pieces bearing the same erection number must be exactly interchangeable with each other and interchangeable in their relative position in all towers or structures of which they form a part.

All materials shall be reasonably straight and if necessary, before being worked shall be straightened and/ or flattened by pressure, unless required to be of curvilinear form and shall be free from twists. Straightening shall not damage the material. The adjacent surfaces of the parts when assembled shall be in close contact throughout keeping in view the tolerance specified. Hammering shall not be permitted for straightening and/ or flattening of members, sharp bends shall be cause for rejection.

Mild steel sections upto 75x75mm (upto 6mm thick) shall be bent cold and including bend angle of 10 Degrees. Angles above 75x75mm (thickness upto 6mm) and upto and including 100x100mm (thickness upto 8mm) may also be bent cold upto the bend angle of 6 Deg. All other angle sections and bend angles not covered above shall be bent hot.

All plates upto 12mm thickness shall be bent cold upto a maximum bend angle of 15 Deg. Greater bends and other thickness shall be bent hot.

Bends on all high tensile steel sections shall be done hot.

Bolts used for erection shall preferably be of 12, 16 and 20mm diameter and in no case bolt diameter shall be less than 12mm.

The length of the bolt shall be such that the threaded portion does not lie in the plane of contact of members.

It shall also be ensured that the threaded portion of the bolt protrudes not less than 3mm and not more than 8mm over the nut after it is fully tightened.

Holes shall be cylindrical and perpendicular to the structural members. Oval or lobed forms of holes shall not be permitted. The diameter of the holes shall be equal to the diameter of the bolt plus 1.5mm.

The accuracy of the location of holes shall be such that for any group of members when assembled the holes shall admit the bolt at right angles to the plane of connection.

Spring washers of positive lock type of the following thicknesses shall be provided for insertion under nuts.

Bolt diameter	Thickness of Spring washer
12mm	2.5mm
16mm	3.5mm
20mm	4.0mm

To obviate bending stress in bolts or to reduce the to a minimum, no bolt shall connect aggregate thickness of more than three times the bolt diameter and also number of members carrying stress to be connected by single bolt shall not generally exceed three (excluding gussets and packing).

The maximum allowable difference in diameter of the structure on the two sides of a plate or angle shall be 0.8mm that is, the allowable taper in a punched hole shall not exceed 0.8mm on diameter.

Tolerance cumulative and between consecutive holes shall be within +/- 0.5mm. Tolerance on the overall length of a member shall be within +/- 1.6mm. Tolerance on gauge distance shall be within +/- 0.5mm.

The galvanizing of steel structure members shall be carried out as per standard practice and as per the guidelines stipulated in the relevant I.S. Specifications with due consideration of latest amendments thereof

8. CABLE TRENCHES & LINK DRAIN

The cable trenches be covered with checquered tile 6mm thick. Cable trenches must be designed for the design criteria stated below, whether it is of concrete or brick for both new substations and bay extension works in existing substations.

The cable trench walls shall be designed for the following loads.

(i) Dead load of 100 kg/m length of cable support + 75 Kg on one tier at the end.

(ii) Triangular earth pressure + uniform surcharge pressure of 1T/m2.

Cable trench crossing the road/rails shall be designed for class A. Loading of IRC/relevant IS Code and should be checked for transformer loading.

Trenches shall be drained. Necessary sumps be constructed and sump pumps if necessary shall be supplied. Cable trenches shall not be used as storm water drains.

The top of trenches shall be kept at least 50 mm above the finished ground level for the new substation. The top of cable trench shall be such that the surface rainwater does not enter the trench. The top of trench shall be kept same as existing one to maintain uniformity of the cable trenches structure in case of bay extension works of existing substations.

Cables from trench to equipments shall run in hard conduit pipes.

Trench wall shall not foul with the foundation. Suitable clear gap shall be provided.

9. Control Room Building:

The scope for new control room building includes the design, engineering and construction including anti-termite treatment, plinth protection, DPC of Building including sanitary, water supply, and electrification etc. The buildings shall be of RCC framed structure of concrete of M20 grade (Min.).

If any extension of the Control Room building is required in augmentation / bay extension works of existing substation then extension part shall be compatible to existing one structurally and architecturally but following design criteria shall be adopted for design purposes for R&M of existing substation.

Minimum floor area requirements shall be 84 sqm excluding space for wash room which may be increased at the time of detailed engineering to suit project requirements. The layout of the control room shall be finalised as per detailed engineering to suit project requirements .The minimum dimension of different rooms required for control room building shall be as per drawing. The control room building shall consist of the following:

a. Control room
b. Battery room
c. Kitchen
d. Toilet

An open space of 1m minimum shall be provided on the periphery of the rows of panel and equipment generally in order to allow easy operator movement and access as well as maintenance.

Any future possibility of annexe building shall be taken care of while finalizing the layout of the control room building.

Minimum headroom of 3 M below soffit of beams/false ceiling shall be considered for rooms. The roof shall have four side sloping roof or flat roof as finalised during detailed engineering.

The buildings shall be designed:

1. To the requirements of the National Building Code of India, and the standards quoted therein.
2. For the specified climatic & loading conditions.
3. To adequately suit the requirements of the equipment and apparatus contained in the buildings and in all respects to be compatible with the intended use and occupancy.
4. With a functional and economical space arrangement.
5. For a life expectancy of structure, systems and components not less than that of the equipment, which is contained in the building, provided regular maintenance is carried out.

6. Be aesthetically pleasing. Different buildings shall show a uniformity and consistency in architectural design.
7. To allow for easy access to equipment and maintenance of the equipment.
8. With, wherever required, fire retarding materials for walls, ceilings and doors, which would prevent supporting or spreading of fire.
9. Suitable expansion joints shall be provided in the longitudinal direction wherever necessary with provision of twin columns.
10. Individual members of the buildings frame shall be designed for the worst combination of forces such as bending moment, axial force, shear force, torsion etc.
11. Permissible stresses for different load combinations shall be taken as per relevant IS Codes.
12. The building lighting shall be designed in accordance with the requirements of relevant section.
13. Seismic considerations as applicable.

Building structures shall be designed for the most critical combinations of dead loads, super- imposed loads, equipment loads, wind loads, seismic loads, and temperature loads.

Dead loads shall include the weight of structures complete with finishes, fixtures and partitions and should be taken as per IS: 1911.

Super-imposed loads in different areas shall include live loads, minor equipment loads, cable trays, small pipe racks/hangers and erection, operation and maintenance loads. Equipment loads shall constitute, if applicable, all load of equipments to be supported on the building frame.

The wind loads shall be computed as per IS 875, Seismic Coefficient method shall be used for the seismic analysis as per IS 1893 with importance factor 1.5.

Wind and Seismic forces shall not be considered to act simultaneously.

Floors/slabs shall be designed to carry loads imposed by equipment, cables piping, equipment and other loads associated with building. Floors shall be designed for live loads as per relevant IS. Cable and piping loads shall also be considered additionally for floors where these loads are expected.

For consideration of loads on structures, IS: 875 shall strictly adhere to. Any other load coming in the structure, not mentioned in IS 875 shall be calculated as per relevant IS code and NBC.

The following information shall be submitted for review and approval to the Owner:

1. Design criteria shall comprise the codes and standards used, applicable climatic data including wind loads, earthquake factors maximum and minimum temperatures applicable to the building locations, assumptions of dead and live loads, including equipment loads, impact factors, safety factors and other relevant information.

2. Structural design calculations and drawing (including construction/ fabrication) for all reinforced concrete and structural steel structures.

3. Fully, dimensioned concept plan including floor plans, cross sections, longitudinal sections, elevations and perspective view of each building. These drawings shall be drawn at a scale not smaller than 1:75 and shall identify the major building components.

4. Fully dimensioned drawings showing details and sections drawn to scales of sufficient size to clearly show sizes and configuration of the building components and the relationship between them.

5. Product information of building components and materials, including walls partitions flooring ceiling, roofing, door and windows and building finishes.

6. A detailed schedule of building finishes including colour schemes.

7. A door & window schedule showing door types and locations, door lock sets and latch sets and other door hardware.

Approval of the above information shall be obtained before ordering materials or starting fabrication or construction as applicable.

M.S. Ladder should be provided to access the control room roof from outside. Ladder shall be made up of ISMC 75x40 which will run as beam one meter apart and intermediate steps will be made up of 45x45x5 angle with rise of 300 mm. Red oxide premier shall be applied initially, then two coats of rich zinc paint shall be applied to avoid corrosion.

Control room buildings shall be of framed superstructure. All walls shall be non-load bearing walls. Min. thickness of external walls shall be 230 mm (one brick) with 1:6 cement sand mortar.

All internal walls shall have minimum 12mm and 15 mm thick 1:6 cement sand plaster on either side of wall. The ceiling shall have 6mm thick 1:4 cement sand plaster.

All external surfaces shall have 18 mm cement plaster in two coats, under layer 12 mm thick cement plaster 1:5 and finished with a top layer 6 mm thick cement plaster 1:6 (DSR 13.19) with water proofing compound. The paint shall be antifungal quality of reputed brand suitable for masonry surfaces for high rainfall zone. White cement primer shall be used as per manufacturer's recommendation. Internal finish Schedule is given Table - 1 below:

TABLE-1

Sl.No.	**Location**	**Flooring & Skirting 30mm high**	**Wall Internal**	**Ceiling**	**Doors, Windows, Ventilators**
1.	Control Room, Relay Room	Precast Terrazo tiles	Oil bound washable distemper on smooth surface applied with	White Wash	1) Aluminium rolled section frames with 5 mm or 4mm glass. 2) Flush door shutters

			2mm thick Plaster.		
2.	Battery room	Acid and Alkali Resistant tiles.	Dado of acid resistant tile 1.2 M high & Paint above 1.2 M to ceiling.	Acid resistant Paint.	1) Aluminium rolled section frames with 5 mm or 4mm glass. 2) Flush door shutters Painted with acid resistant Paint.
3.	Toilet	Ceramic glazed tiles in flooring	DADO glazed tile 2.1M high for toilet	White Wash	1) Aluminium rolled section frames with 5 mm or 4mm glass. 2) Flush door shutters
4	Kitchen	Precast Terrazo tiles	Oil bound washable distemper on smooth surface applied with 2mm thick Plaster.	White Wash	1) Aluminium rolled section frames with 5 mm or 4mm glass. 2) Flush door shutters
4.	Other areas not specified	Terrazo tiles	Oil bound distemper,	White Wash	

Roof of the Control room Building shall consist of Cast-in-situ RCC slab treated with a water proofing system which shall be integral cement based treatment conforming to CPWD specification. The water proofing treatment shall be of following operations:

(a) Applying and grouting a slurry coat of neat cement using 2.75 kg/m^2 of cement admixed with proprietary water proofing compounds conforming to IS: 2645 over the RCC slab including cleaning the surface before treatment.

(b) Laying cement concrete using broken bricks/brick bats 25mm to 100mm size with 50% of cement mortar 1:5 (1 cement: 5 coarse sand) admixed with proprietary water proofing compound conforming to IS: 2645 over 20mm thick layer of cement mortar of min 1:5 (Cement: 5 coarse sand) admixed with proprietary water proofing compound conforming to IS: 2645 to required slope and treating similarly the adjoining walls upto 300mm height including rounding of junctions of walls and slabs.

(c) After two days of proper curing applying a second coat of cement slurry admixed with proprietary water proofing compound conforming to IS: 2645.

(d) Finishing the surface with 20mm thick joint less cement mortar of mix 1:4 (1 cement: 4 course sand) admixed with proprietary water proofing compound conforming to IS: 2645 and finally finishing the surface with trowel with neat cement slurry and making of 300 x 300 mm square.

(e) The whole terrace so finished shall be flooded with water for a minimum period of two weeks for curing and for final test. All above operations to be done in order and as directed and specified by the Engineer-in-charge.

With average thickness of 120 mm and minimum thickness at khurra at 65 mm.

The details of doors and windows of the control room building shall be as per finish schedule Table-1 and tender drawing with the relevant IS code. Rolling steel shutters and rolling steel grills shall be provided as per layout and requirement of buildings. Paints used in the work shall be of best quality specified in CPWD specification.

All plumbing and sanitation shall be executed to comply with the requirements of the appropriate bye laws, rules and regulations of the Local Authority having jurisdiction over such matters. The Contractor shall arrange for all necessary formalities to be met in regard to inspection, testing, obtaining approval and giving notices etc.

PVC syntax or equivalent make Roof water tank of adequate capacity depending on the number of users for 24 hours storage shall be provided. Minimum 1 Nos. 4000 liters capacity shall be provided.

Galvanized MS/PVC pipe of medium class conforming to IS: 1239 shall be used for internal & external piping work for potable water supply.

Sand CI pipes with lead joints conforming to IS: 1729 shall be used for sanitary works above ground level.

Each toilet shall have the following minimum fittings.

(a) WC (Western type) 390 mm high with toilet paper roll holder and all fittings

Or

WC (Indian Type) Orissa Pattern (580 x 440 mm) with all fittings (both types of WCs shall be provided at alternate locations).

(b) Urinal (430 x 260 x 350 mm size) with all fittings.
(c) Wash basin (550 x 400 mm) with all fittings.
(d) Bathroom mirror (600 x 450 x 6 mm thick) hard board backing
(e) CP brass towel rail (600 x 20 mm) with C.P. brass brackets
(f) Soap holder and liquid soap dispenser.
(vi) All fittings, fastener, grating shall be chromium plated.
(vii) All sanitary fixtures and fittings shall be of approved quality and type manufactured by well known manufacturers. All items brought to site must bear identification marks of the type of the Manufacturer.
(viii) Soil, waste and drain pipes, for underground works shall be stoneware for areas not subject to traffic load. Heavy-duty cast iron pipes shall be used otherwise.

10. WATER SUPPLY

(i) Contractor shall make its own arrangement for construction water.

(ii) The contractor shall carry out all the plumbing/erection works required for supply of water in control room building.

(iii) The details of tanks, pipes, fittings, fixtures etc for water supply are given elsewhere in the specification under respective sections.

(iv) A scheme shall be prepared by the contractor indicating the layout and details of water supply which shall be got approved by the Owner before actual start of work including all other incidental items not shown or specified but as may be required for complete performance of the works.

(v) Bore wells and pumps for water supply are in the scope of contractor meeting the day-to-day requirement of the water supply.

(vi) If the water is supplied by Municipal corporation/Village authority then bore well for water supply purposes is not required to be carried out by contractor. Contractor shall also make necessary arrangement /formalities to receive water connection from the water supplier.

11. SEWERAGE SYSTEM

(i) Sewerage system shall be provided for control room building.

(ii) The Contractor shall construct septic tank and soak pit suitable for 5 users. Otherwise, all necessary arrangement for the disposal of sewerage shall be arranged by the contractor at his own cost for regularizing the disposal activity.

12. STATUTORY RULES

Contractor shall comply with all the applicable statutory rules pertaining to factories act (as applicable for the State), Fire Safety Rules, Water Act for pollution control etc.

Foundation system adopted by Bidder shall ensure that relative settlement and other criteria shall be as per provision in IS: 1904 and other Indian Standards

All building/construction materials shall conform to the best quality specified in CPWD specifications if not otherwise mentioned in this specification.

All tests as required in the standard field quality plans have to be carried out.

13. DESIGN OF CIVIL WORKS:

All Civil structural works connected with control room switchyard structures etc. shall be executed as per approved drawings. However foundations for these structures shall be designed by the Contractor as per the load data and structural drawings furnished by the Employer/ Equipment manufacture and to suit the site conditions. Design of supporting structure and its foundation for equipment supplied by the Contractor shall be designed by the Contractor. In cement concrete mark 200 and Bed concrete of 75mm thicknesses in C-C Mark. However 33/ 11kv substation transformer plinth will be cc mark 200. The

Contractor shall perform detailed design for each structures designed in scope of works on the basis of specification and codes specified herein. Prior to proceeding with the design work, design conditions or design values which shall include allowable stresses, safety factors, load conditions and applicable standards seismic forces for region etc. shall be approved by the Engineer.

The Contractor shall submit to Engineer for approval, his drawings and calculation sheets, bill of materials, construction methods and schedules for the construction of civil works.

In case any subsequent modification of detailed design of civil work is required, the Contractor shall promptly inform Engineer of such modification and shall submit modified designs and drawings to Engineer for approval.

B. TECHNICAL SPECIFICATION OF SUB-STATION EQUIPMENTS :

1. 33 & 11 KV STATION CLASS LIGHTNING ARRESTOR

1.1 33kV VOLTAGE CLASS SURGE ARRESTORS

Lightning Arrestors at Grid Substation shall be of Station class only in 33 & 11 KV System.

1.1.1 INTRODUCTION

The section covers the specification of 33kV voltage level, 10 kA, and Station class heavy duty, gapless metal (zinc) oxide Surge Arrestors complete with insulating base, terminal clamps, complete fittings & accessories for installation on outdoor type 33kV switchgear/transmission lines / transformers.

1.1.2 STANDARDS

The design, manufacture and performance of Surge Arrestors shall comply with IS: 3070 Part-3 and other specific requirements stipulated in the specification. Unless otherwise specified, the equipment, material and processes shall conform to the latest applicable Indian/International Standards as listed hereunder:

IS:2071-1993 (Part-1)	Methods of High Voltage Testing General Definitions & Test Requirements.
IS:2071-1974(Part-2)	Test Procedures
IS:2629-1985	Recommended Practice for hot dip galvanizing on Iron & Steel
IS:2633-1986	Method for Testing uniformity of coating of zinc coated Articles.
IS:3070-1993 (Part-3)	Specification for surge arrestor for alternating current systems. Metal-Oxide lightening Arrestors without gaps
IS:4759-1996	Specification for hot dip zinc coating on Structural Steel and Other allied products.
IS:5621-1980	Hollow Insulators for use in Electrical Equipment.
IS:6209-1982	Methods of Partial discharge measurement.
IS:6745	Method for determination of mass of zinc coating on zinc coated iron and steel articles
ANSI/IEEE-C.62.11	Metal oxide, Surge Arrestor for AC Power Circuits.
IEC –60099-4	Surge Arrestors

The equipment complying with any other internationally accepted standards shall also be considered if it ensures performance equivalent to or superior to the Indian Standards.

1.1.3 GENERAL REQUIREMENT

a) The metal oxide gap less Surge Arrestor without any series or shunt gap shall be suitable for protection of 33kV switchgear, transformers, associated equipment and 33 kV lines from voltage surges resulting from natural disturbance like lightning as well as system disturbances.

b) The surge arrestor shall draw negligible current at operating voltage and at the same time offer least resistance during the flow of surge current.

c) The surge arrestor shall consist of non-linear resistor elements placed in series and housed in electrical grade porcelain housing / silicon polymeric of specified creepage distance.

d) The assembly shall be hermetically sealed with suitable rubber gaskets with effective sealing system arrangement to prevent ingress of moisture.

e) The surge arrestor shall be provided with line and earth terminals of suitable size. The ground side terminal of surge arrestor shall be connected with 25x6 mm galvanized strip, one end connected to the surge arrestor and second end to a separate ground electrode. The bidder shall also recommend the procedure which shall be followed in providing the earthing system to the Surge Arrestor.

f) The surge arrestor shall not operate under power frequency and temporary over voltage conditions but under surge conditions, the surge arrestor shall change over to the conducting mode.

g) The surge arrestor shall be suitable for circuit breaker performing 0-0.3sec.-CO-3 min-CO- duty in the system.

h) Surge arrestors shall have a suitable pressure relief system to avoid damage to the porcelain/silicon polymeric housing and providing path for flow of rated fault currents in the event of arrestor failure.

i) The reference current of the arrestor shall be high enough to eliminate the influence of grading and stray capacitance on the measured reference voltage.

j) The arrestors for 33 kV system shall be suitable for mounting on transformers, Bus, Line & structure as per scheme. The supplier shall furnish the drawing indicating the dimensions, weights etc. of the surge arrestors for the design of mounting Structure.

k) The arrestor shall be capable of handling terminal energy for high surges, external pollution and transient over voltage and have low losses at operating voltages.

1.1.4 ARRESTOR HOUSING

a) The arrestor housing shall be made up of porcelain/**silicon polymeric** housing and shall be homogenous, free from laminations, cavities and other flaws of imperfections that might affect the mechanical and dielectric quality. The housing shall be of uniform brown **(for porcelain**)/Grey **(for silicon polymeric)** colour, free from blisters, burrs and other similar defects.

b) Arrestors shall be complete with fasteners for stacking units together and terminal connectors.

c) The housing shall be so coordinated that external flashover shall not occur due to application of any impulse or switching surge voltage up to the maximum design value for arrestor. The arrestors shall not fail due to contamination. The 33 kV arrestors housing shall be designed for pressure relief class as given in Technical Parameters of the specification.

d) Sealed housings shall exhibit no measurable leakage.

1.1.5 FITTINGS & ACCESSORIES

a) The surge arrestor shall be complete with fasteners for stacking units together and terminal connectors.

b) The terminals shall be non-magnetic, corrosion proof, robust and of adequate size and shall be so located that incoming and outgoing connections are made with minimum possible bends. The top metal cap and base of surge arrestor shall be galvanized. The line terminal shall have a built in clamping device which can be adjusted for both horizontal and vertical take off.

1.1.6 TEST OF SURGE ARRESTOR

The Surge Arrestors offered shall be type tested and shall be subjected to routine and acceptance tests in accordance with IS : 3070

(Part-3)/IEC-60099-4. In addition, the suitability of the surge arresters shall also be established for the followings

i) Acceptance tests

a) Measurement of power frequency reference voltage of arrester units.
b) Lightning impulse residual voltage on arrester units (IEC clause 6.3.2)
c) Internal ionization or partial discharge test

ii) Special Acceptance tests

a) Thermal stability test (IEC **99-4**clause 7.2.2)
b) Watt loss test.

iii) Routine tests

a) Measurement of reference voltage
b) Residual voltage test of arrester unit
c) Internal ionization or partial discharge test
d) Sealing test
e) Verticality check on completely assembled surge arresters as a sample test
on each lot if applicable.

iv) Type Tests

Following shall be type test as per IS 3070 (Part 3): 1993 or its latest amendment.

1.	Insulation Withstand test a) Lightning Impulse b) Power Frequency (Dry/Wet)
2.	Residual Voltage Test a) Steep current impulse residual voltage test b) Lightning impulse residual voltage test
3.	Long duration current impulse withstand test
4.	Switching surge operating duty test
5.	Power frequency voltage Vs. Time characteristics
6.	Accelerated Ageing test
7.	Pressure relief test a) High Current b) Low Current
8.	Artificial pollution test (for porcelain housing)
9.	Seismic Test
10.	Partial Discharge test
11.	Bending test
12.	a) Temperature cycle test (for porcelain housing) b) Porosity test (for porcelain housing)
13.	Galvanising test on metal parts
14.	Seal Leakage test (for porcelain housing)
15.	Seal leak test and operation tests (for surge monitor)

16.	Weather ageing test (for polymer housing)

The maximum residual voltages corresponding to nominal discharge current of 10 kA for steep current, impulse residual voltage test, lightning impulse protection level and switching impulse level shall generally conform to **Annex-K of IEC-99-4.**

The contractor shall furnish the copies of the type tests and the characteristics curves between the residual voltage and nominal discharge current of the offered surge arrestor and power frequency voltage v/s time characteristic of the surge arrestor subsequent to impulse energy consumption as per clause 6.6.**7** of IS:3070 (Part-3) offered along with the GTP/Drawing.

The surge arrestor housing shall also be type tested and shall be subjected to routine and acceptance tests in accordance with IS: 5621.

v) Galvanization Test:

All Ferrous parts exposed to atmospheric condition shall have passed the type tests and be subjected to routine and acceptance tests in accordance with IS:2633 & IS 6745.

1.1.7 NAME PLATE

The name plate attached to the arrestor shall carry the following information:

- Rated Voltage
- Continuous Operation Voltage
- Normal discharge current
- Pressure relief rated current
- Manufacturers Trade Mark
- Name of Sub-station
- Year of Manufacturer
- Name of the manufacture
- Name of Client-“ “
- Purchase Order Number along with date

1.1.8 DRAWINGS AND INSTRUCTION MANUALS

Within 15 days of receipt of the order, the successful tenderer shall furnish to the purchaser the following drawings and literature for approval:

(i) Outline dimensional drawings of Surge Arrestor and all accessories.
(ii) Assembly drawings and weights of main component parts.
(iii) Drawings of terminal clamps.
(iv) Arrangement of earthing lead.
(v) Minimum air clearance to be maintained of line components to ground.
(vi) Name plate
(vii) Instructions manual
(viii) Drawing showing details of pressure relief valve
(ix) Volt-time characteristics of surge arrestors
(x) Detailed dimensional drawing of porcelain housing/Silicon polymeric i.e. internal diameter, external diameter, thickness, height, profile, creepage distance, dry arcing distance etc.

1.1.9 TECHNICAL PARTICULARS

The surge arrestors shall conform to the following standard technical requirements. The Insulation values shall be enhanced considering the altitude of operation & other atmospheric conditions.

i) System Parameters:

Nominal system voltage	**:**	33 kV
Highest system voltage	**:**	36 kV
System earthing	**:**	Solidly earthed system
Frequency (Hz)	**:**	50
Lightning Impulse withstand Voltage (kVP)	**:**	170
Power frequency withstand Voltage (kV rms)	**:**	70
Connection to system	**:**	Phase to earth

ii) Surge Arrestors

Type of Surge Arrestor	:	Gapless Metal oxide outdoor
Arrestor rating (kV rms)	:	30
Continuous Operating voltage (kV rms)	:	25
Standard Nominal Discharge Current Rating (kA) (8x20 micro impulse shape)	:	10
Line discharge class	:	2
Degree of protection	:	IP-**67**

Lightning Impulse at 10 kA	:	85
Partial discharge at 1.05 COV not greater than	:	50 (PC)
Energy capability corresponding to		
a) Arrestor rating (kj/kV)	:	4.5
b) COV (kJ/kV)	:	4.9
Peak current for high current impulse operating duty of arrestor classification 10 kA	:	100

iii) Insulator Housing

Power frequency withstand test voltage (wet) (kV rms)	:	70
Lightning impulse withstand/tests voltage (kVP)	:	170
Pressure Relief Class	:	40
Creepage distance not less than	:	900

iv) Galvanisation

Fabricated Steel Aticles		
-- 5 mm thick cover	:	610 g/m^2
-- Under 5 mm but not less than 2 mm thickness	:	460 g/m^2
-- Under 2 mm but not less than 1.2 mm thickness	:	340 g/m^2
Castings		
-- Grey Iron, malleable iron	:	610 g/m^2
Threaded works other than tubes & tube fittings		
-- Under 10 mm dia		270 g/m^2
-- 10 mm dia & above		300 m^2

1.2 11kV VOLTAGE CLASS SURGE ARRESTORS

1.2.1 INTRODUCTION

This section covers the specification of 11kV voltage station Surge Arrestors for installation on outdoor type 11kV switchgear, transmission lines, transformers etc. 11kV side of which is not enclosed in a cable box. Station class surge arrestors shall be complete with fasteners for stacking units.

1.2.2 STANDARDS

The design, manufacture and performance of Surge Arrestors shall comply with IS: 3070 Part-3 and other specific requirements stipulated in the specification. Unless otherwise specified, the equipment, material & processes shall conform to the latest amendments of the following:

IS:2071-1993 (Part-1)	Methods of High Voltage Testing General Definitions & Test Requirements.
IS:2071-1974 (Part-2)	Test Procedures.
IS: 2629-1985	Recommended Practice for hot dip galvanizing on Iron & Steel.
IS: 2633-1986	Method for Testing uniformity of coating of zinc coated Articles.
IS:3070-1993 (Part – 3)	Specification for surge arrestor for alternating current systems. Metal-Oxide lightening Arrestors without gaps.
IS: 4759-1996	Specification for hot dip zinc coating on structural steel and other allied products.
IS: 5621-1980	Hollow Insulators for use in Electrical Equipment.
IS: 6209-1982	Methods of Partial discharge measurement.
IS: 6745	Method for determination of mass of zinc coating on zinc coated iron and steel articles.
ANSI/IEEE-C.62.11	Metal oxide, Surge Arrestor for AC Power Circuits.
IEC –60099-4	Surge Arrestors.

The equipment complying with any other internationally accepted standards shall also be considered if it ensures performance equivalent to or superior to the Indian Standards.

1.2.3 GENERAL REQUIREMENT

i) The metal oxide gap less Surge Arrestor without any series or shunt gap shall be suitable for protection of 11 kV side of power transformers, associated equipment and 11kV lines from voltage surges resulting from natural disturbance like lightning as well as system disturbances.

ii) The surge arrestor shall draw negligible current at operating voltage and at the same time offer least resistance during the flow of surge current.

iii) The surge arrestor shall consist of non-linear resistor elements placed in series and housed in electrical grade porcelain housing / silicon polymeric of specified Creepage distance.

iv) The assembly shall be hermetically sealed with suitable rubber gaskets with effective sealing system arrangement to prevent ingress of moisture.

v) The surge arrestor shall be provided with line and earth terminals of suitable size. The ground side terminal of surge arrestor shall be connected with 25x6 mm galvanized strip, one end connected to the surge arrestor and second end to a separate ground electrode. The bidder shall also recommend the procedure which shall be followed in providing the earthing system to the Surge Arrestor.

vi) The surge arrestor shall not operate under power frequency and temporary over voltage conditions but under surge conditions, the surge arrestor shall change over to the conducting mode.

vii) The surge arrestor shall be suitable for circuit breaker performing 0-0.3 min-CO-3 min-CO- duty in the system.

viii) Surge arrestors shall have a suitable pressure relief system to avoid damage to the porcelain/ silicon polymeric housing and providing path for flow of rated fault currents in the event of arrestor failure.

ix) The reference current of the arrestor shall be high enough to eliminate the influence of grading and stray capacitance on the measured reference voltage.

x) The Surge Arrestor shall be thermally stable and the bidder shall furnish a copy of thermal stability test with the bid.

xi) The arrestor shall be capable of handling terminal energy for high surges, external pollution and transient over voltage and have low losses at operating voltages.

xii) The surge arrestor shall be provided with line and earth terminals of suitable size.

1.2.4 ARRESTOR HOUSING

i) The arrestor housing shall be made up of porcelain/**silicon polymeric** housing and shall be homogenous, free from laminations, cavities and other flaws of imperfections that might affect the mechanical and dielectric quality. The housing shall be of uniform **brown** (**for**

porcelain)/**Grey** (**for silicon polymeric**) colour, free from blisters, burrs and other similar defects.

ii) Arrestors shall be complete with fasteners for stacking units together and terminal connectors.

iii) The housing shall be so coordinated that external flashover shall not occur due to application of any impulse or switching surge voltage upto the maximum design value for arrestor. The arrestors shall not fail due to contamination. The 11kV arrestors housing shall be designed for pressure relief class as given in Technical Parameters of the specification.

iv) Sealed housings shall exhibit no measurable leakage.

1.2.5 ARRESTOR MOUNTING

The arrestors shall be suitable for mounting on 4 pole/2 pole structure used for pole/plinth mounted transformer and for incoming and outgoing lines. Arrestor may also be required to be mounted on a bracket provided in the Transformers.

1.2.6 FITTINGS & ACCESSORIES

i) The surge arrestor shall be complete with fasteners and terminal connectors.

ii) The terminals shall be non-magnetic, corrosion proof, robust and of adequate size and shall be so located that incoming and outgoing connections are made with minimum possible bends. The top metal cap and base of surge arrestor shall be galvanized. The line terminal shall have a built in clamping device which can be adjusted for both horizontal and vertical take off.

1.2.7 TEST ON SURGE ARRESTOR

The Surge Arrestors offered shall be type tested and shall be subjected to routine and acceptance tests in accordance with IS : 3070 (Part-3)-/IEC:600994. In addition, the suitability of the surge arresters shall also be established for the followings.

i) Acceptance tests

a) Measurement of power frequency reference voltage of arrester units.

b) Lightning impulse residual voltage on arrester units (IEC clause 6.3.2)

c) Internal ionization or partial discharge test

ii) Special Acceptance tests:

a) Thermal stability test (IEC clause 7.2.2)

b) Watt loss test.

iii) Routine tests

a) Measurement of reference voltage

b) Residual voltage test of arrester unit

c) Internal ionization or partial discharge test

d) Sealing test

e) Verticality check on completely assembled surge arresters as a sample test on each lot if applicable.

iv) Type Tests

Following shall be type test as per IS 3070 (Part 3): 1993 or its latest amendment

1.	Insulation Withstand test a) Lightning Impulse b) Power Frequency (Dry/Wet)
2.	Residual Voltage Test a) Steep current impulse residual voltage test b) Lightning impulse residual voltage test
3.	Long duration current impulse withstand test
4.	Switching surge operating duty test
5.	Power frequency voltage Vs. Time characteristics
	Accelerated Ageing test
7.	Pressure relief test a) High Current b) Low Current
8.	Artificial pollution test (for porcelain housing)
9.	Seismic Test
10.	Partial Discharge test
11.	Bending test
12.	a) Temperature cycle test (for porcelain housing) b) Porosity test (for porcelain housing)
13.	Galvanising test on metal parts
14.	Seal Leakage test (for porcelain housing)
15.	Seal leak test and operation tests (for surge monitor)
16.	Weather ageing test (for polymer housing)

The maximum residual voltages corresponding to nominal discharge current of 10 kA for steep current, impulse residual voltage test,

lightning impulse protection level and switching impulse level shall generally conform to Annex-K of IEC-99-4.

The contractor shall furnish the copies of the type tests and the characteristics curves between the residual voltage and nominal discharge current of the offered surge arrestor and power frequency voltage v/s time characteristic of the surge arrestor subsequent to impulse energy consumption as per clause 6.6 of IS:3070 (Part-3) offered alongwith the bid.

The surge arrestor housing shall also be type tested and shall be subjected to routine and acceptance tests in accordance with IS :5621.

v) Galvanization Test

All Ferrous parts exposed to atmospheric condition shall have passed the type tests and be subjected to routine and acceptance tests in accordance with IS:2633 & IS 6745.

1.2.8 NAME PLATE

The name plate attached to the arrestor shall carry the following information:

- Rated Voltage
- Continuous Operation Voltage
- Normal discharge current
- Pressure relief rated current
- Manufacturers Trade Mark
- Name of Sub-station
- Year of Manufacturer
- Name of the manufacture
- Name of Client-
- Purchase Order Number along with date

1.2.9 DRAWINGS AND INSTRUCTION MANUALS

Within 15 days of receipt of the order, the successful tenderer shall furnish to the purchaser, the following drawings and literature for approval:

(i) Outline dimensional drawings of Surge Arrestor and all accessories.
(ii) Assembly drawings and weights of main component parts.
(iii) Drawings of terminal clamps.
(iv) Arrangement of earthing lead.

(v) Minimum air clearance to be maintained of line components to ground.
(vi) Name plate
(vii) Surge monitor, if applicable.
(viii) Instructions manual
(ix) Drawing showing details of pressure relief valve
(x) Volt-time characteristics of surge arrestors
(xi) Detailed dimensional drawing of porcelain housing/Silicon polymeric i.e. internal diameter, external diameter, thickness, height, profile, creepage distance, dry arcing distance etc.

1.2.10 TECHNICAL PARTICULARS

The surge arrestors shall conform to the following standard technical requirements. The Insulation values shall be enhanced considering the altitude of operation & other atmospheric conditions.

i) System Parameters

a)	Nominal system voltage	11kV
b)	Highest system voltage	12 kV
c)	System earthing	Effectively earthed system
d)	Frequency (Hz)	50
e)	Lightning Impulse withstand	75 Voltage (kVP)
f)	Power frequency withstand	28 Voltage (kV rms)
g)	Arrestor duty	
	-- Connection to system	Phase to earth
	-- Type of equipment to be protected	transformers & switchgear

ii) Surge Arrestors

a)	Type	Gapless Metal oxide outdoor
b)	Arrestor rating (kV rms)	9
c)	Continuous Operating voltage	7.65 (kV rms)
d)	Standard Nominal Discharge Current impulse shape)	10 Rating (kA) (8x20 micro
e)	Degree of protection	IP **67**
f)	Line discharge Class	2
g)	Steep current at 10 kA	45
h)	Lightning Impulse at 10 kA	40
i)	Energy capability corresponding to	
	a) Arrestor rating (kj/kV)	4.5
	b) COV (kj/kV)	4.9
x)	Peak current for high current impulse operating duty of Standard TS for Arrestor classification10 kA	100

iii) Insulator Housing

i)	Power frequency withstand test voltage (Wet) (kV rms)	28
ii)	Lightning impulse withstand/tests voltage (kVP)	75

iv) Galvanisation

i)	Fabricated Steel Aticles	
	a) 5 mm thick cover	610 g/m^2
	b) Under 5 mm but not less than 2 mm thickness	460 g/m^2
	c) Under 2 mm but not less than 1.2 mm thickness	340 g/m^2
ii)	Castings	
	Grey Iron, malleable iron	610 g/m^2
iii)	Threaded works other than tubes & tube fittings	
	a) Under 10 mm dia	270 g/m^2
	b) 10 mm dia & above	300 g/m^2

NOTE- Surge Monitor shall have to be provided if coverded in BPS.

2. 33kV OUTDOOR TYPE CURRENT TRANSFORMER:

Current transformers shall be supplied with common marshalling box in a batch of three CT's along with terminal connectors and other fittings for forming necessary interphase and control room interconnections. The CT console shall be of Aluminum alloy sheets having 3 mm thickness.

The current transformers shall be of the outdoor type, single phase, 50 Hz, oil immersed, self cooled and suitable for operating in the tropical conditions with maximum ambient temperature upto 50^{0}C. The C.TS should be suitable for use in the areas subject to heavy lightning storms and highly polluted conditions.

The current transformer shall conform in all respects to high standards of engineering, design, workmanship and latest revisions of relevant standards at the time of offer and purchaser shall have the power to reject any work or material which in his judgment is not in full accordance therewith.

Bidders are required to quote for 0.2S accuracy class of metering cores and 5P10 for protection with the following data / information etc.

a) Guaranteed Technical particulars.
b) Technical literatures, brochures and drawings as per this specification.
c) Type Test Reports.
d) List of orders, executed and User's certificates, failing submission of the above particulars with the offer, the tender may not be considered for evaluation**.**

Current Transformers with the requirements of other authoritative standards, which ensure equal or better quality than the standards, mentioned above, shall also be acceptable, Where the equipment, offered by the supplier conforms to other standards, salient points of difference between the standards adopted and specified standards shall be brought out in the offer 1 (one) copy of the reference standards in English language shall be furnished

along with the offer.

The supplier is to furnish the latest edition of the standards as mentioned above from SI.1 to Sl.15 with their amendments, if any, at their own cost, if required by the Purchaser.

All the above alongwith amendments thereof shall be read and interpreted together. However, in case of a contradiction between the Technical Specification and any other volume, the provisions of this specification will prevail.

2.1 EARTHOUAKE INCIDENCE

The current Transformers are to be designed to withstand earthquakes of an intensity equivalent to seismic acceleration of 0.3g in the horizontal direction and 0.15g in the vertical direction, where 'g'stands for acceleration due to gravity.

The current Transformers covered under this specification shall be suitable for outdoor installation.

2.2 PURCHASER'S AUXILIARY POWER SUPPLY :

Following power supplies shall be made available at site.

(a) A.C. Three phase, 415V, 50HZ earthed
(b) A.C. Single Phase, 240V, 50HZ earthed.
(c) 110 V D.C.

2.3 GENERAL TECHNICAL REQUIREMENTS:

i) The **33 KV** C.T. shall be of **dead** tank design and shall be so constructed that it can be easily transported to site within the allowable limitation and in horizontal position if the transport limitations so demand.

ii) For compensation of variation in the oil volume due to ambient variation, nitrogen cushion / metal bellows shall be used. Rubber diaphragms shall not be permitted for this purpose.

iii) The C.T. secondary terminals shall be brought out in a weather proof terminal box. The terminal box shall be provided with removable gland plate and gland (s) suitable for 1100 volts grade PVC insulated, PVC sheathed, multicore 4 Sq. mm stranded copper conductor cable. The terminal blocks shall be stud-type and provided with ferrules indelibly marked or numbered. The terminals shall be rated for not less than 10 Amps. The terminal box shall be dust and vermin proof. Suitable arrangements shall be made for drying of air inside the secondary terminal box. The dimensions of the terminal box and its openings shall be adequate to enable easy access and working space with the use of normal tools.

iv) Polarity shall be indelibly marked on each primary and secondary terminal. Facility shall be provided for short-circuiting and grounding of the C.T. secondary terminals inside the terminal box.

v) The C.T. shall be provided with non-corrosive, legible name plate with the information, specified in the relevant standards, duly engraved/punched on it.

vi) The castings of base, collar etc. shall be die cast and tested before assembly to detect cracks and voids, if any.

vii) The instrument security factor of metering core shall be low enough and not greater than '5'. This shall be demonstrated on all the ratios of the metering core in accordance with procedure, specified in IEC-185 OR IS:2705. In case the instrument security factor of 5 or less is not possible to be achieved on higher ratios, auxiliary CTS of ratio1/1 and 0.2S accuracy class shall be deemed to be included in the supplier's scope of supply. This shall also be specifically brought out by the supplier in his offer. However, all parameters, specified shall have to be met treating auxiliary CT/ reactor as an integral part of the current Transformer. The auxiliary C.TS/reactor shall be inbuilt construction of the C.TS.

viii) Current transformers' guaranteed burdens and accuracy class are to be intended as simultaneous for all cores. Current Transformers, characteristics shall be such as to provide satisfactory performance for burdens ranging from 25% to 100% of rated burden over a range of 5% to 120% of rated current in case of metering CTS and upto accuracy limit factor / knee point voltage in case of relaying C.TS.

ix) Current Transformers shall be designed so as to achieve the minimum risk of explosion in service. The Bidder shall bring out in his offer, the measures taken to achieve this.

2.4 PRIMARY WINDING

i) Primary winding may be either ring type or hair pin type or the type, which has been type tested. The rated extended primary current shall be 120% on all cores of the C.Ts, specified in tables.

ii) The primary windings of current transformers shall be constructed of high purity, annealed, high conductivity electrolytic copper/ Aluminium meeting to the requirements of IEC 28/IS:2705.

2.5 SECONDARY WINDINGS:

Suitably insulated copper wire of electrolytic grade shall be used for secondary windings. Type of insulation, used shall be described in the offer. The secondary taps shall be adequately reinforced to withstand handling without damage.

The rating of the Current Transformer's secondary winding shall be 1 (One) Amp.The secondary terminals shall be brought out in a compartment for easy access.

2.6 PRIMARY TERMINALS

The primary terminals shall be heavily tinned electrolytic copper or Aluminium alloy of 99.9% conductivity. The minimum thickness of tinning shall be 1.5 microns.

2.7 SECONDARY TERMINALS

Secondary terminal studs shall be provided with at least three nuts and adequate plain and spring washers for fixing the leads. The studs, nuts and washers shall be of brass, duly nickel plated. The minimum outside diameter of the stud shall be 6 mm. The length of at least 15 mm shall be available on the studs for inserting the leads. The horizontal spacing between the centers of the adjacent studs shall be at least 1.5 times the outside circum-dia of the nuts. The current transformer shall be provided with suitable test tap for measurement of capacitance, tan delta as well as partial discharges. Provision shall be made on a screw cap for solid and secured earthing of the test tap connection, when not in use. A suitable caution plate shall be provided duly fixed on the cover of the secondary terminal box indicating the purpose of the test tap and the necessity of its solid earthing as per prescribed method before energising the Current Transformer.

The secondary terminals shall be provided with shorting arrangements.

2.8 CORE

Each core of the Current Transformer shall be of torroidal shape. Core laminations shall be of cold rolled grain oriented silicon steel or other equivalent alloys of low hysteresis and eddy current losses, high permeability to ensure high accuracy at both normal and over-current conditions. The cores used for protection shall produce undistorted secondary current under transient conditions at all ratios, with specified Current Transformer parameters. The core material, thickness of lamination, the relevant graphs showing the characteristics of the core material shall be submitted along with the offer.

2.9 TANK

i) Both expansion chambers and the tanks of the Current Transformers shall be made up of high quality steel, which should be able to withstand full vacuums and pressure occurring during transit and thermal and mechanical stresses resulting from maximum short circuit current during operation. The tanks along with all ferrous parts shall be galvanised as per relevant standard.

ii) The metal tanks shall have bare minimum number of welded joints so as to minimise possible locations of oil leakage. Welding in horizontal plane is to be avoided as welding at this location may give way due to vibrations during transport resulting in oil leakage. Supplier has to obtain specific approval from purchaser for any horizontal welding used in the bottom tank.

2.10 SECONDARY TERMINAL BOX :

i) Secondary Terminal Boxes shall be weather proof with a rating

ii) All secondary terminals shall be brought out in a compartment on one side of each current transformer for easy access.

iii) The exterior of this terminal box shall be of aluminium alloy sheet of minimum 3 mm thickness.

iv) A terminal board which shall have arrangement for series / parallel connection and arrangement for shorting of secondary terminals shall be provided. C.T. of ratio-200-100-50/1-1A, the specified ratios may be obtained by Series parallel connection or by secondary tapping.

v) The terminal box shall be provided with a removable cable gland plate at bottom for mounting cable glands for 1.1KV PVC sheathed 4 x 4 Sq. mm stranded copper conductor cables.

vi) The terminal box shall be provided with a door in front so as to have easy access of secondary terminals. The door shall have a sealing / locking arrangement and shall be suitable to prevent penetration of moisture and rain water.

vii) All terminals shall be clearly marked with identification number to facilitate connection to external wiring.

viii) The secondary box of the CT's also of high quality steel materials with galvanizing as per standard (IS).

ix) The CT console to be provided (one per 3 CT's) is also of high quality steel with proper galvanization.

2.11 PORCELAIN HOUSING

i) The housing shall be made up of homogeneous, vitreous porcelain of high mechanical and dielectric strength; Glazing of procelain shall be of uniform brown or dark brown colour with a smooth surface, arranged to shed away rain water or condensed water particles (fog.) The details of location and type of joint, if provided on the porcelain, shall be furnished by the Bidder along with the offer.

ii) The bushings of the Current Transformers shall conform to the latest edition of IS:2099. The hollow porcelain insulator shall conform to the latest edition of IS:5621. 5.19.3 The insulators shall be cemented with Portland cement to the flanges resulting in high mechanical, tensile and breaking strength.

iii) The bushings shall have ample insulation, mechanical strength and rigidity for the condition under which they shall be used and shall

be designed to prevent accumulation of explosive gases and provide adequate oil circulation to remove the internal heat.

iv) Cast metal end caps for the bushings shall be of high strength, hot dip glavanised malleable iron. They shall have smooth surface to prevent discharge taking place between the metal parts and porcelain as a result of ionisation. The insulation of bushings shall be coordinated with that of the current transformer such that the flashover, if any, will occur only external to the Current Transformer.

v) Oil level gauge and convenient means of filling, sampling and draining of oil should be provided.

vi) End shields should be provided for distribution of stresses.

vii) Corona shields for bushings, if required should be provided.

2.12 INSULATING MEDIUM (OIL TYPE)

The quantity of insulating oil for the filling and the complete specification of the insulating oil shall be stated. The oil shall comply in all respects with the provisions of latest edition of IS: 335. The current Transformers shall be supplied, filled with purified oil completely.

2.13 PREVENTION OF OILLEAKAGE AND ENTRY OF MOISTURE:

i) The supplier shall ensure that the sealing of the Current Transformer is properly achieved. In this connection, the arrangement provided by the supplier at various locations including the following ones shall be described, supported by sectional drawings.
   (a) Locations of emergence of primary and secondary terminals.
   (b) Interface between porcelain housing and metal tank/s
   (c) Cover of the secondary terminal box.

ii) Nuts and bolts or screws, used for fixation of the interfacing porcelain bushings for taking out terminals shall be provided on flanges, cemented to the bushings and not on the porcelain.

iii) For gasketed joints, wherever used, nitrite butyl rubber gaskets shall be used. The gasket shall be fitted in properly machined groove with adequate space for accommodating the gasket under compression.

2.14 FITTINGS AND ACCESSORIES :

Fittings and accessories, listed below shall be supplied with each Current Transformer. Any fitting, required essential other than those listed below shall also be supplied along with each Current Transformer without any extra cost to the purchaser :

(a) Oil level gauge.
(b) Oil filling hole and cap.
(c) Pressure relieving device.

(d) Phase terminal connectors.
(e) Lifting lugs for core and windings, bushings and complete Current Transformers
(f) Tank earthing pads/terminals with necessary nuts, bolts and washers for connecting to purchaser's earth strip.
(g) Name / Rating plate. 5.21.1

2.15 OIL LEVEL GAUGE :

An oil level gauge shall be provided to indicate the oil level in the Current Transformer. This gauge shall be mounted in such a way that the oil level can be seen from ground level. If metal bellow is used, a ground glass window shall be provided to monitor the position of the metal bellow. The metal below shall be tested in accordance with relevant standards. The details shall be to the approval of the purchaser.

2.16 PRESSURE RELIEVING DEVICE:

Each Current Transformer shall be provided with a pressure relieving device so as to protect bushing of the Current Transformer even under unfavorable Conditions. In case of non provision of the PRD, the same should be brought out clearly in the offer with detailed explanation and proof.

2.17 OIL DRAIN COCK :

An oil drain cock alongwith a stop cock shall be provided in the bottom flange so as to permit taking of oil samples for testing, if required.

2.18 EARTHING :

Metal tank of each Current Transformer shall be provided with two separate earthing terminals for bolted connection to 50mm X 6mm and 75X10 mm flat, to be provided by the purchaser for connection to station earth-mat.

2.19 LIFTING ARRANGMENT :

The Current Transformer shall be provided with suitable lifting arrangement to lift the entire unit. The lifting arrangement shall be clearly shown in the general arrangement drawing. Lifting arrangement (lifting eye) shall be positioned in such a way so as to avoid any damage to the porcelain housing or the tanks during lifting for installation / transport. Necessary string guides shall be offered which shall be of removable type.

2.20 NAME PLATE & MARKING :

The Current Transformer shall be provided with non-corrosive, legible name plate with the information specified in relevant standards, duly engraved/punched On it.

A schematic drawing indicating the connections shall be provided in the interior of the Terminal box.

2.21 TERMINAL CONNECTORS :

i) All the Current Transformers shall be provided with bimetallic solderless clamp type, rigid type terminal connectors, suitable for ACSR 'Racoon' & Dog conductor.

ii) Each terminal connector shall be of universal type, suitable for both horizontal and vertical connections to the transmission line conductors / station bus bars.

iii) Terminal connectors shall be manufactured and tested as per IS:5561.

iv) All castings shall be free from blow holes, surface blisters, cracks and cavities. All sharp edges and corners shall be blurred and rounded off.

v) No part of a clamp shall be less than 10mm thick.

vi) All ferrous parts shall be hot-dip galvanised conforming to relevant standard.

vii) For bimetallic connectors, copper alloy linear of minimum thickness of 2mm shall be cast integral with aluminium body.

viii) All current carrying parts shall be designed and manufactured to have minimum contact resistance.

ix) Connectors shall be designed to be corona free in accordance with the requirements, stipulated in IS:5561.

2.23 TYPE TESTS & SPECIAL TESTS:-

The current transformers, offered should have been subjected to the following type tests and Special Tests in Government approved test laboratory. The bidder shall furnish four sets of type test and Special Tests reports along with the offer for 0.2S accuracy class CTs. These tests should not have been conducted earlier than five years from the date of opening of the bid. For any change in the design/type already type tested and the design/type offered against this specification, the purchaser reserves the right to demand repetition of some or all type & special tests without any extra cost to OPTCL in the presence of OPTCL's representative(s) at the cost of the supplier.

a) Lightning Impulse Voltage Test.
b) High Voltage power frequency wet withstands voltage Test.
c) Short time current test.
d) Temperature rise test.
e) Determination of errors or other characteristics according to the requirements of the appropriate designation and accuracy class as per individual parts of IS:2705.
f) Instrument Security Factor Test.
g) IP-55 Test on Secondary Terminal Box.
h) Radio Interference voltage test.
i) Corona Extinction test.
j) Thermal stability test.
k) Thermal Co-efficient test.

l) Fast transient test.
m) Seismic withstand test.
n) Mechanical terminal load on bushing.
o) Magnetisation and internal burden tests..
p) Effectiveness of sealing tests

2.24 ROUTINE TESTS :

The following routine tests shall be conducted on each Current Transformer in the presence of P&E Deptt representative(s) for which no charges will be payable by P&E. No sampling will be allowed.

(i) Appearance and Dimensional Check.
(ii) Verification of Terminal Marking and polarity.
(iii) Verification of all individual parts / components of the Current Transformer so as to ensure to have complied the above specification.
(iv) Measurement of Insulation Resistance.
(v) Power Frequency Dry withstands Test on Primary and Secondary winding including primary intersections.
(vi) Over – Voltage Inter turn test.
(viii) Knee point voltage and Excitation current measurement for 'PS' class cores.
(ix) Secondary winding resistance measurement.
(x) Determination of errors.
(xi) ISF Test.
(xii) Leakage Test.
(xiii) Magnetization Characteristics of the Current Transformers.
(xiv) Turn ratio error on 'PS' class cores.
(xv) Checking of SF6 gas Pressure.(for SF6 gas filled CTs)

2.25 QUALITY ASSURANCE PLAN :

The Bidder shall invariably furnish following information alongwith his offer.

(i) Statement giving list of important raw materials, names of sub-suppliers for the raw materials, list of standards, according to which the raw materials are tested, list of tests, normally carried out on raw material in presence of Bidders'' representative, copies of test certificates.
(ii) Information and copies of test certificates as in (i) above in respect of bought out items.
(iii) List of manufacturing facilities available.
(iv) Level of automation achieved and list of areas where manual processing exists.
(v) List of areas in manufacturing process where stage inspections are normally carried out for quality control and details of such test and inspections.
(vi) Special features provided in the equipment to make it maintenance free.
(vii) List of testing equipments, meters available with the Bidder for final testing of equipment specified and test plant limitation, if any, vis-à-vis the type, acceptance and routine tests, specified in the relevant standards. These limitations shall be very clearly brought out in the offer.
(viii) All the testing equipments, meters etc, should have been calibrated in a Government approved laboratory. The Bidder must submit the list of

testing equipments and meters test-wise as per Annexure – B of the Technical Specification.

The supplier shall within 30 days of placement of order submit the following information to the purchaser.

(i) List of raw materials as well as bought out accessories and the names of the materials as well as bought-out accessories and the names of sub-suppliers, selected from those, furnished alongwith the offer.
(ii) Type Test Certificates of the raw material and bought out accessories.
(iii) Quality Assurance plan (QAP) with hold points for the purchaser's inspection. The QAP and hold points shall be discussed between the purchaser and the supplier before the QAP is finalized.

8.3 The supplier shall submit the routine test certificate of bought-out items and raw materials at the time of acceptance testing of the fully assembled equipment.

2.26 DOCUMENTATION :

All drawings shall conform to relevant Indian Standard as per relevant IS. All drawings shall be in ink and suitable for micro filming. All dimensions and data shall be in S.I. unit.

The supplier shall furnish four sets of following drawings/documents along with his offer for 0.2S accuracy class metering core CTs.

(a) General outline and assembly drawings of the Current Transformers.
(b) Sectional views showing.
  (i) General constructional features.
  (ii) Materials / gaskets / sealing used.
  (iii) The insulation of the winding arrangement, method of connection of the primary /secondary winding to the primary / secondary terminals etc.
(c) Schematic drawing
(d) Rating and Diagram plate.
(e) Secondary Terminal Box.
(f) Assembly Sectional view of Primary Terminal
(g) Assembly drawing for secondary terminal.
(h) The detailed dimensional drawing of Porcelain Housing such as ID, OD, thickness and Insulator details such as height, profile of petticoats, angle of inclination and gap between successive petticoats, total creepage distance etc.
(i) Sectional view of Pressure Release device.
(j) Drawing showing details of Oil level Indicator.
(k) All type and special test reports relating to tests, as mentioned at CI. No. 6.1 of this Technical Specification.
(l) Ratio and phase angle error curves for CTS.
(m) Magnetization characteristic curves such as B-H curves and sp.loss vs. flux density curves.
(n) Drawings for Terminal Connector.

2.27 TEST REPORTS:

(i) One set of type test and special test reports shall be furnished to the purchaser with the tender offer for 0.2S accuracy class metering core CTs.

(ii) Copies of acceptance test reports and routine test reports shall be furnished to the purchaser. One copy will be returned, duly certified by the purchaser and only thereafter shall the materials be despatched.

(iii) All records of routine test reports shall be maintained by the supplier at his works for periodic inspection by the purchaser.

(iv) All test reports of tests, conducted during manufacture shall be maintained by the supplier. These shall be produced for verification as and when required for by the purchaser.

2.28 SPARE PARTS

A list of spare parts recommended for five years operations for each Current Transformer shall be furnished with the tender. The purchaser will decide the actual quantities of spare parts to be ordered on the basis of the list and the item wise price of spare parts.

The necessary galvanized flanges, bolts etc. for the base of the Current Transformers shall be supplied without any extra cost to the purchaser.

2.29 PACKING AND FORWARDING:

The equipment shall be packed in suitable crates so as to withstand handling during transport and outdoor storage during transit. The supplier shall be responsible for any damage to the equipment during transit, due to improper and inadequate packing. The easily damageable material shall be carefully packed and marked with the appropriate caution symbols. Wherever necessary, proper arrangement for lifting such as lifting hooks etc. shall be provided. A material found short inside the packing cases shall be supplied by supplier without any extra cost.

13.2 Each consignment shall be accompanied by a detailed packing list containing the following information:-

(a) Name of the consignee
(b) Details of consignment
(c) Destination
(d) Total weight of consignment
(e) Sign showing upper / lower side of the crate
(f) Handling and unpacking instructions
(g) Bill of materials indicating contents of each package.

Sl. No.	Item.	Specification
1	Type of CT/Installation.	Single phase, dead tank, oil filled, outdoor, self-cooled
2	Type of mounting.	Pedestal type
3	Suitable for system frequency.	50 HZ ± 5 %
4	Rated voltage (KV rms)	33
5	Nominal system voltage (KV rms)	33

6	Highest system voltage (KV rms)	36
7	Current ratio (A/A)	200-100-50/1-1A
8	Method of earthing the system where the current transformer will be installed.	Solidly effectively earthed.
9	Rated continuous thermal current (A)	120 % of rated primary
10	Acceptable limit of temperature rise above 50°C ambient temperature for continous operation at rated continuous thermal current.	
(a)	Winding	45°C
(b)	Oil	40°C
(c)	External surface of the core, metallic parts in contact with or adjacent to, insulation.	45°C
11	Acceptable partial discharge level	Less than 10 picco coulombs
12.	Maximum radio interference voltage at l. l times the maximum rated voltage.	Less than 500 micro volts
13.	l.2/50 micro second lightning impulse withstand voltage (KVP) (dry)	170 650
14.	1 minute dry power frequency withstand voltage primary (KV rms)	70 275
15.	Switching Impulse with stand and voltage (KVP)	-- -
16.	l Minute dry power frequency withstand voltage secondary (KV rms)	3 3
17.	Minimum creepage distance of porcelain Housing (mm)	900 3625
18.	Rated short time withstand current for l second at all ratios (KA rms)	25KA
19	Accuracy Class a) Metering b) For protection c) Accuracy limit factor	 0.2 5P10 10
20	Rated burden	30VA
21	Standard	IS 2705(1992)
22	Insulation level	$70kV_{rms}/170kV_p$

3. 33 KV VACUUM CIRCUIT BREAKERS

3.1 SCOPE

This specification covers design, manufacturing, testing at manufactures works, supply of 33 KV Vacuum Circuit Breakers complete with all accessories required for their satisfactory operation for the sub-transmission system. The Breakers shall be used for Transformer protection or Feeder Control, in the system.

3.2 TYPE AND RATING

The circuit breakers shall be suitable for outdoor operation under the climatic conditions, as specified in Tender specification, without any protection from sun and rain.

The circuit breakers shall have the following rating:-

S.No.	PARTICULARS	33 KV
i)	Number of Poles	3 Nos.
ii)	Frequency	50 Cycles
iii)	Nominal System Voltage	33 KV
iv)	Highest System Voltage	36 KV
v)	Interrupting Capacity at nominal system voltage	1500 MVA
vi)	Rated Continuous Current	1250 Amps
vii)	Short-time Current Rating for 3 Secs.	25 KA
viii)	Basic Insulation Level	170 KV
ix)	Power Frequency Withstand Voltage for one Minute	70 KV
x)	Total Break-time for any Current up to the rated breaking current	5 cycles (max.)
xi)	Control Circuit Voltage	110 Volt D.C.
xii)	Operating duty for gang operation	O-0.3 Sec-CO – 3 Min – CO
xiii)	The VCBs shall be suitable for one reclosing followed by one delayed reclosing and lock out	
	Minimum clearances	
a)	Between Phases	430 mm
b)	Between Live Parts & Ground	3700 mm
c)	Creepage Distance	900 mm

The above are our minimum requirements. The *manufacturer*s may offer their standard design, keeping in view our minimum requirements.

3.3 STANDARDS

The circuit breakers shall comply with the requirements of IEC 56 or IS 13118 (1991) with latest amendment thereof, except wherein specified otherwise. Equipment, meeting any other authoritative standard, which ensures equal or better quality then the standard mentioned above, would also be acceptable. The

bidders shall clearly indicate the applicable standards to which their equipments complies-with. A copy of such standard may also be enclosed.

3.4 GENERAL

The circuit breaker shall be of porcelain clad vacuum type. The breaker, complete in all respect, shall be supplied with all accessories in-place and all internal wiring installed and terminated in the mechanism housing and the equipment shall be complete in all respects.

The circuit breakers shall provide rapid and smooth interruption of current under all conditions, completely suppressing all undesirable phenomena, even under the most severe and persistent short-circuit conditions or when interrupting small currents or leading/ lagging reactive currents. The details of any device incorporated to limit or control the rate of rise of Restriking voltage across the circuit breaker contacts shall be stated. The over voltage caused by the circuit breaker switching on inductive or capacitive load shall not exceed 3.2 times the normal phase to neutral voltage. The total break-time for the circuit breaker, throughout the range of breaker operating duty, shall be stated in the tender and shall be guaranteed. The breaker shall be fit for capacitor switching for 5 MVAr Bank.

The breakers shall be provided with trip free mechanism.

The circuit breakers shall be suitable for mounting on steel structures. The cost of necessary frames for mounting the circuit breakers shall be included in the offered prices. All the structures shall be hot dip galvanized with 3 dips. Please note that cantilever type supports for mechanism box are not acceptable. The mechanism box shall have firm supports from bottom. This is necessary to minimize vibration of mechanism box, which in turn may disturb various settings. The agency shall indicate clearly the vibration level of the breaker during fault / normal ON OFF operations in all three directions.

3.5 SPECIFICATION FOR CIRCUIT BREAKERS

The circuit breakers shall consist of three identical phase units with a common operating mechanism. While offering the circuit breaker, the following details should be confirmed and furnished with the tender:-

i) Complete construction details of the equipment offered. It should be noted that the breakers should be suitable for out-door duty. Indoor breakers accommodated in out-door kiosks are not acceptable.

ii) Type, make & source of vacuum bottles with relevant details shall be indicated in the offer, clearly.

iii) The capacity of breaker to interrupt inductive and capacitive currents shall be indicated in the offer (rating of capacitor bank should be stated and type test report shall be furnished).

iv) Spare availability of vacuum interrupter should be confirmed by the bidder for the designed expected life of the breakers being offered.

3.6 VACUUM INTERRUPTER

The design of the vacuum interrupter shall be such that it gives trouble free operation under normal load and fault conditions throughout the life of the equipment. As the efficiency of the breaker depends on the degree of vacuum inside the interrupter, manufacturer shall ensure that the same is maintained consistently during service. To know the residual life of vacuum interrupter, an indicator to indicate the status of contact erosion shall be provided.

The insulating ceramic body of the interrupter should have high mechanical strength and it should be capable of withstanding high temperature without any significant deterioration in its mechanical and electrical properties

The metal/ alloy used for the fixed and moving contacts shall have very low resistivity and low gas content. They should be resistant to arc erosion and the contact should have no tendency to get cold-welded under the high vacuum in the interrupter.

The interrupter design should ensure rapid de-ionization of the gap so that normal electrical strength of the gap is restored instantaneously.

The metallic bellow or any other similar vacuum sealing arrangement should be provided at the moving contact and should have a long fatigue life.

Manufacturer's catalogue on vacuum bottle, indicating all the details shall essentially be submitted with the tender.

3.6 TEMPERATURE RISE

The maximum temperature attained by any part of the equipment, when in service at site, under continuous full load conditions, exposed to the direct rays of the sun, shall not exceed 45° Centigrade, above ambient temperature. The limits of temperature rise shall be as per relevant standards. The corrections proposed shall be stated in the tender and shall be subject to approval of the owner.

3.7 INSULATION OF THE CIRCUIT BREAKER

The insulation to ground, the insulation between open contacts and the insulation between phases of the completely assembled circuit breaker shall be capable of withstanding satisfactorily di-electric test voltage corresponding to specified basic insulation level in the standard.

3.8 INSULATORS

The basic insulation level of the Insulator and insulating porcelains shall be as specified and porcelain shall be homogenous and free from cavities and other flaws. They shall be designed to have ample insulation, mechanical strength and rigidity for satisfactory operation under conditions specified above. All insulators of identical ratings shall be inter-changeable. The puncture strength of the insulators shall be greater than the flash over value. The insulators shall be type tested from independent Govt. Laboratory as per relevant standards or at any recognized and reputed international laboratory or testing institutions.

3.9 OPERATING MECHANISM

The circuit breakers shall be designed for remote control from the control room and in addition there shall be provision for manual operation of circuit breakers during maintenance and for local tripping and closing by the normal means.

The circuit breakers shall have operation control and mechanical “open” “close” indicator, in addition to facilities for remote electrical indication.

The operating mechanism shall be of the spring charging type, by electric control under normal operation. The mechanism shall be trip free electrically and mechanically. The mechanism shall be capable of performing satisfactorily, the reclosing duty cycles indicated above, within the time specified. All working parts in the mechanism shall be of corrosion resistant material and all bearings, which require greasing, shall be equipped with pressured grease fittings. The mechanism shall be strong positive quick in action and shall be removable without disturbing the other parts of the circuit breaker. The mechanism and breaker shall be such that the failure of any spring will not prevent tripping and at the same time will not cause any false tripping or closing. The operating Mechanism should be motor operated spring charged type preferably without chain drive. The motor for spring charging shall be suitable to perform satisfactorily for input supply voltage of 230 Volt A.C. 50 Hz with a variation of plus 10 and minus 20 percent. The A.C. Motor should have overload protection. Provision should also be made for mounting of mechanism box at an adequate height and gear ratios shall be so chosen that one man should be able to charge the spring, without any additional efforts.

3.10 CONTROL CUBICLE

A common control cubicle shall be provided to house electrical, controls, monitoring devices and all other accessories, except those which must be located on individual poles. The cubicle shall be gasketed and shall have weather-proof construction, fabricated from sheet steel of minimum 2.5 mm thickness. The type test report on degree of protection test (IP-55) shall also be furnished.

The cubicle shall have front access door with lock and keys, space heater, internal illumination lamp, 3 pins 5 Amp socket with individual ON-OFF switches shall be provided in the cubicle.

For local operation following shall be provided:-

a) LOCAL / REMOTE selector switch
b) TRIP / NORMAL / CLOSE control switches with pistol grip handle

The control circuits shall be designed to operate on 110 Volt DC, as indicated in the schedule and it shall be possible to adopt to work on other voltages by simply changing the operating coils. The shunt tripping coils shall be designed to operate satisfactorily within 110% and 70% of the rated DC supply voltage and the shunt closing coils should operate up to 85% of the rated DC voltage. These checks shall be repeated during pre-commissioning checks at site before putting the breakers in service.

AC Power supply for auxiliaries will be available at 230 Volt (+/- 10% variation) single phases 50 C/s at substation. The agency shall be required to extend this supply, using proper protection, to desired location through cable.

Necessary double compression type cable glands for the cables of the operating mechanism shall be provided. The cables used for operation are all un-armoured 2.5 sq. mm copper control cables of 1100 V grade. The cable glands shall be suitable for 1 no. 8 core and 2 nos. 4 core cables and cables as per site requirements. The gland plate should be made of non-magnetic materials and suitably drilled at site to suit the cable entry.

The Circuit breaker shall be provided with trip free Mechanism so that tripping instructions could over-ride the closing instructions. An additional tripping coil shall also be provided in the trip circuit. The second coil shall have separate tripping lever arrangements in the mechanism, so as to avail full advantage of second trip coil. Also the two trip coils shall have separate fuses in the DC circuit, so that in the event of any short circuit/damage in any one of the trip coils, the supply is available to the other one.

The circuit diagram of Control circuit of VCB along with operating instructions (DOS/ DON'T) shall be embossed on metallic plate duly laminated and the same shall be fixed on the rear door of the control cubicle from inside.

3.11 WIRING

Wiring shall be completed in all respects to ensure proper functioning of the control, protection, monitoring and interlocking schemes.

All the wiring shall be carried out with 1100 V grade, PVC insulated stranded copper conductor of 2.5 sq. mm as per IS: 1554.

Each wire shall be identified at both ends with permanent markers bearing wire numbers as per wiring diagram.

Wire termination shall be done with crimping type connectors with insulating sleeves. Wires shall not be spliced between terminals.

All spare contacts of auxiliary switches etc. shall be wired up to terminal blocks in the control cubicle.

3.12 TERMINAL BLOCKS

Terminal blocks shall be of 1100 V grade, box clamp type ELMEX 10 sq. mm or approved equivalent. Not more than two wires shall be connected to any terminal. Spare terminals, equal in number to 20% of active terminals, shall be provided.

Terminal block shall be such located to allow easy access. Wiring shall be so arranged that individual wires of an external cable can be connected to consecutive terminals.

3.13 TERMINAL CONNECTORS

6 Nos. Terminal bi-metallic connector suitable for Dog conductors and raccoon conductor shall be supplied with each breaker. For ensuring quality and uniformity, the owner may decide to specify the design of terminal connector, the material of terminal connector and thickness of clamps. Further compliance of which will have to be done by the agency without any extra cost. Suitable earth connector for earthing connections shall also be supplied. The connector drawing shall be got approved from the owner.

3.14 AUXILIARY CONTACTS

Eight numbers each of auxiliary contacts both of the normally open and normally closed types shall be provided in each circuit breaker for use in the remote indication and control scheme of the circuit breaker and for providing safety interlocking. Special contacts for use with trip coils, which permit for relative adjustment with respect to the travel of the circuit breaker contact, shall also be provided, wherever required. There shall be provision to add more auxiliary contacts at a later date, if required.

3.15 ACCESSORIES

The vacuum circuit breaker shall be supplied as a complete unit with internal wiring installed and terminated in mechanism box and equipped with the following accessories:

1	Motor operated spring charged mechanism (Motor voltage – 230 V AC)	1 No.
2	Trip coil suitable for 110 V DC	2 Nos.
3	Closing Coil suitable for 110 V DC	1 No.
4	Pistol grip C.B. Control switch having Trip/ Normal/ Close position	1 No.
5	Local/ Remote selector switch	1 No.
6	Spring Charged indicator	1 No.
7	Manual operating handle for maintenance	1 No.
8	Facility for manual charging of spring	1 No.
9	Operation counter	1 No.
10	Auxiliary contacts (8 NO-8 NC)	1 Set
11	Anti-pumping device suitable for 110 V DC	1 No.
12	Terminal connectors suitable for connecting Dog Conductor and raccoon conductor	6 Nos.
13	Cubicle illuminating lamp with cage and switch	1 No.
14	Spare terminals connectors	20% of Total Terminals
15	Mechanical ON/OFF Indicator	1 No.
16	MCB for both AC and DC supply	1 No. each
17	Space heater and ON-OFF switch in the mechanism box	1 No.
18	Power Type 3 Pin Socket with ON-OFF switch	1 Set
19	Earthing Terminals	2 Nos.
20	LED indicating lamps	Complete set

Indicating Bulbs: The indicating lamps should be supplied with Low Voltage protection Circuit (LVGP) and surge suppressor circuit having LED indication. Lamp assembly should be of fire – retardant glass epoxy PCB, industrial heat resistant, fire resistant, non- Hygroscopic DMC material , chrome – plated corrosion resistant solid brass bezel , polycarbonate lens in desired colour shades of Red , Green, Amber, Yellow etc. the intensity of light should be minimum 100 mcd at 20 mA . Indication lamp should be suitable to operate on 110 V Direct Current supply source.

3.16 TYPE TESTS

Type test certificates on VCB for the following tests, strictly as per IS 13118, with latest amendment thereof, from any of the independent Govt. Laboratory, or at any recognized and reputed international laboratory or testing institution, shall invariably furnished :-

- Short Circuit Duty Tests
- Short Time Current Rating Tests
- Mechanical Endurance Test
- Temperature Rise Test
- Lightning Impulse Voltage withstand Test
- Capacitor Switching Duty Test for Single Bank of 5 MVAR capacity
- Power Frequency withstand Voltage Test dry & wet
- Degree of protection IP-55 for control cubicle

The above type test certificates must accompany drawing of type tested equipment, duly signed by type testing authority.

The above tests must not have been conducted on the equipment earlier than 5 years from the date of opening of bids.

In case of any change in design/type of Breaker already type tested and the one offered against this specification, the owner reserves the right to demand repetition of type tests, without any extra cost.

3.17 ACCEPTANCE AND ROUTINE TESTS

All acceptance and routine tests, as stipulated in relevant standards, shall be carried out by the manufacturer, in presence of owner's representative.

Immediately after finalization of the programme of type testing, the manufacturers shall give, fifteen days advance intimation to the owner, to enable him depute his representative for witnessing the tests.

3.18 RATING PLATES

The detailed rating plate shall be as per IS and in addition, shall indicate serial number of the equipment, manufacturer's name, our order number and date.

3.19 EXPERIENCE

Minimum 3 years' experience in the field of design and manufacture of the equipment offered is essential for the bidder. Details in this regards shall be clearly stipulated in the offer.

4 11 KV AND 33 KV ISOLATORS

4.1 SCOPE

This specification provides for design, manufacture, testing at manufactures works, delivery of outdoor station type 11KV and 33KV (Local) manual operating mechanism isolating without/with earthing blades and complete in all respect with bi-metallic connectors. Operating mechanism, fixing details etc. shall be as described herein.

4.2 PARTICULARS OF THE SYSTEM

The isolators to be provided under this specification are intended to be used on 3 phase A.C. 50 cycles, effectively grounded system. The nominal system voltages are 11 kV & 33 kV respectively.

4.3 STANDARD

The Isolator shall comply in all respects with IS: 9921 or IEC Publication No.: 129. Equipment meeting any other authoritative standard which ensures an equal or better quality than the standard mentioned above will also be accepted.

4.4 TYPE & RATING

Isolators shall have three posts per phase, triple pole single throw, gang operated out-door type silver plated contacts with horizontal operating blade and isolators posts arranged vertically. The isolators will be double break type. Rotating blade feature with pressure relieving contacts is necessary i.e. the isolator shall be described in detail along-with the offer. However, the design of turn & twist arrangement shall be subject to owner's approval. (Banging type feature is not acceptable). All isolators shall operate through 90 degree from their fully closed position to fully open position, so that the break is distinct and clearly visible from the ground level.

The equipment offered by the tenderer shall be designed for a normal current rating of 400 A for 11 KV & 630 A for 33 KV suitable for continuous service at the system voltage specified herein. The isolators are not required to operate under load but they must be called upon to handle magnetization currents of the power transformers and capacitive currents of bushings, bus-bars connections, very short lengths of cables and current of voltage transformers.

The rated insulation strength of the equipment shall not be lower than the levels specified in IS 9921 JEC publication No. 129, which are reproduced below

Standard declared voltage	Rated voltage of the Isolator	Standard withstand voltage	Impulse Voltage polarity	One minute power frequency withstand voltage KV (RMS)

kv/rms		kV (peak)			
		Across the isolating distance	To earth and between poles	Across the isolating distance	To earth and between poles
11 KV	12	85	75	45	35
33 KV	36	195	170	100	75

The 11 KV and 33 KV isolators are required with post insulators but with mounting structures. The isolators should be suitable for mounting on the Boards standard structures. The isolators shall be supplied with base channels along with fixing nuts, bolts and washers for mounting on the structured.

4.5 TEMPRATURE RISE

The maximum temperature attained by any part of the equipment when in service at site under continues full load conditions and exposed to the direct rays of Sun shall not exceed 45 degree centigrade above ambient temperature.

4.6 ISOLATOR INSULATION

Isolation to ground, insulation between open contacts and the insulation between phases of the completely assembled isolating switches shall be capable of withstanding the dielectric test voltage specified above.

4.7 MAIN CONTACTS

All isolators shall have heavy duty self aligning and high pressure line type fixed contacts of modern design and made of hard drawn electrolytic copper. The fixed contact should be of reverse loop type. The various parts shall be accordingly finished to ensure inter- changeability of similar components.

The fingers of fixed contacts shall be preferably in two pieces and each shall form the reverse loops to hold fixed contacts. The fixed contacts would be placed in 'c' clamp. The thickness of 'C' clamp shall be adequate. This channel shall be placed on a channel of adequate thickness. This channel shall be welded on an insulator mounting plate of 8mm thickness. The spring of fixed contact shall have housing to hold in place. This spring shall be made of stainless steel with adequate thickness. The pad for connection of terminal connector shall be of aluminum with thickness not less than 12 mm.

The switch blades forming the moving contacts shall be made from tubular section of hard drawn electrolytic copper having outer dia not less then 38 mm and thickness 3 mm. These contacts shall be liberally dimensioned so as to withstand safely the highest short circuit and over voltage that may be

encountered during service. The surfaces of the contacts shall be rendered smooth and silver plated. The thickness of silver plating shall not be less than 15 microns for 11 KV and 25 microns for 33 KV. In nut shell, the male and female contact assemblies shall be of robust construction and design of these assemblies shall ensure the same.

1. Electro-dynamic withstands ability during short circuit without any risk of repulsion of contacts.
2. The current density in the copper parts shall not be less than 2 Amp/sq.mm and aluminium parts shall be less than 1 Amp/sq.mm.
3. Thermal withstand ability during short circuit.
4. Constant contact pressure even when the live parts of the insulator stacks are subjected to tensile stresses due to linear expansion of connected bus bar of flexible conductors either because of temperature verification or strong winds.
5. Wiping action during closing and opening.
6. Self alignment assuring closing of the switch without minute adjustment.

The earthing switch should be provided with three sets of suitable type of fixed contacts below the fixed contacts assemblies of the main switch on the incoming supply side and the sets of moving contacts having ganged operation. These contacts shall be fabricated out of electrolytic copper for 33 KV isolators with earth switch and designed to withstand current on the line.

Arcing contacts / Horn	:	Arcing contacts are not required.
Auxiliary switches	:	Auxiliary switches are not required.

4.8 CONNECTORS

The connectors for 11KV isolator shall be made of Aluminium alloy LM-9 or LM-25 and shall be suitable for Squirrel, Weasel and Rabbit ACSR Conductors for 11KV and Raccoon/Dog conductors for 33 KV with horizontal and vertical takeoff arrangement. The details in regard to dimensions, the number of bolts to be provided, material and manufacture shall be furnished by the bidder for owner approval before manufacturing. The groove provided in the connection should be able to accommodate conductor size mentioned above smoothly.

The clamps to be offered should be manufactured by gravity die-casting method only and not by sand casting process. It is necessary that suitable clamps are offered along with the isolator and also it is obligatory to give complete technical particular of clamps along with the drawing, as per details given above and also as per following detail.

1. The terminal connector shall be manufactured and tested as per IS: 5561.
2. All castings shall be free from blow holes, surface blistors, cracks and cavities.

3. All the sharp edges shall be blurred and rounded off.
4. No part of the clamp shall be less than 12 mm thick.
5. All current carrying parts shall be designed and manufactured to have minimum contact resistance.
6. Connectors shall be designed to be corona free in accordance with the requirement of IS: 5561.
7. All nuts and bolts shall be made of stainless steel only. Bimetallic sleeve/liner shall be 2 mm thick

Wherever necessary, bi-metallic strip of standard quality and adequate dimension shall be used.

4.9 POST INSULATOR

11KV / 33KV insulators shall be polymer type insulator of reputed make subject to owner approval. All surfaces shall be clean, smooth, without cuts, abrasions or projections. No part shall be subjected to excessive localized pressure. The insulator and metal parts shall be so designed and manufactured that it shall avoid local corona formation and not generate any radio interference beyond specified limit under the operating conditions.

The composite insulator shall have a core, housing & weather shed of insulating material and steel/aluminum hardware components for attaching it to the support/conductor

It shall be a glass-fiber reinforced epoxy resin rod of high strength (FRP rod). Glass fibers and resin shall be optimized in the FRP rod. Glass fibers shall be boron free electrically corrosion resistant (ECR) glass fiber or boron free E-class and shall exhibit both high electrical integrity and high resistance to acid corrosion. The matrix of the FRP rod shall be Hydrolysis resistant. The FRP rod shall be manufactured through Pultrusion process. The FRP rod shall be void free.

The composite polymer weather sheds made of silicone elastomeric compound silicon alloy shall be firmly bonded to the sheath, vulcanized to the sheath or molded as part of the sheath and shall be free from imperfections. The weather sheds should have silicon content of minimum 30% by weight. The strength of the weather shed to sheath interface shall be greater than the tearing strength of the polymer. The interface, if any, between sheds and sheath (housing) shall be free from voids.

The FRP rod shall be covered by a seamless sheath of a silicone elastomeric compound or silicone alloy compound of a thickness of 3mm minimum. It should protect the FRP rod against environmental influences, external pollution and

humidity. It shall be extruded or directly molded on the core and shall have chemical bonding with the FRP rod. The strength of the bond shall be greater than the tearing strength of the polymer. Sheath material in the bulk as well as in the sealing/bonding area shall be free form voids.

The tenders shall in variably enclose with the offer, the type test certificate and other relevant technical guaranteed particulars of insulators offered by them. Please note that isolators without type test certificates will not be accepted.

Each 11KV / 33KV Post Insulators used in the isolators should have technical particulars as detailed below:-

		11KV	33KV
1.	Nominal system voltage KV (rms)	11	33
2.	Highest system voltage KV (rms)	12	36
3.	Dry P.F. One minute with stand KV (rms)	35	75
4.	Wet PF one minute withstand KV (rms)	35	75
5.	P.F. Puncture withstand test voltage KV flash over voltage of the unit.	1.3 time the actual dry	
6.	Impulse voltage withstand test KV (peak)	75	170
7.	Visible discharge test KV voltage	9	27
8.	Creepage distance mm (min)	320	580
9.	Tensile strength in KN	10KN	16KN
10.	Short time current rating for 3 Secs	25KA	25KA

4.10 Operating Mechanism for 11KV / 33KV Isolators:-

All Isolators and earthing switches shall have separate dependent manual operation. The Isolator should be provided with padlocking arrangements for locking in both end position to avoid unintentional operation. For this purpose Godrej make 5 lever brass padlocks having high neck with three keys shall be provided. The isolating distances should be visible for isolators.

The Isolators and Isolators with earth switch inclusive of their operating mechanism should be such that they cannot come out of their open or close position by gravity wind pressure, vibrations reasonable shocks or accidental touching of connecting rods of the operating mechanism. Isolators should be capable of resisting in closed position, the dynamic and thermal effects of maximum possible short circuit current at the installation point. They shall be so constructed that they do not open under the influence of the short circuit current. The operating mechanism should be of robust construction and easy to operate by a single person and conveniently located for local operation in the switchyard. Provision for earthing of operating handle by means of 8 SWG GS wire must be made.

4.11 PIPES

Tandem pipes operating handle shall be class B ISI marked type having at least 24mm internal diameter for 11KV/33KV isolator. The operating pipe shall also be class B ISI marked with internal diameter of at least 32 mm and 38 mm for 11 KV and 33KV isolators respectively.

The pipe shall be terminated in to suitable universal type joints between the insulator bottom bearing and operating mechanism.

4.12 BASE CHANNEL

The Isolator shall be mounted on base fabricated from steel channel section of adequate size not less than 75x40x6 mm for 11KV and 100x50x6 mm for 33KV

To withstand total weight of isolator and insulator and also all the forces that may encounter by the isolator during services, suitable holes shall be provided on this base channel to facilitates it's mounting on our standard structures. The steel channel in each phase shall be mounted in vertical position and over it two mounting plates atleast 8mm thick with suitable nuts and bolts shall be provided for minor adjustment at site.

4.13 CLEARANCES

We have adopted the following minimum clearance for isolators in our system .The bidder should therefore keep the same in view while submitting their offers: -

Description	Center distance between Poles (Center to Center) i.e. Phase to Phase clearance	Distance between center lines of outer posts on same pole
11 KV Isolator	75 Cm	60 Cm
33 KV Isolator	120 Cm	96 Cm

5 DESIGN AND MANUFACTURE OF TRANSFORMER :

5.1 Power Transformer :

5.1.1 Standard : The Power Transformers, their accessories and fittings, insulating oil etc. shall conform to the latest edition of the following standards (as amended update) except where specified otherwise this specification.

Power Transformer	IS:2026/IEC-76
Insulating Oil	IS:335
Gas Oil Operated Relay	IS:3637

Current Transformer	IS:2705
Fittings and Accessories for Power Transformer	IS:3639
bushing for alternating	
Voltage	IS:2099
Guide for loading	IS:6600
Marking and arrangement for Switchgear Bushbars	IS:375
main connection and auxiliary wiring	
Degree of protection for enclosures	IS:2147

5.1.2 Drawings : After receipt of the order, the Supplier will be required to furnish four prints of the following drawings for approval.

i) Outline dimensional drawings of Power Transformers and accessories.

ii) Assembly drawings and weight of main component parts.

iii) Shipping drawings showing dimensions and weights of each package.

iv) HV and LV bushing and assembly drawings.

v) Control and wiring diagrams and drawings showing temperature indicator/recorder circuits and control system for cooling equipments.

vi) Drawings showing typical sectional views of the windings with details of insulation, cooling circuits, method of coil tracing and core construction.

vii) Detailed foundation drawings.

viii) Drawing giving details of name plate, terminal marking and connection diagram.

5.1.3 Design :

The Transformer and accessories shall be designed to facilitate easy inspection, cleaning and repairs. The Transformer and all its accessories shall be designed to withstand without injury the thermal and mechanical effects of any external short circuit to earth and of short circuit at the terminal of any winding for a period of 2 sec. the short circuit level of the HV system to which the Transformer shall be connected is 25KA.

5.1.4 The similar ratio Transformers shall operate satisfactorily in parallel with each other and share load equally from zero to full rating of the Transformer.

5.1.5 Transformers shall withstand, without injuries heating combined voltage and frequency fluctuations which produce the following over fluxing conditions.

i) 125% for 1 Min.

ii) 140% for 5 Sec.

iii) Tenderer shall indicate 150% and 170% over voltage withstand time.

5.1.6 Types of Transformer : The Transformer shall be of 3-Phase, core type construction oil immersed and ONAN cooled and shall be suitable for outdoor service.

5.1.7 Core :

i) The core shall be constructed from high grade non-ageing cold-rolled grain oriented silicon steel laminations having high permeability and low hysteresis loss.

ii) The core shall be provided with lugs suitable for lifting the complete core and coil assembly of the Transformer.

iii) The maximum flux density in any part of the core and yoke at rated MVA and frequency at any tap shall such that under 10% over voltage conditions, it does not exceed 1.9 tesla.

iv) The design of the magnetic circuit shall be such as to eliminate the occurrence of static discharged, development of short circuits paths itself or to the earth clamping structure and the production of flux components at right angles to the plane of laminations which may cause local heating.

5.1.8 Winding :

i) The winding shall be so designed that all coil assemblies of identical voltage rating shall be interchangeable and field repairs to the windings can be made easily. The coils shall be supported between adjacent sections by insulating space and the barriers, tracing and other insulation used in the assembly of the winding shall be arranged to ensure a free circulation of the oil and to reduce hot spots in the windings.

ii) The Winding shall be so designed that all Coil Assemblies are of identical Voltage Rating for similar Transformers shall be interchangeable and field repairing to the Windings can be made readily without special equipments. The Coils shall be supported between adjacent stations by Insulating Spacers and the Barriers, Bracing and other Insulation used in the Assembly of the Windings shall be arranged to ensure free calculation of Coil and to reduce hot spots in the Windings. Coils shall be made up shaped and braced to provide for expansion and contraction due to temperature change, so as to avoid abscision of insulation and provide rigidity to resist movement and distortion caused by abnormal stresses. Adequate bracing shall be provided between the Coils and the Cores and between Low and High Voltage Coils. Each turn shall have additional protection against abnormal line conditions. The assembled Core and Winding shall be vacuum dried and suitably impregnated before removal from the Treatment Tank.

iii) The Copper Conductor used in the Coil structure shall be best suited to the requirements and all permanent current carrying joints in the Winding and the Lead shall be welded or braced.

iv) All threaded connections shall be provided with locking facilities. All Leads from the Winding to the Terminal Board and Bushings shall be rigidly supported to prevent injury from vibration. Guide Tubes shall be used wherever practicable.

5.1.9 Tank and Tank Cover :

i) The Transformer tank and cover shall be fabricated from good commercial grade Carbon Steel of tested quality suitable for welding and of adequate thickness. The tank and the cover shall be preferably of welded construction. All seams, flanges, lifting lugs, braces and permanent parts attached to the tank shall be welded and where practicable they shall be double welded. All joints which may have to be opened from time to time in the course of operation shall be of a design which permits their "oil-tight" being made in reassemble easily. The tank shall be reinforced by stiffener of structural steel for general rigidity. The tank shall have sufficient strength to withstand without permanent distortion (i) Filling under vacuum, (ii) Continue internal gas pressure of 35 KN/M with oil at operating level and (iii) Mechanical shock during transportation.

ii) Transformer tank shall be of the conventional type construction with an oil tight bolted flange joint near the base such that during inspection or maintenance it is possible to lift the upper portion of tank to provide access to the core and coils. Details of necessary facilities for handling the oil in such cases shall be listed by tenderer.

iii) Suitable guides shall be provided for positioning the various parts during assembly or dismantling. Adequate space shall be provided between the core and the windings and the bottom of the tank for collection of any sediment.

iv) Lifting lug shall be provided on all parts of the Transformer requiring independent handling during assembly or dismantling. In addition, the Transformer tank shall be provided with lifting lugs and bollards properly secured to the sides of the tank for lifting the Transformer complete with oil.

v) The tank shall be provided with two suitable alloy or any other suitable materials lugs for the purpose of grounding.

vi) The Transformer tank, fittings, radiators and all accessories shall be designed to withstand seismic acceleration as specified. Special steps shall be taken to prevent maloperation of Buchholz relay under such conditions.

vii) All bolts and nuts used in the connections with the tank and fittings shall be galvanised.

viii) As far as possible the Transformer tank and its accessories shall be designed without pockets where gas may collect.

ix) The tank covers shall preferably be sloped to prevent retention of rain water and shall not distort when lifted.

x) The tank cover shall be fitted with pockets at the position of maximum oil temperature at maximum continuous rating for bulbs of oil and winding temperature indicators. It shall be possible to remove these bulbs without covering the oil in the tank.

xi) Bushing turrets, covers of inspection openings, thermometer pockets etc. shall be designed to prevent ingress of water into or leakage of oil from the tank.

xii) All bolted connections shall be fitted with weather proof; not oil resistant, resilient gasket in between for complete oil tightness. If gasket is compressible metallic stopes / other suitable means shall be provided to prevent over-compression.

xiii) At least two adequate sized inspection openings one at each end of the tank, shall be provided for easy access to bushing and earth connection. The handles shall be provided on the inspection cover to facilitate lifting.

5.1.10 Undercarriage:

i) The Transformer tank shall be supported on a structural steel base equipped with forged steel or cast steel single flanged wheels suitable for moving the complete Transformer filled with oil completely.

ii) Jacking pads shall be provided. It shall be possible to change the direction of the wheels through 90^0 when the Transformer is lifted on jacks to permit movement of the Transformer both in longitude and transverse direction. Suitable locking arrangement shall be provided for wheels to prevent accidental movement of Transformer.

iii) Pulling eyes shall be provided to facilitate haulage of the Transformer. Those shall be suitably braced in the vertical direction so that bending does not occur when the pull has a vertical component.

iv) Suitable jacks for lifting the Transformer and for changing the plane for rotation of the wheels shall be provided.

5.1.11 Anti earthquake clamp device:

The Transformer shall be rigidly mounted on wheels resting on rails gouged in concrete foundations. The complete Transformer shall be rigidly anchored through wheel assemblies to the foundations using anti-earthquake clamping and locking devices. Tenderer's scope of supply shall be included the requisite foundation bolts / clamping bolts and locking devices and all other accessory equipment.

5.1.12 Tap Changing Mechanism:

i) The Transformer shall be provided with an OFF LOAD tap changing mechanism. This shall be designed suitable for remote control operation from switch boards in the control room in addition to being capable of local manual as well as local electrical operation with suitable interlocks.

ii) The Transformer shall be provided with Off Load Tap Changing arrangement as specified.

iii) The Off Load Tap Changing Switch for the Transformer specified shall be 3 Phase Gang Operated suitable for simultaneous switching of similar Taps on the 3 Phase by operating an external wheel provided with an arrangement facilitating its operation from standing height above the ground level.

iv) A Voltage and Tap position indicator for the "Tapping In Use" shall be provided at the External Operating Wheel and the arrangement shall be made for securing and pad locking the Switch in any of the working positions. The arrangement shall be such that no Padlock can be inserted unless the Contacts are correctly engaged and the Switch Set in position where no Open Circuit/Short Circuit is possible. A Warning Plate indicating that Switch shall be operated only when the Transformer is de energised shall be provided.

5.1.13 Oil Preservation System:

i) Oil preserving equipment shall be conservator or expansion tank type. If the conservator or expansion tank type is provided the oil level in the conservator or expansion tank shall be above the level of the bushing flange.

ii) The conservator tank shall have two filter valves one at the bottom at one end and the other at the top opposite end in addition to the valves specified in the accessories for the main tank. The conservator shall also have shut-off valve and a sump with a small drain valve and sampling cock, the latter so arranged so as not to interfere with oil line. The oil level gauge shall be mounted on the conservator or expansion tank.

iii) Each conservator vessel shall be fitted with a breather in which silica gel is dehydrating agent and designed so that :-

a) The passage of air is through the silica gel.
b) The external atmosphere is not continuously in contact with the silica gel.
c) The moisture absorption indicated by a change in colour of the tinted crystals can be easily observed from distance.

iv) The Double Float Bucholtz Relay with Alarm and Trip Contacts suitably rated and suitable for 110VDC supply shall be provided with Shut Off Valve on the Conservator side. Necessary Piping shall be provided.

v) Magnetic Oil Level Gauge with Low Level Gauge Alarm Contacts shall also be provided.

5.1.14 Bushing :

i) The Bushings shall have high factors of safety against leakage to ground and shall be so located as to provide adequate electrical clearance between bushings and grounded parts. Bushings of identical Voltage Rating shall be interchangeable. The Bushing shall

be equipped with suitable Terminals of standard type and size and all external current carrying Contact Surface shall be Silver Plated adequately. The Insulation Class of the Neutral Bushing shall be properly coordinated with the Insulation Class of the Neutral of the Winding and the Voltage Rating should be clearly mentioned in the Offer. The Neutral shall however be brought out through a separate Bushing. The 11kV side of the 33/11kV Transformer shall be provided with a detachable Cable Box suitable for connection of 11kV Cable.

ii) All main Winding and Neutral Leads shall be brought out through Outdoor Type Bushings which shall be located that the full Flashover Strength will be utilised and the adequate phase clearance shall be maintained.

iii) Each Bushing shall be so coordinated with the Transformer Insulation that all Flashover will occur outside the Tank.

iv) All Porcelain used in the Bushing shall be of the Wet Process, Homogenous and free from cavities or other flaws. The Glazing shall be uniform in colour and free from blisters, burn and other defects.

v) The Bushings for 33kV side shall be of Condenser Type and the Bushings for the 11kV and the Neutral shall be of Porcelain.

vi) All Bushings shall have Puncture Strength greater than the Dry Flashover Voltage.

vii) Main Terminals shall be Solderless Terminals and shall be of the type and size suited for Fixing Standard Terminal Connectors.

viii) Terminal Connectors for the 33kV side shall be provided suitable for ACSR 'Dog' Conductor and ACSR Racoon Conductor. Suitable Cable and Box for XLPE armoured cable shall be provided for 11kV side of 33/11kV Transformer.

ix) The space between Bushings must be adequate to prevent Flashover between Phases under all conditions of operation.

x) Special Adjusting Horns shall be provided for all the H.V. Bushings.

xi) The Tenderer is required to give the Guaranteed Withstands Voltages for the above and also furnish Calibration with different settings of the Coordination gap to the Purchaser to decide actual Gap Setting. Tenderer's recommendation are also invited in the this respect.

5.1.15 Center of Gravity :

The centre of gravity of the assembled Transformer shall be as low as near the vertical centre line as possible. The Transformer shall be stable with and without oil. The location of the centre of gravity relative to track shall be clearly marked in the outline drawing.

5.1.16 Internal Earthing Arrangement:

i) **General** : All metal parts of the transformer with the exception of the individual core laminations, core bolts and associated individual clamping plates shall be maintained at fixed potential.

ii) **Earthing of core clamping structure** : Core clamping structure shall be earthed

iii) **Earthing of coil clamping rings** : Where coil clamping rings are of metal at earth potential, each ring shall be connected to the adjacent core clamping structure on the same side of transformer as the main earth connection

5.1.17 Cooling Plant :

i) **General :** Radiators shall be so designed as to avoid pockets in which moisture may collect and shall withstand the pressure tests. The radiator tubes / fins shall be scamless, made of mild steel having as minimum wall thickness of approx. 1.2mm and a clean bright internal surface free from dust and scale. They shall be situably braced to protect them from mechanical shocks, normally met in transportation and to damp the modes of vibration transmitted by the active part of the transformer in service. Each cooler unit shall have a lifting eye.

ii) **Radiator Valves :** The butterfly or similar metal valves shall be provided for isolating detachable radiator assembly. One cock each at the bottom of radiator stack shall be provided for draining oil from radiator stacks. Air release plug each at the top of radiator stack shall be provided for release of locked air from radiator stack. Removable blanking plates shall be provided to permit the blanking off the main oil Connection of each cooler.

Radiator fixing bands in top & bottom of radiators to be provided to minimise the vibration of the same.

5.1.18 Pressure Relief Device :

Pressure relief device shall be provided of sufficient sizes for repaid release of any pressure that may by generated within the tank, and which might result in damage to the equipment. The device shall operate at a static pressure of less than the hydraulic test pressure for transformer tank. Means shall be provided to prevent ingress of rain. It shall be mounted on the cover of the main tank and shall be designed to prevent gas accumulation. Spring loaded setting type Pressure Relief Valve having suitable opening Port hole according to the capacity of the transformers should be provided. The pressure relief valve should have provision of visual indication for opening of the valve and also Contract/Micro Switch arrangement for alarm/Tripping Function.

5.1.19 Gas Oil Operated (BUCHHOLZ RELAY) :

The gas and oil operated (Buchholz relay) when completely assembled and ready for mounting in service shall be subjected to the type of routine tests specified in IS:3637 (amended up-to-date).

5.1.20 Control Cabinet/Marshalling Box:

One number sheet vermin proof, well ventilated and weather proof marshalling box of suitable construction shall be provided for the Transformer ancillary apparatus. The box shall be domed or sloping roof type. Interior or exterior of this marshalling box shall be suitably painted, ventilation louvers shall be provided on both sides of the marshalling box.

i) The marshalling box shall accommodated the following equipments :-

a) All indicating instruments shall be mounted in marshalling box having a glass window. This marshalling box should be mounted not more than 1600mm from the ground level.

b) In the marshalling box all control equipments for remote indications and contacts shall be provided. Terminal boards and gland plates for incoming and outgoing cable shall be suitably mounted in marshalling box.

c) Terminal boards and gland plates for incoming and outgoing cables.

ii) All the above equipments except (c) shall be mounted on panel and back of panel Wiring shall be used for inter-connections.

iii) To prevent internal condensation approved type of metal clad heaters shall be provided controlled by a suitable switch. In the marshalling box all the incoming and outgoing cables shall enter the kiosk from the bottom. The gland plate and associated compartment shall be sealed in suitable manner to prevent the ingress of moisture. Provision shall be made for pin type socket with a switch and convenient outlet for 240V, single phase, 50Hz AC supply. Arrangement shall exist on the marshalling boxes for pad locking.

5.1.21 Jointing and Gasket:

i) All gasket used for making oil tight joints shall be of proven materials such as guaranteed coke bonded with synthetic rubber.

ii) Synthetic rubber, if used for gaskets and for joints shall be resistant to hot oil ageing.

5.1.22 Cleaning and Painting:

i) Before painting and filling with oil all ungalvanised parts shall completely clean and free from rust, scale and grease and all external rough surface of castings shall be filled by metal deposition. The interior of Transformer tanks and other oil-filled chambers and internal structure steel works shall be cleaned of all scales and rust by sand blasting or other suitable method. These surfaces shall be painted with an oil resisting varnish of paint unexposed welds need not be painted.

ii) Except for nuts, bolts and washers, which may have to be removed for maintenance purpose all external surfaces shall received a minimum of three coats of paint. The primary coat shall be of zinc chromate and applied immediately after cleaning. The second coat shall be an oil and weather resistant varnish of a colour distinct from the primary and final coat and shall be applied after the primary coat at site shall be given by coat paint which shall be corrosion resisting and non-facing and light grey in accordance with shade No. 631 of IS:5. The final coat shall be 20 micron and total thickness of all three coat shall be minimum 80 microns.

iii) All interior surfaces of mechanism chambers and boxes except those which have received anti-corrosion treatment shall received three coats of paints which shall be applied to the thoroughly cleaned metal surfaces. The final coat shall be of light grey colour with anti-corrosion mixture.

5.1.23 Accessories fitting:

a) Transformer shall be provided with the following accessories:-

i) Conservator with oil filling hole, cap and drain valve.
ii) Magnetic type and gauge with low level alarm contacts of 5A, 110V DC.
iii) Silicagel breather with oil seal - 2 Nos.
iv) Buchholz relay with alarm and trip contacts of 5A, 110V DC and one shut off valve on conservator side size 80mm.
v) Spring operated Pressure relief device.
vi) Pocket on tank cover for thermometer.
vii) Oil temperature indicator with maximum pointer and two electrical contact.
viii) Winding temperature indicator with maximum pointer and 2 sets of contacts for ONAN
ix) Valve
    a) Drain value with plug or blanking flange.
    b) 1 No. filter value at top of Transformer tank.
x) 2 Nos. earthing terminals.
xi) Rating and diagram plate.
xii) Jacking pads.
xiii) Lifting bollards.
xiv) Air release device.
xv) Inspection cover.
xvi) Haulage lugs.
xvii) Flanged bi-directional type rollers with locking and bolting device and gauge 1676mm shorter axis : 1676mm longer axis.
xviii) Wiring upto marshalling box with PVC Copper Cables 660 / 110V grade.
xix) Tank mounted / floor mounted weather proof marshalling box for housing control equipment and terminal connections.
xx) Cooling Accessories:
    a) Requisite number of radiator with top and bottom shut of valve, air release plug and drain valve.

b) For header mounted radiator 2 Nos. valve, one at top header and other at bottom header to be used for filteration and oil fitting.
c) Air release device.

b) The equipment and accessories furnished with the Transformer shall be suitably mounted on the Transformer for ease of operation, inspection and maintenance and the mounting details shall be subjected to approval of the purchaser. All values shall be provided either with blind companion flanges or with pipe plugs for protection.

c) Any other accessories or appliances recommended by the manufacturer for the satisfactory operation of the Transformer shall be supplied without any extra cost to the purchaser.

d) Rating Diagram & Property plate:

The following plates shall be fixed to the transformer tank at a suitable height so that the particulars could be read by standing at ground level.

i) A rating plate bearing the date specified in the relevant clauses of IS: 2026 including figures of temperature rise of oil and winding and high voltage test values.
ii) A diagram plate showing the internal numbering of taps, tapping switch connection of windings and also the voltages vector relationship in accordance with IS:2026 and in addition a plan view of the transformer giving the correct physical relationship of the terminals. No load voltage shall be indicated for each tap. Details of C.T particulars in respect of phase, Neutral & WTI C.T.
iii) A property plate showing that the equipment belongs to Power & Electricity Department, Government of Mizoram with reference of purchase order.

e) Control Connections & Instrument wiring terminal Board and fuses:

All wiring connections, terminal boards, fuses and links shall be provided by the supplier suitable for tropical atmosphere. Any wiring liable to be in contact with oil shall have oil resisting insulation and bared end of stranded wire shall be sweated together to prevent creepage of oil along the wire.

i) There shall be no possibility of oil entering connection boxes used for cable or wiring.

ii) When 415V connections are taken through marshalling boxes, there shall be adequately reserved screened and 415V DANGER notice must be affixed to the outside of the marshalling boxes.

iii) All panel wiring shall be in accordance with relevant IS. All wiring shall be of stranded copper of 660V grade and size not less than 2.5 Sq.mm.

iv) All wires on panels and all multi-core cables shall have ferrules which bear the same number at both ends.

v) All those points of inter-connection between the wiring carried out by separate contactors where a change of number cannot be avoided, double ferrules shall be provided on each wire. The change of numbering shall be shown on the appropriate diagram of the equipment.

vi) The same ferrule number shall not be used on wires in different circuit on the same panel.

vii) Stranded wires shall be terminated will tinned terminal claw washers or crimped tubular lugs. Separate washers shall be used for each wire. The size of the washers shall be suited to the size of wire terminated. Wiring shall in general be accomodated on the sides of the box and the wires for each circuits shall be separately grounded. Back of panel wiring shall be arranged so that access of the connecting items of relays and other apparatus is not impeded.

viii) Wire shall not be jointed or tied between terminal points.

ix) Wherever practicable all circuits in which the voltage exceeds 125V shall be kept physically separated from remaining wiring. The function of each circuit shall be marked on the associated terminal boards.

x) Where apparatus is mounted on panels all metal cases shall be separately earthed by means of copper wire or strip having across section of not less than 2.0 Sq.mm where strip is used the joints shall be sweated.

xi) Multicore cable trails shall be so bound that each wire may be treated without difficulty to its cable.

xii) All terminal boards shall be mounted obliquely towards rear doors to give easy access to terminations and to enable ferrule number to be read without difficulty.

xiii) Terminal boards rows should be spaced adequately not less than 100mm apart to permit convinient access to wires and termination.

xiv) Terminal boards shall be placed with respect to the cable gland (at a minimum distance 200mm) so as to permit satisfactory arrangement of multicore cable tails.

xv) Terminal boards shall have pairs of terminal for incoming and outgoing wires. Insulating barriers shall be provided between adjacent connections. The height of the barriers and the spacing between terminals shall be such as to give adequate protection while allowing easy access to terminals shall be adequately protected with insulating dust proof covers.

xvi) No live metal shall be exposed at the back of the material boards.

xvii) MCB should be used instead of fuse for protection of circuit and device

xviii) All MCB and links shall be labelled.

5.1.24 Terminal Connector :

i) The bushing shall be provided with terminal connectors suitable for connections with bare ACSR Conductor of 14mm-20mm diameter.

ii) All castings shall be free from blow holes, surface blisters, cracks and cavities. All sharp edges and corners shall be debarred and rounded off.

iii) No parts of a clamp shall be less than 10mm thick.

iv) All ferrous parts shall be hot dip galvanised conforming to IS:2633.

v) For bimetallic clamps, copper alloy liner of minimum thickness of 4mm shall be supplied loose.

vi) Flexible connectors shall be made from tinned Cu / Al sheets.

vii) Size of terminal / conductor for which the clamp is suitable and rated current site conditions shall be embossed, ounched on each component of the clamp except hardware.

viii) All current carrying parts shall be designed and manufactured to have minimum contact resistance.

ix) Clamps shall be corona free and conform to IS:5561.

5.1.25 Terminal Marking :

Each terminal (including the neutral) shall be distinctly marked on both the primary and secondary sides in accordance with the diagram of connections supplied with the Transformer.

5.1.26 TEMPERATURE RISE:

Each Transformer shall be capable of operating continuously at normal rating without exceeding temperature limits as specified

below. Transformers not complying with these requirements will not be accepted.

Type of Cooling Temperature Rise

1)	Winding	ONAN 55^{O}C
2)	Oil	ONAN 45^{O}C

The Ambient Temperature are as follows :-

1)	Maximum	45^{O}C
2)	Maximum Average Daily Ambient Temperature	35^{O}C
3)	Maximum Average Yearly Ambient Temperature	30^{O}C

5.1.27 FREQUENCY :

The Transformer shall be suitable for continuous operation with a frequency variation of ± 3% from normal of 50Hertz without exceeding the specified temperature rise.

5.1.28 PARALLEL OPERATION :

The Transformers as specified, of the same Voltage Rating shall operate satisfactorily in Parallel with each other when connected between High Voltage and Low Voltage Busbars.

5.1.29 IMPEDANCES :

Bidders shall indicate the Guaranteed Impedance and Tolerances and also the Upper and Lower Limits of Impedance which can be offered without any increase in the quoted price. Impedance shall include Positive and Zero Sequence and shall be expressed in terms of branches of the Star connected equivalent diagrams, all on the same kVA base and the range shall be given for each branch of the equivalent circuit in turn.

5.1.30 <u>INSULATING OIL</u> :-

1) The insulating oil shall conform to requirement of IS:335. No inhibitor in the oil shall be used.

2) Sufficient quantity of oil necessary for first filling of tank coolers and radiators at the proper level along with 10% extra oil for topping up shall be supplied in non-returnable container.

3) The supplier shall despatch the Transformer filled with oil or in an atmosphere of nitrogen. In former case necessary arrangement shall be ensured by the supplier to take care of pressure drop of nitrogen during transit and storage till completion of oil filling during erection. A gas pressure testing valve with necessary pressure gauge and adopter valve shall be provided.

5.1.31 Routine Test :

All the routine test in accordance with IS:2026 / IEC shall be conducted. These tests shall strictly conform to IS:2026 / IEC and its latest amendment no tolerance other than those specified in IS / IEC shall be accepted. These test shall be witnessed by the representative of the purchaser at the expense of the tenderer.

5.1.32 Additional Routine Test :

The following additional routine test shall also be carried out on each Transformer :-

a) Magnetic circuit test.
b) Oil leakage test.

All tank and oil filled compartments shall be tested for oil tightness by being completely filled with air or oil of a viscosity not greater

5.1.33 Test on Accessories :

Auxiliary wiring in all equipment connected there to shall be subjected to a test voltage of 2kV at 50Hz for one minute.

5.1.34 Further Tests :

The Purchaser reserves the right to have reasonable tests carried out at his own expense either before despatch or at site to ensure that the Transformer complies with the requirement of this specification

5.1.35 Test Report :

After all tests have been completed four certified copies of each test report shall be furnished. Each report shall comply the information :-

a) Calculating values of regulation at unity, 0.9, 0.8 lagging and 0.8 leading power factor.
b) Calculated values of positive, negative and zero phase sequence imedance of three phase bank.
c) Calculated values of efficiency of Transformer at 50%, 75% and 100% of rated capacity at 1.0 and 0.9 power factor.

5.1.36 EARTHING TERMINAL :

Two earthing terminals capable of carrying the full amount of lower voltage short circuit current of transformer continuously for a period of 5 Second Provision shall be made at positions close to each of the bottom two corners of the tank for bolting the earthing terminals to the tank structure to suit local condition

5.1.37 TEMPERATURE INDICATING DEVICES :

Oil temperature indicator with two electrical contacts for alarm and trip purposes and with repeater for remote indication, shall be provided with anti vibration mounting. The oil temperature indicator shall be housed in the marshalling box.

The winding temperature indicator with two electrical contacts (mercury switch or latest technology) for alarm & trip purposes and with repeater for remote indication shall be provided with anti

vibration mounting. The winding temperature indicator shall be housed in the marshalling Box. The Oil and Winding temperature indicator should be of renowned make preferably of "Perfect Control" or "Pecimeasure". The scale on the dial of the thermometer should be 0 Deg.C to 150 Deg.C. The angular displacement of thermometer should be 270 Deg. The signaling contact of WTI & OTI shall be set to operate at the following temperature:

OIL	:	Alarm-80 deg. C, Trip –90deg. C
WINDING	:	Alarm-85 deg. C, Trip –95deg. C

5.1.38 RATED VOLTAGE OF OPERATING DEVICE :

Rated voltage for indicating & operative device shall be 110 volts D.C. and 240 volts A.C. with variation as specified in the relevant I.S.

5.1.39 FOUNDATION :

The tenderer shall furnish foundation plan of the transformer showing the fixing arrangement of the transformer so that the purchase may be able to finalise the foundation drawings.

5.1.40 LOSSES :

Standard of losses at 75 Deg C will be as follows :

No load loss	:	2.5KW
Full load loss at rated full load current at 75 Deg C	:	15 KW

The bidder shall state the transformer losses Viz (Core) and Copper loss. The iron loass (no load loss) in kW at rated voltage and at rated frequency, and load losses (Copper loss) in kW at rated full load capacity and at rated voltage and frequency shall be guaranted at 75 Deg C.

5.1.41 TECHNICAL PARTICULARS :-

1.	Type.	Outdoor, 3-Phase Power Transformer.
2.	Rated capacity (MVA).	2.5 MVA
3.	System frequency.	50Hz.
4.	Type of cooling.	ONAN
5.	Short circuit level.	25KA for 2 Sec.
6.	Transformer ratio at Normal tap.	33/11kV
7.	Connection.	HV Delta connection. LV star with neutral directly earthed.
8.	Connection symbol.	Dyn 11.
9.	Overload capacity.	As per IS:6600 upto a load 150%.
10.	Tap change gear.	
	i) Type.	Off load Manual operated.
	ii) Location.	At HV winding.
	iii) Tap range.	+5% to -15% in 8 equal steps.
	iv) Operation.	local manual operation.

11.	Percentage impedance at 75% and at principal tap.		7.15%	
12.	Tolerance on percentage impedance voltage at principal tapping.		± 10%	
13.	Terminals.			
	i)	LV terminal.	Line and neutral ends - 12kV solid porcelain or oil communication bushing no arcing horn shall be provided.	
	ii)	HV terminal.	Line end - 36kV oil filled condenser bushings with test taps.	
14.	Rated insulation level.			
	i)	Rated lightning impulse withstand (kV peak).	HV 170 LV 75	
	ii)	One minute power frequency withstand test voltage (kV rms).	HV 75 LV 35	

15.	Parameter of bushing		**HV**	**LV & Neutral**
	i)	Rated voltage (kV).	36	12
	ii)	Current rating (Amp).	315	
	iii)	Lightning impulse withstand voltage (kVp).	170	75
	iv)	One minute power frequency withstand voltage (kV rms).	75	35
	v)	Creepage distance (mm)	840	320
	vi)	Tan delta	As per IS:2099	
	vii)	Partial discharge level	As per IS:2099	

16.	Minimum clearance in air.			
	i)	Phase clearance in air (mm)	HV 350.	LV 280
	ii)	Phase to body (mm).	HV 320	LV 140
17.	Noise level.		As per NEMA standard TRI.	
18.	Cooling equipment.		1-100% tank or separately Mounted cooling system consisting of radiation	

19. Maximum permissible temperature rise. Temperature rise of top oil measured by thermometer (^{0} C) should be IS:2026

21.	Rail gauge.		
	i)	Shorter axis	Two rails with 1676mm gauge.
	ii)	Longer axis	Two rails with 1676mm gauge.

5.2 33 kV Outdoor type Potential Transformer :

5.2.1 Design & Construction :

The Potential Transformer shall be suitable for outdoor installation for upright mounting of structures, oil immersed, self cooled type conforming to IS:3156. The cores shall meet the functional requirements under rated & severe persistant short circuit conditions. The potential transformer shall be provided with lifting, lugs, earthing terminals, oil drain valve, terminal block, rating plate showing diagram & terminal arrangement; oil gauge, pressure relief vent etc. The primary terminal shall be suitable for terminating ACSR "Racoon" conductor and ACSR Dog Conductor for 33 KV PT and the secondaries brought out in a terminal box suitable for termination of 2.5sq. mm. copper cable. The limit for temperature rise shall be as per IS:3156.The PTs shall be built of high grade non-ageing cold rolled grain oriented silicon steel lamination, conforming to IS 3024 of low hysteris losses and high permeability to ensure high accuracy at rated and above rated conditions. A prismatic oil sight gauge glass shall be provided on the top of the bushing metal assembly.

The Supplier shall ensure that the sealing of instrument transformer is properly achieved. In this connection the arrangement provided by the Supplier at various locations including the following ones shall be described, supported by sectional drawings.

i) Locations of emergence of primary and secondary terminals

ii) Interface between porcelain housing and metal tanks.

iii)Cover of the secondary terminal box

Nuts and bolts or screws used for fixation of the interfacing porcelain bushings for taking out terminal shall be provided on flanges cemented to the bushings and not on the porcelain.

5.2.2 Painting

All metal surfaces in contact with Insulating oil shall be painted with heat resistant paint insoluble in oil and Insulating Varnish.

5.2.3 Fitting & Accesories

The PTs shall be supplied complete with atleast following fitting and accessories.

- First oil filling
- Oil drain valve or plug
- Primary terminals with markings
- Secondary Terminals
- Earthing lugs
- Earthing Terminals for secondary terminal box
- Lifting eyes/lugs
- HV neutral and bushing
- Level gauge

5.2.4 Quality Assurance test

a) General : All equipment and materials shall be subjected to quality assurance shop and field test as per latest edition of relevant IS/IEC standard. The contractor shall furnish a master plan indicating various stages of tests to be conducted and specify the

customer hold points. Type test reports shall be submitted for all such equipments which are in conforming with the equipment supplied. The tests shall be conducted for which either no report has been submitted or the test report not in conformity with the equipment supplied.

All the routine tests shall be conducted as per relevant standards.

All test for which relevant standards are not being specified, be conducted by mutual agreement between the contractor and the Engineer-in-Charge.

b) Test at site : The Department reserves the right for having all reasonable tests carried out at site of feasible to ensure that the equipment comply with the requirement of the specifications. The tests to be conducted at site if so desired by the purchaser.

1. Verification of Terminal Markings and Polarity.
2. Voltage ratio.

If testing of the equipment is to be carried out outside mizoram, all the expenditure of the purchaser's representatives for the test carried out at the manufacturer's factory will be borned by the firm/supplier.

5.2.5 Winding :

All Primaries of Potential Transformers will be connected in phase to neutral which will be solidly earthed. The neutral of the system is also effectively earthed.

5.2.6 All Potential Transformers shall be provided with two separate Secondary Windings, rated as specified.

5.2.7 Bushing

High Voltage hollow porcelain brown glaze bushing to IS: 2099 shall be used for the voltage Transformer. The porcelain shall be homogeneous, thoroughly vetrefied, tough and impervious to moisture. The porcelain shall be homogeneous thoroughly vetrefied, tough and impervious to moisture. The glazing of porcelain shall be of uniform brown colour, fred from blisters, burns and other similar defects. The bushing shall have ample insulation, mechnical strength and rigidity for the conditions under which they will be used and shall be designed to prevent accumulation of explosive gases and to provide adequate oil circulation to remove internal heat. There shall be no undue stressing of part of the bushings due to temparature change and adequate means shall be provided to accomodate conductor expansion.

The bushing shall be so designed that when operating at highest system voltage there will be no electrical discharge between the conductor and the bushings. No corrosion or injury should be caused to conductor, insulation or supports by the formation of substances

produced by chemical action. The insulation of bushings shall be so co-ordinated with that of the voltage transformer such that the flash over will occur only externally to the voltage transformers. The bushing should not cause radio disturbances when operated at rated voltage.

In general the bushings shall conform to the latest issue of IS : 2099-1973 or equivalent.

5.2.8 Temperature Rise

Voltage Transformers shall be capable of carrying their rated burden continuously at rated voltage and frequency without the temperature rise exceeding the limits laid down in the approved standards to which they are designed and corrected to differences in ambient temperature at site and that given in the standards. The temperature rise at 1.1 times rated primary voltage when applied continuosly at rated frequency and at rated burden shall not exceed the limits specified in the standard and the temperature rise at 1.5 times rated primary voltage when applied for 30 seconds starting from previous stable operating condition at rated frequency and rated burden shall not exceed the above temperature limits by more than 10^0C. Unless specified otherwise in the Guaranteed Technical Particulars enclosed.

5.2.9 Pressure relieving device

Each voltage transformer shall be provided with a pressure relieving device capable of releasing abnormal internal pressure.

5.2.10 Insulation oil

Insulation oil required for first filling of the instrument transformer shall be covered in supplier's scope of supply. The oil shall meet the requirement of latest edition IS: 335 or equivalent IEC.

The insulation of the instrument transformers shall be so that the internal insulation shall have higher electrical withstand capability than the external insulation. The designed dielectrics withstand values of external and internal insulations shall be clearly brought out in the guaranteed technical particulars. The dielectric withstand values specified in this specification are meant for fully assembled instrument transformer.

Instrument transformer shall be provided with oil sight window at suitable location so that the oil level is clearly visible with naked eye to an observer standing at ground level.

5.2.11 Mountings

The voltage transformers shall be suitable for mounting on steel structures. Structures for 33 KV Potential Transformer shall be as per approved drawing enclosed. The 33 KV P.T should be mounted equally spaced on the horizontal structure depending on the size of the base plate.

5.2.12 Rating plate :

Each voltage transformer shall be provided with a rating plate in accordance with I.S : 3156(Part-I)-1965. Following additional particulars shall also be marked in the rating plate of each voltage transformer.

a) Purpose(measurement & protection), rating output per phase at 0.9 P.F. lagging, rated secondary winding in terms of I.S : 3156.
b) Terminal numbering of secondary windings.
c) Rated voltage factor and corresponding rated time.

5.2.13 Test :

Each voltage transformer shall be subjected to routine test as specified in I.S : 3156(Part-I,II & III)-1965 and those mentioned below in the presence of the purchaser's representative if so desired by the purchaser .

a) Verification of terminal markings and polarity.
b) High voltage power frequency test on primary windings.
c) Determination of the errors according to the requirements of the appropriate accuracy class.

5.2.14 Report of the following type tests as stipulated in I.S : 3156(Part-I,II & III)-1965 shall be supplied :

a) Temparature rise tests.
b) Impulse voltage test for service in electrically exposed installation.
c) Accuracy Class.

5.2.15 All the test reports shall be submitted to and duly approved by the purchaser before despatch of the equipment

5.2.16 Earthing:

Metal tank of the instrument transformer shall be provided with two separate earthing terminals for bolted connection to 50x8mm MS Flat to be provided by the Purchaser for connection to station earthmat.

Instrument transformer shall be provided with suitable lifting arrangement to lift the entire unit. The lifting arrangement shall be clearly shown in the general arrangement drawings. Lifting arrangement (Lifting eye) shall be positioned in such a way so as to avoid any damage to the porcelain housing or the tanks during lifting for installation transport. If necessary string guides shall be offered which shall be of removable type.

5.2.17 Technical Specification of Potential Transformer :

Sl. No	**Item**	**Specification**
1	Type Installation	Single phase, oil filled, self cooled,outdoor type

2	Type of Mounting	G.I Steel Structure
3	Highest System Voltage (KV rms)	36
4	Suitable for system frequency	50 Hz
5	Voltage Ratio	
a)	Rated primary voltage (kV rms)	$33/\sqrt{3}$
b)	Secondary voltage (volts)	$110/\sqrt{3}$ -$110/\sqrt{3}$
6	Method of earthing the system	Solidly earthed
7	Min. creepage distance of porcelain housing	900mm
8	Creepage factor (Max.)	4.0
9	Rated voltage factor	1.2 continuous and 1.5 for 30
10	One minute power frequency withstand voltage for	3.0
11	Max. temperature rise over ambient of 60^0C	As per IS: 3156 or equivalent IEC
12	Accuracy	0.2 for metering (winding-1) and 3p for protection (Winding-2)
13	Output burden (VA)	10
14	Percentage voltage error & phase displacement (minutes) for respective accuracy classes	As per ISS/IEC
15	Insulation level	70kVrms/170kVp
16	Standard	IS 3156 (1992)

5.3 Station service transformer 33/0.4kv, 100 kva

5.3.1. SCOPE :

1) This specification covers design, manufacture, assembly, testing at manufacturer's works, supply and delivery of 100 KVA, 33/0.415 KV, Station Service Transformer for efficient and trouble free operation.

2) The transformer covered by this specification shall be complete in all respect. Any material or accessories which may not here specifically mentioned but which is usual and necessary for satisfactory and trouble free operation and maintenance of the transformer, shall be supplied without any extra charge.

5.3.2. LOCATION:

The transformer may be installed outdoor by Employer anywhere in the project as per site requirement.

5.3.1. SYSTEM DETAILS :

The 33 kV systems are non effectively earthed through grounding transformer & 0.4 KV systems are effectively earthed at the neutral points of the star connected secondary winding of the transformer.

5.3.2. SERVICE CONDITIONS

Environmentally, the region where the equipment will be installed includes coastal areas, subject to high relative humidity, which can give rise to condensation. On shore winds will frequently be salt laden. On occasions, the combination of salt and condensation may create pollution conditions for outdoor insulators.

Therefore, outdoor material and equipment shall be designed and protected for use in exposed, heavily polluted, salty, corrosive, tropical and humid coastal atmosphere

5.3.3. STANDARDS :

a) Transformers covered by this specification shall, unless otherwise specified be built to conform to the latest Indian Electricity Rules, wherever applicable and the requirements of latest issue of ISS:1180 and ISS 2026, CBIP Standards and other ISS(all as per latest issues)

b) In the event of a conflict between the above standard and the specification the latter shall govern.

5.3.4. RATING AND GENERAL DATA FOR STATION TRANSFORMERS :

01. Core Type, three phase oil immersed step down two winding distribution transformers for outdoor installation with weather condition as stated above.
02. Rating: 100 KVA
03. Number of phase : three
04. Frequency : Transformer shall be suitable for continuous operation at the rated output and also with voltage variation of ±10% of rated voltage and a frequency variation of +3% from normal 50 c/s without exceeding the specified temperature rise.
05. Type of cooling : ONAN
06. Voltage Ratio : 33/0.4 KV at normal tap
07. Vector group reference: Dyn.11.

5.3.5. CONNECTIONS :

The primary (HV) winding shall be connected in delta and the secondary (L.V) winding in star with vector group Dyn11.The neutral of the secondary (LV) winding shall be brought out to a separate insulated terminal.

The size (Cross section) of the neutral connection conductors and jumpers must be of same size as that of the phase connecting conductors and jumpers which shall be properly supported and insulated.

5.3.6. TEMPERATURE RISE :

For winding 55^0C (measured by resistance) and for top oil 45^0C (measured by thermometer) when tested in accordance with clause 4.0 of I.S.2026-1977 (latest) Pt-II.

5.3.7. Short Circuit Impedance :

4% at 75^0C, 50HZ with IS tolerance Temp. rise will be conducted corresponding to loss figure at lowest tap position

5.3.8. TERMINAL ARRANGEMENT :

Bare on outdoor porcelain bushings for outdoor type transformers as per ISS/CBIP specification and other relevant specification. The top of the bushing shall be immersed in the oil when the oil level is at the minimum marking of the oil level gauge. The bushings rods should be locked in position so that twisting of leads is avoided during tightening of nuts of bushing rods. H.T. & L.T. studs are to be made of brass for terminal connections as per IS 1180 (Part-I) of 1989.

33 KV SIDE The terminals shall be through outdoor type bushings conforming to IS-2009 and provided with Bi-metallic terminal connectors (rigid type) suitable for "Dog & Racoon" ACSR conductor. Terminal connectors are to be supplied as per Technical specification of Clamps & Connectors. L.V. SIDE Connection from transformer L.V. terminal to the respective 400 V switchgears shall be made through three phase 4 core cable. L.T. terminals of transformers shall be brought out through LV bushing mounted on side wall mounted bushings. The neutral terminal shall be brought out along with the L.V. terminals through a separate bushing for connection to the respective switchgears neutral bus.

5.3.9. LEADS :

All leads of the windings, connection of the windings or their wires to one another to terminal bushing shall be properly insulated and covered with insulation sleeves. The soldering materials shall have higher melting temperature above 300^0C and preferably above 400^0 C for better thermal endurance and mechanical strength. The tenderer shall specifically mention the method and materials to be used by them for lead connection.

5.3.10. CONDUCTORS : Copper

5.3.11. Tank :

01. Tank wall must be fabricated from tested quality of mild steel sheets of adequate thickness.It should be shaped so as to make welding to a minimum . All welding shall be done electrically and relieved of welding stresses. All seams shall be double welded for absolute oil tightness. The tank wall shall be formed by stiffner of structural steel for general rigidity and to dampen transformer noise. It shall also withstand partial vacuum as per latest CBIP manual against standard atmospheric pressure. Maximum tolerance on the negative side of the steel sheets shall be 0.35 mm as per cl.8.22. of IS-1852- 1985 (Specification for Rolling and cutting tolerances for hot rolled steel products.).

    Tank design shall be such that the core and winding assembly can be tanked or de-tanked freely and easily.

    Inside wall of the tank and the M.S.Channel shall be painted with varnish or with hot oil resistance paint. Horizontal&Vertical Stiffner shall be continuously welded on the tank wall.

02. The tank cover shall be bolted on to flanged rim of the tank with a weather proof, hot,/cold oil resistance, resilient gasket in between for oil tightness. If the gasket is compressible, metallic strips shall be provided to prevent over compression of the gasket. Bushing turrets, covers for pockets of thermometers and other devices shall be designed to prevent any ingress of rain water into the tank and the tank cover as a whole shall shed of all rain water. The tank cover should have downward bent edges on all sides so that the gasket under the top cover is protected from direct exposure to weather.

    Gasket used between top cover and tank flange shall be of neoprene rubberized cork sheet and shall be provided with water tight compound between the tank flange and the gasket. G.I. nuts, bolts, flat washers, spring washers shall be used and suitably space to press the tank cover.

03. Bushing turrets, access hole covers, pockets of thermometers shall be so designed to prevent any ingress or collection of water.

04. Conservators along with Silicagel breathers are to be provided inthe transformers. The conservator shall be liberally dimensioned such that with the lowest ambient temperature and no load on the transformer,

the oil level shall not recede too low and with the highest ambient temperature and permissible overload on the transformer, the oil will not spill into the breather pipe or to the exterior to waste. The conservator shall be provided with oil level indicator with Minimum, Normal & Maximum temperature Markings. The inside diameter of the pipe connecting the conservator to the main tank shall be < 25 to 50 mm and it should be projected into the conservator in such a way that its end is approximately 20 mm above the bottom of the conservator.

Conservators shall not be provided with drain plug. Filling hole with cover shall be provided as usual. The conservator pipe hole fitted to the tank cover should be provided with a suitable slanted plate, if required so that while pouring oil into the transformer through the conservator, oil does not fall directly on the winding. Care should be taken so that free oil flow is not impeded. Explosion vents for transformers shall also be welded on the cover. Air release plug should be provided in the explosion vent, and in tank cover to release any entrapped air. One suitable inspection hole with cover of adequate size should be provided on the tank top cover sothat bushing ends and tap changer assembly may be easily accessible through that hole.The inspection cover should be placed on turret and should be provided with lifting handle and air release plug. All the fitting on the top cover should be placed on the turret. An air release plug should also be provided at the topmost point of the H.V.Bushing turrets so that any accumulated air bubble therein may be released through Air release Plug. Conservator tank shall be provided with plain oil gauge with maximum and normal marking visible from the G.L. Conservator tank shall be provided with dehydrating breathers. Drain valve shall be provided on conservator.

The Buchholz relay shall have two contacts for alarm and for tripping. The relay shall also comprise drain cock, air vent, and facility of testing with air injection/mechanical testing facility.

05. OTI pocket is to be Provided.

06. Marshalling box is to be provided for housing OTI. OTI shall be DIAL Type Thermometer with mercury contacts.

07. PRESSURE TEST : The tank shall be fixed with a dummy cover with all fittings including bushings in position and shall be subject to air pressure of 35 Kpa above atmosphere for 30 minutes. The permanent deflection of flat plate after pressure has been released shall not exceed the values given below :-

Length of plate	**Deflection**
Upto 750 mm	5 mm
751 to 1250 mm	6 mm

08. The manufacturers should submit pressure test certificate for the transformers tanks at least for each batch either conducted by them or by their fabricators, for which order is placed with them and the edges (both inside and outside) of the transformer tanks should be double welded electrically and scrupulously as per the specification.

5.3.12. CORE :

01 The magnetic core shall be built of low loss Silicon steel, cold rolled grain oriented steel core may be of stack type or wound type.

02 The materials used for insulating the sheets, shall have high inter-lamination resistance and rust inhibiting property. It shall not be deteriorated by ageing from hottest operating temperature and clamped pressure of the core dis-integrated due to mechanical modes of core vibration. It shall not have the least tendency to absorb moisture or to react with the dissolved particles in the insulting oil thus accelerating sludge formation.

03 The assembled core shall be securely clamped in the lines and in the uniform pressure so as to minimize the noise from the core.

04 The core-clamping frame shall be provided with lifting eyes for the purposes of tanking and untacking the active part of the transformers. The whole core shall be electrically connected by copper strip of adequate section to the core frame at two separate points for being eventually earthed through the tank to drain off electrostatic potential that may be built up.

Core base and top and bottom of yoke shall be supported with M.S. Channel of proper size and properly bolted together for stack type core. For wound type cores suitable M.S. clamping device should be used to hold together core laminations firmly to prevent vibration or noise.

05 The supporting framework of the cores shall be so designed so as to avoid the presence of pockets which would prevent complete emptying of tank through the drain valve or cause trapping of air during filling.

06 Adequate provision shall be made to prevent movement of the core and winding relative to the tank during transport and installation or while in service.

07 The cores shall conform to : IS : 3024 - 1965 Electrical sheet steel & IS : 649 - 1983 method of test steel sheet.

08 Successful bidder will offer for care for inspection and/or approval by the purchaser during the manufacturing stage. The manufacturer"s call notice for the purpose should be accompanied with the following documents as proof towards the use of prime core material:

(i) Invoice of the supplier
(ii) Mill"s Test certificate
(iii) Packing List
(iv) Bill of Ladding
(v) Bill of entry certificate to customs
Core material shall be procured either from core manufacturer or through their accredited marketing organization of repute.

5.3.13. WINDING :

01. The winding shall be made of paper insulated continuous and smooth electrolytic copper conductor & shall be provided with the requisite number of windings and shall be designed to withstand the electromechanical stress exerted under short circuit conditions as per ISS:2026 – 1977.

Voltage	Impulse Voltage(KV Peak)	Short duration Power frequency voltage (KV)
400V	-	3
33000V	170	70

Class A" insulation shall be used. Paper insulation shall be dry and free from punctures and other defects. Solid insulation shall be best quality. Wooden supports, if used, shall be well seasoned and compatible with hot transformer oil. The test certificate of the raw materials shall be made available by the Transformer manufacturer on request during Inspection & Testing.

02. The insulation level of the windings shall be as follows as per Part-III of IS-2026)

03. The winding shall be so designed to reduce to a minimum the out of balance forces in the transformer (at all voltage ratings).
04. The winding shall also be designed such that all coil assembles of identical voltage rating shall be interchangeable and repairing of the winding can be made readily without special equipment's.

05. BRACING OF WINDINGS:

(1) The windings and connections of all transformers shall be braced to withstand shocks which may occur during transport or due to switching/ short circuit and other transient conditions during service.

(2) Coil clamping rings, if provided, shall be of steel or of suitable insulating material. Axially laminated material other than bakelised paper shall not be used.

06. WINDING AND CONSTRUCTION:
The winding shall be assembled on the core co-axially for magnetic balance and symmetrically for electrical balance. Liberal ducts shall be provided for oil circulation and lowering hot spot temperature in the winding. Spacers, wedges shall be robust & hard insulations are so fitted in the winding that they will neither move, nor permit any relative movement of any part of the winding during normal service and under a terminal short circuit, with out causing mechanical injury to any insulation in the windings.

07. (i) The stacks of windings shall receive adequate shrinkage treatment before final assembly. Adjustable devices shall be provided for taking up any possible shrinkage of coils in service.
(ii) The coil clamping arrangement and the finished dimensions of any oil duct shall be such as will not impede free-circulation of oil through the ducts.

08. Conformation to IS standards relating of conductors and insulation. The following Indian standards specification shall govern the quality of conductor, covering insulation such as enamel, paper and insulating boards.
1) IS: 2067-1975: Wrought Aluminium Wire for electrical purposes
2) IS:7404(Pt.I & II)1974:Paper covered copper conductor.
3) IS: 1397-1967: Kraft paper
4) IS: 335-1983 : New insulating oil.
5) IS: 1576-1967
IEC: B-2.1
IEC: B-3.1 Solid Press Board for electrical purposes.
IEC: B-4.3
6) IS: 4800-1968: For enamelled round winding wire.

5.3.14. Bushings :

All bushing shall confirm to the requirements of latest revision of IS:3347. Bushings must be well processed, homogeneous and free from cavities and other flaws. Glazing must be uniform in colour and free from blisters,

burns and other defects. The clearances in air between live and conductive parts and live conductive part to earthed structures shall be as follows:

Nominal System Voltage(KV rms)	Test Voltage Impulse KVP	Clearances Phase to Phase (mm)	Phase to Earth (mm)	Arcing Horn gap
0.430	-	85	40	-
33.00	170	350	320	86*

The minimum creepage distance of 33 KV bushings should be 900 mm.

5.3.15. TAP CHANGER/TAPPINGS :-

The OFF load tap changing shall be effected by an external 3 phase gang operated tap changing switch. The operation shaft shall be brought out of the tank and provided with hand wheel so that it can be operated at standing height from plinth level and be easily accessible. The tap position should correspond to the voltage variation of (+)5% to (-)7½% in step of 2.5% at HV side with its normal position at 3.

A visual tap position indicator shall be provided near the operating handle and provision shall be made to pad lock the handle in each tap position. The locking arrangement shall be such that pad lock cannot be inserted unless required contacts corresponding to the tap position are correctly connected with full contact pressure. All contacts of the tapping shall be silver plated and held in position under strong contact pressure. Taps shall be provided on high voltage windings. At each tap position, rated output shall be available within allowable range of voltage variation.

The tap position marking should increase in clockwise direction and there should be a stopper in between maximum position i.e. 1 and minimum position i.e. 6. The tap position marking should be such that they are easily visible and permanent.

5.3.16. COOLING ARRANGEMENT:

1. The transformer shall be suitable for loading of 100% continuous maximum rating with "ONAN" cooling without exceeding the thermal limit.
2. The transformer shall be fitted with round or elliptical cooling tubes bent and welded to tank or radiators consisting of a series of separate circular or elliptical tubes, or a pressed steel plate assembly formed into elliptical oil channels, welded at their top and bottom to the tank.

3. The round cooling tubes shall be made of mild steel (ERW) having a minimum wall thickness of/ 1.50 mm and a clean bright internal surface free from rust and scale. They shall be suitably branched to protect them from mechanical shocks normally met in transportation and to damp the modes of vibration transmitted by the active part of the transformer in service. The elliptical tubes or elliptical oil channels of pressed steel plate at least of 18 SWG (or 1.25mm Thickness).
4. The manufacturer will have to provide information regarding wall surface area of tank radiator cooling tubes separately as part of the guaranteed technical particulars.

5.3.17. PAINTING:

1. The surface to be painted shall be completely cleaned & made free from all rust, scale or foreign adhering matter on grease. The cleaning & de rusting can be done by sand blasting or other approved method.
2. All steel surfaces in contact with insulating oil as far as accessible shall be painted with heat resistant, oil insoluble, insulating varnish or paint.
3. All steel surface exposed to weather, shall be given a primary coat of Zinc chromate and two coats of dark admiral gray paints. (IS 104 & IS 2932) OR Powder coating painting as specified by CEA/REC
4. All paints shall be carefully selected to withstand tropical heat and extremities of weather. The paint shall not scale off or winkle or be removed by abrasion due to normal handling.
5. All nuts and bolts used in the transformer for external fittings shall be galvanized or zinc passivated and painted with body paint.

5.3.18. TEST & INSPECTION (AS PER I.S.S)

01. ROUTINE TEST.

All transformers shall be subject to routine tests at the manufacturers Works. The following tests are to be carried out.

a. Measurement of winding resistance at all taps.
b. Ratio, polarity and phase relationships.
c. Impedances voltage.
d. Load losses.
e. No load less and no load current.
f. Insulation resistance.
g. Induce over voltage withstand.
h. Separate source voltage withstands.
i. Characteristic requirement of oil sample will be as per IS-1866, 1983 amended up to 1987.

j. Unbalance current: The maximum value of unbalance current in transformer shall not exceed 2% of full load current as per CBIP manual for transformer.

k. Magnetizing current at rated voltage & frequency and 112.5% of rated voltage & frequency should not exceed the limit as per IS 1180(part-I) 1989

l. Insulation resistance between windings & wings to earth at 75 0C

m. To facilitate testing, arrangement should be made for Carrying out Heat Run tests for one transformer.

02. TYPE TESTS:

In addition to the routine tests, the following type tests, if required, are to be made by the manufacture, who does not have type tests Report of identical transformers.

a. Dynamic short circuit withstand test to be conducted as per Cl.16.11 & 16.11.4.4 of IS:2026 (Part-I) 1977

b. Impulse voltage withstand test to be conducted as per Cl.13 of relevant IS

c. Temperature rise test –will be conducted on one transformer for every lot offered for inspection.

If records of type tests (a) & (b) above on a transformer which in essential details, is representative of the one being purchased, are furnished the purchaser may accept these as evidence test instead of actual test.

d. Employer or its appointed authorized agency may witness the said tests at the manufacturers' premises.

03. The manufacture will have to submit thermal calculation of short circuit withstand ability for 2 seconds and 3 seconds.

04. Performance under external short Circuit condition and limit of temperature rise.

All transformers shall be capable of withstanding, without damage the thermal and mechanical effects of a short circuit at the terminals of any of windings for 2 secs. The temperature in the windings after 2 secs. of over current must not exceed 200^0C for Al and 250 ^{0}C for Cu windings After the above tests, the transformer shall be subjected to all or a part of the routine test. The criteria for evaluation of test results shall be the same as that for the test to determine the dynamic ability to withstand short circuit in accordance with ISS 2026. Employer may also make a testing arrangement for carrying out short circuit tests with duration not exceeding 2 secs. in a suitable place. The transformer Subjected to such test shall be examined for

temperature rise within specified limit for any damage or displacement of any parts within the transformer.

The transformer so tested shall not exhibit more than 2 percent variation in percentage reactance after the short circuit test form the original measured value before testing according to clause 16.11.5.4 of IS 2026 (Part-I), 1977. The selection of transformer for such test shall be carried out at the discretion of the Company from any lot of transformers of same capacities offered for inspection and testing before delivery. The cost of to and fro transportation to the test premises for the above testing shall be borne by the Suppliers/Manufactures of the Transformers.

05. The bidder should submit Type Test Report from CPRI/ NABL/Govt. approved laboratories along with their offer having identical technical parameters as that of the tendered item failing which their offer may not be technically accepted.

However, if it is found that the bidder has submitted Tests Report but those have not been conducted on identical design of equipment/material as per specification of Employer, the same may be accepted subject to the following condition :- Employer at his discretion request the successful bidders to conduct Type Tests/special tests on identical design as per specification of Employer . Such Type Tests/special tests if required to be carried out at NABL/Govt. approved Laboratories for which no extra cost will be charged to Employer.

06. Transformers shall have to be tested for Dynamic Short Circuit withstand Test and Impulse voltage withstand test at CPRI/ NABL Accredited Laboratory or any other Govt. recognized Test House. Transformers for such tests are to be manufactured as per relevant technical specification and approved drawing and should be offered for preliminary testing like routine and temperature rise test prior to type tests, by Employer "s testing wing. After successful completion of preliminary tests, transformers may be sent for type tests. Type tested passed transformers, duly witnessed and sealed by Employer "s Testing Wing are to be retained at the manufacture "s premises with Employer seals for comparison of the transformers to be offered. The transformers to be manufactured and supplied should have identical design, dimension and drawings as that of approved design, dimensions and drawings of the type tested transformers.

07. **INSPECTION** : The transformer may be stage inspected at the factory of the manufacture. The manufacture shall intimate in advance in

writing to the purchaser about the stages of manufacture & subsequent readiness of the transformers to enable him to carry out stage inspection & final inspection and testing of the finished transformers. The stage inspection will be carried out at the discretion of the purchaser during the process of manufacturing of the transformers. The manufacturer need not stop the process of production because of programme of stage inspection of the Purchaser. While offer for final inspection the following point should invariably betaken care of.

i) Name plates should be welded/rivetted on the tanks of the transformer.

ii) The bolts connecting the top cover of the transformer with the tank at the two opposite comers are to be provided with holes at their lower portions which would go beyond nuts so that the transformers may be sealed by inserting sealing wire in these holes.

5.3.19. Over Load Capacity :

Each transformer shall be capable of carrying sustained overload as stated in IS: 6600.

5.3.20. Over Fluxing:

Over fluxing in the core shall be limited to 10% so that the flux density in the core does not exceed 1.9. Tesla (19000 lines/ sq.cm) The maximum flux density in any part of the core under such condition shall not exceed 19000 lines/Sq.cm. on the basis of M4, M5 & M6 grades as per BS 601: Part-2: 1973 (Specification for sheet and for magnetic circuits of electrical apparatus oriented Steel)

5.3.21. Transformer Oil:-

The oil shall be as specified in IS:335-1980 and it shall be free from moisture and have uniform quality throughout.

a. The outdoor apparatus including bushing insulators shall be designed so as to avoid pocket in which water can collect.

b. All mechanism shall be so as to prevent sticking of “dew” to avoid rust and corrosion.

c. All apparatus shall be designed to minimize the risk or accidental short circuit caused by animals, birds or verurin.

5.3.22. Internal Earthing Arrangement :

All metal parts of the transformer with the exception of the individual core laminations, core bolts and associated clamping plates shall be maintained at some fixed potential and core should be earthed at two points.

Anything not covered by this specification will be as per relevant I.S.S./IEC Specification.

5.3.23. MAXIMUM ALLOWABLE LOSS VALUES AND % IMPEDANCE.

KVA Ratting	Voltage Ratio	No. load loss. In watts	Load loss at 75^0C in watts	Percentage Impedance
100 KVA	33/0.430 KV	260	1760	4%

No load loss and load loss figures as mentioned above are without any positive tolerance. Tolerance i.r.o. percentage impedance will be as per ISS-2026-1977.

5.3.24. CAPITALIZATION OF LOSSES

The Capitalization of guaranteed losses of the transformer shall be calculated and considered while evaluating the bids.

5.3.25. LIQUIDATED DAMAGES FOR EXCESSIVE LOSSES

There is no positive tolerance on the guaranteed losses offered by the bidder. However, the transformer(s) shall be rejected out rightly, if any of the losses i.e. no load loss or load loss or both exceed (s) the guaranteed maximum permissible loss figures quoted by the bidder in the Technical Data Schedule with the bid.

5.3.26. Asset Codification no. – Asset codification no. for the ordered quantity shall be communicated to the supplier after placement of order. Necessary Engrave/Embossing (cold punch) shall be done on the main tank with 28 no font size and DTR name and diagram plate with font size not less than that used for marking KVA rating of the DTR.

If cold punch on the tank is not possible then separate property plate (details marking of the plate shall be submitted with the transformer drawing for approval) shall be welded to the tank with the following details:-

1. Ratings :
2. Manufacturer's Sl.No. :
3. Manufacturer's Name :
4. P.O. No. :

5. Year of Manufacturing:
6. Property of :
7. Asset Code Number :

Again the following points shall have to be noted

a) Front Size of letter shall be 28 i.e. 7 mm x 5.5 mm
b) Letters shall be distinctly engraved by cold Punch
c) Plate size shall be minm 125mm X 170mm and shall be electrical run Welded be throughout its perimeter
d) Material of Plate shall be Mild Steel and not less than 3mm thick.
e) Plate shall be welded on the transformer tank at visible position and height.

5.3.27. INSPECTIONS AND TESTING

The Employer shall have free entry at all times, while work on the contract is being performed, to all parts of the manufacturer's works which concern the processing of the equipment ordered. The manufacturer shall afford the Employer without charge, all reasonable facilities to assure that the equipment being furnished is in accordance with this specification. After approval of Drawings by the Employer, the manufacture shall manufacture a Prototype Model as per the Approved Drawing and offer the same for inspection.

The Supplier shall offer the core, windings and tanks of each transformer for inspection by the Employer's representative(s). During stage inspection of the Prototype Model, all the measurements like diameter, window, height, leg centre, stack width, stack thickness, thickness of laminations etc for core assembly, conductor size, insulation thickness, I.D., O.D., Winding height, major and minor insulations for both HV and LV windings, length, breadth, height and thickness of plates of transformer tanks, the quality of fittings and accessories will be taken/ determined.

The Inspection Report for the Tests conducted by our Authorized Inspectors in presence of the manufacturer's representative, for the Prototype Model offered for inspection with suggested modifications, if any shall be submitted to the undersigned for approval.

After Inspection, the Prototype Model shall be kept sealed, in the premises of the manufacturer till the completion of delivery of final consignment, for future reference during subsequent Inspections.

The Supplier can offer for final inspection of the transformers subject to clearance of the stage inspection report by the Employer

The Employer reserves the right to reject an item of equipment if the test results do not comply with the values specified or with the data given in the technical data schedule.

Routine tests shall be carried out by the Supplier at no extra charge at their works.

Adequate facility with calibrated testing equipment must be provided by the manufacturer free of cost to carry out the tests. Type test certificates must be furnished along with the tender for reference of the Employer.

The Employer will witness all required tests. In order to facilitate this, the Supplier shall give the Employer a minimum of 10 days notice that the materials are ready for testing.

The supplier shall submit to the Employer five signed copies of the test certificates, giving the results of the tests as required. No materials shall be dispatched until material dispatch clearance is not issued by employer.

The test certificates must show the actual values obtained from the tests, in the units used in this specification, and not merely confirm that the requirements have been met.

The Employer at his discretion may re-confirm the Routine Test Results, particularly no load losses, load losses and percentage impedance in his own laboratory or laboratory of his choice.

No inspection or lack of inspection or passing by the Employer's Representative of equipment or materials whether supplied by the Supplier or sub-supplier, shall relieve the Supplier from his liability to complete the contract works in accordance with the contract or exonerate him from any of his guarantees.
However in case of future discrepancy, if any, after acceptance of equipments, observed at any stage during guarantee period, the matter may be referred to Bureau of Energy Efficiency (B.E.E) for random testing of equipments supplied. In such cases the observation of B.E.E shall be binding to both parties.

5.3.28. GUARANTEE

The supplier shall guarantee the following:

- Quality and strength of materials used;
- Satisfactory operation during the guarantee period from the date of commissioning,as per general terms of condition of the contract.
- Performance figures as supplied by the tendered in the schedule of guaranteed particulars;
- The offered surface treatment shall protect the treated metal from corrosion for a period of not less than five years from the date of delivery.

5.3.29. PACKING AND SHIPPING

Packing

The equipment and any supporting structures are to be transported adequately sealed against water ingress. All accessories and spares shall be packed and securely clamped against movement in robust, wooden, non returnable packing cases to ensure safe transit in rough terrain, cross country road conditions and in heavy rains from the manufacturer's works to the work sites/earmarked destinations.

All accessories shall be carefully packed so that they are fully protected during transport and handling operations and in storage. Internal surfaces of loose accessories shall be sealed by means of gaskets and blanking off plates. All parts liable to rust shall receive an anti-rusting coat and shall be suitably protected. It shall be the responsibility of the Supplier to make good any damage caused through insufficient packing. Each packing case shall be indelibly marked, on two adjacent sides and on the top, with the following:

- Individual serial number;
- Employer's name;
- Contract number;
- Destination;
- A colour coded marking to indicate destination;
- Supplier's name;
- Description and numbers of contents;
- Manufacturer's name;
- Country of origin;
- Case measurements;
- Gross and net weight in kilograms: and
- All necessary slinging and stacking instructions.

Each crate or container shall be marked clearly on the outside of the case to show TOP and BOTTOM positions with appropriate signs to indicate where the mass is bearing and the correct positions for slings. All component parts which are separately transported shall have permanent identification marks to facilitate correct matching and assembly at site. Welded parts shall be marked before welding. Six copies of each packing list shall be sent to the Employer prior to dispatching the equipment.

Transportation

The contractor shall be responsible for the transport of all plant and equipment supplied by them and for the transport of all goods to the various specified destinations including all road clearance, offloading, warehousing and insurance. The Supplier shall inform himself fully as to all relevant transport facilities and requirements and loading gauges and ensure that the equipment as packed for transport conform to these limitations. The Supplier shall also be responsible for verifying the access facilities specified.

The contractor shall be responsible for the transportation of all loads associated with the contract works and shall take all reasonable steps to prevent any highways or bridges from being damaged by his traffic and shall select routes, choose and use vehicles and restrict and distribute loads so that the risk of damage shall be avoided. The Supplier shall immediately report to the Employer any claims made against the Supplier arising out of alleged damage to a highway or bridge. All transport accessories, such as riding lugs, jacking pads or blanking off plates shall become the property of the Employer.

All items of equipment shall be securely clamped against movement to ensure safe transit from the manufacturer's facilities to the specified destinations.

The Supplier shall advice the storage requirements for any plant and equipment that may be delivered to the Employer's stores. The Supplier shall be required to accept responsibility for the advice given in so far as these arrangements may have a bearing on the behavior of the equipment in subsequent service.

5.3.30. LABELS

All apparatus shall be clearly labeled indicating, where necessary, its purpose and service positions. The material of all labels and plates, their dimensions, legend and the method of printing shall be subject to approval of the Employer. The surfaces of all labels and plates shall have a mat or satin finish to avoid dazzle from reflected light. Colours shall be permanent and free from fading. Labels mounted on black surfaces shall have white lettering. Danger plates shall have white lettering on a red background. All labels and plates for outdoor use shall be of in-corrodible material. Where the use of enameled iron plates is approved, the whole surface including the back and edges, shall be properly covered and resistant to corrosion. They shall be engraved in English. Name plates shall be white with black engraved lettering and shall carry all the applicable information specified in the applicable items of the Standards. No scratching, corrections or changes will be allowed on name plates.

Name plates shall be provided of white background with black engraved lettering carrying all the applicable information specified in the standards and other details as required by the Employer. The name plate inscription and the size and lettering shall be submitted to the Employer for approval.

6. 33kV CONTROL AND RELAY PANELS & 11kV SWITCH BOARD PANELS

6.1. SCOPE:

This section contains the technical specification for the Indoor Control, indication, relay and metering panels associated with the outdoor switchgear for use at various sub-stations. The control and relay panels and other requirements specified under this section shall be complete in themselves with all main and auxiliary relays, MCBs, links, switches, wiring, labels, terminals blocks, earthing terminals, foundation bolts, illumination, cable glands etc.

6.2. PANEL FINISH AND COLOUR:

The owner has standardized that the colour finish of control panel shall be opening green as per colour no. 275 of BS: 381C (1948). Equivalent colour as per relevant Indian Standards or any other standard shall be acceptable. This colour finish shall be applied to all the exterior steel work of the panels. The exterior finish shall be semi-glossy only and shall not be fully glossy. The interior of the panels shall be painted with egg shell white.

6.3. PROTECTIVE RELAYS AND INSTRUMENTS:

The protective relays shall be manufactured, tested and supplied with the guaranteed particulars, as per following Indian Standard Specifications with latest amendment thereof :-

i	IS-3842 (Part-I) 1967	Application guide for electric relays for A.C. Systems over-current relays for Feeders and Transformers
ii	IS-3842 (Part-IV) 1967	Application guide for electric relays for A.C. System thermal protection relays
iii	IS-3231 (1965)	Electric Relay for Power System Protection
iv	IS-1885 (Part-I & II)	Electro-technical vocabulary Electrical Relays & Electrical Power System Protection
v	All indicating instruments shall conform to IS-722 or BS-89	

The equipment meeting any other authoritative standard which ensures equal or better quality than the standards mentioned above shall also be acceptable. Equipment for which Indian Standards are not available the relevant British Standards and IEC recommendations will be applicable.

6.4. NUMERICAL OVER CURRENT & EARTH FAULT RELAY:

Numerical MiCom P 127 should be fitted for over current and earth fault relays. Relays shall be suitable for 5 Amp and 1.0Amp C.T. secondary current and 110

Volts DC auxiliary supply with 1.3/0.6 seconds operating time at 10 times current setting and instantaneous cut off features with setting 4 to 10 times of rated current with arrangement to bypass the features, when not required. The relays should have under/over voltage protection under/over frequency relay, disturbance/fault/recorder etc.

6.5. CURRENT SETTING RANGE:

- 50% to 200% in seven equal steps of 25% for over current elements.
- 10% to 40% in seven equal steps of 5% for earth fault element.

However, setting in more than seven steps will be preferred. Further, change of settings under load condition should be possible without interruption of feeder.

Resetting Current: More than 90% of setting value.

Transient over reach less than 3% on maximum and 5% on minimum setting for primary source angle up to 75 degree. Time of operation 30 seconds at times setting.

Over shoot time of maximum 80 secs. at 10 times current.
Pick Up Current : 1.1 times the current rating.
Operating Time : 1.3/0.6 secs. at 10 times current with time multiplier 1.0.

The setting should be in 10 times more, fixed calibrated steps from 0.01 to 1.0 and in between variable separately for over current and earth fault relays.

Resetting Current	:	More than 90% of setting value.
Resetting Time	:	Less than 5 m sec.

6.6. CONTACTS :

Two sets of NO contacts (for Trip and Annunciation) self-rest type suitable for make and break having continuous rating 1250W/VA and 30 W/VA respectively.

Operational Indicator: Should be provided by way of LED for, ON, O/C 1, O/C 2, E/F, and should fulfill the following requirements:

- Must give permanent visual signal after fault is cleared and relay has been reset.
- Should operate with pulse time of less than 20 m sec..
- Should not give indication until the trip pulse is being executed.

Other: Facility to re-set indicating lamp manually should be provided. During testing / calibration of relays, facility for blocking tripping should be provided. Facility for self -monitoring / test should be provided, so that hardware and software are constantly monitored and irregularities are immediately detected and signaled.

In case of non-draw out type relays test socket alongwith test prob should be provided, so that calibrated current and values are checked as also current can be injected through and adaptor.

6.7. TYPE TEST CERTIFICATES FOR RELAYS:

The bidders should submit the following type test certificates in respect of relays offered by them for their control panels:

i) 5 KV Impulse peak voltage test on the relays. This type test report is essential for over current and earth fault relays.

ii) Type test report for vibration test to prove the stability of relays under vibration normally encountered and also vibration under abnormal conditions.

iii) Type test report for overshoot time for IDMT relays.

NOTE: Regarding testing of the relays, reference may please be made to BS - 142 - 19. The tenders not accompanied with the above type test reports shall be rejected.

6.8. PANEL CUT OUT AND DIMENSIONS:

i) The panels shall be fabricated from 14 SWG steel sheets free from all surface defects. The panels shall have sufficient structural reinforcement to ensure a plain surface to limit vibration and to provide rigidity during dispatch and installation. All control panels and switchgear cubicles shall be made absolutely vermin-proof and subjected to the approval of the owner.

ii) The panels shall have the following dimensions:-

Height	2000 mm
Width	700 mm
Depth	700 mm

If the dimension of panels stated above is required to be changed depending on the actual requirement, approval of the owner has to be obtained.

iii) The preferred panel cut out dimensions for mounting of the relays shall be as per Indian Standard Specification IS-4483 (Part – I & II).

iv) The design, material selection and workmanship shall be such as to present a neat appearance, outside and inside with no works of welds, rivets, screw or bolt heads apparent from the exterior surface of the Control Panels.

6.9. PANEL LIGHTING:

a) For interior illumination, an LED lamp/tube operating at 230 Volt 50 Hz with switch shall be provided in each panel. The lamp/ tube shall be located at the ceiling and guarded with protective cage. The switch shall be mounted on one of the side walls and shall be easily accessible.

b) One 5 Amp. 3 Pin receptacle with plug, switch and fuse shall be provided in each control panel.

6.10. AUXILIARY SUPPLY:

a) For each Control Panel, the owner will provide the following:-

i) 230 V plus 10% minus 20%, 50 Hz neutral grounded A.C. supply.

ii) 110 V ± 10% D.C. supply.

b) MCBs shall be provided by the agency for both the A.C. and D.C. power supplies.

6.11. CONTROL WIRING:

a) The agency shall provide complete wiring up to the terminal block for the equipment, instrument devices mounted in the control panel strictly according to the wiring diagram prepared by the bidder based on the owner's information and schematic diagram and get approved from the owner.

b) The wiring shall be completed in all respects so as to ensure proper functioning of the control, protection and metering schemes. Agency shall supply, lay and terminate all the control cables between VCB panel, Control panel (Indoor) and CT.

c) All spare contacts of relays and switches shall be wired up to the terminal block.

d) The Control Panels shall be supplied completely wired ready for owner's external connections at the terminal blocks. For CT circuits the wiring shall be carried out with 1100 V Grade PVC insulated stranded copper conductor of size 2.5 sq. mm. For PT circuits and also for control circuits, the wiring shall be carried out with 1100 Volt Grade PVC insulated stranded copper conductor of size 1.5 sq. mm.

e) Colour coded wires should be used to facilitate easy tracing, as under:-

i) Three Phase A.C. Circuit:-
Red for R Phase
Yellow for Y Phase
Blue for B Phase
Black for Neutral

ii) Single Phase A.C. Circuit:-
Red for Phase
Green for Earthing
Black for Neutral

iii) D.C. Circuit:-
Red for Positive
Black for Negative

iv) Control Wiring:-
Gray for annunciation and other control circuits.

f) Each wire shall be identified at both ends with wire designation number by plastic ferrules, as per wiring diagram based on latest revision of IS-375 to denote the different circuit functions. The agency shall take approval for the system of wire numbering.

g) All wire termination shall be made with solderless compression type connectors. Wires shall not be tapped or spliced between terminal points. All wire shall have crimp type termination and direct connection at any place is not at all required.

h) All series connected devices and equipment shall be wired-up in sequence. Loop-in/loop-out system of wiring shall be avoided, as far as possible and the common buses shall normally be made through the terminal block for better reliability of testing and maintenance.

i) MCB shall be provided for isolation of individual circuit from the bus wires without disturbing the other circuits' and equipments.

j) The DC trip and DC voltage supplies and wiring to main protective gear shall be segregated from these for back up protection and also for protective apparatus for special purposes. Each such group shall be fed through separate fuses, either direct from main supply fuses or the bus wires.

k) Since a number of wires will run from one point to another, it is desired that the support arrangement should be adequate and neat. The conventional method of bunching of wire should not be adopted, since the same may create problems in case any wire is required to be removed. The wires should be accommodated in plastic channel with sliding plastic cover mounted inside the panel, suitably. Inspection/removal of wires should be possible by sliding the covers.

l) Blank plastic channels should be provided by the sides of the panel to accommodate the incoming cables from switchyard through the cable glands.

m) The circuit diagram of control circuit along with operating instructions (DOS/DON'TS) embossed on metallic plate duly laminated shall be provided on rear side of the door.

6.12. TERMINAL BLOCKS

a) Multi-way terminal blocks complete with necessary binding screws and washers for wire connections and marking strips for circuit identification shall be provided for terminating the panel wiring and outgoing cables. The terminal block shall be suitable for receiving atleast 2×7/0.737 mm stranded copper or aluminum conductor wire per terminal.

b) Terminal blocks shall have shorting and disconnection facilities. The panel-side and outgoing wires should be dis-connectable just by opening the disconnecting links which slide up or down without dislodging the wires from their position. However, dis-connectable type terminal connectors may be limited to CT & PT circuits only.

c) The terminal blocks shall be grouped according to circuit functions and each terminal block group shall have at least 20% spare terminals.

6.13. CABLE ENTRY

a) The control panel shall have provision of cable entry from the bottom. One no. cable gland for 8 cores and 2 nos. for 4 core 2.5 sq mm unarmoured cables duly fitted in gland plate and covered shall also be provided. The agency will arrange for necessary floor opening, below the panels to suit the requirement. Agency shall also be responsible for laying of control cable in trench, floor opening below the panel, trench cutting and making the damages good as per the satisfaction of Engineer in charge inside the control room.

b) The wiring through terminal blocks shall be such located so that it is convenient for floor opening.

c) The control panel shall have provisions inside for fixing the multi-core cable glands which shall be included by the bidder in scope of supply. For fixing these cable glands, detachable gland plates of 4 mm thickness shall be mounted at least 200 mm above the floor level.

d) The cable gland plate and rear door shall be properly gasketed.

e) Rigid supports shall be provided along the terminal block for holding plastic channel. Suitable clamps may also be provided in plastic channel for holding cables.

6.14. GROUNDING

a) 25 mm × 6 mm copper round bus shall be provided extending along with the entire length of the panel and effectively grounding all metal structures. The earth bus should be designed for suitable inter connection with adjacent control panel which are to be placed side by side in the control room.

b) Each continuous length of ground bus shall have provision of two terminals at two separate points for connection to ground.

c) Potential and Current transformer neutrals shall be grounded only at the terminal blocks where they enter the control panel from the transformer.

d) Wherever a circuit is shown grounded in the drawings, a single wire for the circuit shall run independently to the ground bus and connected to it.

6.15. DOORS

Each panel shall be completed with end enclosing sheets on both sides and door in the rear. There shall be one door with handle and also turn twist locks at top and bottom. Proper gasketing shall be provided on the door. A type test report from the recognized Govt. Laboratory on degree of protection test (IP-55) shall also be furnished with the tender. The doors should be grounded with flexible braided copper conductor of 10 sq.mm.

6.16. LABELS & INDICATIONS FOR CONTROL AND RELAY PANELS

The control panels required for installation at all the sub-stations shall be of simplex type. The control and indication apparatus, all meters and relays shall be mounted in the front. The instruments and relays shall be flush pattern.

The labeling for the circuits shall be provided at the front control panel, as well as on the inside wall. All indicating instruments, meters and important components shall have identification labels from inside also, in addition to outside. The terminal block shall also have identification labels to them, clearly indicating phase's identifications and also circuits and instruments identification. For example, the terminal connector shall have an identification indicating that CT circuit for metering, for protection etc. Labeling should be provided by using 2 mm thick aluminium strip embossed with desired information and fitted in the panel sheet by means of rivets.

6.17. PROTECTION SCHEME

The protection schemes to be supplied under this control shall cover the following equipments:

a) Transformers
b) Overhead sub-transmission lines

The protection schemes are described in the following clauses:-

6.18. TRANSFORMER PROTECTION

Transformer Control Panel is required for control/ protection on both 33 KV and 11 KV sides of 33/ 11 KV transformers. This will be in the form of a numerical (MiCom P 127) at 11kV and 33kV Control Panel. The current settings of O/C relay elements shall be from 50 to 200% and of E/F relay element from 10 to 40%. They shall be suitable to work on 110 Volt D.C. supply. The secondary rating of C.T. shall be 5 Amps for 11kV panels and 1 Amp for 33kV panels. The over current and earth fault relays shall have operating time of 1.3 sec. at 10 times of plug setting current. Further, the relays shall have self re-set contacts and hand re-set flag arrangement. Besides this provision for alarm and tripping due to Buchholtz relay operation, OTI and WTI may be kept in the panel.

6.19. FEEDER PROTECTION

a) Feeder Control Panel is required for control/ protection of both 33 KV & 11 KV sub-transmission lines. This will be in the form of a Numerical relay (MiCom 127). The current settings of O/C relay element shall be 50 to 200% and of E/F relay element 10 to 40%. They shall be suitable to work on 110 Volt D.C. supply. The secondary rating of C.T. shall be 5 Amps for 11kV panels and 1 Amp for 33kV Panels. The over current and earth fault relays shall have operating time of 0.6 sec. at 10 times of plug setting current (in case of 11 KV Control Panels) and 1.3 sec. at 10 times of plug setting current (in case of 33 KV Control Panels).

6.20. CONTROL AND INDICATING CIRCUITS

The control and relay panels shall have the following instruments, relays and accessories:-

1No Numerical type relay (MiCom P-127) which consists O/C & E/F relays, over/under frequency relay, Disturbance recorder, Fault & event recorder.

1 Set – provision for alarm and tripping due to Buchholtz relay operation, OTI and WTI may be kept in the 33 KV transformer control panel.

1 No. - Circuit Breaker Control switch (Push Button type) having Trip/ Neutral/ Close positions.

1 No Frequqency meter with accuracy class 0.5 for 11kV Panel & 0.2 for 33kV Panels

1 No Digital Trivector Meter or multifunction meter for recording Power & energy etc with accuracy class 0.2 for 33kV panel & 0.5 for 11kV panel

1No Watt meter with accuracy class 0.2 for 33kV panel & 0.5 for 11kV panel

1 No watt-hour meter with accuracy class 0.2 for 33kV panel & 0.5 for 11kV panel

4 nos. - Lamps for circuit breaker “ON”, “OFF”, “TRIP CKT HEALTHY” and “AUTO TRIP” indications. LED indicating lamp complete with static circuits and features should be supplied with Low voltage protection circuit (LVGP) and surge suppressor circuit having LED indication. Lamp assembly should be of fire – retardant glass epoxy PCB , industrial heat resistant, fire resistant, non hygroscopic DMC material, chrome – plated corrosion resistant solid brass bezel, polycarbonate lens in desired colour shades of Red, Green , Amber, Yellow etc. the intensity of light should be minimum 100 mcd at 20 mA . Indication lamp should be suitable to operate on 30 V direct current supply source. Acceptable make are BINAY Opto Electronic Private Ltd. or equipment.

1 no. - Ammeter 96 sq. mm. Square MISC type flush pattern having class 0.2 accuracy. The ammeter shall have dual scale 0-200/100 Amps. or 0-300/150 Amps as per requirement.

1 no. - Ammeter selector switch to indicate current in three R, Y and B phases.

1 no. - Voltmeter 96 sq.mm. Square MISC type flush pattern having class 0.5 accuracy with selector switch (for Transformer Control Panel. (The range of

Voltmeter shall be 0-15 KV for 11 KV Control Panel and 0-40 KV for 33 KV Control Panel).

1 no. - Alarm bell for circuit breaker trip alarm.

1 no. - Alarm cancellation relay for C.B. trip alarm

2 nos.- Push Buttons for alarm "ACCEPT" & "RESET"

1 no. - DC Failure Visual indication by way of providing a lamp.

2 nos.- Push Button for testing healthy condition of trip circuit. (Separate circuits for Supervision of healthiness of two trip coils are required. Accordingly, the DC circuit complete with fuses etc. shall be separate for the two trip coils).

1 no. - Illumination lamp with cage and switch.

1 no. - Space heater with associated ON-OFF switch.

1 no. - Power type 3 pin 5 Amps plug and socket with ON-OFF switch and fuse.

A trip healthy lamp shall be provided for each circuit breaker and connected in such a way as to indicate the healthy condition of the trip circuit. The lamp should have the indication on demand when breaker is on. Such indication is also necessary when the breaker is off, but it should be possible to check the trip circuit condition before closing the circuit breaker. In brief, pre and post close trip supervision facility on demand is required and shall be included.

The automatic tripping of the circuit breaker due to operation of protective relays shall be indicated by a common audible alarm. The audible alarm shall be cancelled by the flag cancellation of relay, in case of relays of hand-reset type. Space shall be provided for provision of KWH meter, with proper sealing.

NOTE: - Any other indications which are required for proper protection/ operation of circuit breaker should be provided in control panel, without any extra cost.

6.21. RELAYS

All relays, except where otherwise approved, shall be capable of breaking the maximum current which shall not be affected by vibration or by external magnetic fields. The contacts shall be of silver, platinum or other approved materials and shall be capable of repeated operation, without deterioration.

All relays, which are connected to complete the tripping circuit breaker coil of the auxiliary tripping relay shall be provided with approved flag indication, which whenever possible, shall be mechanically operated type. Indicators shall also be provided on such additional relay elements as it will enable the type and phase of the fault condition to be identified. Each indicator, whether of the electrically or mechanically operated type, shall be capable of being reset by hand, without opening the relay case. Each indicator shall be so designed that it cannot move before the relay has completed its operation.

It shall not be possible to operate any relay by hand without opening case.

All relays shall be so arranged that on opening the case it shall be impossible for any dust, which may have collected in or upon the case to fall on the relay mechanism.

Over current/Earth fault relays shall be numerical type and shall have inverse definite minimum time limit characteristics with separately adjustable time and current settings. Unless otherwise approved, the definite minimum time shall be continuously variable from 0.2 seconds and current setting range shall be variable between 50% and 200% in six equal steps of 25% each. The relay rating shall be 5 Amps.

O/C and E/F relays shall have characteristics 1.3 second for protection of transformer on both primary as well as on secondary sides and 0.6 second characteristics for protection of 11 KV feeders. In case of 33 KV feeder protection, the characteristics operating time shall be 1.3 seconds. Further, these relays shall have self-re-set contacts with hand re-set DC operated flag arrangement.

Type test certificates for relays shall be submitted.

6.22. INSTRUMENTS

All indicating instruments shall conform to IS – 1248 and shall be of types and sizes specified under Sr. No. 15 above. They shall be capable of carrying their full load currents continuously without heating. They shall have long clearly divided and indelibly marked scales of engraved or enameled metal and the pointers shall be of clean outline. The pointers and scales shall be subject to approval. The marking on the dials shall be restricted to the scale marking. All indicating instruments, shall be provided with non-reflecting glass type fronts. All indicating instruments shall be of class 1.0 accuracy.
Type test certificate for Ammeter and Voltmeter shall be submitted.

The following may be carefully noted:-

i) The components of alarm scheme shall be strictly in accordance with tender specification and shall be explained very clearly. The alarm scheme is required with Transformer Control Panel only.
ii) The scheme incorporated should ensure that flag resetting of relay is "self-hand operated" type. Thus it should not be necessary to reset the flag at the time alarm/ annunciation is accepted in case of fault. It should be possible to separately reset the flag, after the fault is attended.

The automatic tripping of the circuit breakers due to operation of protective relays shall be indicated by audible alarm. The offered alarm scheme shall be complete in all respects including one DC bell for trip alarm with a connector/ auxiliary relay suitable to handle breaking of DC bell current. The contactor/ auxiliary relay will get energized through the self-reset alarm contact of protective relay and will remain actuated by its own seal-in contact. A push button shall be provided to accept the alarm by breaking the seal-in circuit.

6.23. 11KV SWITCH GEAR PANEL

6.23.1. CONSTRUCTION

i). The switchgear shall be of CRCA steel construction with sheet not less than 3mm thickness for load bearing section and not less than 2 mm thickness for non-load bearing and shall totally dust and vermin proof. However, if vendor has standardized the thickness of enclosure other than above mentioned and it meets the performance requirements and the design has been established through type test, the same shall be accepted. The panels shall be rigid without using any external bracings. The switchboard panels should comply with relevant IS/IEC and revision thereof and shall be designed for easy operation maintenance and further extension. Bus bar, metering circuit breaker chamber, cables and cable box chamber should have proper access for maintenance, proper interlocks should be provided. All instruments shall be non-draw out type and safe guard in every respect from damages and provided with mechanical indicator of connection and disconnection position. The switchgear shall be completed with all necessary wiring fuses, auxiliary contacts terminal boards etc.

ii). The arcing contacts and bus bar should be rated for 350 MVA for 3 seconds. Bus bars shall be capable of connecting one switchgear panel to other through proper insulated arrangement, which does not decrease the insulation strength of the bus bar at the point of connection between two panels. The panels shall be modular in design.

iii). The breakers should be able to be drawn out in horizontal position at ground level [with vertical/horizontal isolation] when breaker is drawn out in horizontal position none of the live components inside the 11 KV switchgear panel should be accessible. The safety shutters shall be

robust and shall automatically cover the live components when the breaker is drawn out. The switchgear shall have complete interlocking arrangements at the fully inserted and fully drawn out and test positions. Withdrawal of the breaker should not be possible in ON position, it should not be possible to close the circuit breaker in service unless the entire auxiliary and control circuit are connected.

iv). Breaker should have three distinct positions inside the cubical; i.e. service, test and isolated.

v). Built-in/separate trolley mounted earthing switches for incomer and outgoing shall be provided.

vi). All the high voltage compartments must have pressure discharge flap for the exit of gas due to internal are to insure operator safety. All the HV compartment design ensures conformity to IEC-60298 and must be type tasted for Internal Arc Test.

6.23.2. BUS BARS AND CONNECTORS

i). Bus bars and all other electrical connection between various components shall be made of electrolytic copper of rectangular cross sections. The bus bars section shall be ample capacity to carry the rated current of minimum 1250 Amp continuously without excessive heating and for adequately meeting the thermal and dynamic stresses in the case of short circuit in the system up to full 2.5 MVA rating.

ii). All bus bars connections shall be firmly and rigidly mounted on suitable insulators to withstand short circuit stresses and vibrations.

iii). Adequate clearance between 11 KV point and earth and between phase shall be provided to ensure safety as per provision in Indian Electricity Rule 2003 and its amendment thereof and also in accordance with the relevant Indian standard specification and the same shall be capable of withstanding the specified high voltage tests as per IS-13118/ IEC 62271-100 and amendment thereof.

iv). Sharp edges and bends either in the bus bars or bus bar connections shall be avoided as far as possible. Wherever such bends or edges are un-avoidable, suitable compound or any other insulation shall be supplied to prevent local ionization and consequent flashover.

6.23.3. CIRCUIT BREAKER

i). The vacuum circuit breaker shall be draw out type suitable for installation in the switchgear cubicles (indoor). The breaker shall comply with IS-13118 (1991)/ IEC 62271-100 and latest amendment thereof. Construction of breaker shall be such that the points, which require frequent maintenance, shall be easily accessible.

ii). The circuit breakers shall be spring operated, motor/manually charging of the spring feature, manually released. VCB shall have spring closing

mechanism for 3 pole simultaneous operation. The speed of closing operation shall be independent of the speed of hand operating level. The indication device shall show the OPEN and CLOSE position of breaker visible from the front of cubical.

iii). The breakers shall be capable of making and breaking the short time current in accordance with the requirement of IS 13118(1991)/ IEC 62271-100 and latest amendment thereof and shall have three phase rupturing capacity of 350MVA for 3 second at 11 KV. The continuous current rating of breaker shall not be less than 1250 Amp for all items. The total break/make time shall be not more than 4 cycles for break and 6 cycles for make time for all breakers.

iv). The vacuum circuit breakers shall ensure high speed extinction and adequate control of pressure during breaking of current and also designed to limit excessive over voltages.

v). Comprehensive interlocking system to prevent any dangerous or inadvertent operation shall be provided. Isolation of circuit breaker from bus bar or insertion into bus bar shall only be possible when the breaker is in the open position.

vi). Vacuum Circuit Breaker shall have completely sealed interrupting units for interruption of arc inside the vacuum. The vacuum bottle sealed for life shall be provided with contact wear indicator.

vii). Vacuum interrupter should have an expected life of 10000 operations at rated current and should be capable for operating more than 100 times at rated short circuit current.

viii). Vacuum interrupter technical data particularly provided by the manufacturer should also be provided with Bid.

6.23.4. INSTRUMENT TRANSFORMERS AND CIRCUIT BREAKER FOR 11kV PANELS

a) 3Nos of 1-phase PT with 2 winding should be provided for 11kV incoming Panel. The PT should have the following specification :

Type : Dry type PT

Ratio : 11kV/$\frac{110}{\sqrt{3}}$ + $\frac{110}{\sqrt{3}}$ (Star – Star & open delta)

Burden : 100VA for metering & 50 VA for protection

b) 3Nos of 1 –Ph CT with 0.2 core should be provided for 11kV panels

Type : Dry type C.T

Ratio : 200-100-50/5-5A

Metering : Burden 10VA, Accuracy Class 0.5

Protection : Burden 10VA, Accuracy class – 5P10

c) 1No 3-ph Vacuum circuit breaker should be provided for each 11kV panels. The VCB should have the following specifications

No of pole :3Nos
Frequency : 50Hz
Highest system voltage : 12kV
Rated continous current : 800A or more
Basic insulation level : 75kV
Short circuit current rating for 3 sec : 25kA
Control Circuit voltage : 110V DC
Spring charge motor supply : 1-ph 230V AC

6.23.5. TESTS

(i) Each control panel shall be completely assembled, wired, adjusted and tested at the factory prior to despatch.

(ii) The tests shall include wiring continuity tests, insulation tests and functional tests to ensure operation of the control scheme and individual equipment.

(iii) The test procedures shall have prior approval of the owner.

(iv) All instruments, meters and relays shall be tested and calibrated in accordance with relevant standards.

(v) All auxiliary instrument transformers shall be tested in accordance with procedure as laid down in relevant standards.

6.23.6. TEST WITNESSING

The tests shall be performed in presence of owner's representative. The agency shall give atleast fifteen (15) days advance notice of the date when the tests are to be carried out.

6.23.7. TEST CERTIFICATE

Copies of test certificates for all routine and acceptance tests shall be furnished to the owner for approval before dispatch of the equipment from the works. Test certificates for important components used shall also be furnished along with drawings.

6.23.8. PRE-TREATMENT AND PAINTING PROCESS

The control panel sheet steel shall be subjected to pre-treatment process before painting. The process shall be carried out as under.

The procedure can broadly be divided as "Metal Treatment" and "Painting".

A. METAL TREATMENT

i) DEGREASING

This can be achieved either by immersing in hot alkaline degreasing bath or in hot dry chlorothelene solution. In case, degreasing is done by alkaline bath, rinse with cold water thoroughly.

ii) PICKLING

This is to remove rust and metal scales by immersing in diluted sulphuric acid (approximately 20%) at nearly 80°C until scale and rust are totally removed.

iii) Rinse in cold water in two tanks to remove traces of acids.

iv) Treat with phosphoric acid base neutralizer, for removal of chlorine from the above acid pickling and again wash with running water.

v) PHOSPHATING

Immerse in grenadine Zinc phosphate solution for about 20 minutes at 80 to 90°C. The uniform phosphate coating of 4 to 5 gms. per sq. meter shall be achieved.

vi) Swill in cold water.

vii) Rinse in decxy to bath at 70 to 80°C to neutralize any traces of salts.

viii) Seal the above phosphate coating with hot dilute chromate solution.

ix) Dry with compressed air

B. PAINTING

i) Spray one coat wet on wet specially developed, "High Lusture" Zinc chromate primer and stove at 150 to 160°C for 25 to 30 minutes. Alternatively, Red-oxide primer with chromate content may be used. However, former process is preferred.

ii) Rubbing and putting :-

Apply putty to fill up the scar, if any, to present smooth surface and stove 15 to 20 minutes. Apply putty several times to get perfectly smooth finish.

iii) Surfacing :-

Sand down with mechanical abrasive and stove for 20 minutes.

iv) **Primer :-**
Spray second coat of primer as per(i) above or grey primer surface wet on wet and stove for 30 to 40 minutes at 150°C.

v) **Finish Paint :-**
Rub down dry and spray first coat of synthetic enamel finish paint wet on wet and stove for 30 minutes.

vi) **Surfacing :-**
Sand down or rub dry to prepare for final finish. Spray 2 coats o synthetic enamel finish paint wet on wet and stove it at 150°C for 30 minutes.

NOTE :-

i) Necessary stiffness may be welded between large cut outs to provide rigidity before painting process.

ii) Painting process shall be done within 24 Hrs. of completion of metal treatment.

iii) Small coating shall be supplied along with equipment for touching up at site.

7. TECHNICAL SPECIFICATION FOR 110V 250AH VRLA BATTERIES LEAD ACID TYPE & CHARGER UNIT

7.1. Title : 110Volts DC, 250AH VRLA/Maintenance free Sealed Lead Acid Battery Bank with float cum charger.

7.2. Introduction: The battery bank is required for providing reliable control supply for HT Switch Gear and Control Systems for 5MW to supply power.

7.3. Scope: This specification covers the design, manufacturing, assembly, testing at manufacturer's works and supply of battery unit complete in all respect for successful and trouble free operation of systems in the 5MW.

7.4. Technical Requirements of VRLA Battery: The number of years (or cycles) of service for which a battery is designed assuming optimum manufacturing materials and processes and optimum distribution, installation and operating conditions.

7.5. Life Expectancy - That estimated life attained by sample batteries when subjected to accelerated life test conditions. **Service Life -** That life actually attained in service under actual operating conditions for which the battery was designed. **Block -** An individual unit consisting of one or more cells.

7.6. RELEVANT STANDARDS AND SPECIFICATIONS

UL-924	Emergency Power and Lighting Equipment
UL-1989	Standby Batteries (ISBN 0-7629-0078-4)
UL-1778	Uninterruptible Power Supply Equipment
NEC Section 480	Storage Batteries
NEMA IB-4	Determination of Ampere-hour and Watt-hour Capacity of Lead- Acid Industrial Storage Batteries for Stationary Service (vented cells)
NEMA IB-7	Testing Flame Arrestor Vents Used on Lead-Acid Industrial Storage Batteries for Stationary Service (vented cells)
IEEE 1189	Guide for Selection of Valve Regulated Lead-Acid (VRLA) Batteries for Stationary Applications
IEEE 1187	Recommended Practice for Installation Design and Installation of Valve Regulated Lead-Acid Batteries for Stationary Applications
IEEE1188	Recommended Practice for Maintenance, Testing and Replacement of Valve Regulated Lead-Acid (VRLA) Batteries for Stationary Applications

The VRLA battery shall be Absorbed Glass Mat (AGM) construction, The battery shall be of the 5 to 8 year design life construction.. The battery shall be of the 10+ year design life construction. The battery shall be configured as a parallel string to reduce the chance of a single cell failure taking down the entire battery.

An acid resistant label shall be applied to the exterior of the battery in a location that is obvious to a viewer in typical installations and which includes, as a minimum, the following information written in English:

a) Battery Model / Part No.
b) Battery Nominal Voltage
c) Battery Rated Capacity and rating conditions
d) Battery average charging voltage range per cell or block and related charging conditions
e) Appropriate recycling information - may be internationally recognized symbols appropriate safety information - may include internationally recognized symbols
f) Battery terminal polarity markings either in English or as + and - symbols located in the immediate area of the related terminal. Polarity markings may be embossed or molded in the container.

7.7. Construction

7.7.1 Containers -

a) Material - The battery container (including cover) must be durable for handling, structurally rigid, electrically insulative, and of sufficient thickness to render gas permeability a non-issue. Acceptable materials include SAN, ABS, PVC, polycarbonate and polypropylene. In certain applications, the

containers must be flame retardant with a minimum oxygen index factor of 28 and a V rating of 0, 1, or 2.

b) Rigidity - Container end walls shall be sufficiently rigid to minimize bowing under vent release pressure at 25°C and shall not exceed 3/16 " per end (3/8" overall).

c) Case to Cover Seal - The cover may be either bonded or welded to the container and shall be capable of remaining gas and electrolyte tight throughout the life of the battery. The assembly, including the terminal seal, shall be capable of withstanding 5 times the maximum vent operating pressure at 40°C without leakage.

d) Terminals

The block shall have "flag", "L", threaded stud, or threaded insert terminations. The terminals shall be sufficiently robust to withstand a short circuit connection for at least one-minute without damage. Density of terminations made of lead shall be such that re-torquing is not required more than once per year. Threaded terminations shall be capable of withstanding twice the recommended torque value without damage.

e) Terminal Seals

The terminal to cover seal shall remain gas and electrolyte tight when the battery is subjected to a 1 minute short circuit. The terminal to cover seal shall remain gas and electrolyte tight for the design life of the product under normal operating conditions throughout the products operating temperature range.

7.7.2 Intercell Connections

The intercell connections shall be sufficiently robust to withstand a 1 minute short circuit condition without damage to either the connection or the container and cover assembly.

7.7.3 Performance

Rated Capacity : High rated capacity batteries shall be rated in watts per cell at the 15-minute discharge rate 1.67volts per cell at 25^0C.

The cycle life of batteries used in float service shall be dentified. This shall be the cycle life attained to 80% of rated capacity at the 3 hour discharge rate to 1.75 volts per cell.

7.7.4 Storage Life

The block shall have a self discharge rate of no more than 5% per month at 25°C and shall be capable of being restored to full rated capacity after 6 months storage at 25°C utilizing the manufacturers recommended "freshening" charge practices.

7.7.5 Ripple Current Tolerance

The battery shall be able to withstand up to 5 amperes per 100 ampere-hours rated capacity (at the 20 hour rate) without significant heating (less than 1°C) or degradation in the expected life.

7.7.6 Thermal Runaway Resistance

The battery shall be capable of withstanding the following conditions without entering thermal runaway:

2.4 volts per cell charging voltage at 40°C Indefmite
2.45 volts per cell charging voltage at 40°C 168 hours
2.5 volts per cell charging voltage at 40°C 72 hours

7.7.7 Battery Cabinet

The battery cabinet shall be sized with adequate space between shelves to allow maintenance and test measurement access. Increased clearance is required for multiple rows of batteries behind the front row in the cabinet. Batteries on pull out drawers are encouraged for safety and maintenance access.

7.7.8 On-Site Testing

A factory test is acceptable to verify rated capacity of the system. A full - rated capacity test at 100% load rating to the prescribed voltage discharge level shall be performed on site by the manufacturer's representative after the installation is completed to verify adequate installation techniques and ratings in final configuration. Multi-cell battery block temperatures shall be taken during this load test to verify that adjacent blocks remain within 1°C of each other. During the capacity discharge test, individual battery performance measurements shall be taken at the battery, not just combined readings at the UPS.

As part of on-site testing, intercell connector resistances and internal cell (block) resistances will be taken and documented.

7.7.9 Safety

a. Short Circuit Conditions: The battery shall be able to withstand a hard short circuit condition of indefmite duration without explosion or rupture.

b. Spark Arresting Vent System: When claimed to have a flame/spark arresting vent system, the venting system shall be designed to prevent direct entry into the cell of ignition sources from the outside atmosphere which could result in an explosion within the cell.

c. Flame Retarding Container Materials: When so claimed, the entire container system, including vents, shall be made of a flame retarding

material having an oxygen index factor exceeding 28, and shall be classified as being a VO, V1 or V2 material.

7.7.10 Product Published Information

As a minimum, the following information shall be published concerning the product characteristics and application:

a) Product Mechanical Characteristics & Specifications Dimensions, weight, terminal type and dimensions, and terminal hardware type and torque values

b) Product Electrical Characteristics and Specifications Nominal voltage, open circuit voltage when fully charged, short circuit current, internal resistance at DC or specified frequency, and recommended maximum AC ripple voltage and current

c) Product Electrical Discharge Characteristics and Specifications

Rated ampere-hour capacity to 1.75 volts per cell at 25°C for the 8, 10, or 20-hour discharge rates.

Constant power discharge rate for the 5, 10,15, 30, 40, 60, and 90-minute periods to 1.67 and 1.75 volts per cell at 25°C.

d) Product Charging Electrical Characteristics and Specifications

i). Recommended float-charging voltage at 25°C.
ii). Recommended float-charging voltage temperature compensation factor.
iii). Recommended equalization (freshening) charge voltage at 25°C.
iv). Recommended charging current limit for intended application
v). Recommended Maximum allowable AC ripple voltage and current on the DC charging voltage and current

e) Safety Considerations

i) Type and specific gravity of the electrolyte
ii) Short circuit current
iii) Any warnings directly related to use of the product

7.8. FLOAT CUM BOOST CHARGER

Scheme : FLOAT CUM BOOST CHARGER
Type : FULL WAVE, HALF CONTROLLED.
Rating : 110V/10A (suitable for 110V/250AH VRLA battery of 15 cells)

7.8.1. AC INPUT

Voltage :240 Volts +/- 10% AC
Frequency : 50Hz, +/-5%
Phase : Single Phase.

7.8.2. DC OUTPUT

Float Voltage: 110V DC adjustable by +2% -5% Boost Voltage: 110 V DC adjustable by +2% -5% Regulation : Better than +/- 1% of the set value.

Ripple : Less than 500mVolts rms.
Current : 10A
System O/P Voltage: Max.34.5V DC +0.5V (At Load Terminals) Efficiency better than 65% at full load.

7.8.3. INDICATIONS : LED indicators shall be provided for the following indications with audio alarm.

a) Mains ON (Neon Lamp)
b) Charger ON
c) DC over Voltage
d) DC under Voltage
e) Battery Reverse Polarity

7.8.4. METERS: Following Analog type meters of 72x72mm with 90 Deg. Deflection shall be provided in the system for measuring the respective parameters.

DC Voltmeter with selector switch
DC Ammeter
Battery Charge/Discharge Ammeter.

7.8.5. PROTECTIONS: Following protections shall be provided.

a. AC Input Circuit Breaker
b. Fast acting semiconductor Fuse for the Rectifier Bridge
c. DC over voltage cutback
d. DC over Load Protection
e. DC output Circuit Breaker.
f. Battery Input Fuses
g. Blocking Diode

7.8.6. Controls& Switches: The following Controls and switches shall be provided in the system.

a) Float voltage adjust potentiometer
b) Boost Voltage adjust potentiometer
c) Auto/Float/Boost selector switch
d) AC input Circuit Breaker
e) DC output Circuit Breaker
f) DC Voltmeter selector switch
g) Battery test position push button
h) DC voltmeter push button

7.8.7. Special features: The following features shall be provided in the system.

a. Soft start on DC side
b. Class F insulation for all magnetics
c. Automatic voltage regulation using digital controlled logic.
d. Automatic Float/Boost change over based on current drawn by the battery.
e. Smoothing filter Circuit to limit ripple

7.8.8. GENERAL

a. Cabinet : Free standing steel cabinet, easy access for installation and commissioning and cable entry at bottom.
b. Paint : Siemens Grey (RAL-7032)
c. Protection : IP-30
d. Temperature : 0 - 50 deg.C Range of operation
e. Relative humidity: 0% to 95% non-condensing.

7.8.9. BATTERIES: 110 Volts, 250 Ampere hour maintenance free , Valve Regulated lead Acid batteries (Exide make is preferred) in factory filled condition along with MS Racks and suitable connectors housed at the bottom compartment of the cabinet.

7.8.10. Other Requirements: Equipment shall be guaranteed for the period of 3 years. Batteries and battery charger shall be manufactured as per the relevant Indian Standards. Final inspection & Testing of the equipment shall be done in presence of BHEL representative.

8. TECHNICAL SPECIFICATION FOR 33 KV AND 11 KV POST INSULATORS

8.1. GENERAL REQUIREMENTS

(i) The porcelain/polymer shall be sound and free from defects, thoroughly vitrified and smoothly glazed.

(ii) Unless otherwise specified the glaze shall be brown in colour. The glaze shall cover all the expose porcelain/polymer part of the insulator except those areas which serve as support or required to be left un-glazed.

(iii) Precaution shall be taken during design and manufacture to avoid the following:

a) Stress due to expansion and contraction which may lead to deterioration.
b) Stress concentration due to direct engagement of the porcelain with the metal fittings.
c) Retention of water in the recesses of metal fitting and
d) Shapes which do not facilitate easy cleaning by normal methods.

(iv) Cement used in the construction of the post insulator shall not cause fracture by expansion or loosening by contraction and proper care shall be taken to locate the individual parts correctly during cementing. Further, the cement shall not give rise to chemical reaction with metal fittings and its thickness shall be as uniform as possible.

(v) All ferrous metal parts except those of stainless steel, shall be hot dip galvanized and the uniformity of zinc coating shall satisfy the

requirements of IS : 2633. The parts shall be galvanized after mechanizing. The finished galvanized surface shall be smooth.

(vi) The threads of the tapped holes in the post insulators metal fittings shall be cut after giving anti- corrosion protection and shall be protected against rest by greasing or by other similar means. All other threads shall be cut before giving anti-corrosion protection. The tapped holes shall be suitable for bolts with threads having anti - corrosion protection and shall confirm to IS : 4218(Part-I to VI). The effective length of thread shall not be less than the nominal diameter of the bolt.

(vii) The post insulator unit shall be assembled in a suitable jig to ensure the correct positioning of the top and bottom metal fitting relative to one another. The faces of the metal fittings shall be parallel and at right angles to the axis of the insulator and the corresponding holes in the top and bottom metal fittings shall be in a vertical plan containing the axis of insulator.

8.2. CLASSIFICATION

The post insulators shall be of type 'B' according to their construction, which is defined here under :

A post insulator or a post insulator unit in which the length of the shortest puncture path through solid insulating material is less than half the length of the shortest flash over path through air outside the insulator.

8.3. Standard insulation levels :

(i) The standard insulator levels of the post insulator or post insulator unit shall be as under :

Highest system voltage	Visible discharge test	Dry one minute power frequency withstand test.	Wet one minute power frequency withstand test.	Power frequency puncture withstand test.	Impulse voltage withstand test.
12 KV (rms)	9 KV (rms)	35 KV(rms)	35 KV(rms)	1.3 times the actual dry flash over voltage of the unit (KVrms)	75 KV peak
36 KV (rms)	27 KV (rms)	75 KV (rms)	75 KV (rms)	1.3 times the actual dry flash over voltage of the unit (KVrms)	170 KV peak

(ii) In this standard, power frequency voltage is expressed as peak values divided by √2. The impulse voltages are expressed as peak values.

(iii) The withstand and flashover voltage are referred to the atmospheric condition.

8.4. TESTS

(i) The insulators shall comply with the following constitute the type tests :

a) Visual examination.
b) Verification of dimensions.
c) Visible discharge test.
d) Impulse voltage withstand test.
e) Dry power frequency voltage withstand test.
f) Wet power frequency voltage withstand test.
g) Temperature cycle tests.
h) Mechanical strength tests.
i) Puncture test.
j) Porosity test.
k) Galvanising test.

Type test certificates for the tests carried out on prototype of same specifications shall be enclosed with the tender and shall be subjected to the following acceptance test in the order indicated below.

(vii) Acceptance test:

The test samples after having withstood routine test shall be subjected to the at least following acceptance test in the order indicated below :

a) Verification of dimensions.
b) Temperature cycle tests.
c) Mechanical strength tests.
d) Puncture test.
e) Porosity test.
f) Galvanising test.

(iv) Routine tests:

The following shall be covered under routine tests on each post insulator or post insulator unit.

a) Visual examination as per Cl. No.- 9.12 of IS : 2544/1973
b) Mechanical routine test as per Cl. No.- 9.14 of IS : 2544/1973
c) Electrical routine test as per Cl. No.- 9.13 of IS : 2544/1973

(v) MARKING

a) Each post insulator shall be legibly and indelibly marked to show the following.

b) Name or trade mark of the manufacturer.
c) Month & year of manufacture.
d) Country of manufacture.

(vi) Marking on porcelain shall be printed and shall be applied before firing.

(vii) Post insulator or post insulator units may also be mark with I.S.I. certification mark.

8.5. PACKING

All post insulators shall be packing in wooden crates suitable for easy but rough handling and acceptable for rail, transport. Where more than one insulator is packed in a create wooden separators shall be fixed between the insulators to keep individual insulator in position without movement within the crate.

Table-I

Highest System Voltage in kV	Minimum Creepage distance in mm
12	320
36	900

9. 1.1 KV GRADE COPPER STRANDED CONTROL CABLE

9.1. SCOPE

The specification cover the design, manufacture, at manufacturer's works, supply and delivery of Copper Control Cables screened/armoured for use indifferent EHT/HT /Grid Sub-Stations.

9.2. GENERAL INFORMATIONS

The Control Cables are required for the control, protection, instrumentation, auxiliary Power Supply. Each tender must be accompanied by full information required in the bidding schedule together with pertinent manufacturer's literatures, drawings, instruction manuals to enable the purchaser to make an appraisal of the quality and suitability of the materials offered. Failure to comply with the provision may be sufficient reasons to reject the bid.

9.3. STANDARDS AND REGULATIONS

All materials shall comply with the applicable provisions of the latest edition of Indian Standards, Indian Electricity Rules, Indian Electricity Act and other applicable statutory provisions, rules and regulations.

The following standards would apply to the specification.

1. IS-1554 (Part-I) – PVC insulated heavy duty.
2. IS-8130-Conductors for PVC insulated Cables.
3. IS-3961 (Part-II) - Recommended current ratings for Cables.

4. IS-5831-PVC insulated and sheath of Electric Cable.
5. Other relevant standards for screening.

9.4. CLIMATIC AND ISOCERAUNIC CONDITIONS

The climatic conditions at site under which the material shall operate Satisfactory are as follows;

a) Maximum ambient temperature of the air-in shade (˚C):	50
b) Minimum temperature of the air in shade (˚C):	4
c) Maximum daily average ambient temperature (˚C):	45
d) Maximum Yearly average ambient temperature (˚C):	30
e) Maximum relative humidity (%):	100
f) Average number of thunderstorm days per annum. :	100
g) Average annual rainfall (cm):	200
h) Maximum wind pressure (Kg/M2):	150

The material offered shall be suitable for continuous operation at the full rated capacity under the above conditions.

9.5. DESIGN CRITERIA

The Cables will be used for control protection and instrumentation, auxiliary Power Supply connections of the various equipment.

The Cable will be laid in ground or on ladder type traps or drawn in conduit in a hot, humid and tropical atmosphere. The trays may be over head, suspended or run in concrete trenches with removable covers. The tenderer shall indicate clearly the de rating factor for the above conditions.

The maximum conductor temperature for various classes and type of cables shall be limited to safe value as per applicable I.S. Cables shall be marked with ISI Certification Mark, if any.

9.6. SPECIFIC DESIGN REQUIREMENTS

1100 Volts Grade Heat Resisting (HR) Copper Cables suitable for use where the combination of ambient temperature and temperature rise due to load results in conductor temperature not exceeding 85 deg. C under normal continuous operation and 160 deg. C under short-circuit condition with stranded annealed copper conductor, HR PVC insulated, HR extruded PVC inner sheathed, round galvanised steel wire armoured (for multicore cable only) and overall HR extruded PVC sheathed shall generally conform to latest revision of IS:1554(Part-I). The cores shall be colour coded as per I.S. for easy identification.

Each Conductor shall consists of multi Strands copper wire for 2.5sq.mm cross section. Conductor wire shall be stranded. The PVC material for insulation and outer sheathing shall have smooth finish. Armouring shall

be of single layer of 1.6/1.4 mm. dia. G.I.Steel Wires though enough to withstand mechanical stressed during handling and shall be resistant to action of oil, acid and alkali. The above cable shall be used for control, identification, inter-link and instrumentation etc.

9.7. CURRENT RATING

The Cables will have current rating derating factors for an ambient temperature of 45 deg. C and ground cable is required to be taken into consideration. The current ratings shall be based on the maximum temperature 85 deg. C for continuous operation at the rated current.

9.8. OPERATION

Cables shall be capable of satisfactory operation under Power Supply System frequency variation of + 5% and voltage variation of + 10%.

9.9. DRUM LENGTH OF CABLES

The Cables shall be packed in non-returnable wooden drums. The wooden drums should be bearing distinguishing number with following information duly stenciled on the outer side of one flange.

1. Name of the Manufacturer.
2. Normal sectional area of the Conductor of the Cable.
3. Number of Cores.
4. Type of Cable & Voltage for which it is suitable.
5. Length of Cable in this drum.
6. Direction of rotation of Drum (an arrow)
7. Gross Weight.
8. Purchase Order No. & Date.
9. Year of Manufacture.

Drums shall be proofed against attack by white ant and termite, Conforming toIS-10418-1982.

The Cables shall be supplied in Drum lengths of 250/500 Mtr. which shall be subject to tolerance of not more than + 5% and the variation in the total quantity of Cables due to tolerance in individual drum length shall be limited to+ 2.5% for all types of Cable. Non-standard drum length shall not be acceptable. However, before packing the Cables on Drums, the successful bidders will be required to obtain *purchaser's approval* for the drum lengths.

9.10. DRAWING DATA &MANUAL

The following information shall be furnished in triplicate along with the tenders:

a) Manufacturer's leaflets giving construction details, dimensions and characteristics of different Cables.

b) Current rating of cables including derating factor due to grouping, ambient temperature and Type of various installations.

c) Write up sketch illustrating the manufacturer's recommendation for splitting, jointing and termination of different type of cables.

d) List of customers to whom the cable for similar rating has been supplied.

9.11. TESTS

Routine tests in accordance with the provision of relevant standard specification shall be carried out for each drum of finished cable lengths. Type Tests and acceptance tests on the samples taken on random basis from the lot of cables offered for inspection shall have to be carried out as per relevant Indian Standard Specification to prove the general qualities and design of a given type of cable and for the purpose of acceptance of the lot.

TYPE TEST REPORTS for the type tests conducted in accordance with IS:1554(Part-I for similar type of Cables (as per Tender Specification) Type Test Report conducted on similar type of Cable from NABL/ Central Govt./ approved Accredited Testing Laboratory within 5 years is to be submitted.

The tabulation for each test result shall contain corresponding I.S. specified limiting figures to facilitate checking of test Results. Six (6) copies of type tests certificate lot-wise for each type of cables should be sent to the Employer for acceptance. Type Test Certificate for each lot and routine test certificate for each drum of cables shall be submitted to the Employer for approval before dispatch of cables from the Works. The test certificates shall be completed with all results.

10. XLPE 1-CORE AND 3-CORE 185 mm^2, 11KV CABLES

10.1 SCOPE

The scope of this package, covers the design, manufacture, stage inspection at works, inspection and testing of finished cables at manufacture's works, testing at independent test house, packing transport and delivery to consignee's address of 6.35/11 KV three core, 185 mm^2aluminium conductor, XLPE insulated, screened, underground cables as per specified construction.

10.2 TECHNICAL REQUIREMENT

Three core cable

3 core 6.35/11 KV grade, 90^0 C rating heavy duty power cable with stranded, compacted, circular, aluminum conductor shielded with extruded semi conducting compound, cross linked, polyethylene insulated, shielded with

extruded semi conducting compound and copper tape, shielded cores laid up with fillers, inner sheath of extruded PVC, Galvanized steel strip Armour and PVC ST-2 overall sheath.

The cables should be suitable for use in solidly earthed system.

10.3 STANDARDS

The 11KV XLPE cable shall, in general, meet the requirements of the latest edition of the Bureau of Indian standards, (generally referred as IS) IS 7098 (Part 2) 1985. The cables manufactured to, and meeting the testing requirements of international standards, like B.S.S. IEC or equivalent standards are also acceptable. The Manufacturers shall enclose a copy of the equivalent international standard, in English language, along with the bid.

The cable and components in general shall meet the requirements of the following standards published by the Bureau of Indian standards with latest amendments or equivalent international standards.

(Part – 2)

1985 : Specification for cross linked polyethylene insulated PVC sheathed cables, up to 33KV.

1984 : Specification for conductors for insulated Electric cables.

1979 : Specification for mild steel wires, strips and tapes for armouring of cables.

1984 : Specification test on cable.

1984 : Specification for PVC insulation and sheath of electric cables.

1982 : Specification for drums for electric cables

(part – I)1983 : Fictitious calculation method for determination of dimensions of protective coverings of cables part – 1 Elastomeric and thermoplastic insulated cables.

The 6.35/11KV underground cables shall be manufactured to the highest quality, best workmanship with scientific material management and quality control. The manufacturer shall furnish the quality plan, giving in detail the quality control procedure / management system.

The successful Manufacturer shall give sufficient advance notice to the Employer of not less than fifteen days to arrange for stage inspection and inspection of quality assurance programme during manufacture, at the works.

10.4 SYSTEM DETAILS

General Technical particulars

Nominal system voltage (rms) (u)	.. 11KV
Highest system voltage (rms) (Um)	.. 12KV
Phase to Earth voltage (Uo)	.. 6.35 KV

Number of Phase (for 3 core cables)	.. 3
Number of Phase (for single core cables)	.. 1
Frequency	... 50Hz
Variation in Frequency	... +/- 3%
Type of Earthing	.. Solidly Earthed
Basic impulse level (1.2/50 Micro second wave)	.... 75KV
Total relay & circuit breaker operating time	.. 15 – 20 Cycles
One Minute power frequency withstand voltage	..28 KV

10.5 INSTALLATION CONDITIONS

Mostly, directly buried in ground, partly in RCC / Hume pipes or stoneware pipes at road crossing in case of 3 core cables.

Metallic coverings are connected solidly to earth at both ends of the run for 3 core cables.

Normal depth of laying is 900mm to 1000mm (from top, of ground to centre of cable).

Nature of soil – Normally black cotton soil, but sometimes sandy or stone may also come up for excavation enroute.

Soil resistivity : variable 18 to 100 ohm-meter

Soil Thermal resistivity (assumed) 120^0 to 150^0 C/ Cm/w.

10.6 DESIGN CRITERIA

The cables that are covered in these specifications are intended for use in the state of Mizoram for Power distribution system, under the climatic conditions and installation conditions prevailing in the area.

Any technical feature, not specifically mentioned here, but is necessary, for the good performance of the product, shall be incorporated in the design. Such features shall be clearly brought out under Technical deviations schedule only, in the offer made by the manufacturer, giving technical reasons, and justifying the need to incorporate these features.

For continuous operation of the cables, at specified rating, the maximum conductor temperature shall be limited to the permissible value as per the relevant standard, generally not exceeding 90^0C under normal operation and 250^0C under short – circuit conditions.

The cables in service will be subject to daily load cycles, of two peaks during a day; morning peak and evening peak, with around 50% loading during the nights.

The materials used for outer sheaths shall be resistant to oils, acids and alkalis.
The cables shall have the mechanical strength required, during handling and laying.
The cables shall be designed to withstand the thermo mechanical forces and electrical stresses during normal operation and transient conditions.
The cables shall be designed to have a minimum useful life span of Thirty years.

Core identification : The core identification for 3 core cables shall be provided, by suitable means, like, by application of coloured stripes, or by numerals or by printing on the cores as per clause 13 of IS: 7098.

10.7 MANUFACTURE PROCESS, CROSS LINKING OF INSULATION

Cross linking of the insulation materials (pre compounded polyethylene) shall be conforming to IS: 7098 (Part – II). The conductor screen shall be of extruded semi conducting compound. The insulation screen shall consist of the nonmetallic part, extruded semi conducting compound with non-magnetic metallic part. The XLPE insulation and the shields for conductor and insulation shall be extruded in one operation.

10.8 MATERIALS

Conductor : The conductor shall be of stranded construction. The material for conductor shall consist of the plain aluminum of H2 or H4 grade as per clause – 3 of IS: 8130/ 1984.
The No. of wires in the conductor shall be not less than the appropriate minimum number given in table – 2 of IS: 8130/ 1984.
Insulation: The insulation shall be cross linked polyethylene conforming to the requirements given in the table – 1 of IS : 7098 Part – II.

10.9 SCREENING

The screening shall consist of semi conducting compound. The metallic screen for core shall consists of copper tape. The semi-conducting compound shall withstand the operating temperature of the cable and shall be compatible with the insulating material.

10.10 FILLER AND INNER SHEATH FOR MULTICORE AND SINGLE CORE CABLES

For multi-core cables, the interstices at the center shall be filled with a non-hygroscopic material.

The interstices around the laid up cores shall be covered with PVC compound type ST-2. This will form the inner sheath for multicore / single core cables.

10.11 ARMOURING FOR 3 CORE AND SINGLE CORE CABLES:

For three core cables the armour shall be galvanized steel strip, complying with the requirements of IS: 3975. The single core cables shall be armoured with hard drawn Aluminum round wire. A binder tape may be applied on the armour.
Manufacturers shall furnish the calculation / data sheet for the short circuit carrying capability of the armour.

10.12 OUTER SHEATH

The outer sheath shall consist of poly vinyl chloride (PVC) compound, conforming to the requirements of type ST-2 of IS: 5831. Suitable additives shall be added to give anti termite protection.

10.13 CONSTRUCTION

The general constructional features of the cables shall be as follows:

10.13.1 Core cables:

1 Stranded, compacted, circular, aluminium conductor,
2 Conductor screen of extruded semi conducting compound.
3 Cross linked polyethylene insulation, cross linking shall be conforming to IS : 7098 (Part-II).
4 Insulation screen consisting of non metallic part of extruded semi conducting compound and the metallic part of copper tape (s).
5 Extruded PVC inner sheath.
6 Armour (Galvanized steel strip).
7 Outer PVC sheath with anti-termite treatment.

10.13.2 Conductor

The conductor shall be stranded, compact, circular of aluminium wires of H2 or H4 grade plain aluminium wires. The conductor shall be clean, uniform in size and shape smooth and free from harmful defects.
Not more then two joints shall be allowed in any one of the single wire forming every complete length of conductor and no joint shall be with in 300mm of any other joint in the same layer. The joint shall be made by brazing, silver soldering or electric or gas welding.
No joints shall be made in the conductor after it has been stranded.

10.13.3 Conductor screen

The conductor screen shall be provided over the conductor consisting of extruded non- metallic semi conducting compound.

10.13.4 Insulation

The insulation shall be provided over the screened conductor with cross linked polyethylene, applied by extrusion and shall be of high quality, cross linked, insulation shall conform to IS:7098 (Part– II).

10.13.5 Thickness of insulation

The average thickness of XLPE insulation shall not be less than the nominal value subject to the applicable tolerance as specified in table 2 of IS:7098.
The insulation shall be applied to closely fit on the conductor screen, and it shall be possible to remove it without damaging the conductor.
The thickness of semi conducting screen over insulation should not be included in the thickness of insulation.

10.13.6 Insulation screening

The insulation screen shall be applied over the insulation.
The non metallic part of the insulation screen shall consist of extruded semi conducting compound.
The metallic part of the insulation screen shall consist of non magnetic material, consisting of copper tape or tapes, and shall be applied over the non metallic part. For single core armoured cable the armouring shall constitute the metallic part of armouring.

10.13.7 Laying up of cores

For multicore cables, the cores shall be laid together with a suitable right hand lay. The interstices at the center shall be filled with a non – hygroscopic material.

10.13.8 Inner sheath for Multi core cables

The cores shall be laid up with a suitable right hand lay and the interstices should be filled with PVC compound type ST-2 conforming to IS:5831 or equivalent standard. The filling up of interstices shall be by pressure extrusion and this shall form the inner sheath. This inner sheath shall be of circular shape and shall bind the cores also.
In case of single core cables where there are both metallic screening and armouring, there shall be extruded inner sheath between them.

The minimum thickness of the inner sheath shall conform to Table – 3 of IS: 7098 (Part -II), 1985 or equivalent standard.
The inner sheath shall be so applied that it fits closely on the laid up cores and it shall be possible to remove it without damage to the insulation cables.

10.13.9 Armouring for 3 core cables

The armour consisting of galvanised steel strip shall be applied over the inner sheath for multi core cables.
The single core cables armour consisting of hard drawn aluminum round wire shall be applied over the inner sheath.
The armour wires shall be applied as closely as possible.
The dimensions of the galvanized steel strip and Hard drawn aluminium wires shall conform to IS:7098 part (II).
A binder tape may be applied on the armour.
The joints in the armour wires shall be brazed / welded with joint surface and rendered smooth. The joints shall be staggered by at least 300mm from the nearest joint in any other armour wire in the completed cable.

10.13.10 Outer sheath

The PVC Outer sheath with anti termite treatment shall be extruded over the armouring for 3 core cables and single core cables.
The color of the outer sheath shall be black.
The Thickness of outer sheath shall be not less than the minimum value specified in column 5 of table 5 of IS: 7098 (part II) 1985.

10.13.11 Identification

The outer sheath shall have the following information embossed or indented on it; the manufacturer's name or trade mark, the voltage grade, the year of manufacture and the letters "RGGVY". The identification shall repeat every 300/350 mm along the length of the cable
Note: The outer sheath of the cable should be embossed with "RGGVY Project& name of Employer" at the time of supply.

10.14 INSPECTION

Quality control: The Manufacturer shall furnish a complete and detailed quality plan for the manufacturing process of the cable. All raw materials shall conform to relevant applicable standards and tested for compliance to quality and requirement.
During the manufacturing process, at all stages, inspections shall be made to check the physical and dimensional parameters, for verification to compliance to the standards.

The manufacturer shall arrange, for inspection by the Employer, during manufacture, if so desired by the Employer, to verify the quality control process of the Manufacturer.

10.15 TYPE TESTS

Notwithstanding, that type test have been conducted earlier, the manufacturer shall conduct all type tests as per IS : 7098 part-II, 1985, with upto date amendments or equivalent international standard, and supplies made only after approval of test reports from the Employer. The Employer reserves the right to wave the repetition of the type test.

All type tests, routine, acceptance test shall be conducted in the presence of the Employer/ representative.

The manufacturer shall give 15 days' advance notice for inspections, and witnessing of tests by the Employer or his representative.

The following type tests will be conducted on the cable.

a) Test on conductor.
b) Test on armour.
c) Test for thickness of XLPE insulation and inner and outer sheaths
d) Physical test on XLPE insulation.
e) Physical test for outer sheath.
f) Partial discharge test.
g) Bending test
h) Di-electric power factor test
   i) As a function of voltage
   ii) As a function of temperature
i) Insulation resistance (volume resistivity) test
j) Heating cycle test
k) Impulse withstand test
l) High voltage test
m) Flammability test

The following test shall be performed successively on the same test sample of completed cable, not less than 10 M in length between the Test accessories.

I. Partial discharge test.
II. Bending test followed by partial discharge test.
III. Dielectric power factor as a function of voltage.
IV. Dielectric power factor as a function of temperature.
V. Heating cycle test, followed by dielectric power factor as a function of voltage and partial discharge tests.
VI. Impulse withstand test
VII. High voltage test.

10.16 ACCEPTANCE TEST

The sampling plan for acceptance test shall be as per IS ; 7098 part -II 1985, Appendix 'A'.

The following shall constitute the acceptance test.

a) Tensile test for aluminium.
b) Wrapping test for aluminium.
c) Conductor resistance test.
d) Test for thickness of insulation.
e) Test for thickness of inner and outer sheath.
f) Hot-set test for insulation.
g) Tensile strength and elongation at break test for insulation and outer sheath.
h) partial discharge test (on full drum length).
i) High voltage test.
j) Insulation resistance (volume resistivity) test.

10.17 ROUTINE TEST

The following shall constitute routine tests :

a) Conductor resistance test.
b) partial discharge test on full drum length.
c) High voltage test.

10.18 PACKING

The cables, as per specified delivery lengths, shall be securely wound /packed in non-returnable, well seasoned sturdy wooden drums, with strong reinforcements so as to withstand rough handling during transport by rail, Road, etc. The packing should withstand storage conditions in open yards. The cable drums shall conform to IS: 10418-1982 or equivalent standard.

The drawings of cable drums with full detail shall be furnished, and got approved before dispatch.

10.19 SEALING OF CABLE ENDS ON DRUMS

The cable ends shall be sealed properly so that ingress of moisture is completely prevented.

The individual core endings shall be sealed effectively with water resistant compound applied over the core and provided with a heat shrinkable cap of sufficient length with adequate cushion space so that the conductor does not puncture the cap in case of movement of the core during unwinding or laying. Before sealing, the semi conducting layer on the cores may be removed for about 2 mm at each end, to facilitate checking the insulation resistance from one end, without removing the sealing cap at the other end.

The three cores should have a overall heat shrinkable cap with adequate end clearance, and sufficient cushioning to prevent puncturing of the overall

sealing cap due to stretching of the cores. The sealing cap shall have sufficient mechanical strength and shall prevent ingress of moisture into the cable.

The ends of single core cables shall also be sealed on the same lines to prevent entry of moisture.

10.20 CABLE LENGTHS

The cables shall be supplied in continuous lengths of 500M in case of 3 core cable with a tolerance of + or – 5% of drum length.

10.21 QUANTITY TOLERANCE

+3% tolerance shall be allowed on the ordered quantity.

a) Reference to Standard and ISI mark.
b) Manufacturer's Name or trade mark.
c) Type of cable & voltage grade.
d) Number of cores.
e) Nominal cross sectional area of conductor.
f) Cable code.
g) Length of cable on the drum.
h) Direction of rotation.
i) Gross weight.
j) Country of Manufacture.
k) Year of Manufacture.
l) Purchase order and date.
m) Address of consignee.

10.22 DRAWING & LITERATURE

The following shall be furnished along with the tender

a) Cross sectional drawings of the cables, giving dimensional details for each size of cable.
b) An illustrated literature on the cable, giving technical information, on current ratings, cable constants, short circuit ratings, de-rating factors for different types of installation, packing date, weights and other relevant information.

10. CABLE GLANDS AND LUGS

Cable glands shall be Double compression type, tinned/Nickel plated (coating thickness not less than 20 microns in case of tin and 10 to 15 microns in case of nickel) brass cable glands for all power and control cables. They shall provide dust and weather proof terminations. They shall comprise of heavy duty brass casting, machine finished and tinned to avoid corrosion and oxidation. Rubber components used in cable glands shall be neoprene and of tested quality. Required number of packing glands to close unused openings in gland plates shall also be provided.

The cable glands shall be tested as per BS: 6121. The cable glands shall also be duly tested for dust proof and weather proof termination.

Cables lugs shall be tinned copper solder less crimping type conforming to IS: 8309 and 8394 suitable for aluminum or copper conductor (as applicable). The cable lugs shall suit the type of terminals provided. The cable lugs shall be of Dowell make or equivalent.

11. CABLES TAGS AND MARKERS

Each cable and conduit run shall be tagged with numbers that appear in the cables and conduit schedule.

The tag shall be of aluminum with the number punched on it and securely attached to the cable conduit by not less than two turns of 20 SWG GI wire conforming to IS: 280. Cable tags shall be of rectangular shape for power cables and of circular shape for control cables.

Location of cables laid directly underground shall be clearly indicated with cable marker made of galvanized iron plate.

Location of underground cable joints shall be indicated with cable marker with an additional inscription “Cable Joint”.

The marker shall project 150 mm above ground and shall be spaced at analysis interval 30 meters and at every change in direction. They shall also be located on both sides of road and drain crossings.

Cable tags shall be provided on all cables at each end (just before entering the equipment enclosure), on both sides of a wall or floor crossing and on each duct/ conduit entry. Cable tags shall be provided inside the switchgear, motor control centers, control and relay panels, etc., wherever required for cable identification, such as where a number of cables enter together through a gland plate.

The price of cable tags and markers shall be included in the installation rates for cables/ conduits quoted by the contractor. Specific requirements for cabling for cabling, wiring, ferrules as covered in respective equipment section shall also be complied with.

11.1 Cable glands

Double compression type cable glands shall be provided by the Contractor for all power and control cables to provide dust and weather proof termination. Required number of packing glands to close unused openings in gland plates shall also be provided.

11.2 Cable lugs

Solderless crimping of terminals shall be done by using corrosion inhibitory compound. The cable lugs shall suit the type of terminals provided. Crimping tool used shall be of approved design and make.

11.3 Storage and handling of cable drums

Cable drums shall be unloaded, handled and stored in an approved manner. Rolling of drums shall be avoided as far as practicable. For short distances, the drums may be rolled provided they are rolled slowly and in proper direction as

marked on the drum. In absence of any indication the drums may be rolled in the same direction it was rolled during taking up the cables.

11.4 Cable supports and cable tray mounting arrangements

Cable trenches in the control room are normally provided with embedded steel inserts on concrete floors/ walls. The Contractor shall secure supports by welding to these inserts or available building steel structures.

Insert plates will be provided at an interval of 600 mm wherever cables are to be supported without the use of cable trays, while at all other places these will be at an interval of 2000 mm.

11.5 Cable terminations and connections

The termination and connection of cables shall be done strictly in accordance with cable and termination kit manufacturer's instructions, drawing and/ or as directed by the Owner.

The work shall include all clamping, fittings, fixing, plumbing, soldering, drilling, cutting, taping, heat shrinking (where applicable), connecting to cable terminal, shorting and grounding as required to complete the job.

The equipment will be generally provided with un-drilled gland plates for cables/ conduit entry. The Contractor shall be responsible for drilling of gland plates, painting, and touching up. Holes shall not be made by gas cutting.

The Contractor shall tag/ferrule the control cable cores at all terminations, as instructed by the Owner. In panels where a large number of cables are to be terminated and cable identification may be difficult, each core ferrule may include the complete cable number as well. Spare cores shall be similarly tagged with cable numbers and coiled up.

Control cables shall have stranded copper conductor. Bare portion of the solid conductors shall be tinned after removing the insulation and shall be terminated directly without using cable lugs.

All cable entry points shall be sealed and made vermin and dust proof. Unused openings shall be effectively closed.

If the cable-end box or terminal enclosure provided on the equipment is found unsuitable and requires modification, the same shall be carried out by the Contractor with the approval of the Owner.

11.6 Directly buried cables

The Contractor shall construct the cable trenches required for directly buried cables. The scope of work and unit rates for construction of cable trenches for cables shall include excavation, preparation of sand bedding, soil cover, supply and installation of brick or concrete protective cover, back filling and reaming, supply and installation of route markers and joint markers. The Bidder shall ascertain the soil conditions prevailing at site, before quoting the unit rates. Laying the cable and providing protective covering shall be as per approved drawing.

Installation of cables

Power and control cables shall be laid in separate tiers. The order of laying of various cables shall be as follows:

- Power cables on top tiers.
- Control, instrumentation and other service cables in bottom tiers.

Single core cable in trefoil formation shall be laid with a distance of three times the diameter of cables between trefoil center lines. All power cables shall be laid with a minimum center to center distance equal to twice the diameter of the cable.

Power and control cables shall be securely fixed to the trays/ supports. Trefoil clamps for single core cables shall be pressure die-cast aluminum (LM-6). Nylon-6 or fiber glass and shall include necessary fixing nuts. bolts, washer, etc. These are required at every 2 meter of cable run. Vertical and inclined cable runs shall be secured with 25 mm wide and 2 mm thick aluminum strip clamps at every 2 m Horizontal runs in cable trays and trenches shall be secured using 4 mm nylon cord at every 2 m.

Cables shall not be bent below the minimum permissible limit. The minimum bending radius of power cables shall be 12D and that of control cables shall be 10D, where D is overall diameter of cable.

Where cables cross roads, drains and rail tracks, the cables shall be laid in reinforced spun concrete or steel pipes, buried at not less than one meter depth.

In each cable run some extra length shall be kept at a suitable point to enable one (for LT Cables) or two (for H.T. cables) straight through joints to be made, should the cable develop fault at a later date.

Selection of cable drums for each run shall be so planned as to avoid using straight through joints. Cable splices will not be permitted except where called for by the drawings, unavoidable or where permitted by the Owner.

Control cable terminations inside equipment enclosures shall have sufficient lengths so that switching of termination in terminal blocks can be done without requiring any splicing.

Metal screen and armour of the cable shall be bonded to the earthing system of the station, wherever required.

Rollers shall be used at intervals of about 2.0 meters, while pulling cables.

All due care shall be taken during unreeling, laying and termination of cable to avoid damage due to twist, kink, sharp bends, etc.

Cable ends shall be kept sealed to prevent damage.

Inspection on receipt, unloading and handling of cables shall generally be in accordance with IS:1255 and other Indian Standard codes or practices.

Wherever cables pass through floor or through wall openings or other partitions, wall sleeves with bushes having a smooth curved internal surface so as not to damage the cables shall be supplied, installed and properly sealed at no extra charges.

The erection work shall be carried out in a neat workmanlike manner and the areas of work shall be cleaned of all scrap materials after the completion of work

in each area every day. Contractor shall remove the RCC/steel trench covers before taking up the work and shall replace all the trench covers after the erection work in that particular area is completed or when further work is not likely to be taken up for some time.

Contractor shall furnish three copies of the report on work carried out in a particular week, such as cable numbers and a date on which laid, actual length and route, testing carried out, terminations carried out, along with the marked up copy of the cable schedule and interconnection drawing wherever the modifications are made.

In case the outer sheath of a cable is damaged during handling/ installation, the Contractor shall repair it at his own cost, and to the satisfaction of the Engineer-in- Charge. In case any other part of a cable is damaged, the same shall be replaced by a healthy cable, at no extra cost i.e. the Contractor shall not be paid for supply, installation and removal of the damaged cable.

All cable terminations shall be appropriately tightened to ensure secure and reliable connections. The Contractor shall cover the exposed part of all cable lugs whether supplied by him or not with insulating type, sleeve or paint.

12. CABLE TERMINATIONS AND JOINTS FOR 11 KV XLPE CABLES.

12.1 **General**: The term heat shrink refers to extruded or moulded polymeric materials which are cross linked to develop elastic memory and supplied in expanded or deformed size or shape.

12.2 **Qualifying experience**: The kits should have satisfactory performance record in India in excess of 5 years supported with proof of customers having had satisfactory use of these kits in excess of 5 years.

12.3 **Type test reports:** The Joints and terminations should have been type tested and type test reports made available.

12.4 **Kits contents** : The Kits should generally consist of:

(a) Heat shrinkable clear insulating tubes
(b) stress control tubing where necessary,
(c) Ferrule insulating tubing for joints,
(d) Conductive cable break outs for terminations, non tracking, erosion and weather resistant tubing both outer / inner
(e) non tracking erosions and weather resistant outdoor sheds in case of terminations.
(f) high permittivity mastic wedge
(g) Insulating mastic.
(h) Aluminium crimping lugs of ISI specification.
(i) Tinned copper braids
(j) Wrap around mechanical protection for joints.
(k) Cleaning solvents, abrasive strips.
(l) Plumbing metal.
(m) Binding wire etc. adequate in quantity and dimensions to meet the service and test conditions.

The kit shall have installation instructions and shall be properly packed with shelf life of over 3 years.

13. GI EARTHING PIPE

Earthing pipe should be made of 40 mm diameter ISI marked B class GI Pipe. 12 mm dia suitable holes on its circumference shall be made as per approved drawing. The pipe should be in one piece. No joints or welding would be allowed on its length. Clamps made of 50x6mm GI flat duly drilled with 12 mm size holes should be welded at the top end for connection of earth conductor.

Pipe used shall be 40mm NB diameter, ISI marked Galvanized Mild Steel Tubes continuously welded Electric Resistance Welded ERW/High Frequency Induction welded (HFIW)/Hot finished welded (HFW) type, conforming to IS-554-1985 with latest amendment of MEDIUM quality (Class B).

13.1. Manufacture

GI earth pipe (40 mm diameter & 3 metre long) shall be made of tubes which shall be made from tested quality steel manufactured by any approved process as follows:

a) Electric Resistance Welded (ERW).
b) High Frequency Induction Welded (HFIW) and
c) Hot finished Welded (HFW).

Tubes made by manual welding are not acceptable.

13.2. Dimensions

The dimensions and weights of tubes shall be in accordance with Table-I and Table-II of IS: 1239 (Part-I)/1990 with latest amendments, subject to tolerance permitted therein. Necessary 12 mm diameter holes across the circumference shall be provided as per approved drawing. Drawings shall be approved by the owner before start of the manufacturing work. The tube, earthing pipe shall be provided with 50x6mm GS clamps on one end, one clamp is to be welded with the pipe and another is removable to enable measurement of earth resistance of the pit. Other end of the earth pipe should be cut half in slop to make it a sharp.

13.3. Galvanizing

Tubes shall be galvanized in accordance with IS-4736-1986 with latest amendment for not dip zinc coating of Mild Steel Tubes. The minimum mass of zinc coating on the tubes shall be in accordance with clause 5.1 of IS-4736-1986 (specification for hot dip zinc) and when determined on a 100mm long test piece in accordance with IS: 6745:1972 shall be 400 g/m^2. The zinc coating shall be uniform adherent reasonably smooth and free from such imperfections as flux, ash and dross inclusions, bare patches, black spots, pimples, lumpiness, rust, stains, bulky white deposits and blisters.

13.4. Hydraulic test

(Before applying holes) Each tube shall withstand a test pressure of 5 M Pa maintained for at least 3 seconds without showing defects of any kind. The pressure shall be applied by approved means and maintained sufficiently long for proof and inspection. The testing apparatus shall be fitted with an accurate pressure indicator.

13.5. Test on finished tubes and sockets

The following tests shall be conducted by the manufacturer of finished tubes and sockets.

a) The tensile strength of length of strip cut from selected tubes when tested in accordance with IS-1894-1972, (Method for tensile testing of steel tubes), shall be at least 320N/mm^2.

b) The elongation percentage on a gauge length of 5.65/so (where so is the original cross-sectional area of test specimen) shall not be less than 20%.

c) When tested in accordance with IS-2329-1985 (Method for Bend test on Metallic tubes) the finished tube shall be capable of with standing the bend test without showing any sign of fracture or failure. Welded tubes shall be bent with the weld at 90 degree to the plane of bending. The tubes shall not be filled for this test.

d) Galvanized tubes shall be capable of being bent cold without cracking of the steel, through 90 degree round a former having a radius at the bottom of the groove equal to 8 times the outside diameter of tube.

e) Flattening Test on Tubes above 50 mm Nominal Bore: Rings not less than 40 mm in length cut from the ends of selected tubes shall be flattered between parallel plates with the weld, if any, at 90 degree (point of maximum bending) in accordance with IS-2328-1983. No opening should occur by fracture in the weld unless the distance between the plate is less than 75 percent of the original outside diameter of the pipe and no cracks or breaks in the metal elsewhere than in the weld shall occur, unless the distance between the plates is less than 60% of the original outside diameter. The test rings may have the inner and outer edges rounded.

f) GALVANISHING TEST:

- Weight of zinc Coating: For tubes thickness upto 6 mm the minimum weight of zinc coating, when determined on a 100 mm long test piece in accordance with IS-4736-1986 shall be 400 grm/m^2.
- The weight of the coating expressed in gram/m^2 shall be calculated by dividing the total weight of the zinc (inside plus outside) by the total area (inside plus outside) of the coated surface.
- Test specimen for this test shall be cut approximately 100 mm in length from opposite ends of the length of tubes selected for testing. Before cutting the test specimen, 50 mm from both ends of the samples shall be discarded.

g) Free Bore Test: A rod 230mm long and of appropriate diameter shall be passed through relevant nominal bore of the sample tubes to ensure a free bore.

h) Uniformity of Galvanized Coating: The galvanized coating when determined on a 100 mm long test piece [see V (a) (iii)] in accordance with IS-2633-1986 (Method for testing uniformity of coating on zinc coated articles) shall with stand 4 one minute dips.

13.6. Workmanship

The tubes shall be cleanly finished and reasonably free from injurious defects. They shall be reasonably straight, free from cracks, surface flaws, laminations, and other defects, both internally and externally. The screw tubes and sockets shall be clean and well-cut. The ends shall be cut cleanly and square with the axis of tube.

13.7. Marking

The medium class of tubes shall be distinguished by Blue colour bands which shall be applied before the tubes leaves the manufacturers' works. Tubes shall be marked with the standard mark.

14 EARTHING

Earthing shall generally be carried out in accordance with the requirements of Indian Electricity Rules 2003 amended from time to time and relevant regulations under Electricity Supply Authority concerned.

In case of high and extra high voltages, the neutral points shall be earthed by not less than two separate distinct connections with earth, each having its own electrodes sub-station and will be earthed at any other point provided no interference is caused by such earthing. If necessary, the neutral may be earthed through suitable impedance.

As far as possible, all earth connections should be visible for inspection. Each earthing system shall be so designed, that, the testing of individual earth electrodes is possible. It is recommended that the value of any earth system resistance shall be such as to conform to the degree of shock protection desired.

It is recommended, that a drawing showing the main earth connections and earth electrodes be prepared for each installation and submitted to Employer.

No addition to the current carrying system, either temporary or permanent, shall be made which will increase the maximum available fault current on its duration until it has been ascertained that the existing arrangement of earth electrodes, earth bus-bar etc., are capable of carrying the new value of earth fault current which may be obtained by this addition.

All materials, fittings etc., used in earthing shall conform to Indian Standard Specifications, wherever they exist.

14.1. General requirements and procedures for earthing at sub-stations.

The ground resistance for sub-stations should not exceed a value 2(two) ohms. The joints/connections in the earthling, system shall be welded only, except the connections, which require opening for testing/maintenance. Such connections should be bolted tightly, using spring and ring washers for proper contact pressure. The G.S. flats to be provided for the horizontally laid earth grid should have overlap welded joints, with length of welding at least twice the width of the flat, e.g., 100 MM for 50x8 mm G.S. flats. There should not be any dirt, grease, oil, enamel, paint or any such non-conductive coatings on the surfaces being joined/ connected. Only the finished joints/connections above ground may be provided with red-oxide or any other protective coating. Underground earth electrodes and earth grid elements, when laid, should have a clean metallic surface, free from paint, enamel, grease or any such non-conductive coatings.

As far as possible, all earth connections should be accessible for visual inspection. No cut-outs, links or switches, other than linked switches arranged to operate simultaneously on the earthed or earthed neutral conductor and the live wire shall be inserted in the supply system. Earth electrodes or mate should not be installed in close proximity to metal fence to avoid possibility of fence becoming live. Separate earth electrodes, isolated from the earth grid, are to be provided for grounding the fence wires.

Pipes or rods used as electrodes should be in one piece, as far as possible, with a minimum allowable length of 3 mtrs. Except where rock or hard stratum is encountered, the pipe/rod electrodes should be driven into the ground to a minimum depth of 3 mtrs. The strip electrodes, forming the horizontal grid, should be buried underground to a minimum depth of 0.6 mtrs. The path of earth wire should be out of normal reach of any person, as far as possible.

For high resistivity soils, above 100 Ohm-mtrs., attempts should be made to bring the soil resistivity in the range of 50 to 60 Ohm-mtrs. By digging and treating the soil mass around the earth grid/electrodes with a mixture Betonite clay.

In case of rocky top soil and sub-stratum, having very high resistivity, with no scope of improvement by other means, the procedure given below should be followed:

(i) At least two bores of diameter little less than 40 mm, with a minimum distance of 10 mtrs. between them, should be made in the ground at suitable locations inside the S/S yard. The boring should be done until soil sub-stratum rich in moisture and low in resistivity is encountered. G.I. pipes of 40 MM dia. should be descended in each bore, such that, the soil mass around the pipes grips them

tightly, Back – filling of bores, if required, with wet soil/clay may be done to ensure this condition. The G.I. pipes in these deep bores should be interconnected with the main earthing grid of the S/S through 50x8 mm G.S. flat, with all the joints/connections and terminations being either fully welded, or clamped/bolted and welded simultaneously. The G.I. pipes in the bores should also be interconnected with each other. In extreme cases, the bores may have to be made at remote locations i.e. outside the S/S yard, with inter-connections, through 50x8 MM flats, as explained before.

(ii) The procedures to be observed stringently for making connections and joints between various elements of the earthing system are as follows:

a) G.S. flat to Structure/flat - The G.S. flat should be welded to the metallic portion (leg) of the structure after thoroughly cleaning the surfaces to be welded. The length of the welding should be at least twice the width of the G.S. flat, e.g.- minimum 100 mm for 50x8 mm G.S. flat. Exactly similar procedure is to be adopted for joints between two G.S. flats.

b) G.I. wire to structure. The G.I. wire should be bolted to the structure after making an eye formation and kept tight with the help of spring and ring washer. Then, the entire arrangement should be welded.

c) G.I. wire to G.S. flat- The G.I. wire should be bolted and then welded to G.S. flat, as explained above.

d) G.I. rod to G.S. flat- The G.I. rod should be securely clamped to the G.S. flat with the help of bolts and washers and the entire arrangement should then be welded.

e) G.I. wire to G.I. pipe – GI wire should be bolted to the G.I. pipe and then welded, keeping in view the relevant precautions, mentioned before.

f) G.I. flat to G.I pipe – The GI flat should be bolted tightly to the G.I. pipe and then the connection should be welded.

g) Before making connections and joints, it should be ensured that, the elements to be joined have a clean metallic contact surface without any non-conductive coating.

14.2. Earth grid system

Grid system of interconnected conductors forming a closed loop mesh is to be installed using 50x8 mm MS flat for peripheral and branch conductors. Interconnections are made by welding them. This earth grid will be laid at a depth of about 0.6 mtr. bonded to general mass of the earth by 3 mtrs. long earth electrode of solid MS rod (or pipe) of dia 25mm. The G.I. pipe 40 mm. dia 3 mtrs. long in the earthing pits, driven vertically.

It is to this earth grid that the transformer neutral, apparatus, frame work and other non-current carrying metal work associated like transformer tank, switchgear frame etc. are to be connected. All these connections should be made in such a way that reliable and good electrical connection is ensured. Aluminum/ other paint, enamel, grease and scale should be removed from the point of contact before connections are made. No part of the ground connection leads should be embedded in concrete.

14.3. Arrangement of connection of earth connection shall be as follow:

(i) Structures

Structures including frames, metal supports within the substation grid at least two legs, preferably diagonally opposite (where more than two legs are provided) on each metal structure shall be connected to earth grid with 50x8mm G.S. Flat.

(ii) Isolators/ switches

The operating handle shall be connected to earth grid independent of the structure earthing or through the steel mounting structure, through 50x8mm G.S. Flat.

(iii) Lightning arrestor

The bases of lightning arrestors shall be directly connected to the earth electrodes by 50x8mm G.S. flat as short and as straight as practicable, to ensure minimum impedance. Separate earth leads should be used for L.A. in each phase. In addition there shall be as direct connections as practicable from the earthed side of the lightning arrestors to the frame of the apparatus being protected. Surge counters, could also be inserted in the circuit where lightning incidences are high, but in such cases, the lightning arrestor should be mounted on insulated base. Invariably, earth connections for lightning arrestors should be separate, and in no case should they be joined looped or meshed with other conductors. For lightning arrestors mounted near transformers, earthing connections shall be done with the earthing pits and earthing leads shall be laid clear of the tank and collars in order to avoid possible oil leakage caused by arcing. The earth connection should not pass through iron pipes, as it would increase the reactive impedance of the connection. Each L.A.

should have separate earth electrode and these earth electrode should be interconnected with the main earth mat.

(iv) Power transformer:

- The tank of the transformer shall be directly connected to the main earth grid. In addition there shall be a separate and as direct a connection as practicable from the tank to the earth side of protecting LA using 4 50x8mm G.S flat.
- The earthing of the neutral shall be connected by two separate, distinct and direct connections of 50x8 mm GS flat to earth pits, which shall be interconnected with the earth grid, and shall be run clear of the tank and collars.
- The transformer track rails shall be connected to earth

(v) Out door VCB:

At least two legs, preferably diagonally opposite of the supporting structure frame work of each circuit breaker unit shall be connected to the earth grid, through 50x8mm G.S. flats.

(vi) Fencing:

Fencing and gate should be earthed separately.

(vii) Current transformers / potential transformers:

The bases of the current transformers should be directly connected to the earth grid through 50x8mm G.S. flat. The base (neural side) of the P.Ts. should be directly connected to the earth grid through 50x8mm G.S. flat. Separate earth leads should be used for P.Ts. in each phase. The termination of leads on the P.T. neutral should be bolted/clamped and not welded, to facilitate opening of the earth connection for testing purposes. In addition, all bolted cover plates to which bushings are attached, should be connected to the earth grid, both in case of C.Ts. and P.Ts.

(viii) Armoring of armored metal-sheathed cables within the station grid area shall be connected to the earth grid.

(ix) Substation L.T. Supply Transformer: Same as above except that the neutral earthing conductor used shall be 50x8mm G.S. flat.

14.4. General instructions for design and laying of earth mat

(i) Design touch voltage should be less than tolerable touch voltage safe design

(ii) Design step voltage should be less than the tolerable step voltage for safe design

(iii) Actual length of earth conductor should be more than minimum length required for gradient control

(iv) Earthing resistance of earthmat should be less than 2.0 ohms.

(v) Size of earth conductor should be 50x8 mm

(vi) The trenches dug for drawing the earth conductor should be filled with earth free of stones.

(vii) The earth conductor should be buried at a depth of not less than 0.6mm below the ground

(viii) All joints of grounding steel strips between themselves and earthing electrodes should be overlap welded. The length of welds should be double the width of the strip.

(ix) For protection against rust of buried welded joints located in soil, the weld should be coated with bituminous paint

(x) The equipment earthing should be done in comply with the rule 61(2) of the Indian Electricity Rules 1956

(xi) The overhead grounded wires of transmission lines should be solidly connected to the earth mat

(xii) Separate earthing electrodes with bentonite should be provided in the vicinity of the L.A and transformer neutral. The electrodes should be interconnected with the earth mat

(xiii) The earth conductors should be laid in parallel lines and at reasonably uniform spacing. Wherever practicable, these should be located along rows of structures or equipments to facilitate making of earth connections. Where essential, a few extra cross connections may be added to form a closer mesh at corner.

(xiv) All the area over which earth mat is spread should be covered by 0.10-0.20mm thick hard crushed rock which should also be spread upto 1.5meters from the periphery of grounding grid. Where fencing is connected to the main earth mat crushed rock should be placed outside, along the periphery of the fencing.

SECTION -IV

GUARANTEED TECHNICAL PARTICULARS

1. 33kV LIGHTNING ARRESTOR

Sl. No	Description	Bidder Particulars	
		For 33kV	For 11kV
1	**LA : GENERAL**		
1.1	Name of Manufacturer		
1.2	Type & Model of the Manufacturer		
1.3	Conforming Standard		
1.4	Date of Last Type Test		
1.5	Diameter of Primary Stud (mm)		
1.6	Total Height of the LA		
1.7	Total Weight of the LA		
1.8	No. of Units per Arrestor		
2	**LA: VOLTAGE**		
2.1	Rated voltage of Units		
2.2	MCOV		
2.3	Switching Surge Impulse withstand voltage with 250/2500 micro sec. wave(KVp)		
2.4	Lightning Impulse Residual voltage (KVp) (8/20 microsecond wave)		
2.5	Temporary over voltage capability (KVrms)		
2.5.1	0.1 seconds		
2.5.2	1.0 seconds		
2.5.3	10.0 seconds		
2.5.4	100.00 seconds		
2.6	Residual voltage after passing a steep current (1 microsecond front time) with amplitude equal to Nominal Discharge Current		
2.7	Residual voltage for switching impulse currents (front time of about 30 to 60 microseconds) in KV crest at 500/1000 Amps		
2.07	Maximum RIV at 1.1 Ur/ √3 voltage at 1 MHz (Micro volts)		
3	**LA: CURRENT**		
3.1	Nominal Discharge Current (KAp) (for a 8/20 microsecond wave)		
3.2	High current Impulse withstand capacity(4/10 microsecond) in Kap		
3.3	Ir at MCOV		

3.4	Ic at MCOV		
4	**LA : ENERGY**		
4.1	Minimum energy discharge capability(KJ/KV) at		
4.2	Long duration discharge class		
4.3	Pressure Relief Class		
5	**Protective Ratio based on Transformer/Reactor BIL.**		
5.1	5000 Amps		
5.2	10,000 Amps		
6	**LA: HOUSING**		
6.1	Material of Housing Insulator		
6.2	Total Creepage Distance of whole Arrestor housing (mm)		
6.3	Cantilever strength of complete Arrestor(Kgf)		
6.4	L.A. Housing Insulation Withstand (KV)		
6.5	Dry(P.F)		
6.6	Wet (P.F)		
6.7	Lightning Impulse (Dry)		
6.8	Partial Discharge in Pico-Coulomb		
6.9	Corona Extinction Voltage (KVrms)		
6.10	Type of Surge Monitor		
6.11	Each ZNO Block Dimensions		

2. 33kV CURRENT TRANSFORMER

Sl No	Description	Bidders particulars
1	Ratio	
2	Name of Manufacturer	
3	Manufacturers Type	
4	Name of resin employed in manufacture of C.T	
5	Rated Voltage	
6	Rated primary current	
7	Rated Secondary current	
8	Rated Secondary output	
9	Class of Accuracy	
10	Instrument Security Factory	
11	Short Time Rating (1 Second)	

12	Rated continuous Thermal current (also indicate Temp. rise over ambient Temp.	
13	Rated current Dynamic (peak value)	
14	Power frequency (dry withstand test voltage on primary winding) one second	
15	Power frequency withstand voltage on secondaries.	
16	1.50 micro seconds impulse withstand test voltage	
17	Power frequency (dry withstand test voltage on primary winding)	
18	Total Weight (1 phase)	
19	Overall Dimensions a)Length b)Width c)Height	
20	The CT of the offered Design should have type tested during last five years from the date of opening of tender and it should be indicated that whom and where they type tested	
21	Details of test reports (to be enclosed with the tender)	

3. 33kV VACUUM CIRCUIT BREAKER

Sl No	Description	As Per Specification	Units	Bidder's Particulars
1	**GENERAL**			
	Name of manufacture			
	Manufacturer's type designation			
	Governing standards	IS : 13118 & IEC : 56		
	No. of poles of circuit breaker	3	no.	
	No. of breaks per phase	1	no.	
	Total length of break per phase		mm	
	Type	Vacuum	Yes/No	
2.	**NOMINAL VOLTAGE**			

	Rated voltage	33	KV	
	Maximum(continuous)service rated voltage	36	KV	
3.	**RATED NORMAL CURRENT**			
	Under normal condition	1250	Amps	
	Under site condition	1250	Amps	
4.	**SHORT CIRCUIT PERFORMANCES**			
	Rated short circuit breaking current:			
	i) Symmetrical, rms	25	KA	
	ii) Asymmetrical including DC component	31.25	KA	
	Rated short circuit making current; peak	62.5	KA	
	Short time current withstand capability:			
	i) Peak value	62.5	KA	
	ii) Rms value	25	KA	
	iii) Duration	3 Seconds	Sec	
5.	**MAX. TEMP. RISE OVER AMBIENT OF 50^{0}C**			
	At normal continuous current		0_C	
	After performing the operating sequence		0_C	
	At 10% rupturing capacity		milli-sec	
6	**Make & Break Times**			
	Total break times			
	i) At 10% rupturing capacity	60	milli-sec	
	ii) At rated rupturing capacity	60	milli-sec	
	iii) Arcing time at rated breaking current	60	milli-sec	
	iv) Make time form giving close command	60	milli-sec	
	Minimum reclose time at full rated interrupting Capacity from trip coil energisation		sec	
	Minimum dead time for 3 phase reclosing		mill-sec	
	Circuit breaker opening time:			
	i) at 125% of rated voltage of opening device	60	milli-sec	

	ii) at 100% of rated voltage of opening device	60	milli-sec	
	iii) at 70% of rated voltage of opening device	60	milli-sec	
	Circuit breaker closing time:			
	i) at 125% of rated voltage of closing device	60	milli-sec	
	ii) at 100% of rated voltage of closing device	60	milli-sec	
	iii) at 70% of rated voltage of closing device	60	milli-sec	
7	**RESTRIKING VOLTAGES FOR 100% RATED CAPACITY**			
	Amplitude factor		KV	
	Phase factor		KV	
	Natural frequency		KHz	
	Rate of rise of recovery voltage	0.57	kv/µs	
8	**RATED INSULATION LEVEL**			
	Dry and wet power frequency withstand test voltage (rms) for 1 minute			
	i) Between live terminals and grounded objects	70	KV	
	ii) Between terminals with breaker contacts open	70	KV	
	1.2/50 µsec full wave impulse withstand voltage +ve and - ve polarity (peak)			
	i) Between live terminals and grounded object	170	KV	
	ii) Between terminals with breaker contacts open	170	KV	
	One mimute power frequency voltage of auxiliary wiring	2	KV	
9	**OPERATING PERFORMANCE**			
	Rated transient recovery voltage	0.57	KV/µs	
	Rated cable charging breaking current	50	Amps.	
	Rated single capacitor bank breaking current	400	Amps.	

	Rated back-to-back capacitor bank breaking current		Amps	
	Rated capacitor bank in-rush making current		KA	
	Rated small inductive breaking current	25	KA	
	First pole-to-clear factor	1.5		
	Rated operating sequence	O-0.3 Sec-CO-3 Min-CO		
	Rated out-of-phase breaking current	25	KAmp	
	Re-ignition and Re-strike free	Yes	Yes/ No	
10	**NUMBER OF OPERATION POSSIBLE WITHOUT MAINTENANCE**			
	at full rated interrupting current	> 100	no.	
	at 50% of rated interrupting current	> 100	no	
	at 100% of full load current	10,000	no	
	at no load		no	
11	**MINIMUM CLRARANCE IN AIR**			
	Between phases	460	mm	
	Live parts to earth	400	mm	
	Live parts to ground level	3700	mm	
12	**WEIGHTS AND DIMENSIONS**			
	Total weight of one complete breaker, including mounting structure		kg	
	Mounting structure weight		kg	
	Control cabinet weight		kg	
	Dimensions:			
	Height		mm	
	Width		mm	
	Depth		mm	
	Drawings must be provided			
13	**HOLLOW INSULATOR HOUSING**			
	Type and make of insulators.			
	Power frequency withstand test voltage for one minute:			

	i) Dry	70	KV	
	ii) Wet	70	KV	
	Flash over value			
	i) Dry	135	KV	
	ii) Wet	95	KV	
	1.2/50 impulse voltage withstand capability			
	i) positive polarity	170	KV	
	ii) negative polarity	170	KV	
	Creepage distance total	900	mm	
	Creepage distance protected	450	mm	
	Weight of assembled housing		kg	
	Corona shield provided or not	Yes		
14	**SUPPORT INSULATOR**			
	Type and make of insulators			
	Power frequency withstand test voltage for one minute:			
	i) Dry	70	KV	
	ii) Wet	70	KV	
	Flash over value			
	i) Dry	135	KV	
	ii) Wet	95	KV	
	1.2/50 impulse voltage withstand capability			
	i) positive polarity	170	KVp	
	ii) negative polarity	170	KVp	
	Creepage distance, total	900	mm	
	Creepage distance, protected	450	mm	
	Weight of assembled housing		kg	
	Corona shield provided or not	Yes		
15	**CONTACTS**			
	Type of main contacts	Butt		
	Type of auxiliary contacts			
	Material of auxiliary contacts	Silver Plated Brass		
	Type of plating, if any	Silver		
	Thickness of plating	20	micron	

	Contact pressure		gm/sq. mm	
	No of auxiliary contacts provided:	6 NO + 6 NC		
	Those closed when breaker is closed	6	no	
	Those open when breaker is closed	6	no	
	Those adjustable		no	
16	**OPERATING MECHANISM**			
	Opening type	Shunt Trip		
	Closing type	Motor / Manual spring charge,Shunt/Magnetic actuator operation		
	Force applied by charged spring for closing		kg	
	Time taken by motor for charging the spring form fully discharged to fully charged position	<30	sec	
	Full sequence of operation	O-0.3sec-CO-3min-CO		
	Whether limit switches are provided with spring	Yes	yes/no	
	Whether spring limit switches start & stop the motor	Yes	yes/no	
	Type and material of spring employed			
	Whether trip free	Yes		
	Whether anti pumping device provided	Yes		
17	**AUXILIARY AND CONTROL POWER SUPPLY**			
	Normal auxiliary A.C supply voltage	230	Volts	
	Voltage limits for proper operation		olts	
	Maximum	115%	Volts	
	Minimum	85%	Volts	

	Frequency limits for proper operation			
	Maximum	+5%	Hz	
	Minimum	-5%	Hz	
	for circuit breakers :		Volts	
	Normal DC control circuit voltage	24	Volts	
	Voltage limits for proper operation			
	Maximum	120%	Volts	
	Minimum	70%	Volts	
	Power required for trip coil	300	Watts	
	Power required for closing coil	300	Watts	
18	**LOCAL CONTROL PANEL**			
	Material			
	Degree of protection			
	Vermin proof provisions	Yes	Yes/no	
	Weather proof provision	Yes	Yes/no	
	Dust proof provision	Yes	Yes/no	
	Ventilation provision	Yes	Yes/no	
	Thickness of sheet materials used	3	mm	
	Overall dimensions		mm	
	Total weight		kg	
	Mounting arrangement			
19	**TERMINAL CONNECTOR**			
	Material			
	Bi-metallic or not	Yes		
	Weight		kg	
	Dimensions		mm	
	Size and type of conductor it can accommodate	100	sq mm	
	Terminal pads silver plated or not	Yes		
	Thickness of silver plating		microns	
20	**CORROSION PREVENTION SYSTEM FOR CIRCUIT BREAKER AND CONTROL CABINET**			
	Surface preparation	Preferable Galvanized		

	Rust inhibition			
	Zinc thickness/paint thickness		microns	
	Treatment of fasteners			
21	**CORROSION PREVENTION SYSTEM FOR SUPPORT STRUCTURE**			
	Surface preparation	Hot Dip Galvanized		
	Rust inhibition			
	Zinc thickness		microns	
	Treatment of fasteners.			
22	**VACUUM CIRCUIT BREAKER SEALING**	Hermetically Sealed		

4. 33kV & 11kV ISOLATOR

S.No.	Particulars	Bidder's Particulars	
		33kV Isolator	**11kV Isolator**
1	**Manufacturer's Type/Designation/Installation**		
2	**Manufacturer's Name and Country of Manufacture**		
3	**Standard(s) according to which the isolators are manufactured**		
4	**Maximum design voltage at which the isolator can operate (kV)**		
5	**Rated Requency (Hz)**		
6	**Rated Voltage (KV)**		
7	**Max. current that can be safely interrupted by the isolator**		
	i)Inductive (A & % PF)		
	ii)Capacitive (A & % PF)		
8	**Continuous current rating**		
	i)Nominal (Amps)		
	ii)Under site conditions (Amps)		
9	**Rated short time withstand current**		
	i)For 3 seconds (KA rms)		
	ii)For 1 second (KA rms)		
	iii)Rated peak withstand current (kAp)		
10	Mile Volt drop test voltage between :		
	i)Contacts		
	ii)Terminals of each phase		

11	**Current density at the minimum cross-section of:**		
	a)Moving blade (Amps/Sq.mm.)		
	b)Terminal pad (Amps/sq.mm.)		
	c)Male Contacts (Amps/sq.mm.)		
	d)Female Contacts (Amps/sq.mm.)		
	e)Terminal Connector (Amp/sq.mm)		
12	**Max. temp. rise of following current carrying parts when carrying rated current continuously (deg.C) over an ambient of 50 deg.C instead of 40 deg.C mentioned in relevant IS.**		
	i)Moving blades		
	ii)Contacts with silver plating		
	iii)Terminal pad.		
	iv)Bi-metallic terminal connector		
	v)Springs		
13	**Class (outdoor or indoor)**		
14	**Derating factor for specified site conditions**		
15	**15) Insulation levels**		
	i) Lightning Impulse withstand voltage (kV peak)		
	a)Phases to Earth		
	b)Isolating Distance		
	ii) Power frequency withstand voltage (kVrms)		
	a)Phases to Earth		
	b)Isolating Distance		
16	**Minimum clearance in air (mm):**		
	i) When switch is closed:		
	a)Between adjacent poles of different phases (centre to centre)		
	b)Between live parts and earth		
	ii) When switch is open:		
	a)Between poles of same phase (centre to centre)		
	b)Between adjacent poles of different phases (centre to centre)		
17	**Design and Construction**		
	i) No. of insulators per pole		
	ii) No. of breaks per pole		
	iii) Type of closing/opening mechanism (Horizontal/Vertical break straight etc.)		

iv) Contacts (Male):		
a)Material and grade		
b)Dimensions & Cross-sectional area in sq.mm.		
v) Contacts(Female):		
a)Material and grade		
b)Dimensions & Cross-sectional area in sq.mm.		
vi) Moving Blades:		
a)Material and grade		
b)Dimensions & Cross-sectional area in sq.mm.		
vii) Terminal pad:		
a)Material and grade		
b)Dimensions & Cross-sectional area in sq.mm.		
viii) Arching horns :		
a)Material and grade		
b)Dimensions & Cross-sectional area in sq.mm.		
ix Springs		
a)Material and grade		
b)Dimensions & Cross-sectional area in sq.mm.		
x) Contact Support:		
a)Material, size and length of plate		
b)Material and size of plate		
xi) Rain hood - Material grade and size		
xii) Nuts and Bolts		
a)Size, material and grade in live parts		
b)Size, material and grade in other parts		
xiii) Insulator base plate Material and size & min. thickness of plate below insulators.		
xiv) Bearings:		
a) Make, Type and No. of bearings		
for:		
i)Rotating insulator base assembly		
ii)Operating mechanism		
iii)Whether lubricating nipple is provided		
b) Make, and size of bearing housing		
xv) Size of GI pipes (medium class) used for :		

a) Down operating pipe (mm)		
b) Connecting pipe for same phase (mm)		
c) Connecting Pipe for adjacent poles(mm)		
xvii) Tandem pipe		
a)Size class and No. of pipes		
b)Size of shackle, screw		
c)No. of bearings/bush and its material and size.		
xvii) Type of interlock		
xviii) Type of universal/swived joint		
a)Between bearing and down pipe		
b)Between down pipe and operating mechanism		
xix) Insulators		
a)Type.		
b)No. of units per insulator		
c)Rating of insulators(KV)		
d)Height of each insulator stack (mm)		
e)Bolt circle diameter(mm)		
f)Tensile strength (kg).		
g)Compressive strength(Kg.)		
h)Torsional strength (kg.m.)		
i)Cantilever strength upright		
j)Power frequency dry flash- over voltage (KV) rms.		
k)Power frequency wet flash-over voltage(KV) rms.		
l)Impulse flash-over voltage(positive wave) (KV) peak.		
m)Impulse withstand voltage (kv) peak		
n)Power frequency puncture voltage (KV) rms.		
o)Visual discharge voltage level (KV) rms.		
p)Creepage distance : Total(mm)		
q)Dry arcing distance (mm)		
xx) Base:		
a)Size ,Nos. & length of steel sections used		
b)Overall size(mm)		
c)Total weight (Kgs)		
xxi) Terminal Connectors:		
a) Clamp Body:		
i) Alloy Composition		

	ii)Plating if any		
	iii)Dimension		
	b) Bolts and nuts size		
	i)Alloy composition		
	ii)Tensile strength		
	c) Type of washers used		
	d) Materials of braids		
	e) Temperature rise when carrying rated current at 50 deg.C ambient (deg.C)		
	f) Weight of each type of clamp (Kg.)		
18	**Mass of isolator hardware in Kg. Without earth blade**		
19	**Type of contacts**		
20	**Nuts & Bolts**		
	a)Size, material & grade in live parts		
	b)Terminal connectors.		
	c)Other parts.		
21	**Locking arrangement of Isolators and earth switch operating mechanism**		
22	**Whether isolator hardware is complete with all accessories**		
23	**Details of type test reports furnished:**		
	item IS:Type test Testing		
	Report No. authority & date		
	i)Isolator		
	ii)Terminal connector		
	iii)Degree of protection		
24	**List of brought out items**		
25	**List of drawing furnished**		

5. 2.5 MVA 33/11KV TRANSFORMER

Sl No	Description	Bidder's Particulars
1	Name and Address of the Manufacturer	
2	Country of Origin	
3	Applicable standard	
4	Maximum continuous rating (in MVA)	
5	No load voltage ratio at Normal (Nominal) tap (in kV/kV)	
6	Rated frequency (in Hz)	
7	Number of phases	
8	Type of Cooling	
9	Connections	
	i) H.V. Winding	

	ii)L.V. Winding	
10	Vector Symbol	
11	Tappings	
	i) Tap Range (in %)	
	ii) Number of steps	
	iii) Variation of voltage in each step	
	a) Tap No 1	
	* Voltage in HV (in kV)	
	* Voltage in LV (in kV)	
	b) Tap No 2	
	* Voltage in HV (in kV)	
	* Voltage in LV (in kV)	
	c) Tap No 3	
	* Voltage in HV (in kV)	
	* Voltage in LV (in kV)	
	d) Tap No 4	
	* Voltage in HV (in kV)	
	* Voltage in LV (in kV)	
	e) Tap No 5	
	* Voltage in HV (in kV)	
	* Voltage in LV (in kV)	
	f) Tap No 6	
	* Voltage in HV (in kV)	
	* Voltage in LV (in kV)	
	g) Tap No 7	
	* Voltage in HV (in kV)	
	* Voltage in LV (in kV)	
	h) Tap No 8	
	* Voltage in HV (in kV)	
	* Voltage in LV (in kV)	
	iv) No load voltage in HV and LV side in each tap	
12	i) Temperature rise under normal operating condition above ambient temperature	
	a) Top oil (in Degree C)	
	b) Windings (in Degree C)	
	ii) Maximum hot spot temperature of Copper windings (in Degree C)	
13	Magnetising current referred to H.V. at rated frequency	
	i) at 90% rated voltage : (in Amps)	
	ii) at 100% rated voltage : (in Amps)	
	iii) at 110% rated voltage (in Amps)	
14	Power factor of magnetizing current at 100% rated voltage & frequency	

15	No load current at rated voltage and Rated frequency (in Amps)	
16	No load loss (iron loss) in KW at rated frequency and voltage	
	i) at Lowest tap	
	ii) at normal tap	
	iii) at highest tap	
17	Load loss (Copper loss) in KW at 75 Deg. C. at Rated output and frequency	
	i) at Lowest tap	
	ii) at normal tap	
	iii) at highest tap	
18	Percentage Voltage Regulation at full load at 75 Deg.C	
	i) at unity power factor	
	ii) at 0.8 power factor lagging	
19	Efficiencies at 75 Deg.C (in percentage)	
	i) at full load	
	a) at unity power factor	
	b) at 0.8 power factor lagging:	
	ii) at ¾ full load	
	a) at unity power factor	
	b) at 0.8 power factor lagging:	
	iii) at 1/2 full load (i) at unity power factor	
	a) at unity power factor	
	b) at 0.8 power factor lagging:	
20	Impedance voltage on rated MVA base at rated current and frequency for the Normal tapping 75 Deg.C. (in percentage)	
21	a) Reactance voltage at rated current and frequency for the normal tapping at 75 Deg.C. (in percentage)	
	b) Resistance voltage at rated current and frequency for the principal tapping at 75 Deg.C.(in percentage)	
22	Withstand time without injury for three phase dead short circuit at terminal (in seconds)	
23	Short time current rating for short circuit with duration	
	i) H.V. winding (in K. Amps)	
	ii) L.V. winding (in K Amps)	
	iii) Duration (in seconds)	
24	Permissible overloading with time	
25	Core	

	i) Type	
	ii) Flux density of Core at normal tap	
	a) at 100% rated voltage at 50 Hz (in Tesla)	
	b) at 110% rated voltage at 50 Hz (in Tesla)	
	iii) Thickness of core lamination (in mm)	
	iv) Type of insulation between core laminations	
	v) Core bolt withstand Insulation (in kV rms for 1 min)	
	vi) Approximate area of Cross Section of Core limb (in sq.mm.)	
	vii) Material of Core clamping plate	
	viii) Thickness of Core clamping plate (in mm)	
	ix) Insulation of Core clamping plate	
	x) Describe location/Method of Core grounding:	
26	Positive Sequence Impedance between HV & L.V. winding on rated MVA base at rated Current and frequency at 75 Deg.C. winding temperature	
	i) At Normal tapping (in percent)	
	ii) At lowest tapping (in percent)	
	iii) At highest tapping (in percent)	
27	Zero Sequence Impedance at reference temperature of 75 Deg.C at Normal tap (in percent)	
28	Details of type windings	
	i) High Voltage	
	ii) Low Voltage	
29	Winding conductor	
	i) Material of the winding conductor	
	a) High Voltage	
	b) Low Voltage	
	ii) Conductor cross sectional Area	
	a) High Voltage (in sq.cm)	
	b) Low Voltage (in sq.cm)	
	iii) Current density of windings at rated MVA	
	a) At Normal Tapping	
	1) High Voltage (Amp per sq cm)	
	2) Low Voltage (Amp per sq cm)	
	b) At lowest Tapping	
	1) High Voltage (Amp per sq cm)	
	2) Low Voltage (Amp per sq cm)	
	c) At highest Tapping	
	1) High Voltage (Amp per sq cm)	
	2) Low Voltage (Amp per sq cm)	
	iv) Insulating material used for	

	(a) High Voltage Winding	
	(b) Low Voltage winding	
	v) Insulting material used between	
	(a) High Voltage Winding	
	(b) Low Voltage winding	
	vi) Whether adjustable coil clamps are provided for H.V. & L.V. winding (if yes, details may be given)	
	vii) Type of Axial Coil Supports	
	a) H.V. winding	
	b) L.V. winding	
	viii) Type of Radial Coil Supports	
	a) H.V. winding	
	b) L.V. winding	
30	Current in the winding at rated MVA	
	a) At Normal Tapping	
	1) High Voltage (Amp)	
	2) Low Voltage (Amp)	
	b) At lowest Tapping	
	1) High Voltage (Amp)	
	2) Low Voltage (Amp)	
	c) At highest Tapping	
	1) High Voltage (Amp)	
	2) Low Voltage (Amp)	
31	Voltage per turn (kV per turn)	
	a) At Normal Tapping	
	1) High Voltage (in Volt per turn)	
	2) Low Voltage (in Volt per turn)	
	b) At lowest Tapping	
	1) High Voltage (in Volt per turn)	
	2) Low Voltage (in Volt per turn)	
	c) At highest Tapping	
	1) High Voltage (in Volt per turn)	
	2) Low Voltage (in Volt per turn)	
32	Ampere turn (in MKS)	
33	Number of winding turns	
	a) At Normal Tapping	
	1) High Voltage (No of turn)	
	2) Low Voltage (No of turn)	
	b) At lowest Tapping	
	1) High Voltage (No of turn)	
	2) Low Voltage (No of turn)	
	c) At highest Tapping	
	1) High Voltage (No of turn)	

	2) Low Voltage (No of turn)	
34	Details of Tapchanger	
	i) Number of steps	
	ii) Number of Plus taps	
	iii) Number of minus taps	
	iv) Position of normal taps on HV	
	v) Description of tap changing arrangement	
35	Bushing :	
	i) Make	
	* High Voltage	
	* Low Voltage	
	ii) Type	
	* High Voltage	
	* Low Voltage	
	iii) Applicable standard	
	* High Voltage	
	* Low Voltage	
	iv) Insulation withstand test voltage	
	a) Lightning impulse withstand test voltage (1.2 x 50 Micro second inKV peak)	
	* High Voltage	
	* Low Voltage	
	b) Power frequency withstand test voltage (in KV rms for 1 min)	
	1) Dry	
	* High Voltage	
	* Low Voltage	
	2) Wet	
	* High Voltage	
	* Low Voltage	
	v) Creepage distance	
	a) Total in mm	
	* High Voltage	
	* Low Voltage	
	b) Protected in mm	
	* High Voltage	
	* Low Voltage	
	vi) Minimum height of the bushing	
	* High Voltage	
	* Low Voltage	
36	Minimum clearance (in mm) :	
	i) In oil	
	a) between phase to phase	
	* High Voltage	

	* Low Voltage	
	b) between phase to ground	
	* High Voltage	
	* Low Voltage	
	ii) In air	
	a) between phase to phase	
	* High Voltage	
	* Low Voltage	
	b) between phase to ground	
	* High Voltage	
	* Low Voltage	
37	Particulars of Bushing & Neutral C.T.	
	i) CT at bushing turret	
	a) Type	
	b) Ratio	
	c) Accuracy Class	
	d) Knee Point Voltage	
	e) RCT at 75 Deg.C	
	f) Magnetising Current at Knee Point Voltage	:
	g) Additional winding particulars of testing on the C.T.	
	h) Short Time Rating	
	i) Reference Standard	
	ii) CT at Neutral	
	a) Type	
	b) Ratio	
	c) Accuracy Class	
	d) Knee Point Voltage	
	e) RCT at 75 Deg.C	
	f) Magnetising Current at Knee Point Voltage	:
	g) Additional winding particulars of testing on the C.T.	
	h) Short Time Rating	
	i) Reference Standard	
38	Approximate weight of Transformer (in Kgs)	
	i) Core with clamping	
	ii) Coil with insulation	
	iii) Core and winding	
	iv) Weight of oil	
	v) Haviest transport weight	
	vi) Overall weight	
39	Tank and fitting with accessories	
	i) Untanking weight	
	ii) Oil required for first filling	

	iii) Total weight with Core, Winding, Oil Fittings:	
40	Details of Tank	
	i) Type of tank	
	ii) Approximate thickness of Sheet (in mm)	
	a) Sides	
	b) Bottom	
	c) Cover	
	d) Radiators	
	iii) Vacuum recommended for hot oil circulation (in torr.)	
	iv) Vacuum to which the tank can be subjected without distorsion (in torr.)	
	v) Under carriage dimensions	
	a) No. of bidirectional wheels provided	
	b) Track gauge required for the wheels	
	* Transverse	
	* Longitudinal	
	vi) Type of Pressure relief device and pressure at which it operates	
41	Conservator	
	i) Total volume (in Litres)	
	ii) Volume between the highest and Lowest visible oil level (in litres)	
42	Transformer Oil	
	i) Applicable standard	
	ii) Total quantity of oil (in Litres)	
43	Radiator	
	i) Number of Radiator Bank	
	ii) Number of tubes/fins in each radiator Bank	
	iii) Thickness of tubes/fins (in mm)	
	iv) Overall dimensions (in mm)	
	a) Length	
	b) Breadth	
	c) Height	
	v) Type of mounting	
	vi) Vacuum withstand capability	
44	Buchholz Relay	
	i) Make	
	ii) Type	
	iii) Number of float contacts	
45	Temperature indicator	
	i) Make	
	a) Oil temperature indicator	

	b) Winding temperature indicator	
	ii) Type	
	a) Oil temperature indicator	
	b) Winding temperature indicator	
	iii) Permissible setting of alarm & trip	
	a) Oil temperature indicator	
	b) Winding temperature indicator	
	iv) Number of contact	
	a) Oil temperature indicator	
	b) Winding temperature indicator	
	v) Current rating of each contact	
	a) Oil temperature indicator	
	b) Winding temperature indicator	
46	Approximate overall Dimensions (in mm)	
	i) Length	
	ii) Breadth	
	iii) Height	
	iv) Minimum height of bottom most protion of bushing from bottom of base channel	
47	Winding resitance (in ohm)	
	i) H.V Side	
	a) R to Y	
	* At Normal tapping	
	* At lowest tapping	
	* At highest tapping	
	b) Y to B	
	* At Normal tapping	
	* At lowest tapping	
	* At highest tapping	
	c) R to B	
	* At Normal tapping	
	* At lowest tapping	
	* At highest tapping	
	ii) L.V Side	
	a) r to n	
	* At Normal tapping	
	* At lowest tapping	
	* At highest tapping	
	b) y to n	
	* At Normal tapping	
	* At lowest tapping	
	* At highest tapping	
	c) b to n	
	* At Normal tapping	

	* At lowest tapping	
	* At highest tapping	
48	Minimum clearance height for lifting tank cover (in mm):	

6. 33kV POTENTIAL TRANSFORMER

Sl No	Description	Bidder's Particulars
1	**GENERAL**	
1.1	Name of Manufacturer	
1.2	Type & Model of the Manufacturer	
1.3	Conforming Standard	
1.4	Date of Last Type Test	
1.5	Oil Filled Insulation or Gas filled Insulation	
1.6	Diameter of High Voltage Stud (mm) x Length (mm)	
1.7	Total Height of the VT	
1.8	Total Weight of the VT	
1.9	Material Used in Primary Winding	
1.10	Material Used in Secondary Winding	
1.11	Rated voltage (KV)	
2	**INSULATION LEVEL**	
2.1	1.2/50 micro second Impulse withstand voltage (dry) on primary winding (KV peak)	
2.2	One minute power frequency withstand voltage(Dry) on primary winding (KV rms)	
2.3	One minute power frequency withstand voltage(Wet) on primary winding (KV rms)	
2.4	One minute power frequency withstand test voltage in secondary winding (KV rms)	

2.5	Rated voltage factor and time between line & Earth with Effective earthing System. (For Continious / 30 secs)	
2.6	Temperature rise at 1.5 time the rated voltage for 30 sec. after operation with 1.1 times the rated voltage (^{0}C)	
2.7	Temperature rise at 1.1 time the rated voltage for continuous operation (^{0}C)	
3	**Bushing**	
3.1	Minimum creepage distance (mm)	
3.2	Whether CT bushing is hermetically sealed or not	
3.3	Cantilever Strength (Kgf)	
4	**Details of Cores**	
4.1	Ratio	
4.2	Burden	
4.3	No. of core	
4.4	Class of accuracy	
4.5	Maximum phase angle error with rated burden & 5% voltage (degree) for Meetering Core	
4.6	Maximum ratio error with rated burden & 5% voltage forMeetering Core.	

7. 33/0.4kV STATION TRANSFORMER

Sl. No.	Description	Unit	Bidder's Particulars
1	**Make & Manufacturer**		
2	**Place of Manufacture**		
3	**Voltage Ratio**		
4	**Rating in KVA**	KVA	
5.Core Details:			
5.1	Core Grade		
5.2	Thickness of core plates		

5.3	Flux density (Max)	TESLA	
5.4	Over fluxing without saturation		
5.5	Core Details. 1)No. of Core steps. 2)Max. width of first step lamination. 3)Stacking factor 4)Core building factor.		
5.6	Core diameter	cm	
5.7	Gross Core area	cm	
5.8	Net Core area	cm	
5.9	Wt. Core	Kg.	
5.10	Loss per Kg. of core at the specified Flux Density	Watts/ kg	
5.11	Core loss in watts a) Normal Voltage b) Maximum Voltage		
5.12	Power factor magnetizing current (lag max)		
5.13	Magnetizing (No load) current at a)Normal Voltage b)Maximum Voltage		
5.14	Core window height	mm	
5.15	Center to center distance of the core	mm	
5.16	Maximum temperature rise of Core by Thermometer		
6.Winding Details			
6.1	Maximum temperature rise of Windings by resistance method		
6.2	Winding material : LV & HV		
6.3	Resistance of windings at 20 Deg. C (with 5% tolerance for LV) a) HV Winding (ohms), b) LV winding (ohms)		
6.4	No. of LV Turns		
6.5	No. of HV Turns		
6.6	Size of LV conductor bare/covered	mm	
6.7	Rounding Factor for LV		
6.8	No. of parallels		
6.9	Area of LV cross section (sq.mm)	sq.mm	
6.10	Current density of LV winding	Amp/sq.mm	
6.11	Current density of HV winding	Amp/sq.mm	
6.12	Wt. Of the HV winding for transformers	Kg.	

6.13	Wt. Of the LV winding for transformers	Kg.	
6.14	No. of LV Coils/Phase		
6.15	No. of HV Coils/Phase		
6.16	ID/OD of LV winding	mm	
6.17	ID/OD of HV winding	mm	
6.18	Height of LV winding	mm	
6.19	Height of HV winding	mm	
6.20	Axial height of HV coil	mm	
6.21	Axial height of LV coil	mm	
6.22	Radial depth of LV coil	mm	
6.23	Radial depth of HV coil	mm	
6.24	Full load current HV	Amps	
6.25	Full load current LV	Amps	
6.26	Full load losses (watts) at 75 Deg. C	Watts	
6.27	Estimated stray losses	Watts	
6.28	Estimated Breaker Losses	Watts	
6.29	Total Losses(Full load losses+ stray losses+ Breaker Losses)	Watts	
6.30	Calculated Impedance	%	
6.31	Edge strip size on LV coil (top & Bottom)	mm	
7.Clearances			
7.1	Size of the duct in HV winding	mm	
7.2	Size of the duct in LV winding	mm	
7.3	Size of the duct between HV & LV	mm	
7.4	HV winding to LV clearance	mm	
7.5	HV winding to tank clearance	mm	
7.6	HV to earth creepage distance	mm	
7.7	LV to earth creepage distance	mm	
7.8	Clearances (minimum) a)Core & LV b)LV & HV c)HV Phase to phase d)End insulation clearance to Earth e)Any point of winding to tank	mm	
8.Heat Disspation Calculations			
8.1	Maximum temperature rise of Oil by Thermometer		

8.2	Transformer (minimum) 1)Overall length x breadth x height 2)Tank length x breath x height 3)Height of Oil level in tank 4)Thickness of plates a)Side walls (min.) b)Top & bottom plate (min.)		
8.3	Radiation: 1)Heat dissipation by tank walls exclusive top & bottom 2)Heat dissipation by cooling tube 3)Dia & thickness of cooling tube 4)Whether calculation sheet for selecting cooling area to ensure to ensure that the transformer is capable of giving continuous rated output without exceeding temperature rise & also transformer tank size is sufficient is enclosed. 5)Minimum free space available above oil level.		
8.4	Weight content of a)Core lamination (min.) b)Windings (min.) c)Tank & Fittings d)Oil e)Oil Qty in liters(min.) f)Core channels, rods, bolts, etc g)Insulation material inside tank. h)Total Weight		
8.5	Oil Data 1)Qty. for first filling (min.) 2)Grade of oil used 3)Maker's name 4)BDV at the time of filling		
9.Efficiency,Regulation, and other particulars			
9.1	Efficiency at 75 Deg. C a)Unity P.F. & b)0.8 P.F. 125% load 100% load 75% load 50% load 25% load		
9.2	Regulation at a)Unity P.F. b)0.8 P.F at 75 Deg. C		
9.3	Percentage Impedance at 75 Deg. C		
9.4	Flash Test HV 28 KV/50Hz for I minute LV 3 KV/50 Hz for 1 minute		
9.5	Over potential Test Double Voltage & Double frequency for 1 minute		

9.6	Impulse test		
9.7	Inter layer insulation provided in design for 1)Top & Bottom layer 2)In between all layer 3)Details of end insulation 4)Whether wedges are provided at 50% turn of the HV coil.		
9.8	Insulation materials provided a) For Conductors (1) HV (2) LV b) For Core		
9.9	Is the name plate gives all particulars are required in tender		
9.10	Particulars of Bushing HV/LV 1)Maker's name 2)Type IS-3347/IS-1180 3)Rating as per I.S. 4)Dry power frequency voltage withstand test 5)Wet power frequency voltage withstand test		
9.11	Particulars of metal oxide Lightening arrestor		
9.12	Medium of free space above oil level Transformer		
9.13	Details of type tests conducted (indicating rating, year of testing, details of tests)		

8. 33kV CONTROL & RELAY PANEL

Sl No.	Description	Bidder's Particulars
A	**CONTROL & RELAY PANELS**	
1	Name Of Manufacturer	
2	Type and Designation	
3	Conforming Standard	
4	Type of sheet steel	
5	Thickness of sheet steel	
5.1	Front	
5.2	Back	
5.3	Sides	
6	Details of Painting	
7	Weight of each panel section	
8	Overall dimensions of each panel section in mm. (width x depth x height)	
9	Total weight of all panels	
10	Space required for installation of all panels	
11	Details of Tropicalisation	

12	Largest package for Transport	
12.1	Gross weight	
12.2	Overall dimensions	
B	**LED POSITION INDICATORS**	
1	Name Of Manufacturer	
2	Type and Designation	
3	Conforming Standard	
4	Operating Voltage	
C	**TERMINAL BLOCK**	
1	Name Of Manufacturer	
2	Type and Designation	
3	Conforming Standard	
4	No. of terminal studs per way	
5	Rated current	
6	Rated voltage	
7	Materials used	
7.1	Body	
7.2	Terminal studs	
7.3	Connecting links	
7.4	Support springs	
8	Minimum no. of conductors of area 2.5 sq.mm suitable for connection	
8.1	All circuits except CT	
8.2	CT Circuits	
D	**CONTROL SWITCHES**	
1	Name Of Manufacturer	
2	Type and Designation	
3	Conforming Standard	
4	Type of Handle	
5	No. of possible positions of handle with diagrams	
5.1	No. of contacts available	
5.2	Maximum No. of contacts which can be accommodated for each position	
6	Rating of Contacts :	
6.1	Voltage	
6.2	Make and carry current continuously	
6.3	Make and carry Current for 0.5 sec.	
6.4	Break resistive load	
6.5	Break inductive load	
7	Whether locking arrangement provided	
8	Mounting details	
9	Dimensions	
10	Other information, if any	

E	**INDICATING LAMPS**	
1	Name Of Manufacturer	
2	Type and Designation	
3	Conforming Standard	
4	Ratings :	
4.1	Current	
4.2	Voltage	
4.3	Wattage	
5	Colour of lamp	
6	Permissible voltage variation	
7	Whether series resistance is provided, if so :	
7.1	Ohmic value	
7.2	Power loss	
8	Life of lamp in burning hours	
9	Other information, if any	
F	**PUSH BUTTONS**	
1	Name Of Manufacturer	
2	Type and Designation	
3	Conforming Standard	
4	Contact type momentary / maintained	
5	Whether integral engraved inspection plates provided	
6	No. of NO/NC contacts	
G	**ANNUNCIATORS**	
1	Name OF Manufacturer	
2	Type and Designation	
3	Conforming Standard	
4	No. of windows	
5	Dimensions of each Window (Length x height x depth)	
6	No. of lamps per window	
7	Auxiliary supply voltage	
8	Power Consumption	
9	Details of auxiliary equipment such as relays etc.	
10	Required instantaneous making capacity of initiating contacts	
11	Type of reset-manual / self	
12	Overall dimensions of annunciators	
13	Particulars of wiring	
14	Technical literature	
15	Brief write-up of the scheme furnished	
16	Built-in facility of DC Fail Annunciation (Yes/No)	

H	**INDICATING METERS (Digital) (To be furnished separately for each type of meter)**	
1	Name Of Manufacturer	
2	Type and Designation	
3	Conforming Standard	
4	Range :	
4.1	Effective Range	
4.2	Fiducial value	
5	Whether CTR & PTR are Programmable	
6	CT Ratio	
7	PT Ratio	
8	Accuracy class	
9	Overall dimensions	
10	Auxiliary Voltage (If required)	
11	Display dimension	
12	Display illumination	
13	EMC	
14	Measurement principal	
15	Whether communicable	
16	Response time	
I	**NUMERICAL TYPE DISTANCE RELAY**	
1	Name OF Manufacturer	
2	Type and Designation	
3	Conforming Standard (Whether IEC 61850 compliant)	
4	Input Quantities	
4.1	Rated AC Current & Maxm. Continuous AC Current	
4.2	Rated AC Voltage & Maxm. Continuous AC Voltage	
4.3	Rated DC Voltage	
4.4	Tolerance Allowance in DC Voltage	
4.5	Allowable Maxm. Ripple	
5	Burden	
5.1	C.T. Circuit	
5.2	P.T. Circuit	
5.3	D.C. Circuit :	
5.3.1	Operating (Maxm.)	
5.3.2	Quiescent (Maxm.)	
6	Thermal withstand rating (Current/Voltage)	
6.1	For one sec.	
6.2	For 0.5 sec	
7	Frequency range for satisfactory operation	

8	Characteristic on R - X plane	
9	Number of zones provided	
10	Setting ranges for distance measurement :	
10.1	Zone 1	
10.2	Zone 2	
10.3	Zone 3	
10.4	Any other zone	
11	Timer setting ranges	
11.1	Zone 2	
11.2	Zone 3	
11.3	Any other zone	
12	Power swing blocking characteristics	
13	Power swing blocking	
13.1	Setting ranges	
13.2	Whether independent zone selection provided	
13.3	Timer setting whether selectable or fixed and its value	
14	V.T. Supply supervision	
14.1	Method of detection	
15	Switch on to fault feature	
15.1	Method of detection	
16	Whether scheme is suitable for autoreclose	
16.1	Single phase	
16.2	Three phase	
16.3	Whether check synchronising relay and deadline charging relay is in-built with the distance relay	
17	Whether scheme is suitable for carrier aided tripping scheme	
18	Directional O/C & earth fault element	
18.1	Whether provided as in-built of numerical distance relay:	
18.2	Its setting range	
18.3	Whether contact for carrier inter tripping from the DEF relay is provided	
19	Accuracy :	
19.1	Zone 1 reach	
19.2	Zone 2 reach	
19.3	Zone 3 reach	
19.4	Zone timer unit	
19.5	Angular reach	
20	Operating time for fault at 50% of zone 1 set with CVT on line side and with :	

20.1	SIR = 4	
20.2	SIR = 15	
21	Accuracy due to variation of frequency (+/- 5%)	
22	Setting range of residual compensation	
23	Trip contact ratings	
23.1	Make and carry continuously	
23.2	Make and carry for 0.5 sec.	
23.3	Break :	
23.3.1	Resistive load	
23.3.2	Inductive load (with L/R = 40)	
24	No. of B/Is & B/Os	
25	Details of Man Machine interface both for local and remote control and monitoring provided such as serial communication protocol, communication speed, LAN compatible, type of connectors etc.	
26	Additional functions provided in the relay which are not specified in the specification	
	AUTO RECLOSE RELAY (Built-in feature of Numerical Distance Relay)	
1	Suitable for single and three phase auto re-closing.	
2	Single phase dead time setting range	
3	Three phase dead time setting range	
4	Reclaim time setting range	
5	Whether check synchronising and dead line charging relays included as a part of the auto reclose scheme	
6	Whether four position selector switch is included ?	
7	Whether single shot?	
	FAULT LOCATORS (Built-in feature of Numerical Distance Relay)	
1	Triggering Method	
2	Rate of sampling per cycle	
3	A/D converter bit resolution	
4	Whether following fault information provided in displaying unit	
4.1	Distance to fault location reach in Km	
4.1.1	Resistive detection	
4.1.2	Reactive detection	
4.2	Faulted Phase	
4.3	Time of Fault	
4.4	Date of Fault	
5	Whether mutual compensation of D/C line provided	

6	Maximum registering time	
7	Whether direct display unit provided ? If so, details to be given	
8	Accuracy	
J	**NUMERICAL TRANSFORMER DIFFERENTIAL RELAYS**	
1	Name of Manufacturer	
2	Type and Designation	
3	Conforming Standard (Whether IEC 61850 compliant)	
4	Current Rating	
5	Operating setting range	
6	Bias setting range	
7	No. of B/Is & B/Os	
8	Whether ICT required	
9	Display	
10	Detail of Man-machine Interface both for Local & Remote control and monitoring provided	
11	Speed of Operation of Relay	
12	Setting of instantaneous element	
13	Type and scheme for second and fifth harmonic restrain	
14	Contact rating :	
14.1	Make and carry continuously	
14.2	Make and carry for 0.5 sec.	
14.3	Break :	
14.3.1	Resistive load	
14.3.2	Inductive load with 40 millisec time constant	
15	Additional function & feature provided in the Relay which are not specified in the specification	
K	**TRANSFORMER OVERFLUXING RELAY**	
1	Name of Manufacturer	
2	Type and Designation	
3	Conforming Standard	
4	Rated voltage and frequency	
5	Rated DC voltage	
6	Solid state or Electro mechanical	
7	Thermal Withstand Rating	
8	Number of Contacts	
8.1	Normally open	
8.2	Normally closed	
9	Contacts - Self reset	

10	Rated Burden at highest and lowest tap	
11	Operating indicator provided ?	
12	Contact Ratings :	
12.1	Make and carry continuously	
12.2	Make and carry for 0.5 sec.	
12.3	Break	
12.3.1	Resistive Load	
12.3.2	Inductive Load (with L/R = 40)	
13	Setting ranges :	
13.1	V/F	
13.2	Time for alarm	
13.3	Time for tripping	
L	**NUMERICAL OVERCURRENT & EARTH FAULT RELAYS - NON-DIRECTIONAL / DIRECTIONAL :**	
1	Name of Manufacturer	
2	Type and Designation	
3	Conforming Standard (Whether IEC 61850 compliant)	
4	Rated current	
5	Rated AC voltage (Directional Relay only)	
6	Rated DC voltage	
7	Operating Principle	
8	Thermal Withstand Rating	
9	Number of B/Is & B/Os	
10	Contacts - Latched/Unlatched/Programmable	
11	Burden	
12	Operation indicator provided ?	
13	Contact Ratings	
13.1	Make and carry continuously	
13.2	Make and carry for 0.5 sec.	
13.3	Break :	
13.3.1	Resistive Load	
13.3.2	Inductive Load (with L/R = 40)	
14	Operating characteristics	
15	Current unit setting range	
15.1	Inverse time	
15.2	High set inst. unit	
16	Characteristic angle for Directional Relay	
M	**Additional features applicable for numerical relays only**	
1	Whether self supervision and diagnostic feature available	

2	Whether potential free change over contact for annunciation in the event of internal failure	
3	Whether password protection available for setting change etc.	
4	Number of binary inputs & outputs available	
5	Whether LED indication available for visual annunciation of different types of faults	
6	Current and time setting range & steps	
7	Whether separate IVT is required for derivation of zero sequence voltage in Directional relays	
M	**DISTURBANCE RECORDERS (Built-in feature of Numerical Distance Relay)**	
1	Number of channels provided for analog recording	
2	Number of channels provided for event recording	
3	Time of recording prior to event	
4	Duration of recording after the event	
5	By how many nos. can the channels be expanded :	
5.1	Analog Channel	
5.2	Event Channel	
6	Whether all starting sensor Provided?	
7	Linearity Error	
8	Memory :	
8.1	Pre fault in ms	
8.2	Post fault in sec.	
9	Frequency Response	
10	Resolution of the event channel (ms)	
11	Resolution :	
11.1	Time	
11.2	Amplitude	
12.1	Whether facility provided for downloading of station identification code along with date & time	
12.2	If yes mention the programmable character length (nos.) available	
13	Details of arrangements for date & time marking	
N	**RESTRICTED EARTH FAULT RELAY / CIRCULATING EARTH FAULT PROTECTION**	

1	Name of Manufacturer	
2	Type and Designation	
3	Conforming Standard	
4	Rated current	
5	Rated DC voltage	
6	Operating principle	
7	Solid state or Electro mechanical	
8	Thermal Withstand Rating	
9	Number of Contacts and ratings	
10	Contacts - Self reset/hand reset	
11	Burden	
12	Operation indicator provided ?	
13	Contact Ratings	
13.1	Make and carry continuously	
13.2	Make and carry for 0.5 sec.	
13.3	Break	
13.3.1	Resistive Load	
13.3.2	Inductive Load (with L/R = 40)	
14	Setting range	
15	Operating Time	
16	Whether tuned to system frequency	
17	Value of stabilising resistor	
18	Particulars of non-linear resistor	
O	**NUMERICAL BUS BAR PROTECTION SCHEME**	
1	Name of Manufacturer	
2	Type and Designation	
3	Conforming Standard (Whether IEC 61850 compliant)	
4	Rated current	
5	Rated DC voltage	
6	Operating principle (Distributed architecture or Central architecture)	
7	Maximum no of bays can be incorporated in the scheme	
8	Suitable for 2 Main & 1 Transfer bus or not	
9	Operation – Low impedance/High Impedance:	
10	% Biasing	
11	Thermal Withstand Rating	
12	Number of Contacts :	
12.1	Normally open	
12.2	Normally closed	
13	Contacts - Self reset	

14	Burden	
15	Operation indicator provided ?	
16	Contact Ratings :	
16.1	Make and carry continuously	
16.2	Make and carry for 0.5 sec.	
16.3	Break :	
16.3.1	Resistive Load	
16.3.2	Inductive Load (with L/R = 40)	
17	Operating time	
18	Setting ranges	
19	Transient free in operation ?	
20	Particulars of end zone protection	
21	Particulars of CT secondary open circuit protection	
22	Does the scheme give 100% security and reliability during all system operating conditions	
23	Through fault stability	
P	**CIRCUIT BREAKER FAILURE RELAY**	
1	Name of Manufacturer	
2	Type and Designation	
3	Conforming Standard	
4	Rated current	
5	Rated DC voltage	
6	Operating principle	
7	Solid state or Electro mechanical	
8	Thermal Withstand Rating	
9	Number of Contacts :	
9.1	Normally open	
9.2	Normally closed	
10	Burden	
11	Operation indicator provided ?	
12	Contact Ratings :	
12.1	Make and carry continuously	
12.2	Make and carry for 0.5 sec.	
12.3	Break :	
12.3.1	Resistive Load	
12.3.2	Inductive Load (with L/R = 40)	
13	Operating time	
14	Resetting time	
15	Setting range :	
15.1	Current	
15.2	Time	
Q	**TRIP CIRCUIT SUPERVISION RELAY**	

1	Name of Manufacturer	
2	Type and Designation	
3	Conforming Standard	
4	Rated DC voltage	
5	Operating principle	
6	Electro mechanical	
7	Thermal Withstand Rating	
8	Number of Contacts :	
8.1	Normally open	
8.2	Normally closed	
9	Contacts - self reset	
10	Burden	
11	Operation indicator provided ?	
12	Contact Ratings :	
12.1	Make and carry continuously	
12.2	Make and carry for 0.5 sec.	
12.3	Break :	
12.3.1	Resistive Load	
12.3.2	Inductive Load (with L/R = 40)	
13	Whether pre-closing and post closing supervision provided ?	
14	Time delay	
R	**UNIVERSAL TYPE AUXILIARY CTs AND VTs :**	
1	Name of Manufacturer	
2	Type and Designation	
3	Conforming Standard	
4	Ratio	
5	Rated output VA	
6	Class of accuracy	
7	Short time rating :	
7.1	Current	
7.2	Voltage	
8	Knee point voltage for Class `PS'	
9	Excitation current for Class `PS'	
9.1	KPV	
9.2	50 Percent KPV	
10	Internal resistance of	
10.1	Primary	
10.2	Secondary	
11	Temperature rise	
12	Mounting details	
13	Overall dimensions	
14	Any other details	

S	**MASTER TRIP RELAY**	
1	Name of Manufacturer	
2	Type and Designation	
3	Conforming Standard	
4	Rated DC voltage	
5	Electro mechanical	
6	Whether Electrical Reset (Yes/No)	
7	Thermal Withstand Rating	
8	Number of Contacts :	
8.1	Self Reset	
8.2	Hand Reset	
9	Burden	
10	Operation indicator provided ?	
11	Contact Ratings :	
11.1	Make and carry continuously	
11.2	Make and carry for 0.5 sec.	
11.3	Break :	
11.3.1	Resistive Load	
11.3.2	Inductive Load (with L/R = 40)	
12	Operating Time	
T	**OVER VOLTAGE RELAY**	
1	Name of Manufacturer	
2	Type and Designation	
3	Conforming Standard	
4	Rated Auxuliary DC voltage	
5	Solid state or Electro mechanical	
6	Rated AC Voltage & Frequency	
7	Setting Range (Voltage & Time)	
7.1	for First Stage	
7.2	for Second Stage	
8	Drop-Off to Pick-Up ratio	
9	Burden	
10	Operation indicator provided ?	
11	No. of Output Contacts for each Phase	
12	Contact Ratings :	
12.1	Make and carry continuously	
12.2	Make and carry for 0.5 sec.	
12.3	Break :	
12.3.1	Resistive Load	
12.3.2	Inductive Load (with L/R = 40)	

9. 11kV CONTROL & RELAY PANEL

Sl No.	Description	Bidder's Particulars
A	**CONTROL & RELAY PANELS**	
1	Name Of Manufacturer	
2	Type and Designation	
3	Conforming Standard	
4	Type of sheet steel	
5	Thickness of sheet steel	
5.1	Front	
5.2	Back	
5.3	Sides	
6	Details of Painting	
7	Weight of each panel section	
8	Overall dimensions of each panel section in mm. (width x depth x height)	
9	Total weight of all panels	
10	Space required for installation of all panels	
11	Details of Tropicalisation	
12	Largest package for Transport	
12.1	Gross weight	
12.2	Overall dimensions	
B	**LED POSITION INDICATORS**	
1	Name Of Manufacturer	
2	Type and Designation	
3	Conforming Standard	
4	Operating Voltage	
C	**TERMINAL BLOCK**	
1	Name Of Manufacturer	
2	Type and Designation	
3	Conforming Standard	
4	No. of terminal studs per way	
5	Rated current	
6	Rated voltage	
7	Materials used	
7.1	Body	
7.2	Terminal studs	
7.3	Connecting links	
7.4	Support springs	
8	Minimum no. of conductors of area 2.5 sq.mm suitable for connection	
8.1	All circuits except CT	
8.2	CT Circuits	

D	**CONTROL SWITCHES**	
1	Name Of Manufacturer	
2	Type and Designation	
3	Conforming Standard	
4	Type of Handle	
5	No. of possible positions of handle with diagrams	
5.1	No. of contacts available	
5.2	Maximum No. of contacts which can be accommodated for each position	
6	Rating of Contacts :	
6.1	Voltage	
6.2	Make and carry current continuously	
6.3	Make and carry Current for 0.5 sec.	
6.4	Break resistive load	
6.5	Break inductive load	
7	Whether locking arrangement provided	
8	Mounting details	
9	Dimensions	
10	Other information, if any	
E	**INDICATING LAMPS**	
1	Name Of Manufacturer	
2	Type and Designation	
3	Conforming Standard	
4	Ratings :	
4.1	Current	
4.2	Voltage	
4.3	Wattage	
5	Colour of lamp	
6	Permissible voltage variation	
7	Whether series resistance is provided, if so :	
7.1	Ohmic value	
7.2	Power loss	
8	Life of lamp in burning hours	
9	Other information, if any	
F	**PUSH BUTTONS**	
1	Name Of Manufacturer	
2	Type and Designation	
3	Conforming Standard	
4	Contact type momentary / maintained	
5	Whether integral engraved inspection plates provided	
6	No. of NO/NC contacts	

G	**ANNUNCIATORS**	
1	Name OF Manufacturer	
2	Type and Designation	
3	Conforming Standard	
4	No. of windows	
5	Dimensions of each Window (Length x height x depth)	
6	No. of lamps per window	
7	Auxiliary supply voltage	
8	Power Consumption	
9	Details of auxiliary equipment such as relays etc.	
10	Required instantaneous making capacity of initiating contacts	
11	Type of reset-manual / self	
12	Overall dimensions of annunciators	
13	Particulars of wiring	
14	Technical literature	
15	Brief write-up of the scheme furnished	
16	Built-in facility of DC Fail Annunciation (Yes/No)	
H	**INDICATING METERS (Digital) (To be furnished separately for each type of meter)**	
1	Name Of Manufacturer	
2	Type and Designation	
3	Conforming Standard	
4	Range :	
4.1	Effective Range	
4.2	Fiducial value	
5	Whether CTR & PTR are Programmable	
6	CT Ratio	
7	PT Ratio	
8	Accuracy class	
9	Overall dimensions	
10	Auxiliary Voltage (If required)	
11	Display dimension	
12	Display illumination	
13	EMC	
14	Measurement principal	
15	Whether communicable	
16	Response time	

I	**NUMERICAL OVERCURRENT & EARTH FAULT RELAYS - NON-DIRECTIONAL / DIRECTIONAL :**	
1	Name of Manufacturer	
2	Type and Designation	
3	Conforming Standard (Whether IEC 61850 compliant)	
4	Rated current	
5	Rated AC voltage (Directional Relay only)	
6	Rated DC voltage	
7	Operating Principle	
8	Thermal Withstand Rating	
9	Number of B/Is & B/Os	
10	Contacts - Latched/Unlatched/Programmable	
11	Burden	
12	Operation indicator provided ?	
13	Contact Ratings	
13.1	Make and carry continuously	
13.2	Make and carry for 0.5 sec.	
13.3	Break :	
13.3.1	Resistive Load	
13.3.2	Inductive Load (with L/R = 40)	
14	Operating characteristics	
15	Current unit setting range	
15.1	Inverse time	
15.2	High set inst. unit	
16	Characteristic angle for Directional Relay	
J	**Additional features applicable for numerical relays only**	
1	Whether self supervision and diagnostic feature available	
2	Whether potential free change over contact for annunciation in the event of internal failure	
3	Whether password protection available for setting change etc.	
4	Number of binary inputs & outputs available	
5	Whether LED indication available for visual annunciation of different types of faults	

6	Current and time setting range & steps	
7	Whether separate IVT is required for derivation of zero sequence voltage in Directional relays	
K	**RESTRICTED EARTH FAULT RELAY / CIRCULATING EARTH FAULT PROTECTION**	
1	Name of Manufacturer	
2	Type and Designation	
3	Conforming Standard	
4	Rated current	
5	Rated DC voltage	
6	Operating principle	
7	Solid state or Electro mechanical	
8	Thermal Withstand Rating	
9	Number of Contacts and ratings	
10	Contacts - Self reset/hand reset	
11	Burden	
12	Operation indicator provided ?	
13	Contact Ratings	
13.1	Make and carry continuously	
13.2	Make and carry for 0.5 sec.	
13.3	Break	
13.3.1	Resistive Load	
13.3.2	Inductive Load (with L/R = 40)	
14	Setting range	
15	Operating Time	
16	Whether tuned to system frequency	
17	Value of stabilising resistor	
18	Particulars of non-linear resistor	
L	**CIRCUIT BREAKER FAILURE RELAY**	
1	Name of Manufacturer	
2	Type and Designation	
3	Conforming Standard	
4	Rated current	
5	Rated DC voltage	
6	Operating principle	
7	Solid state or Electro mechanical	
8	Thermal Withstand Rating	
9	Number of Contacts :	
9.1	Normally open	
9.2	Normally closed	
10	Burden	
11	Operation indicator provided ?	

12	Contact Ratings :	
12.1	Make and carry continuously	
12.2	Make and carry for 0.5 sec.	
12.3	Break :	
12.3.1	Resistive Load	
12.3.2	Inductive Load (with L/R = 40)	
13	Operating time	
14	Resetting time	
15	Setting range :	
15.1	Current	
15.2	Time	
M	**TRIP CIRCUIT SUPERVISION RELAY**	
1	Name of Manufacturer	
2	Type and Designation	
3	Conforming Standard	
4	Rated DC voltage	
5	Operating principle	
6	Electro mechanical	
7	Thermal Withstand Rating	
8	Number of Contacts :	
8.1	Normally open	
8.2	Normally closed	
9	Contacts - self reset	
10	Burden	
11	Operation indicator provided ?	
12	Contact Ratings :	
12.1	Make and carry continuously	
12.2	Make and carry for 0.5 sec.	
12.3	Break :	
12.3.1	Resistive Load	
12.3.2	Inductive Load (with L/R = 40)	
13	Whether pre-closing and post closing supervision provided ?	
14	Time delay	
N	**UNIVERSAL TYPE AUXILIARY CTs AND VTs :**	
1	Name of Manufacturer	
2	Type and Designation	
3	Conforming Standard	
4	Ratio	
5	Rated output VA	
6	Class of accuracy	
7	Short time rating :	
7.1	Current	

7.2	Voltage	
8	Knee point voltage for Class `PS'	
9	Excitation current for Class `PS'	
9.1	KPV	
9.2	50 Percent KPV	
10	Internal resistance of	
10.1	Primary	
10.2	Secondary	
11	Temperature rise	
12	Mounting details	
13	Overall dimensions	
14	Any other details	
O	**MASTER TRIP RELAY**	
1	Name of Manufacturer	
2	Type and Designation	
3	Conforming Standard	
4	Rated DC voltage	
5	Electro mechanical	
6	Whether Electrical Reset (Yes/No)	
7	Thermal Withstand Rating	
8	Number of Contacts :	
8.1	Self Reset	
8.2	Hand Reset	
9	Burden	
10	Operation indicator provided ?	
11	Contact Ratings :	
11.1	Make and carry continuously	
11.2	Make and carry for 0.5 sec.	
11.3	Break :	
11.3.1	Resistive Load	
11.3.2	Inductive Load (with L/R = 40)	
12	Operating Time	
P	**OVER VOLTAGE RELAY**	
1	Name of Manufacturer	
2	Type and Designation	
3	Conforming Standard	
4	Rated Auxuliary DC voltage	
5	Solid state or Electro mechanical	
6	Rated AC Voltage & Frequency	
7	Setting Range (Voltage & Time)	
7.1	for First Stage	
7.2	for Second Stage	
8	Drop-Off to Pick-Up ratio	
9	Burden	

10	Operation indicator provided ?	
11	No. of Output Contacts for each Phase	
12	Contact Ratings :	
12.1	Make and carry continuously	
12.2	Make and carry for 0.5 sec.	
12.3	Break :	
12.3.1	Resistive Load	
12.3.2	Inductive Load (with L/R = 40)	

Q CIRCUIT BREAKERS

		Prefer Sepcification	**Bidder's particulars**
1	No. of Poles	Three	
2	Manufacturer's type & designation	Outdoor Porcelain Clad pad type Vacuum circuit Breaker	
3	Rated Voltage	11KV/12 KV	
4	Rated Insulation-Level	28kV/75kV	
	i)Impulse withstand voltage	75KV Peak	
	ii)One minute Power frequency withstand voltage.	28 KV Rms	
	iii)One minute Power frequency withstand voltage on Auxiliary wiring.	2 KV Rms	
5	Rated Frequency	50 HZ	
6	Rated Thermal Current	1250 A	
7	Rated Cable charging current	25A	
8	Rated (Single) Capacitor breaking current	400 A	
9	Rated Small Inductive breaking current		
10	Rated Symmetrical Short Circuit breaking Current and breaking capacity in MVA.	(25 KA & 350 MVA)	
11	Rated Transient Recovery Voltage.	20.6 KV Rms As per IS : 13118/1991/IEC-62271-	
12	Rated short Circuit making current	62.5 KA Peak	
13	Rated Operating Sequence	O-0.3Sec-Co - 3Min-CO	
14	Rated duration of short circuit	3Sec	
15	Opening time and Break time (milli Sec.)	60ms max	
16	Closing Time (Milli Sec.)	<100ms max	
17	Whether type test certificate enclosed with tender		

18	Weight of complete Circuit Breaker		
19	i)Pressure maintained in vacuum chamber.	10^{-6} torr	
	ii)Gap between the contacts in Vacuum.	6-8 mm	
	iii)Area of contacts.	Adequate	
	iv)The voltage to which the circuit breaker shall be capable of withstanding indefinitely across open contacts.	12KV	
20	Minimum Clearance in air		
	i)Between Poles	300mm	
	ii)Between Live parts to earth	350mm	
21	Details of vacuum interrupter make and ratings		
22	Type of closing mechanism.	Spring charged, motor operated	
23	Whether Circuit breaker is Fixed trip or Trip free.	Trip free	
24	No. and type of auxiliary contacts (No. of spare normally open contacts and No. of spare normally closed contacts are to be indicated)	6NO+6NC (4NO+4NC spare)	
25	Power requirement :		
	i)Closing coil	200W maximum	
	ii)Opening coil	200W maximum	
	Electrical service life :		
	i)Rated Current (times)	10000 Operations	
	ii) Rated interruption current (times)	100 Operations at STC	
	Periodicity of maintenance for the following : For maintaining Vacuum in interrupting	_	
	1)For maintaining Vacuum in Interrupting		
	2)For changing contacts.		
	3)Other maintenance schedules if any.	_	
R	**CURRENT TRANSFORMERS 11 KV Feeder**		
1	Type	Single phase oil cooled Live tank type	

2	Manufacturer's Type & designation		
3	Rated Voltage/Highest voltage	11 KV/12KV	
4	Rated Primary current	200-100-50	
5	Rated Secondary current	Core-I : 5A Core-II: 5A	
6	No. of cores (Secondary core details)	Two	
7	Turns ratio	200-100-50	
8	Rated Output in VA	Core I : 15VA, Core II :5VA	
9	Class of Accuracy	Core I : 5P10, CoreII: 0.2S	
10	Accuracy Limiting factor	10 for protective core	
11	Knee point voltage of PS cores		
12	Maximum excitation current for PS cores.		
13	Method of ratio change and secondary connection details & connection diagram.	Secondary Tapping	
14	Secondary voltage		
15	Secondary Limiting Voltage	Core-I:15V Core-II-5V	
16	Short time current	25 KA/3Sec	
17	Rated current dynamic (Peak Value)		
18	Rated continuous thermal current temperature rise over ambient.	As per IS: 2705	
19	One minute power frequency Dry/Wet withstand voltage in KV (r.m.s)	28KV	
20	1/50 micro second Impulse withstand test voltage in KV (Peak)	75KV	
21	One minute power frequency withstand test voltage on secondaries in KV (r.m.s)	3KV	
22	Total Quantity/weight of oil in KL/KG		
23	Total weight of in KG		
24	Magnetization curve of CT core		
25	Mounting details		
26	Overall dimensions		
27	Total creepage distance of the bushing	300 mm (min)	
28	Phase to phase clearance in air	280mm(min)	
29	Live part to the ground clearance	360mm	
30	Whether the CT is hermetically sealed	Yes	
31	Whether over voltage protection for open circuit of secondary moulded if provided details to be furnished	No	
S	**HT TRIVECTOR METERS**		

1	Makers name and country	Secure/L&T	
2	Type of Meter/model	Static/As per supplier make	
3	Accuracy class	0.2s as per IS 14697/99/Meter PTR : 11KV/110V CTR : ___/5A	
4	Power consumption for phase		
	i)Voltage Circuit	1 Watts & 8 VA per phase	
	ii)Current circuit	Less than 1VA/Phase	
5	Minimum starting current (%Ib)	0.1% Ib per IS 14697/99	
6	No of digits of display and height of character	---	
7	P.F. range	0 Lag – UPF – 0 Lead	
8	Variation of voltage at which meter functions normally	-30% to + 20%	
9	Particulars of read out		
	a) Continuous display	As per Sl.No.6 of above.	
	b) manually on display	1.Supply frequency	
		2.Present PT & CT status	
		3.Last occurrence tamper ID	
		4.Time and date of last occurrence	
		5.Time & date of last tamper restoration	
		6.Cumulative tamper occurrence counts	
	c) auto display parameters		
	i)Scrolling period	10 Sec	
	ii)Display off period between two cycles	2 Sec	

	d) With CMRI/RMR	As per technical specification	
10	Details of Meter base and cover		
	a) Type of material	1.base : Poly Carbonate 2. Top : Polycarbonate Transparent	
	b) Dimensions and weight	As per the make of the meter	
11	Non volatile memory retention time in absence of power	10 Years	
12	Memory capacity (kB)	Suitable for 40 days data	
13	Communication protocol	DLMS and RS 232 port in addition to optical port.	
T	**POTENTIAL TRANSFORMERS**		
1	Makers name and country		
2	Ratio	11/0.110kV	
3	Rated primary current (Amp)		
4	Over voltage factor and capacity offered		
5	Rated output (VA) and accuracy class		
6	Over voltage factor and capacity as per ISS		
7	Total weight (kg)		
8	Insulation level (lightening impulse withstand voltage & with PF withstand voltage)		
9	Overall dimensions and mounting details		
10	Applicable standard and type of PT		

10. VRLA BATTERY (110V, 250AH)

Sl No.	Description	Bidder's Particulars
1	Type/ Designation	
2	Manufacturer's type designation	
3	Ampere-Hour capacity 10hrs rate of discharge to 1.75V	

4	Total No. of Plates per cell	
5	Nominal Cell Voltage (V)	
6	No. of Cells in each Bank	
7	No. of Spare Cell, if any, in each Bank	
8	Internal Resistance for each Cell	
9	Resistance of the Battery including Inter-connection between the Cells (Q)	
10	Cell Discharge rate in Ampere (from rated Voltage to final discharge rate in Ampere (i) 5hrs Discharge rate in Amp (ii) 2hrs Discharge rate in Amp (iii) 1hr Discharge rate in Amp (iv) 30min Discharge rate in Amp (v) 10min Discharge rate in Amp (vi) 1min Discharge rate in Amp (vii) 30sec Discharge rate in Amp (viii) 1sec Discharge rate in Amp (Please furnish a graph showing Amps against time for the type of battery offered)	
11	Short Circuit Current (Amps)	
12	(i)Material of Cell Containers (ii)Material used for Battery Box (iii)Trays	
13	Thickness, Type & Material of Separators	
14	Constructional details and dimension: Surface area plates of (i)Positive Plate (ii)Negative Plate in Sq.mm.	
15	(i)Ampere Hour efficiency (%) (ii)Watt Hour efficiency (%)	
16	(i)Recommended Float Charge Current & Voltage (ii)Recommended Boost Charge Current & Voltage	
17	Time required for Boost Charging from Discharged condition	
18	(i)Max. Charging Current/Cell (ii)Nominal Charging Rate	
19	(i)Whether explosion proof or vent plugs provided (ii)Whether vent is spill proof	
20	Type of Inter Cell connection & whether they are covered with plastic sleeves	

21	(i) Dimensions of each 2V Block/Cell a.Length (mm) b.Width (mm) c.Height (mm) (ii) Thickness of Container (mm) (iii) Net weight of the cell complete with acid 12V block (kg)	
22	Expected Life Span of Battery	
23	Accessories provided	
24	Special conditions, if any	

11. BATTERY CHARGER

Sl No.	Description	Bidder's Particulars
1	Manufacturer's Name & Address	
2	Conforming Standard	
3	(i) Type & Designation of charger	
	(ii)Capacity(min.) of Battery Charger	
	(iii)Charger rate/output current	
	(iv)Float charger (A) – min. 30A	
	(v)Float Cum Boost charger(A) – min 60	
	(vi)Confirm whether battery chargers are type tested as per spec. (Yes/No)	
4	% voltage regulation of float charger :	
5	% Ripple Content :	
6	Method of control	
7	Transformer for Float for Float Cum Boost	
	a)Make :	
	b)Type :	
	c)Rating :	
8	Rectifier	
	a)Make :	
	b)Type :	
	c)Rating :	
9	A.C. Switch fuse unit	
	a)Make :	
	b)Continuous Rating Amps. :	
	c)Interrupting Rating KA. :	
10	A.C. Contactors	
	a)Make :	
	b)Rating (Amps) :	
11	MCB/MCCB	

	a)Make :	
	b)Type :	
	c)Rating :	
12	Fuses	
	a)Make :	
	b)Continuous Rating Amps. :	
	c)Interrupting Rating KA. :	
13	D.C. Contactors	
	a)Make :	
	b)One (1) minute rating :	
	c)One (1) hour rating :	
14	D.C. tripple pole switch connected between battery and charger	
	a)Make :	
	b)Continuous Rating Amps :	
	c)Short Time Rating KA. :	

12. CONTROL CABLE

Sl No.	Description	Bidder's Particulars
1	Name of manufacturer and location of factory	
2	Standards to which conform	
3	Type and size of cables	
4	Voltage Rating	
5	Thickness of insulation (mm)	
6	No. of cores	
7	Thickness of inner sheath (mm)	
8	Material for inner sheath	
9	Thickness of outer sheath (mm)	
10	Material for outer sheath	
11	Overall dia. of cable (mm)	
12	Armour	
13	Material	
14	Shape	
15	Dimension	
16	No. of strands and wire dia.	
17	Cross-section of the conductor (sq.mm)	
18	Maximum continuous current (amps.)	
19	Maximum short circuit current (amps.)	

20	Conductor resistance at 20°C	
21	Approx. net weight per 100 m. length (Kg)	
22	Standard drum length (m)	

13. XLPE 11kV POWER CABLE

Sl No.	Description	Bidder's Particulars	
		1 core	3 core
1	Name of Manufacturer & Address		
2	Voltage Grade.		
3	Core & Cross Section No x sqmm		
4	Type & Designation(as per ISS)		
5	List of Standards applicable (IS)		
a	Service Voltage		
b	Neutral Earthing		
6	Maximum. Conductor temperature		
a	Continuous (in Deg. C)		
b	Short time (in Deg.C)		
7	Conductor		
a	Material to IS- 8130(Class/Grade)		
b	Size (Sq.mm.)		
c	No./Nominal diameter of wires in each.		
	Conductor (no./mm.)		
d	Shape of conductor(Circuler/ other shaped)		
8	Shielding/screening on Conductor		
a	Material		
b	Type		
c	Whether thermosetting?		
9	Insulation		
a	Material		
b	Type		
c	Thickness (mm)		
10	Shielding / screening on insulation		
a	Material		
b	Type		
c	Thickness (mm)		
	i)Non-metallic		
	ii)Metallic		

11	Inner - sheath		
a	Material		
b	Type		
c	Minimum Thickness of sheath (mm)		
d	Extruded/Wrapped		
e	Approx. outside diameter		
12	Armouring		
a	Material		
b	Size		
c	D.C. resistance at 20 deg.C (Ohm/Km.)		
d	A.C. resistance at 20 deg.C		
13	Overall Sheath		
a	Material		
b	Type		
c	Thickness (mm.)		
d	Colour of Sheath		
14	Approx. overall diameter of the Cable (mm.)		
15	Continuous current rating for		
	standard condition, laid direct		
a	In ground at temp 30 deg.C		
b	In duct at temp 30 deg.C		
c	In air at temp40 deg.C		
16	Charging current attracted system voltage A/KM		
17	Short Circuit Current in KA (Maxm.)		
a	for 1 sec		
b	for 0.5 sec		
18	Combine Earth Fault Current for Screen and Armour in KA for 1 sec		
19	Electrical Parameters		
a	Maxm. D.C. resistance/km		
	of conductor at 20 deg.C (Ohm/Km)		
b	AC resistance/kilometer of		
	conductor at 90 deg.C(approx.) (Ohm/Km)		
c	Reactance/kilometer(approx.) (Ohm/Km)		

d	Capacitance/Kilometer(approx.) (um/Km)		
e	Di-electric losses at rated		
	(Uo/U) system KV, 50 cycles/sec		
	in Watts/KV/Phase)		
f	i)tan-delta at 0.5 Uo		
	ii)tan-Delta at Uo		
	iii)tan-Delta at 1.5 Uo		
	iv)tan-Delta at 2 Uo		
20	Vol. Resistivity at 27 deg.C(ohm/Cm)		
21	Recommended minimum bending radius		
22	Derating factor for following ambient temperature in Air/Ground		
a	at30 deg. C		
b	at35 deg. C		
c	at45 deg. C		
d	at 50 deg.C		
23	Cable Drums		
a	Standard Length of Cable/Drum (Mtrs)		
b	Net weight of cable/Drum (kg)		
c	Shipping weight (Kg)		
26	Details of the protective measures against attack by white antevarmints etc. to be XLPE's outer sheath during manufacture		
27	Type of curing of XLPE insulations		
28	Cut ends of the Cable shall be sealed		

Signature with Seal of the Bidder

PRICE SCHEDULE

Sl No	Name of Items/ Works	Unit	Provisional Qnty	Rate	Amount
1. Levelling of Switch Yard					
i)	Surface dressing of ground including removing vegetation and inequalities not exceeding 15cm deep and disposal of rubbish, lead upto 50 m and lift upto 1.5m .				
	a) All kind of soil	Sqm	1125.00		
ii)	Earthwork in excavation over areas (exeeding 30cm in depth,1.5m in width as well as 10sqm on plan) including disposal of excavated earth, lead upto 50m and lift upto 1.5m, disposed earth to be levelled and neatly dressed.				
	a) Ordinary Soil	Cum	562.50		
2. Construction of Control Room					
i)	Earthwork in excavation in foundation trenches or drains etc. (not exceeding 1.5m in width or 10sqm on plan) including dressing of sides and ramming of bottoms, lift upto 1.5m including getting out excavated soil and disposal of surplus excavated soil as directed within a lead of 50 metres.	Cum	56.70		
ii)	Filling available excavated earth (excluding rock) in trenches, plinth, sides of foundations etc. in layers not exceeding 20cm in depth, consolidating each deposited layer by ramming and watering, lead up to 50 m and lift upto 1.5 m.	Cum	118.56		
iii)	Providing and laying in position cement concrete of specified grade excluding cost of centering and shuttering - All work upto plinth level:				
	1:3:6(1 cement :3 course sand :6 stone aggregate 20mm nominal size)	Cum	2.70		

iv)	Reinforced cement concrete work in walls including attached pillasters, columns, pillers, posts, piers, abutments, return walls, retaining walls, struts, buttresses, string or lacing courses, fillets etc. upto floor five level excluding cost of centering shuttering etc complete.				
	a) 1:1.5:3 (1 cement : 1.5 coarse sand : 3 graded stone aggregate 20mm nominal size)	Cum	2.92		
v)	b) 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate 20mm nominal size)	Cum	32.20		
vi)	Steel reinforcement for RCC work including straighthening, cutting, bending, placing in position and binding all complete.				
	Thermo-Mechanically Treated bars.	Kg.	6939.00		
vii)	Centering and shuttering including strutting,propping etd. And removal of form for: c) Columns, pillars, piers, abutments, posts and struts. d) Lintels, beams, plinth beams, girders, bressumers and cantilevers, etc.	Sq. m	205.49		
	For e) Suspended floors, roofs, landings, shelves and their support, balconies and chajjaj,etc. k) Vertical and horizontal fins individually or forming box, louvres and bends, eaves boards.	Sq.m	12.12		
viii)	Half brick masonry with first class brick in foundation and plinth in in cement mortar 1:3 (1 cement : 3 coarse sand) for wall	Sq.m	133.13		
ix)	Regular coursed rubble masonry with hard stone in foundation upto one storey above and below ground level including curing, etc. complete.	cum	26.94		
x)	Providing Ist class local wood dressed in frames of chaukat for doors, windows, clerestory windows fixed in position.	cum	0.06		

xi)	Providing and fixing 1st class local wood *panelled* shutters for doors etc. including M.S. butt hinges with necessary screws, etc. complete. c) 30 mm thick - Toilet Door	Sq.m	2.16		
xii)	Cement concrete flooring 1:2:4 (1 cement : 2 sand : 4 well graded stone aggregate 20mm size) finished with a floating coat neat cement including cement slurry etc. complete but excluding the cost of nosing of steps etc. 40mm thick.	Sq.m	108.24		
xiii)	Providing & laying vitrified floor tiles in different sizes (thickness to be specified by the manufacture) with water absorption less than 0.08% and conforming to IS:15622,of approved make, in all colours and shades, in skirting , riser of steps, over 12mm thick bed of cement mortar 1 :3 (1cement:3course sand), including the joints with white cement and matching pigments etc.complete. a) Full body polish vitrified (General)	Sq.m	394.200		
xiv)	Applying one coat of cement primer of approved brand and manufacture on wall surface. Qnty taken from Sl 13	Sq.m	394.200		
xv)	Applying priming coat with ready mixed primer of approved brand and manufacture on wood work and plywood complete.	Sq.m	6.12		
xvi)	Painting with synthetic enamel paint of approved brand and manufacture in all shades on new work (two or more coats). a) General quality	Sq.m	6.12		
xvii)	Finishing walls with water proofing cement paint of approved brand and manufacture and of required shade on new work (three or more coats) to give an even shade.	Sq.m	63.480		

xviii)	Steel work welded in built up sections/framed work including cutting, hoisting, fixing in position and applying a priming coat of approved steel primer using structural steel etc. as required. a) In stringers, treads, landings etc. of stair-cases including use of chequered plates wherever required; all complete : Chequered Plate (5mm thick)	Kg.	785.00		
xix)	b) In a grating, frames, guard bar, ladders, railings, brackets, gates & similar works. : Cable Tray (45 x 45 x 5mm)	Kgs	285.60		
xx)	Providing and fixing anodised aluminium work for doors, windows, ventilators and partitions with extruded built up standard sections/ other sections of approved make conforming to IS : 733 and IS : 1285 fixing with dash fasteners of required dia and size, including necessary filling up of gaps at junctions, at top, bottom and sides with required PVC/ neoprene gaskets etc. Aluminium sections shall be smooth, rust free, straight, mitred and jointed mechanically wherever required including cleat angle, aluminium snap beading for glazing /panelling, CP brass /stainless steel screws all complete including fixing of glasses but excluding cost of glasses.	Kgs	287.09		

xxi)	Providing and fixing anodised aluminium work for doors, windows, ventilators and partitions with extruded built up standard tubular and other sections of approved make conforming to IS: 733 and IS : 1285, anodised transparent or dyed to required shade according to IS : 1868. (Minimum anodic coating of grade AC 15), fixed with rawl plugs and screws or with fixing clips, or with expansion hold fastners including necessary filling up of gaps at junctions, at top, bottom and sides with required PVC/neoprene felt etc. Aluminium sections shall be smooth, rust free, straight, mitred and jointed mechanically wherever required including cleat angle, Aluminium snap beading for glazing / paneling, C.P. brass / stainless steel screws, all complete as per architectural drawings and the directions of Engineer-in-charge. (Glazing and paneling to be paid for separately) .	Kgs	438.97		
xxii)	For shutters of doors, windows & ventilators including providing and fixing hinges/ pivots and making provision for fixing of fittings wherever required including the cost of PVC / neoprene gasket required (Fittings shall be paid for separately) .	Kgs	105.32		
xxiii)	Providing and fixing glazing in aluminium door, window, ventilator shutters and partitions etc. with PVC/ neoprene gasket etc. complete as per the architectural drawings and the directions of engineer-in-charge . (Cost of aluminium snap beading shall be paid in basic item) :				
	b) With glass panes of 5.50 mm thickness (weight not less than 13.75 kg/ sqm) Door	Sq.m	11.82		
	a) With glass panes of 4.0 mm thickness (weight not less than 10.0 kg/ sqm) Window, Ventillation	Sq.m	23.76		

xxiv)	Earthwork in excavation in foundation trenches or drains etc. (not exceeding 1.5m in width or 10sqm on plan) including dressing of sides and ramming of bottoms, lift upto 1.5m including getting out excavated soil and disposal of surplus excavated soil as directed within a lead of 50 metres.				
	Hard Soil	Cum	5.28		
xxv)	Providing and laying in position cement concrete of specified grade excluding cost of centering and shuttering - All work upto plinth level:				
	1:3: 6 (1 cement : 3 course sand : 6 stone aggregate40mm nominal size) - Base Slab	Cum	0.36		
xxvi)	Providing and laying in position reinforced cement concrete excluding cost of centering and shuttering , finishing and reinforcement in -	Cum	0.25		
xxvii)	Steel reinforcement for RCC work including straighthening, cutting, bending, placing in position and binding all complete. Thermo-Mechanically Treated bars.	Kg.	25		
xxviii)	Centering and shuttering including strutting,propping etd. And removal of form for: Suspended floors, roofs, landings, shelves and their support, balconies and chajjaj,etc.	Sq.m	2.20		
xxix)	Half brick masonry with first class brick in foundation and plinth in: in cement mortar 1 : 4 (1 cement : 4coarse sand) - Wall	Sq.m	13.20		
xxx)	Providing and fixing SWRPVC plain bend of required degree (87.50°) including jointing with rubber lubricant/cement solvent complete. 75mm dia	No.	4.0		
xxxi)	Providing and fixing ventilation cowl including jointing with rubber lubricant/cement solvent complete. 75mm SWRPVC vent cowl	No.	1.00		
xxxii)	15mm cement plaster 1 : 3 (1 cement : 3 fine sand).	Sq.m	6.00		

xxxiii)	Constructing soak pit 1.20x1.20x1.20m filled with brickbats including S.W. drain pipe 100 mm diameter and 1.20 m long complete as per standard design.	No.	1		
xxxiv)	Providing and fixing single equal SWRPVC plain junction of required degree with access door (T-junction). (75x75x75mm)	No.	1		
xxxv)	Internal electrification	Building	1		
xxxvi)	Water supply and santury/installation	Building	1		
xxxvii)	External service connection	Building	1		
xxxviii)	Site development	Building	1		
xxxix)	Overhead water tank	Lit	4000		
3. Gravelling of Switch Yard as per specified in the tender					
i)	Earthwork in surface excavation and dressing including cutting and filling upto 15 cm depth, disposal of excavated earth upto 50m and lift upto 1.5m.	Sqm	563.00		
ii)	Half brick masonry with first class brick in foundation and plinth in (a) in cement mortar 1:3	Sqm	7.77		
iii)	Providing and laying cement concrete 1:3:6 *(1 cement : 3 coarse sand : 6 graded stone aggregate 20mm nominal size)* excluding cost of centering and shuttering in - (a) All works upto foundation and plinth level.	Cum	0.252		
iv)	Providing and filling stone aggregates of size below 90mm in plinth, etc. in layers not exceeding 10 cms in depth, consolidating each layer by ramming and watering and dressing complete .	Cum	110.25		
4. Construction of Cable trench & Link drain with chequered tile cover as directed by Engineer in charge					

i)	Earthwork in excavation in foundation trenches or drains etc. (not exceeding 1.5m in width or 10sqm on plan) including dressing of sides and ramming of bottoms, lift upto 1.5m including getting out excavated soil and disposal of surplus excavated soil as directed within a lead of 50 metres.				
	a) Hard soil 40%	Cum	30.04		
	b) Very hard soil 60%	Cum	45.06		
ii)	Providing and laying cement concrete 1:3:6 *(1 cement : 3 coarse sand : 6 graded stone aggregate 20mm nominal size)* excluding cost of centering and shuttering in -	Cum	4.13		
iii)	Half brick masonry with first class brick in foundation upto one storey above and below ground level including curing, etc. complete. (a) in cement mortar 1:3	Sqm	114.32		
iv)	Structural steel work welded in built up sections, trusses and framed works, including cutting, hoisting, fixing in position and applying a priming coat of approved steel primer all complete. *(in tees, R.S. joists, angles, flats and channels.) Angle iron 40x40x5mm*	Kg	534.78		
v)	Chequered plate 6mm thick	Kg	1,716.80		
vi)	12mm cement plaster 1 : 3 *(1 cement : 3 fine sand)* finished with a floating coat of neat cement.	Sqm	164.91		
5. Providing and construction of Switch Yard earthing system including Earth pit, Earth mat and all necessary requirement to cover the area of 21mx30m					
i)	Earthwork in excavation in foundation trenches etc. not exceeding 2 meters depth including dressing of bottom and sides of trenches and subsequent filling and compaction in 15cm layers as in column foundations, fence posts, etc. and disposal of all surplus soil as directed within a lead of 30 metres.				
	(b) hard soil		90.477		

		Cum			
	(c) very hard soil	Cum	180.954		
	(f)(i) soft rock (blasting prohibited)	Cum	180.954		
ii)	Structural steel work welded in built up sections, trusses and framed works, including cutting, hoisting, fixing in position and applying a priming coat of approved steel primer all complete. *(in tees, R.S. joists, angles, flats and channels.) Flat Iron 50x8mm*	Kgs	3,200.04		
iii)	Filling available excavated earth (excluding rock) in trenches, plinth, sides of foundations etc. in layers not exceeding 20cm in depth, consolidating each deposited layer by ramming and watering, lead up to 50 m and lift upto 1.5 m.	Cum	452.385		
iv)	G.I. Pipes 40mm dia. fabricated for earthing electrode.	Rm	62.4		
v)	Bentonide powder @ 4 bag per pit	Bag	96		
vi)	Welding electrode 3.14mm @1 No per 2 Kgs of steel	No	1396		
vii)	Hackshaw blade (double side) @1 No per 10 kgs of steel	No	279		
6.	**Construction and installation of Electrical equipment**				
1	Providing and erection of 33/11kV, 2.5MVA Transformer with construction of foundation 2.8mx3.05mx1.4m in size (planting depth of 0.4m) with PCC1:2:4 (1 cement : 2 coarse sand : 4 grades stone aggregate 40mm nominal size) including commissioning as directed by Engineer-in-Charge.	No	2		
2	Providing and erection of 33kV/0.415kV, 100kVA Transformer with contruction of foundation 1.2mx1.2mx1.65m in size (planting depth of 0.4m) with PCC 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate 40mm nominal size) including commissioning as directed by Engineer-in-Charge.	No	1		

3	Providing and erection of 33kV Circuit Breaker with structure in complete set including excavation and refilling of foundation pit 1.6mx1.25mx1.2m (Ixbxh) in size; foundation casting footing PCC 1:3:6 (0.8m thick(, RCC 1:2:4 (0.12m thick) and 2 column RCC 1:2:4 0.30mx0.65mx1.50m (Ixbxh) in size with planting depth of 1.0m, 12mm thick 1:3 cement plastering of plint 0.50m height; erection of Structure and Circuit Breaker as directed by Engineer-in-Charge.	No	3		
4	Providing and erection of 33kV Isolator with earthswitch with structure in complete set including excavation and refilling of foundation pit 2.84mx1.60mx1.20m (lxbxh) in size foundation casting- footing PCC 1:3:6 (0.2m thick) and 2 column RCC 1:2:4 0.45mx1.00mx1.50m (lxbxh) in size with planting depth of 1.2m, 12mm thick 1:3 cement plastering of plint 0.50m height; erection of mounting Structure and Isolator as directed by Engineer-in-Charge.	Set	1		
5	Providing and erection of 33kV Isolator without earthswitch with structure in complete set including excavation and refilling of foundation pit 2.84mx1.60mx1.20m (lxbxh) in size; foundation casting-footing PCC 1:3:6 (0.1m thick) ans 2 column RCC 1:2:4 0.45mx1.00mx1.50m (lxbxh) in size with planting depth of 1.2m, 12mm thick 1:3 cement plastering of plint 0.50m height; erection of mounting Structure and Isolator as directed by Engineer-in-Charge.	Set	5		

6	Providing and erection of 11kV Isolator with earth switch with structure in complete set including excavation and refilling of foundation pit 2.84mx1.60mx1.20m (lxbxh) in size; foundation casting-footing PCC 1:3:6 (0.1m thick) and 2 column RCC 1:2:4 0.45mx1.00mx1.50m (lxbxh) in size with planting depth of 1.0m, 12mm thick 1:3 cement platering of plint 0.50m height; erection of mounting Structure and Isolator as directed by Engineer-in-Charge.	Set	6		
7	Providing and erection of 33kV PT with structure in complete set including excavation and refilling of foundation pit 4.35mx1.35mx1.20m (lxbxh) in size; foundation casting-footing PCC 1:3:6 (0.20m thick) and 3 column PCC 1:2:4 0.75mx0.75mx1.50m (lxbxh) in size with planting depth of 1.20m, 12mm thick 1:3 cement platering of plint 0.50m height; erection of structure and PT as directed by Engineer-in-Charge.	Set	1		
8	Providing and erection of 33kV CT with structure in complete set including excavation and refilling of foundation casting-footing PCC 1:3:6 (0.2m thick) and 3 column PCC 1:2:4 0.75mx0.75mx1.50m (lxbxh) in size with planting depth of 1.0m, 12mm thick 1:3 cement plastering of plint 0.50m height; erection of Structure and CT as directed by Engineer-in-Charge.	Set	3		
9	Providing and erection of 33kV Surge Arrester with structure in complete set including excavation and refilling of foundation pit 4.35mx1.35x1.20m (lxbxh) in size; foundation casting-footing PCC 1:3:6 (0.2m thick) and 3 column PCC 1:2:4 0.75mx0.75mx1.50m (lxbxh) in size with planting depth of 1.20m, 12mm thick 1:3 cement plastering of plint 0.50m height; erection of Structure and LA as directed by Engineer-in-Charge.	Set	4		

10	Providing and Installation of 33kV Horn Gap Fuse Unit	No	1		
11	Providing and Installation of 33kV Control and Relay Transformer Panel complete with MW meter, anmeter, voltmeter, indicators as necessary, overcurrent and earth fault delays (numerical type) with time delay setting facilitie, trip circuit supervising relay, Bucholz relay, oil temperature relay, winding temparature relay, master trip relay, remote switches, energy meter, import & export recorder, faulth annunciator, digital metering, event logger, disturbance recorder, communication facilities etc. of the latest technology conforming to IS:3231 of the latest versions, aux. supply of 110V DC as directed by the engineer in charge. (Appropriate transformation ratios should be selected as per requirements)	Each	2		
12	Providing and Installation of 33kV Control and Relay Feeder Panel complete with MW meter, ammeter, voltmeter, frequency meter, power factor meter, indicators as necessary, overcurrent and earth fault relays (numerical type) with timme delay setting facilities, trip supervising relay, master trip relay, remote switches, energy meter, import & export recorder, fault an nunciator, digital metering, event logger, disturbance recorder, communication facilities etc. of the latest technology conforming to IS:3231 of the latest versions, aux. supply of 110V DC as directed by the engineer in charge. (Appropriate transformation ratios should be selected as per requirements) **Remark : 1(one) no of 33kV Control and Relay is also required at 33kV S/Station Meisatla for 33kV outgoing feeder to the proposed (new) 33kV S/Station at P&E Complex, Saiha.**	Each	2		

13	Providing and Installation of 11kV Indoor Switch board Panel for Incoming Feeder Panel with the following specifications: 12kV, 350 MVA, 800 A, 18.4 KA, Multi panel, shunt trip, Indoor Type, motor operated, spring closing Vacuum Circuit Breaker, Current Transformer having accuracy class of 0.2 for metering & 5P 10 for protection, Potential Transformer having accuracy class of 0.2 for metering & 3P for protection, MW meter, ammeter, voltmeter, frequency meter, power factor meter, overcurrent and earth fault relays (numerical type) with time delay setting facilities, trip supervising relay, mater trip relay, energy meter, import & export recorder, SIM card compatible, fault annunciator, digital metering, event logger, disturbance recorder, communication facilities etc. of the latest technology, conforming to IS:13118 (1991), IEC:56 (1987) as directed by the engineer in charge. (Appropriate transformation ratios should be selected as per requirements).	Each	2		
14	Providing and Installation of 11kV Outdoor Feeder Panel with following 12kV, 350MVA, 800A, 18.4KA Multi panel, shunt trip Indoor Type, Motor operated, spring closing Vacuum Circuit Breaker, Current Transformer having accuracy class of 0.2 for metering snf 5P 10 for protection, MW meter, ammeter, voltmeter, overcurrent and reath fault relays, SIM card compatible fault annunciator, digital metering event logger, distubance recoder, communication facilities etc. of the latrest technology, conforming to IS:13:13118 (1991), IEC:56 (1987) as directed by the Engineer in charge. (Appropriate transformation ratios should be selected as per requirements).	Each	6		

15	Providing and Installation of 11kV Indoor switch board Panel for Bus Couple Panel with the following : 12kV, 350MVA, 800A, 18.4KA Multi panel shunt trip, Indoor Type, motor operated, spring closing Vacuum Circuit Breaker, Current Transformer having accuracy class of 0.2 for metering & 5P 10 for protection, MW meter, ammeter, voltmeter, overcurrent and earth fault relays (numerical type) with time delay facilities, trip supervising relay, master trip relay, energy meter, import & export recorder, SIM card compatible fault annunciator, digital metering, event logger, disturbance recorder, communication facilities etc. of the latest technology, conforming to IS:13118 (1991), IEC:56 (1987) as directed by the engineer in charge. (Appropriator transformation raions should be selected as per requirements)	Each	1		
16	Providing and Installation of 110V DC Distribution Board, Float cum Boots Battery Charge (30A) suitable for charging 250Ah battery and supply of continuous load as 15A as directed by the engineer in charge.	Each	1		
17	Providing and Installation of 110V, 250Ah, SMF-VRLA Battery Bank consiting of 55 nos cell. Model : UPST-250 along with MS Steel enclosure and inter connection complete with accessories as directed by the engineer in charge.	Each	1		
18	Providing and Installation of AC Distribution Board	Each	1		
19	Providing and Fitting 1.1kV Copper Cable of per meter length, 16 Core, 2.5sqmm conforming to IS:1554-1 (1988) or any ammendments with 2.5sq.mm Copper Cable Lug of Ring/For/Pin type, as directed by the engineer in charge.	M	200		

20	Providing and fitting of 1.1kV Copper Control Cable of per meter length, 6 Core, 2.5sq.mm comforming to IS:1554-1 (1988) or any ammendments with 2.5sq.mm Copper Cable Lug of Ring/Fork/Pin type, as directed by the engineer in charge.	M	350		
21	Providing and fitting of 1.1kV Copper Control Cable of pwer meter length 4 Core, 2.5sq.mm conforming ot IS:1554-1 (1988) or any ammendments with 2.5sq.mm Copper Cable Ring/Fork/Pin type, as directed by the Engineer in charge.	M	200		
22	Providing and fitting of 1 Core, 11kV XLPE Alluminium Cable of per meter length, 185sq.mm conforming IS:7098 Part-2 (1985) or any ammendments with suitable jointing kit, as directed by the engineer in charge.	M	300		
23	Providing and fitting 1 Core, 11kV XLPE Alluminium Cable of per meter length, 150sq.mm conforming to IS 7089 Part 2 (1985) or any ammendments with suitable jointing kit, as directed by the engineer in charge.	M	900		
24	Providing and erection of 9kV, 10KA Lightning Arrester conforming to IS:3070 and IEC:60099-4 Complete with Hard drawn stranded alluminium conductors galvanised steel wire reinforced ACSR 6/1/2.59MM Weasek, M.S Flat Iron of size 40x6mm and M.S Nuts & Bolt of size 16x50mm full thread, as directed by the engineer in charge.	Each	18		
25	Providing and erection of 33kV Galvanised steel structure of Column S1 type having Total weight of galvanized steel structure 0.66 MT with Nuts & bolts weight 0.089 MT including pack washer, Step bolt, foundation bolt etc	No	4		

26	Providing and erection of 33kV Galvanised steel structure of Column S2 type having Total weight of galvanized steel structure 0.45 MT with Nuts & bolts weight 0.06 MT including pack washer, Step bolt, foundation bolt etc	No	2		
27	Providing and erection of 33kV Galvanised steel structure of Beam B1 type having Total weight of galvanized steel structure 0.31 MT with Nuts & bolts weight 0.03 MT including pack washer, Spring washer etc	No	3		
28	Providing and erection of 33kV Post Insulator with complete steel structure	No	3		
29	Providing and erection of steel tubular pole (SP-29) strut in cement concrete 1:3:6 (1 cement : 3 coarse sand : 6 graded stone aggregate 40 mm nominal size) foundation (0.342Cum inclusive of muffling) with planting depth of 1.5m including pole painting; excavation and back filling of pole pit; carriage of Materials at site as directed by the engineer in charge.	No	8		
30	Providing and erection of 4 nos. of MS Channel Iron 75 mm X 40 mm X 6 mm (7.14Kg per metre) double pole cross arm for three wire 11 kV over head line conductors (triangular formation) complete with through bolts and nuts for clamping to the poles including drilling of holes for insulator pins/fitting bolts, nuts and washers etc and painting with primer and finished paint as required (for SP-29) as directed by the engineer in charge.	No	4		
31	Providing and stringing of 33kV Bus Bar, Guard wire including hardware fitting, and all other equipment connection with ACSR Dog Conductor as directed by Engineer in charge	Lot	1		

32	Providing and Installation of 10Nos LED (100W) with all accessories including supporting structure (Steel Tabular pole), Bracket, Cables & wires etc for switchyard lighting	Lot	1		
33	Auxiliary works like installation of fire fighting equipment (minimum 4Nos of fire extinguisher), Rubber matting etc as directed by Engineer in charge	Lot	1		
34	Supply of Materials & Tools				
	i) Insullation Testing Meggar (0-5kV)	No	2		
	ii) Earth tester with testing kit	No	1		
	iii) Pulling & Lifting Machine 5MT	No	2		
	iv) Transformer Oil testing kit (0-60kV)	No	2		
	v) Digital Multimeter	No	2		
	vi) Vehicle mounted Transformer Oil filtering Machine Capacity 4500LPH with suitable vehicle alongwith host and all other accessories	No	1		
	vii) Tong tester	No	1		
	viii) Polypropoline rope (25mm dia)	Kg	250		
	ix) Drilling Machine with stand (25mm dia)	No	1		
	x) Rubber matting	Sqm	20		
	xi) Communication System	Set	1		
				TOTAL	

(Rupees …….) only

Signature with Seal of the bidder

SECTION - V

ANNEXURE

ANNEXURE

Bank Guarantee for Advance Payment

We ..... (hereinafter called as 'Bank') do hereby agree to pay on demand in writing from .... (hereinafter called 'the Owner') of any amount upto and not exceeding Rs. ..... (Rupees ....) only to the owner on behalf of M/s ..... (hereinafter called the 'Tenderer') who received an order for .... against tender No. ..... dated ..... (hereinafter called as the 'contract') and whereas the contract provides for payment as advance at the rate of 15% value of the contract by the owner to the Tenderer against this undertaking.

Whereas this guarantee shall be valid and binding on the Bank upto and including .... and the liability against this guarantee from Bank to the owner shall be limited to the amount remaining outstanding out of 10% advance payment after progressive adjustment of the same in the normal bills for progressive work by the Tenderer.

The liability of the Bank under this guarantee shall not be impaired or discharged by any extension of time or variations or alternations made, given, conceded to agree with or without the knowledge of the Bank by or between the owner and the Tenderer.

This guarantee shall remain in full force until ..... and unless a suit or action to enforce a claim under the guarantee is filed against the Bank within 6 months from that date (ie. .....), all the rights of the owner under this guarantee shall be forfeited and the Bank shall be relieved and discharged from all liability thereon.

Dated this ..... day of ..... 20....

For and on behalf of the Bank

The above guarantee is accepted by me on behalf of P&E Department,
Govt. of Mizoram, Aizawl.

Engineer-in-Chief (P&E)
Mizoram : Aizawl

ANNEXURE

Form of Bank Guarantee

(In lieu of Contract/Performance Guarantee Form)

To,

The Engineer-in-Chief,
Power & Electricity Deptt.,
Govt. of Mizoram, Aizawl.

In consideration of the Engineer-in-Chief, Power & Electricity Deptt., Govt. of Mizoram, Aizawl (Hereinafter called 'the Purchaser', the expression of which shall, unless repugnant to the subject or context, include his successors and assigns) having agreed under the terms and conditions of order No..... Dated ..... made between Power & Electricity Deptt., Government of Mizoram, and M/s ..... (hereinafter called 'the said contract') to accept a Deed of Guarantee as herein provided for Rs. ..... (Rupees .....) only from a Nationalised or Scheduled Bank in lieu of the Contract Performance Guarantee to be made by the Tenderer or in lieu the deduction to be made from the Tenderer's bills, for the due fulfilment, by the said Tenderer, of the terms and conditions contained in the said contract No..... we, the ..... Bank and having its registered office at ..... (hereinafter referred to as 'the said Bank') do hereby undertake and agree to indemnify and keep indemnified the Power & Electricity Deptt., Govt. of Mizoram from time to time to the extent of Rs. ..... (Rupees ....) only i.e. 10% of the total contract value against any loss or damage, costs, charges and expenses caused to or suffered by or that may be caused to or suffered by the Power & Electricity Deptt., Govt. of Mizoram by reason of any breach or breaches by the said Tenderer of any of the terms and conditions contained in Clause 5.0 of the said contract and to unconditionally pay the amount claimed by the Purchaser on demand and without demur to the extent aforesaid.

2. We ..... Bank further agrees that the Purchaser shall be the sole judge of and as to whether the said Tenderer has committed any breach or breaches of any of the terms and conditions of the said contract and the extent of loss, damage, costs, charges and expenses caused to or suffered by or that may be caused to or suffered by the Power & Electricity Deptt., Govt. of

Mizoram on account thereof and the decision of the Purchaser that the said Tenderer has committed such breach of breaches and as to the amount or amount of loss, damage, cost, charges and expenses caused to or suffered by or that may be caused to or suffered by the Power & Electricity Deptt., Govt. of Mizoram from time to time shall be final and binding on us.

3. We, the said Bank, further agrees that the Guarantee herein contained shall remain in full force and effect during the period that would be taken for the performance of the said contract and till all the dues of the Purchaser under the said contract or by virtue of any of the terms and conditions governing the said contract have been fully paid and its claim satisfied or discharged and till the Purchaser certifies in writing that the terms and conditions of the said contract and accordingly discharges this Guarantee subject, however, that the Purchaser shall have no claim under this Guarantee after the expiry of the equipment Guarantee period of 12 calendar months as provided in Clause '**Guarantee**' of the said contract or from the date of cancellation of the said contract, as the case may be, unless a notice of the claim under this Guarantee has been served on the Bank before the expiry of the said equipment Guarantee period.

4. The Purchaser shall have the fullest liberty without affecting in any way the liability of the Bank under this Guarantee or Indemnity, from time to time to vary any of the terms and conditions of the said contract or to extent time of performance by the said Tenderer to postpone from any time and from time to time any of the powers exercisable by it against the said Tenderer and either to enforce or for bear from enforcing any of the terms and conditions governing the said contract or securities available to the Purchaser and the said Bank shall not be released from its liability under these presents by any exercise by the Purchaser of the liberty with reference to the matters aforesaid or by reasons of time being given to the said Tenderer or any other forbearance, act or omission on the part of the Purchaser or any indulgence by the Purchaser to the said Tenderer or any other matter or thing whatsoever which under the law relating to sureties would but for this provision have the effect of so releasing the Bank from its such liability.

5. It shall not be necessary for the Purchaser to proceed against the Tenderer before proceeding against the Bank and the Guarantee herein contained shall be enforceable against the Bank notwithstanding any security which the Purchaser may have obtained or obtain from the Tenderer shall at the time when proceedings are taken against the Bank hereunder be outstanding or unrealised.

6. We the Bank lastly undertake not to revoke this Guarantee during its currency except with the previous consent of the Purchaser in writing and agree that any change in the Constitution of the said Tenderer or the said Bank shall not discharge our liability hereunder.

Dated this..... day of 201....

For and on behalf of the Bank

The above Guarantee is accepted by me on behalf of P&E Department, Govt. of Mizoram, Aizawl

Engineer-in-Chief (P&E)
Mizoram : Aizawl

Diagram of 33/11kV Sub-Station: