Assam Power Distribution Company Ltd.

BID DOCUMENT
FOR

R&M of 33/11 kV, 2x 5MVA Gohpur S/S along with construction of Control Room Building and with available APDCL supply materials.

Under Gohpur ESD of Tezpur Electrical Circle, APDCL.

ON

"PARTIAL TURNKEY" MODE

SCHEME: R&M Scheme.

NIT NO: 2020/5/APDCL (CAR) Dtd. 04.11.2020

INDEX

SECTION-I
(Notice Inviting Tender)

Assam Power Distribution Company Ltd.
O/o the Chief General Manager (D&S), Central Assam Region.
2nd Floor, Bijulee Bhawan, Paltanbazar, Guwahati – 1
E-mail: cgmdapdclcaz@yahoo.com

NIT NO: 2020/5/APDCL (CAR) Dtd. 04.11.2020

The Chief General Manager (D&S), CAR, Assam Power Distribution Co. Ltd. Bijulee Bhawan, Paltanbazar, Guwahati-1, invites E- tenders from Enlisted Electrical Contractors of APDCL having valid Electrical Contractor's License upto 33 KV level for the following works:

R&M of 33/11 kV, 2x 5MVA Gohpur S/S along with construction of Control Room Building and with available APDCL supply materials under Gohpur ESD of Tezpur Electrical Circle, APDCL.

Details may be seen in websites www.assamtenders.gov.in or www.apdcl.org. w.e.f. 06.11.2020

Sd/-
Chief General Manager (D&S),
APDCL, CAR, Bijulee Bhawan, Ghy-1

Memo No: CGM (D&S)/APDCL (CAR)/33/11kV Harangajao SS/2020/10(a) Dtd: 04.11.2020

Copy to: -

1. PS to MD, APDCL for kind appraisal of MD.
2. The CGM(M, CR & S), APDCL, Bijulee Bhawan, Paltan Bazar, Guwahati-1 for publication of the above tender in one issue of "The Assam Tribune" and one Assamese daily news paper.
3. The OSD to Chairman, APDCL, Bijulee Bhawan, Paltan bazaar, Guwahati for publication in the official website.

Sd/-
Chief General Manager (D&S),
APDCL, CAR, Bijulee Bhawan, Ghy-1

Assam Power Distribution Company Ltd.
O/o the Chief General Manager (D&S), Central Assam Region.
2nd Floor, Bijulee Bhawan, Paltanbazar, Guwahati – 1
E-mail: cgmdapdclcaz@yahoo.com

NOTICE INVITING TENDER

NIT NO: 2020/5/APDCL (CAR) Dtd. 04.11.2020

The Chief General Manager (D&S), CAR, Assam Power Distribution Co. Ltd., Bijulee Bhawan, Paltanbazar, Guwahati-1, invites E- tenders from Enlisted Electrical Contractors of APDCL having valid Electrical Contractor's License up to 33 KV level issued by the competent authority on partial Turnkey mode of contract.

Work description	Average annual Turnover (in lakh)	EMD amount (in lakh)	Period of completion in days	Tender processing fees in Rs.
R&M of 33/11 kV, 2x 5MVA Gohpur S/S along with construction of Control Room Building and with available APDCL supply materials under Gohpur ESD of Tezpur Electrical Circle, APDCL on Partial turnkey mode under R&M Scheme.	410	3.75	180	3,000

1. **Source of fund**: **"R&M Scheme"**
2. **TENDER PROCESSING FEES:** The Bid documents can be downloaded from the websites: www.assamtenders.gov.in or www.apdcl.org for tender submission purpose. The bidder shall mandatorily make payment of tender processing fees and Earnest money deposit ((EMD) through internet banking (SBMOPS) or through NEFT/RTGS. Procedures for submission of Tender processing fees and EMD may be seen in the '*Announcements*' tab of E-tendering portal www.assamtenders.gov.in. **Any other mode of payment for submission of tender processing fees and EMD shall not be accepted.**
3. **Earnest money**: As shown in the table above.
4. **Eligibility Criteria**:

a) **The intending Bidder (including JV partner) must be registered in the Contract Management System (CMS) portal of APDCL before submission of bid.**

b) Average annual turnover of the bidder for last three consecutive financial years i.e. **FY 17-18,18-19 & 19-20** for the package, supported by audited balance sheet, shall be as per the requirements shown in the table and duly **certified by Registered Chartered Accountant with Registration No.**

c) Past and present performance of the bidder in any Electrical utility within India will be taken into account to decide the eligibility as per clause mentioned in the detail bid document.

d) Financial resources: The bidder shall have to specify proposed source of financing, such as liquid assets, unencumbered real assets, letter of credit and other financial means, net current commitments etc. available to meet the total construction cash flow demand of the subject contract (evaluation & qualification criteria).

e) Other Eligibility Criteria may be seen at detail bid document.

5. **Bid validity**: **180 days** from the last date of submission of Bid.
6. **Pre-bid Queries**: From 10:00 Hrs of 09.11.2020 to 16:00 Hrs. of 09.11.2020
   (Pre-bid Queries shall only be submitted via e-mail at cgmdapdclcaz@yahoo.com)
7. **Settlement of Queries**: From 16:00 Hrs. of 09.11.2020 to 16:00 Hrs. of 11.11.2020
8. **Downloading of Bid:** From 17:00 Hrs. of 06.11.2020 to 16:00Hrs. of 19.11.2020
9. **Date of submission of Tenders**: From 10:00 Hrs. of 12.11.2020 up to 16:00 Hrs. of 19.11.2020
10. **Date of opening of Bid**:
    a) Techno commercial bids will be opened at **14-00 hrs of 20.11.2020**
    b) Price bids will be opened on a date to be notified later on.
    c) Note that no physical presence of Bidders or their representatives is required in both Techno commercial as well as Price Bid opening, as all perspective bidders will be able to view their Bid status in e-portal www.assamtenders.gov.in by themselves.

Note:

1. The work shall be carried out as per latest APDCL specification and construction standards.
2. Bids must be submitted electronically through e-tender portal www.assamtenders.gov.in in two parts as **Techno Commercial bid (Part-I)** and **Price bid (Part-II).** A copy of the Technical bid has to be submitted in a sealed envelope super scribing (a) Tender No. (b) Name of the bidder with full address.
3. **Techno-Commercial as well as Price Bids uploaded in the e-tender portal shall only be considered for final assessment.**
4. The bids of those bidders, who are found acceptable in Part-I Bid i.e. Techno Commercial bid, shall only be considered for opening of Price Bid. The date and time of opening of Part-II Bid (Price) shall be communicated to those bidders whose bids are found qualified for opening.
5. **All prospective bidders shall upload the relevant Techno-Commercial as well as Price Bid carefully. APDCL will not be responsible for any corrupt file that is uploaded by the bidders**.
6. The Company reserves the right to accept or reject any tender in part or in full without showing any reason thereof.
7. Bidders will not be allowed to withdraw their bids after expiry of the time of submission of bid and he/she shall be considered as active bidder throughout the bidding process.

Sd/-
Chief General Manager (D&S),
APDCL, CAR, Bijulee Bhawan, Ghy-1

Memo No: CGM (D&S)/APDCL (CAR)/33/11kV Gohpur SS/2020/7(a) Dtd: 04.11.2020

Copy to:-

1. The Managing Director, APDCL Bijulee Bhawan Paltan Bazar, Guwahati-1.
2. The CEO, Tezpur Electrical Circle, APDCL, CAR for kind information.
3. To the OSD to the Chairman, APDCL. He is requested to arrange for uploading the above notice along with bid document at the official website of APDCL.

Sd/-
Chief General Manager (D&S),
APDCL, CAR, Bijulee Bhawan, Ghy-1

SECTION 2
TENDER INVITING PROPOSAL

NIT NO: 2020/5/APDCL (CAR) Dtd. 04.11.2020

TENDER INVITING PROPOSALS WITH TERMS & CONDITIONS.

1. **Name of work:**

R&M of 33/11 kV, 2x 5MVA Gohpur S/S along with construction of Control Room Building and with available APDCL materials under Gohpur ESD of Tezpur Electrical Circle, APDCL on Partial turnkey mode under R&M Scheme.

2. **Intent of the Tender Enquiry**

The intent of the Tender enquiry is to invite proposals from the prospective and relevantly experienced and financially sound contractor(s) (individual or joint venture)/firms to carry out the works as mentioned above on turnkey mode of contract**.**

3. **Scope of Work**

The various activities under the scope of work shall among other related aspects cover the following:

i) Site survey work.

ii) Procurement and supply of all materials required for the work excluding the materials supplied by the Company.

iii) Arrange inspection/testing of any/all items ordered at manufacturer's works for officer deputed by APDCL for such inspection/testing.

iv) Site unloading, storage and handling of all materials supplied including watch and ward for safe custody till handover.

v) Site fabrication work as per requirement.

vi) Submission of implementation schedule from the date of award of contract for: -

Supply, Erection, testing and commissioning of all materials/equipment supplied (including APDCL supplied items)/system installed Project management and site organization.

vii) Obtaining clearance from statutory Agencies, Government Departments, Village Panchayats etc. wherever necessary.

viii) Submission of technical specification/Test Certificate/Drawings etc. of all materials to be supplied and get it approved through competent authority before procurement.

ix) A list of various items normally involved in proposed type of work is provided in this document. This, however, is not to be considered as limiting but only typical. Bidders' scope will include all other items and materials as may be required to effectively complete the work.

x) Return of dismantled materials of dismantled lines, if any, to the concerned sub-divisional/ divisional store. Bidder will compulsorily consider the dismantling charge at the time of submission of bid.

xi) Required jungle cutting.

xii) Prior to starting of the physical work, the successful bidder shall carry out route survey through GPS (Global positioning System) and shall submit (in A2 paper) to office of the CEO,

Tezpur Electrical Circle,APDCL, CAR for approval. Layout drawing & Plan of the Control Room must be approved.

Above all, the scope of work of the bidder/contractor will include all items and facilities as may be necessary to complete the electrification work on turnkey basis and as binding requirement.

4. <u>Basic specification of the various equipment/ works to be supplied /carried out</u>

i. All equipment supplied shall conform to the requirement of relevant IS (BIS) as approved by APDCL/REC construction standards.

ii. All materials supplied shall be erected, protected as per approved standard practice for proposed type of electrical work so as to supply electricity to the consumers most effectively and in an intrinsically safe manner.

iii. All equipments supplied and installed shall provide easy and effective:

- Maintainability
- Reliability
- Availability
- Long life

All equipments supplied and installed shall be provided stable and adequate weather protection, system earthing etc. LA shall be earthed separately.

iv. All items, which may require frequent opening up/ dismantling for maintenance, shall be adequately sealed against any tampering/ theft etc.

v. Generally, supply and erection of materials and system shall meet the requirement of construction standard being followed in the electrification works under APDCL.

5. Basic qualifying requirement:

To be qualified for the package, the bidder must compulsorily meet the following minimum criteria:-

A. <u>Technical</u>:

<u>The prospective bidder must fulfill the following qualifying requirements:</u>

a. The bidders must register themselves (including JV partner) in the Contract Management System (CMS) portal before submission of bid and shall furnish the Provisional Registration Certificate if not issued the original certificate from the portal.

b. The bidder must have valid electrical Contractor's and Supervisor's License (HT minimum up to 33 KV) issued by the Chief Electrical Adviser, Govt. of Assam. The Bidder must have experience of following Electrical works:

1. **<u>Must have experience of construction of at least 1(one) no. of new/R&M of 33/11 KV S/S during last 5 years with successful operation for a period of minimum 1(one) year.</u>**
2. **<u>Must have experience of construction of Civil works in any utilities/Govt./Semi Govt. Department etc.</u>**

c. The experience certificate must be from an officer not below the rank of CEO/DGM/ Superintending Engineer of electrical utilities/ departments.

d. The bidder shall furnish details of the work / works along with its value already in hand either in APDCL or in any other successor companies of ASEB as well as works executed outside the state of Assam along with date of completion as per Letter of Award and likely date of completion duly certified by the competent authority as per format enclosed as **<u>Annexure-I(C)</u>**. **This shall be treated as one of the major qualifying criteria for technical evaluation of the bid. Submission of false data, if found, will be penalized as per rule.**

e. **If any milestone of an existing project of APDCL is not completed by the contractor in time or if any of the project awarded to the contractor has not been completed in time and if the delay is solely because of fault of contractor or reasons attributable to the firm, then the firm will be barred from participating in this bid and the bid shall be considered as non-responsive**.

B. <u>Financial:</u>

a. Average annual turnover of the bidder for the last three consecutive financial years shall be as per NIT and the annual turnovers must be certified by a registered Chartered Accountant. This shall be supported by the copy of audited balance sheet, for last three consecutive financial years along with the income tax return. In case of joint venture firms, the figures of average annual turnovers for each Joint Venture partners shall be added together to determine the bidder's compliance with the minimum average turnover requirement for the package. However, the lead partner must meet at least 40% and each of the other partners must meet at least 25% of the minimum average annual turnovers criteria required for the package as per NIT.

b. Net worth for each of the last three financial years shall be positive. Net worth means the sum of total of paid up capital and free reserves (excluding reserves created out of revaluation) reduced by aggregate value of accumulated losses (including debit balance in profit and loss account for current year) and intangible assets. **Certificate from the Registered CA must be submitted in this regard.**

c. The bidder shall furnish GST Registration Certificate, Employee Provident Fund and valid Labour License (wherever applicable).

d. The bidder/firm shall furnish copy of their Pan Card. The card must be in the name of the firm if the bidder is a firm. If it is a joint venture, copies of PAN Cards of both the partners/firms must be submitted.

e. Joint Venture Agreement shall be a **registered one or certified by Notary**.

f. Power of Attorney shall be a **registered/ notarized one.**

g. Formal authority, Registered/Notarized for signing the tender or other documents on behalf of the firm / individual must be submitted along with the bid. In case of registered company, Board's resolution of the company for authorized signatory shall be furnished.

h. Notwithstanding anything stated herein above, APDCL reserves the right to assess the capacity and capability of the bidder to execute the work, shall the circumstance warrant such assessment in the overall interest of APDCL.

- Even though the bidders meet the above qualifying criteria, they are subject to be disqualified if they have :
  - Made misleading or false representations in the forms, statements and enclosures submitted as a proof of the qualification requirements; and/or recorded of poor performance such as abandoning the work, rescinding of contract for which the reasons are attributable to the non-performance of the contractor, consistent history of litigation awarded against the Applicant/firm or financial failure due to bankruptcy. The rescinding of contract of a Joint Venture on account of reasons other than non-performance, such as most experience partner of Joint Venture pulling out, court directions leading to breaking up of a Joint Venture before the start of work, which are not attributable to the poor performance of the contractor will, however, not affect the pre-qualification of the individual partners.

6. Agreement:

The successful bidders shall have to enter in to an agreement with APDCL within **7(seven) days** from the date of issue of detailed work order (LOA/PO) failing which the LOA/PO shall be treated as cancelled without further communication from APDCL end.

7. Performance Guarantee:

The successful bidder shall have to deposit performance security deposit in the shape of Bank Guarantee from a nationalized bank or scheduled bank of RBI having their regional office in Assam or at least a branch office at Guwahati (in case of those , whose regional office is not located in the state of Assam) with a certificate from the Bank to the effect that the verification or any confirmation in regard to the BG issued by the bank can be taken up with the Branch office at Guwahati pledged in favour of "ASSAM POWER DISTRIBUTION COMPANY LIMITED." as per proforma for an amount equivalent as per the below mentioned table:

Sl. No.	Ceiling of offered price (in % of estimated amount)	Amount of BG to be submitted (Rs.)
1	Upto 10% below than the estimated amount	10% of Contract value.
2	Below 10%- upto15% than the estimated amount	15% of Contract value
3	Below 15% than the estimated amount	Bid will be considered as Non-Responsive.

Note that, if L_1 is above the estimated value but accomodable with 3% Contingency & Sundries, than their Price offer shall be accepted. Otherwise negotiation shall be made with the L_1 Bidder to bring down to accomodable value.

The Contract Performance Guarantee (CPG) as per above table shall be furnished to the CGM (D), APDCL (CAR) along with the acceptance of Letter of Award (LOA) **for 7 months** from the date of LOA/PO. Further, another Performance Bank Guarantee (PBG) equivalent to **10%** of the value of the Contract amount shall be furnished **for 18 months** as Security after successful commissioning of the Project/Work. The 1st BG shall be returned on furnishing of PBG. Again an additional BG equivalent to **10%** against installed equipments **(**VCB, CT, PT, CR panel, Energy meter etc. if any) shall be submitted and required to be guaranteed for **60(sixty) months** on or before expiry of the earlier PBG submitted as Security to cover the entire warranty period and shall be valid for **1(one) month** beyond warranty period of **60(sixty) months**. The earlier PBG will be released on receipt of 3rd BG. If supplier fails or neglect to perform any of his obligations under the contract, the APDCL shall have the right to forfeit in full or in part at its absolute discretion the performance security deposit furnished by the contractor. No interest shall be payable on such deposits.

8. Joint Venture Requirement

i. **In case of Joint Venture Bid, only one Partner is allowed with the Lead Partner.**
ii. **In case of successful Bidder, one agreement shall be signed by the both partners so as to be legally binding on both.**
iii. One of the partners shall be authorized as the lead partner and authorization shall be evidenced by submitting a Power of Attorney signed by legally authorized signatories of the both the partners. **Both the JV partners must have valid electrical Contractor's** License of required level issued by the Licensing Authority of GOA.
iv. The lead partner shall be authorized to incur liabilities, receive payments and receive instructions for and on behalf of any or all partners of the joint venture for entire execution of the contract.
v. All the partners of the joint venture shall be jointly and severally liable for the execution of the contract in accordance with the contract terms and conditions. A relevant statement to this effect shall be included in the authorization mentioned above as well as in the bid form and the form of agreement (in case of successful bidder).
vi. A copy of the joint venture agreement shall be submitted with the bid.
vii. The figure of average annual turnovers for the joint venture partners shall be added together to determine the bidder's compliance with the minimum average turnover requirement for

the package. However, the lead partner **must meet at least 40% and other partner must meet the at least 25%** of the minimum average annual turnover criteria given in the Tender.

viii. Apart from the above, the following are the documents that need to be submitted by each individual partner constituting the joint venture-

a. Company/Firm Registration No
b. List of order executed in last 5 years and order in hand.
c. Bank Solvency Certificate.
d. Labour license
e. GST Registration certificate
f. Provident fund Registration certificate
g. List of labour registered under Assam building and other construction Workers' welfare Board.
h. ESIC Registration Certificate.

ix. The submission of E-tender shall be digitally signed by the contactor/firm and by the lead partner only in case of JV.

9. Other requirements:

The Bidder:

i) Shall acquaint himself with relevant conditions of the local geography and socio economic setup of the different locations of the State and having done so, accordingly mobilize, organize and expedite the activities.
ii) Shall have adequate working personnel comprising of Electrical/ Mechanical engineers or diploma holders, electrical supervisor, skilled and unskilled labour to be deputed to the proposed assignment.
iii) Shall be conversant with the code/ standards applicable to proposed type of work: BIS, REC/APDCL guidelines.

10. Submission of bid:

Whether Price Bid or Techno-Commercial bid, both bids must be submitted electronically through e-tender portal https://assamtenders.gov.in. Only the documents submitted electronically will be considered for tender evaluation. A copy of the Technical bid has to be submitted in a sealed envelope super scribing (a) Tender No. (b) Name of the bidder with full address to the O/o the CGM (D&S), CAR, APDCL **for reference purpose only**. **Please note that no documents shall be accepted after opening of techno techno-commercial bid.**

The EMD shall be valid for 180 days from the last date of submission of tender. The earnest money of the unsuccessful bidders will be released on finalization of the tender. The EMD to the successful bidder will be released on submission of CPG as per the clause of the bid document. The EMD of the successful bidder will be forfeited on non-acceptance of Letter of Award (LOA) within the stipulated period mentioned in LOA.

11. Submission of documents with technical bids:

i) Detail list of makes and materials offered with catalogues, technical specification, type tests certificate, performance certificate from utilities, authorization letter from manufacturer, customer list etc.
ii) Certificates and testimonials in support of credentials of the bidder's organization.
iii) Details past experience along with present works in hand with awarded amount and progress report.
iv) Brief write-up on methodology to carry out the assignment, if awarded.
v) Details of manpower to be engaged for the assignments.

vi) Any other information, the bidder may feel facilitative in evaluating the bid.
vii) Copies of contractor's licence and supervisor's license, etc.
viii) Certificate from Registered Charted Accountant in support of Annual turn over.
ix) Solvency certificate from Bank.
x) Certificate in support of performance of the bidder.
xi) If the bidder is involved in any litigation with APDCL/ or any successor company of ASEB. The bidder shall furnish the information to that effect.
xii) The bidder shall submit the list of materials that are to be brought from outside the state.
xiii) A self declaration by the bidder shall invariably be submitted along with Techno-Commercial bid, for supplying the materials required for the works from the approved vendor/supplier of APDCL only.
xiv) GTP'S of items as described in BOQ shall not be submitted along with Techno-Commercial bid. However, Qualified Bidder shall submit the required GTP for approval after issuance of LOA in favour of them.

Note:-

a. If the price of any item is kept blank, the highest rate quoted among the techno-commercially qualified bidders will be loaded for evaluation purpose. However, if the bidder happens to be L-1 after evaluation, then rate against the item which the bidder has kept blank will be awarded as zero i.e. he will have to execute the work without any financial involvement.
b. **No separate declaration offering discount on price will be allowed. Offered price in the price schedule will be final.**

12. **Pre-bid meeting**: **No pre-bid discussion will be held. Instead of physical meeting, intending bidders may submit their Pre-bid Queries if any via e-mail at cgmdapdclcaz@yahoo.com from 10:00 Hrs of 09.11.2020 to 16:00 Hrs. of 09.11.2020. APDCL will not accept any complain, request for correction/modification etc. after expiry of above time period.**

13. **Quantity Variation**: There may be increase or decrease in quantity of individual items subject to the condition that the corresponding change in total contract value does not increase or decrease by more than **10%**. The quantity variation is allowed at the unit rate of individual material quoted at the time of bidding or prevailing rates of those item in the SOR, whichever is lower. However, for consequential change in labour portion on account of such quantity variation, the price quoted in the original price schedule at the time of bidding shall only be applicable. The variation which may occur must have the approval of CGM (D&S), CAR.

14. **Award of work:**
    i. The evaluation of bids will be carried out in two parts, technical bid and price bid. The price bid will be opened and evaluated only of those bidders who are declared as qualified in technical bid only.
    ii. Company is not bound to accept the lowest quoted rate if the bidder is not responsive as per requirement of APDCL's T&C.
    iii. Work shall have to be started within fifteen (15) days from the date of issue of the work order, failing which order will be cancelled without further correspondence.
    iv. The successful bidder must have to complete survey works within **10(ten) days** from the date of issue of work order & submit quantity variation within that period.
    v. All the materials installed shall be under custody of the contractor till the date of commissioning and handed over to APDCL. The properties will be taken over by APDCL, only after satisfactory commissioning and charging.
    vi. All quoted rate shall be inclusive of all taxes as applicable as per prevailing rate.

15. **Period of completion: 180 (One hundred & Eighty days) days from the date of issue of work order.**

NB: The project being a time bound priority scheme, the intending bidder who feel competent enough to complete within the stipulated period shall only participate.

16. Implementation schedule:

Comprehensive implementation schedule of work for the mentioned works: (Tentative).

Sl. No	Description	EXECUTION PERIOD					
		7 days	10 days	30 days	30 days	90 days	13 days
1	Signing of Agreement						
2	Survey works & submission of drawings/GTP						
3	Manufacture & supply of materials						
4	Erection of equipments						
5	Testing & commissioning						

17. Termination of work order:

Company reserves the right to terminate the work order at any stage in accordance with the Company's General Condition of Supply and Erection in force.

18. Terms of Payment:

a. For Supply:

During the pendency of the contract, 2(two) nos. of progressive bill will be entertained for which 60% payment shall be made against each progressive bill retaining the balance 40% amount. The balance amount shall be paid along with the Erection bill after satisfactory completion & commissioning of the portion of the project subject to validity of performance guarantee submitted as per clause. No mobilization advance will be entertained.

100% bills raised against supply of materials shall be passed by the concerned Assistant General Manager countersigned by the concerned CEO will be placed to the CGM (D&S), CAR for payment.

For Erection:

First & final erection bill shall be paid along with retained 40% of supply bills after successful completion & commissioning of the work. Erection, bills after due verification by the concerned SDE, 100% of the bill passed by the concerned Asstt. General Manager and countersigned by the concerned CEO will be placed to the CGM (D&S), CAR for payment.

b. The right of the contractor/supplier to have payment or reimbursement of any cost for execution of works/supply of materials, as the case may be, against this order will be forfeited or deemed to have been relinquished if the claim for it is not preferred to the appropriate authority within **6(Six) months** from the date of completion or deemed completion as per clause of Company's GCSE.

19. Project Management and site Organization:

In Consideration of the tight schedule of the project, the successful bidder(s)/Contractor(s) shall exercise systematic closely controlled project management system with the aid of commonly used soft tools. Following are the major activities/deliverables to be organized /generated for submission to the Board.

(I) Liaison/Construction offices will be established in the concerned Circle of APDCL.

(II) Work Progress Report:

- Progress monitoring by the contractor as per implementation schedule and approved milestones.
- Fortnightly progress report will be submitted to the concerned Deputy General Manager, Asstt. General Manager & Sub-Divisional Engineers.

The progress report will highlight the points like, work completion vis-à-vis planned, plan for next working period, delay analysis vis-à-vis committed schedule with reasons and remedies, etc.

(III) Site Organization-

The bidder at each working site shall establish the following.

- Store house
- Site fabrication facilities
- Construction supervision office.

All offices shall be adequately furnished and staffed so as to take all site decisions independently without frequent references to head offices.

20. Guarantees and Penalties:

a) **Liquidated Damages (LD)** The proposed work is to be completed within stipulated/agreed schedule. Any delay beyond that will attract penalty as per Company's General condition of supply and erection. An amount shall be recover from the Turnkey Contractor at the rate of **1% (one percent)** of the Contract Price per week or part thereof of delay, subject to maximum of **10% (ten percent)** of the contract price as liquidated damage to APDCL.

b) **Defect liability period: 18 months** from the date of commissioning (except VCB, CR panel, Energy meter etc.)

c) Equipment & materials installed shall be guaranteed individually and also for integrated operations for a period as mentioned below-

i. All equipments /materials, erected structures etc. for period of 18(eighteen) months from the date of commissioning.

In case of detection of any defect in individual equipment or in the system as a whole, the same shall be replaced / corrected by the contractor free of cost within 15(fifteen) days from the date of receipt of the communication, failing which it will lead to forfeiture of the BG against the equipments in full or in part which is at the absolute discretion of APDCL.

b) Warranty from the manufacturer shall be produced along with manufacturer's test certificate for all equipment/ materials covered under Manufacturer's warranty.

c) If the bidder/contractor fails to complete the project within the stipulated period, the bidder maybe debarred from participating in future bids for a period which shall not be less than 1 (one) year but may extend up to 3(three) years.

21. Approvals/Clearances:

a) Concerned CEO of APDCL shall approve all site and documents prepared by the contractor for construction of the sub-station.

b) GTPs and drawings of all equipments/ materials shall be approved from the CEO, Kanch Electrical Circle, APDCL, CAR. The contractor shall obtain all statutory approvals and clearances from the statutory authorities before charging the system at their own cost and effort.

22. Testing & Inspection:

All major equipments/materials to be supplied and erected shall be tested/inspected at manufacturer's works by authorized officer/ Engineers of APDCL before dispatching them to worksite at the discretion of APDCL. The contractor shall intimate the CGM (D&S),CAR sufficiently in advance (at least 15 days) regarding the date of inspection of materials/ equipments at manufacturer's works. The materials to be dispatched to site only after receipt of dispatch clearance issued by the CGM (D&S), CAR after satisfactory testing of the same. Each lot of materials has to be inspected by the concerned field officials of APDCL before utilization.

23. Environmental Considerations:

While carrying out the assignment, no damage to environment /forests will be caused by the contractor. If so done, the contractor will have to compensate the same to the satisfaction of the concerned Authority.

24. Submission of documents

a) With bids.

i) Certificates and testimonials in support of credentials of the bidder's organization.
ii) Details past experience along with present works in hand with awarded amount and progress report.
iii) Brief writ-up on methodology to carry out the assignment, if awarded.
iv) Details of manpower to be engaged for the assignments.
v) Any other information, the bidder may feel facilitative in evaluating the bid.
vi) Copies of contractor and supervisor's license, etc.
vii) Certificate from Registered Charted Accountant in support of Annual turn over
viii) Solvency certificate from Bank
ix) Earnest money deposit along with Techno- Commercial bid
x) Certificate in support of performance of the bidder.

b) During project execution

i) All documents for approval shall be submitted in 3 (three) copies.
ii) All final documents to be submitted to statutory organizations will be furnished as per requirement of the authority.

25. Funding of the project: The proposed work is funded under R&M scheme of APDCL.

26. Ceiling on acceptance of bid value

If the bid of the successful bidder is seriously unbalanced or unrealistic with respect to the prevailing Schedule of Rate (SOR) of APDCL which may likely to have adverse effects on the quality of workmanship as well as timely completion of the project, APDCL may ask the Bidder to produce detailed price analysis for any or all items of the BOQ. **The Ceiling on acceptance of bid value with submission of CPG is tabled as below:**

Sl. No.	Ceiling of offered price (in % of estimated amount)	Amount of BG to be submitted (Rs.)
1	Upto 10% below than the estimated amount	10% of Contract value.
2	Below 10%- upto15% than the estimated amount	15% of Contract value
3	Below 15% than the estimated amount	Bid will be considered as Non-Responsive.

Note that, if L_1 is above the estimated value but accomodable with 3% Contingency & Sundries, than their Price offer shall be accepted. Otherwise negotiation shall be made with L_1 Bidder to bring down to accomodable value.

Note that, in case of tie (in respect of quoted price) between two bidders, the bidder with higher turn-over will be preferred.

In the event of non-compliance of the following, APDCL shall have absolute discretion and right to scrap/reject the bid submitted by the successful bidder:

- If a bid contains several items in the Bill of Quantities which are unrealistically priced low and which cannot be substantiated satisfactorily by the bidder in price analysis.
- Non-submission of additional performance security, if required as per the terms mentioned above.

27. Termination of contract on Contractor's default

If the Contractor neglects to execute the Works with due diligence and expertise or shall refuse or neglect to comply with any reasonable order given to him by the Engineer in connection with the works or shall contravene the provisions of the Contract, the owner may give notice in writing to the contractor to make good the failure, neglect or contravention complained of. Shall the contractor fail to comply with the notice within thirty (30) days from the date of serving the notice, then the Owner shall be at liberty to employ other workmen and forthwith execute such part of the works as the Contractor, may have neglected to do or if the owner shall think fit, without prejudice to any other right he may have under the Contract to take the work wholly or in part out of the contractor's hands and re-contract with any other person or persons to complete the works or any part thereof and in that event the Owner shall have free use of all Contractor's equipment that may have been at the time on the site in connection with the works without being responsible to the Contractor for fair wear and tear thereof and to the exclusion of any right of the contractor over the same, and the Owner shall be entitled to retain and apply any balance which may otherwise be due on the Contract by him to the contractor, or such part thereof as may be necessary, to the payment of the cost of executing the said part of the work or of completing the Works as the case may be. If the cost of completing the Works or executing a part thereof, as aforesaid, shall exceed the balance due to the contractor, the contractor shall pay such excess. Such payment of excess amount shall be independent of the liquidated damages for delay which the contractor shall have to pay if the completion of works is delayed.

In addition, such action by the Owner, as aforesaid, shall not relieve the Contractor of his liability to pay liquidated damages for delay in completion of works as defined in clause no.26 of GCSE.

Such action by the Owner as aforesaid, the termination of the Contract under this clause shall neither entitle the contractor to reduce the value of the Contract Performance Guarantee nor the time thereof. The Contract Performance Guarantee shall be valid for the full value and for the full period of the contract including guarantee period.

Please note that as per the office order no. APDCL/OSD/MISC/2018-19/8 dtd. 14.11.2018, no time extension will be granted in any circumstances irrespective of size & volume of work. If any extension is needed for an unavoidable reason (except force majure), the permission from Chairman, APDCL through the Managing Director, APDCL will be mandatory.

28. Termination of contract on owners' initiative

The Owner reserves the right to terminate the Contract either in part or in full due to reasons other than those mentioned under clause entitled "Contractor's Default." The Owner shall in such an event give fifteen (15) days notice in writing to the Contractor of his decision to do so.
The Contractor upon receipt of such notice shall discontinue the work on the date and to the extent specified in the notice, make all reasonable efforts to obtain cancellation of all orders and contracts to the extent they are related to the work terminated and terms satisfactory to the Owner, stop all further sub-contracting or purchasing activity related to the work terminated, and assist the Owner in maintenance, protection, and disposition of the Works acquired under the Contract by the Owner.

In the event of such a termination, the Contractor shall be paid compensation, equitable and reasonable, dictated by the circumstances prevalent at the time of termination.

If the Contractor is an individual or a proprietary concern and the individual or the proprietor dies and if the contractor is a partnership concern and one of the partners dies then unless the Owner is satisfied that the legal representatives of the individual contractor or of the proprietor of propriety concern and in the case of partnership, the surviving partners, are capable of carrying out and completing the Contract, the Owner shall be entitled to cancel the Contract as to its uncompleted part without being in any way liable to payment of any compensation to the estate of deceased Contractor and/or to surviving partners of the contractor's firm on account of the cancellation of the contract. The decision of the owner that the legal representatives of the deceased contractor or surviving partners of the contractor's firm cannot carry out and complete the contract shall be final and binding on the parties. In the event of such cancellation, the Owner shall not hold the estate of the deceased Contractor and/or the surviving partner of the Contractor's firm liable to damages for not completing the Contract.

29. **Frustration of contract**

In the event of frustration of the contract of supervening impossibility in items of Section 56 of the Indian Contract Act, parties shall be absolved of their responsibility to perform the balance portion of the contract.
In the event of non-availability or suspension of funds for any reasons whatsoever (except for reason of willful or flagrant breach by the Owner and/or contractor) then the Works under the contract shall be suspended. Furthermore, if the Owner is unable to make satisfactory alternative arrangements for financing to the contractor in accordance with the terms of the Contract within three months of the event, the parties hereto shall be relieved from carrying out further obligations under the Contract treating it as frustration of the Contract. In the event Performance Bank Guarantee**,** the parties shall mutually discuss to arrive at reasonable terms on all issues including amounts due to either party for the work already done on "Quantum merit" basis which shall be determined by mutual agreement between the parties.

30. **Disclaimer:**

While the Company will make every endeavor to extend necessary facilitation in expediting the work, the contractor shall be responsible to organize and arrange all necessary inputs right from mobilization activities up to completion of the project. Company will not entertain any failure / delay on such accounts. Also, Company will not be responsible for any compensation, replenishment, damage, theft etc. as may be caused due to negligent working, insufficient coordination with Government / non Government / Local Authority by the contractor and/ or his personnel deputed for work. The contractor shall take necessary insurance coverage under LIC/GIC etc. for his working personnel and the goods in store as well as in transit. The contractor will be deemed to have made him acquainted with the local working conditions at site(s) and fully provide for into the bid submitted.

31. **Before submitting the tender, the intending bidders are requested to physically survey/inspect the location/route and the scope of work and have discussion with concerned Sub-divisional Engineer /Asstt. General Manager in this regard in order to minimize issues after awarding the contract. Any additional work/quantity which may be required for laying / renovation of the line but inadvertently left out in the BOQ may be raised in the pre-bid meeting only.**
32. **No pre-bid discussion will be held. Instead of physical meeting, intending bidders may submit their Pre-bid Queries if any via e-mail at cgmdapdclcaz@yahoo.com from 10:00 Hrs of 09.11.2020 to 16:00 Hrs. of 09.11.2020**
33. **Terms and conditions, which are not specified herein above will be governed by the APDCL's General Conditions of supply and erection in force.**

34. **During the course of execution of the project, if any requirement of additional work arises which happens to be not in scope of the BOQ and primarily involves permission from other State/Central department in regard to Railway track crossing or Highway crossing, then obtaining such necessary permission will be the obligation to the Turn key Contractor. APDCL, however shall bear the essential financial involvement required in this process, if any.**

35. **APDCL's General Conditions of supply and erection (GCSE) may be seen in our official website www.apdcl.org--** (Notice part)

Annexure – I (A)

Tender Proforma part – I (Techno-commercial Bid)

NIT NO: 2020/5/APDCL (CAR) Dtd. 04.11.2020

a.	Name and full address of the Bidder	:	
b.	Particulars of payment made for Purchase of tender document in the shape of.	:	
c.	Amount of earnest money paid in the shape of	:	
d.	Whether Sales Tax Clearance Certificate submitted	:	Yes / No
e.	GST Registration.	.:	
f.	Acceptance of guarantee clause of Materials /equipment and system Installed individually and for integrated Operation.	:	
g.	Acceptance of penalty clause	:	
h.	Acceptance of terms of payment	:	
i.	Certificate/ documents regarding adequate experience of doing similar job	:	
j.	Details of work presently in hand with amount (Awarded by APDCL and other successor Companies of ASEB) - a separate sheet if Required may be enclosed.	:	
k.	Details of manpower and T&Ps including Vehicles available with the firm to be Enclosed separately.	:	
l.	List of documents enclosed	:	

a) ….
b) ….
c) ….

Signature with full name
and designation of bidder or
his/her authorized representative
with seal

Annexure- I (B)

REQUIRED QUALIFICATION

Sl No.	Qualification Requirement	Furnished at Annexure	Page	Remark
A	**LEGAL**			
1	Document in support of legal status of firm			
2	Memorandum of Association & Registered / Notarised Joint venture Agreement if JV			
3	Registered / Notarised power of attorney of the signatory of the Bidder to participate in the Bid in case of JV			
4	Board resolution of the company to authorizing the signatory in case of company			
5	Information regarding any litigation, current or during the last five years, in which the Bidder is involved, the parties concerned, and disputed amount			
6	Valid Electrical Contractor's License			
7	Valid Electrical & Supervisory License			
8	Labour License			
9	GST Registration Certificate			
10	Provident Fund Registration Certificate			
11	List of labour registered under Assam building and other construction Workers' Welfare Board			
12	ESIC Registration Certificate			
B	**Financial**			
1	Audited Balance sheet, Profit & Loss account, Auditor's report for last three year (FY 2017-18 , FY 2018-19 & FY 2019-20)			
2	CA Certified Turnover of bidder during the last 3(three) years. (i.e. (FY 2017-18 , FY 2018-19 & FY 2019-20))			
3	Evidence of adequacy of working capital for this contract (access to Letter of Credit and availability of other financial resources)			
4	Authority to seek references from the Bidder's Bankers			
5	Income Tax return for last 3 (three) years i.e. (FY 2017-18 , FY 2018-19 & FY 2019-20)			
6	Value of similar work performed by the bidder in each of the last five years – Statement			
7	Proposals for subcontracting components of the Works amounting to more than 10 percent of the Contract Price			
8	**Details of the Bank Guarantee as EMD (BG/TD/Bank Call Deposit)**			
C	**Technical ability and experience**			
1	Experience in works of a similar nature and volume for each of the last 5(five) years and details of works under way or contractually committed including full address of client for communication- Statement			
2	Certificates issued by an Engineer not below the Cadre of Deputy General Manager/SE along with supporting photo-copies of			

	agreements for the works executed.			
3	Detailed activity plan and methodology supported with layout and necessary drawings and calculations (detailed) to allow the employer to review their proposals.			
4	Quality Assurance plan with Bar Chart			
5	List of technical personnel and their qualification and experience with organization chart			
6	Proof of availability of the tools, tackles, spare parts, etc. for carrying out the works.			
D	**Technical particulars of equipments and Materials offered in the Bill of Material and their GTPs**			

LIST OF ONGOING & COMPLETED PROJECTS: ANNEXURE- I(C)

List of ongoing & completed projects of -

(i) APDCL & Other successor companies of ASEB &

(ii) works executed outside the state of Assam

Sl. No.	Name of the work	Order No	Contract value	Scheme	Stipulated date of completion	Present Status
1						
2						
3						

BIDDER'S INFORMATION SHEET: Annexure- I (D)

Bidder's Information	
Bidder's legal name	
In case of JV, legal name of each partner	
Bidder's country of constitution	
Bidder's/Firm year of constitution	

Bidder's legal address in country of constitution	
Bidder's authorized representative (name, address, telephone numbers, fax numbers, e-mail address)	
Attached are copies of the following original documents. 1. In case of single entity, articles of incorporation or constitution of the legal entity. 2. Authorization to represent the firm or JV named in above, in accordance with clause stated in the Bid document. 3. In case of JV, letter of intent to form JV or JV agreement, in accordance with clause stated in the Bid document.	

……..
…….
Signature, name and designation of Authorised Signatory

For and on behalf of ……(*Name ofthe* Bidder)

Place : Date:

FINANCIAL SITUATION (FIN-1)

Each bidders or member of JV must fill in this form

Financial Data for Previous 3 Years [Rs in lakhs]		
Year 1:	**Year 2:**	**Year 3:**

Information from Balance Sheet

Total Assets			
Total Liabilities			
Net Worth			
Current Assets			

Current Liabilities			

Information from Income Statement

Total Revenues			
Profits Before Taxes			
Profits After Taxes			

- ❑ Attached are copies of financial statements (balance sheets including all related notes, and income statements) for the last three years, as indicated above, complying with the following conditions.
  - All such documents reflect the financial situation of the Bidder or partner to a JV, and not sister or parent companies.
  - Historic financial statements must be audited by a certified accountant.
  - Historic financial statements must be complete, including all notes to the financial statements.
  - Historic financial statements must correspond to accounting periods already completed and audited (no statements for partial periods shall be requested or accepted).

Form FIN - 2: Average Annual Turnover

Each Bidder or member of a JV must fill in this form.

Annual Turnover Data for the Last 3 Years	
Year	**Amount (Rs. In lakhs)**
Average Annual Turnover	

The information supplied shall be the Annual Turnover of the Bidder or each member of a JV in terms of the amounts billed to clients for each year for contracts in progress or completed in ₹(Rupees).

Form FIN – 3: Financial Resources

Specify proposed sources of financing, such as liquid assets, unencumbered real assets, lines of credit, and other financial means, net of current commitments, available to meet the total construction cash flow demands of the subject contract or contracts as indicated in Section 3 (Evaluation and Qualification Criteria)

Financial Resources		
No.	**Source of financing**	**Amount (Rs. In lakhs)**
1		
2		
3		

SECTION III
BILL OF QUANTITY (BOQ)

BOQ

WORKS: R&M of 33/11 kV, 2x 5MVA Gohpur S/S along with construction of Control Room Building (with available APDCL supply materials) under Gohpur ESD of Tezpur Electrical Circle, APDCL.

Sl No	Item Description	Unit	Qty
1	33 KV outdoor installation type VCB with terminal connector & GI mounting structure	Set	3
2	33KV 1 ph CT with GI mounting structure & marshaling box(set comprising of three units) 200-100/5-5-5 Amp	Set	2
3	33KV 1 ph CT with GI mounting structure & marshaling box(set comprising of three units) 400-200/5-5 Amp	set	1
4	33 KV 10 KA lightening arrestor with surge monitor & GI mounting	Set	1
5	33 KV 800 Amps Double break isolator without earth switch with terminal connector & GI mounting structure	Set	1
6	33 KV C&R Panel for Transformer (with differential relay numerical type & with static TVM)	No	2
7	33 KV C&R Panel for Feeder (with relay numerical type & with static TVM)	no	1
8	33 KV/110V, 1ph PT with GI mounting structure & marshaling Box(Set comprising of three units)	Set	1
9	Battery charger suitable for 150AH, 110V Battery bank	Set	1
10	33KV Polymeric Disc Insulator 70 KN	No.	3
11	33KV Polymeric Pin Insulator	No.	3
12	DCDB	Set	1
13	ACDB	Set	1
14	11KV 400AmpGang switch	Set	3
15	PSC pOle 9.75Mtr.	No.	4
16	11 KV XLPE Cable 3 core 240 sq. mm. (Aluminium)	Mtr	500
17	11 kV XLPE cable 1-core x 120 Sq. mm	Mtr	400
18	11 KV Cable Kit for XLPE 3 core 240 sq. mm. (Indoor)	No	6
19	11 KV Cable Kit for XLPE 3 core 240 sq. mm. (Outdoor)	No	6
20	11 KV Cable Kit for XLPE 1 core 120 sq. mm. (Indoor)	No	8
21	11 KV Cable Kit for XLPE 1 core 120 sq. mm. (Outdoor)	No	8
22	**11 kV Indoor VCB panel - 11 unit (APDCL supply materials)**	No	1
23	150AH, 100V MAINTENANCE FREE battery bank	Set	1
24	12KV,9KA station type lightening arrestor with surge monitor	Set	6
25	Control cable copper 10 Corex2.5 sqmm	Mtr	250
26	Control cable copper 7 Corex2.5 sqmm	Mtr	200
27	Control cable copper 4 Corex2.5 sqmm	Mtr	500

28	Control cable copper 2 Corex2.5 sqmm	Mtr	400
29	PVC Cable 1 core 2.5sqmm copper cable	Mtr	200
30	4 Core PVC copper cable 4 sq. Mm	Mtr	150
31	2 Core PVC copper cable 4 sq. Mm	Mtr	400
32	16 sq.mm Armoured single core copper cable	Mtr	20
33	LT XLPE armoured aluminum cable 3.5-core 120 sqmm	Mtr	40
34	Bi metalic lug (Assorted)	No	120
35	GI Channel (100x50x6)mm	Mtr	325
36	Pole clamp of GI flate (50x6 mm)	No	150
37	GI wire 6 SWG	Kg	100
38	GI Nuts & Bolts and Spring Washer	Kg	500
39	ACSR Wolf conductor	Km	0.7
40	H/W fittings for disc insulator tension type 70KN	No	20
41	Tension clamp for Wolf conductor	No	42
42	PG Clamp for Wolf	No	60
43	11KV Polymeric Disc Insulator 70KN	No	24
44	Hardware fittings for Disc Insulator 70KN	No	30
45	11KV Polymeric Pin Insulator	No	40
Job works	i) Switchyard lighting (complete with 6 Nos. of 40W LED bulb with structure and accessories)	LS	1
	ii) Fire fighting equipment consisting of 4 nos. of free standing type, portable, dry chemical powder type fire extinguishers of 6.0 Kg. and 4 no. of fire bucket filled with sand with 1 no. steel hanger	1	Lot
	iii) Furniture & fixture Godrej make 2 no. office tables 102 , Godrej make 4 no. chairs CHR 703, 1 no. steel almirah (Godrej Storwel plain 4 shelves H 6.5' X B3' X D9''), 1 no. Godrej 7' steel rack with 6 piecs 18' panel (H7' X B3' X D18'')	1	Lot
	iV) PCC Foundation (1:2:4) for 33KV CT	Cum	15
	V) PCC Foundation (1:2:4) for 33 KV LA	Cum	5
	VI) PCC Foundation (1:2:4) for 33KV PT	Cum	5
	VII) RCC Foundation for 33KV VCB	No	15
	VII) Construction of Cable trench size(950x450)mm for control cable including supply of all materials and labours as per specification and drawing.	Mtr	350
	IX) Switchyard Gravelling of 0.15 m (thickness) by 40mm size crushed stone	Sqm	600
	X) Construction of RCC control room building(120 sqm) , including internal electrification, water supply & sanitery works etc. complete .	Job	1
	XI) Earth filling with river sand earth work in filling, levelling, compacting, grading etc. as per site condition and texcnical specification.	CM	705
	XII) Grouting of PSC Pole PCC	No.	4

SECTION-IV
GENERAL REQUIREMENT

GENERAL REQUIREMENTS

The bidder shall comply with the following general requirements along with other specifications.

1.0 **QUALITY ASSURANCE PLAN**

1.1 The bidder shall invariably furnish the following information along with his offer failing which the offer shall be liable for rejection. Information shall be separately given for individual type of equipment offered.

i) The structure of organization
ii) The duties and responsibilities assigned to staff ensuring quality of work
iii) The system of purchasing, taking delivery and verification of materials
iv) The system for ensuring quality of workmanship
v) The quality assurance arrangements shall confirm to the relevant requirement of ISO 9001 on ISO 9002 as applicable.
vi) Statement giving list of important raw materials, names of sub-supplies for the raw materials, list of standards according to which the raw material are tested, list of tests normally carried out on raw material in the presence of suppliers representative, copies of test certificates.
vii) Information and copies of test certificates as on (i) above in respect of bought out items
viii) List of manufacturing facilities available
ix) Level of automation achieved and list of areas where manual processing exists.
x) List of areas in manufacturing process, where stage inspections are normally carried out for quality control and details of such test and inspection.
xi) List of testing equipment available with the bidder for final testing of equipment specified and test plant limitation, if any vis-à-vis the type. Special acceptance and routine tests specified in the relevant standards. These limitations shall be very clearly brought out in "Schedule of Deviations" from the specified test requirement.

1.2 The contractor shall within 30 days of placement of order, submit the following information to the purchaser.

i) List of the raw material as well as bought out accessories and the names of sub-suppliers selected from those furnished along with the offer.
ii) Type test certificated of the raw material and bought out accessories if required by the purchaser.
iii) Quality Assurance Plant (QAP) with hold points for purchaser's inspection. QAP and purchasers hold points shall be discussed between the purchaser and contractor before the QAP is finalized.

The contractor shall submit the routine test certificates of bought out accessories and central excise asses for raw material at the time of routine testing if required by the purchaser and ensure that the quality assurance requirements of specification are followed by the sub-contractor.

1.3 The Quality Assurance Programmed shall give a description of the Quality System and Quality Plans with the following details-

i) Quality System

- The structure of the organization.
- The duties and responsibilities assigned to staff ensuring quality of work.
- The system of purchasing, taking delivery of verification of materials
- The system of ensuring of quality workmanship.
- The system of control of documentation.
- The system of retention of records.
- The arrangement of contractor internal auditing.
- A list of administrator and work procedures required to achieve contractor's quality requirements. These procedures shall be made readily available to the purchaser for inspection on request.

ii) Quality Plans

- An outline of the proposed work and program sequence.
- The structure of contractor's organizations for the contract.

- The duties and responsibilities ensuring quality of work.
- Hold and notification points.
- Submission of engineering documents required by this specification.
- The inspection of the materials and components on request.
- Reference to contractor's work procedures appropriate to each activity.
- Inspection during fabrication /construction.
- Final inspection and test.

2.0 **Inspection**

2.1 The Owner's representative or third party nominee shall at all times be entitled to have access to the works and all places of manufacture, where insulator, and its component parts shall be manufactured and the representatives shall have full facilities for unrestricted inspection of the Contractor's and sub-Contractor's works, raw materials, manufacture of the material and for conducting necessary test as detailed herein.

2.2 The material for final inspection shall be offered by the Contractor only under packed condition as detailed in the specification. The Owner shall select samples at random from the packed lot for carrying out acceptance tests. Insulators shall normally be offered for inspection in lots not exceeding 5000 nos. the lot shall be homogeneous and shall contain insulators manufactured in the span of not more than 3-4 consecutive weeks.

2.3 The Contractor shall keep the Owner informed in advance of the time of starting and the progress of manufacture of material in their various stages so that arrangements could be made for inspection.

2.4 No material shall be dispatched from its point of manufacture before it has been satisfactorily inspected and tested unless the inspection is waived off by the Owner in writing. In the latter case also the material shall be dispatched only after satisfactory testing for all tests specified herein have been completed.

2.5 The acceptance of any quantity of material shall be no way relieve the Contractor of his responsibility for meeting all the requirements of the specification and shall not prevent subsequent rejection, if such material are later found to be defective.

3.0 **Additional Tests**

3.1 The Owner reserves the right of having at his own expense any other test(s) of reasonable nature carried out at Contractor's premises, at site, or in any other place in addition to the type, acceptance and routine tests specified in these bidding documents against any equipments to satisfy himself that the material comply with the Specifications.

3.2 The Owner also reserves the right to conduct all the tests mentioned in this specification at his own expense on the samples drawn from the site at Contractor's premises or at any other test center. In case of evidence of noncompliance, it shall be binding on the part of the Contractor to prove the compliance of the items to the technical specifications by repeat tests or correction of deficiencies, or replacement of defective items, all without any extra cost to the Owner.

4.0 **Test Reports**

4.1 Copies of type test reports shall be furnished in at least six (6) copies along with one original. One copy shall be returned duly certified by the Owner only after which the commercial production of the concerned materials shall start.

4.2 Copies of acceptance test reports shall be furnished in at least six (6) copies. One copy shall be returned duly certified by the Owner, only after which the material shall be dispatched.

4.3 Record of routine test reports shall be maintained by the Contractor at his works for periodic inspection by the Owner's representative.

4.4 Test certificates of test during manufacture shall be maintained by the Contractor. These shall be produced for verification as and when desired by the Owner.

5.0 List of Drawings and Documents*:*

5.1 The bidder shall furnish the following along with bid.

i) Two sets of drawings showing clearly the general arrangements, fitting details, electrical connections etc.

ii) Technical leaflets (user's manual) giving operating instructions.

iii) Three copies of dimensional drawings of the box for each quoted item.

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

Approval of drawings/work by purchaser shall not relieve the supplier of his responsibility and liability for ensuring correctness and correct interpretation of the drawings for meeting the specification.

5.2 The requirements of the latest revision of application standards, rules and codes of practices. The equipment shall conform in all respects to high standards of engineering, design, workmanship and latest revisions of relevant standards at the time of ordering and purchaser shall have the power to reject any work or materials which, in his judgment is not in full accordance therewith.

5.3 The successful Bidder shall within 2 weeks of notification of award of contract submit three sets of final versions of all the drawings as stipulated in the purchase order for purchaser's approval. The purchaser shall communicate his comments/approval on the drawings to the supplier within two weeks. The supplier shall, if necessary, modify the drawings and resubmit three copies of the modified drawings for their approval. The supplier shall within two weeks. Submit 30 prints and two good quality report copies of the approved drawings for purchaser's use.

5.4 Eight sets of operating manuals/technical leaflets shall be supplied to each consignee for the first instance of supply.

5.4.1 One set of routine test certificates shall accompany each dispatch consignment.

5.4.2 The acceptance test certificates in case pre-dispatch inspection or routine test certificates in cases where inspection is' waived shall be got approved by the purchasers.

6.0 Any Item specification if not available in this document Contractor shall supply and execute the items meeting the relevant IS specification with the approval of the purchaser.

7.0 **SAFETY PROVISIONS:**

The contractor is responsible for non compliance of the safety measures, implications, injuries, fatalities and compensation arising out of such situations or incidence as per regulation 7(4) of the Central Electricity Authority (Safety Requirements for Construction, Operation and Maintenance of Electrical Plants and Electric lines) Regulations, 2011.

1. All the electrical installation works including additions, alternations, repairs and adjustments to existing installations shall be carried out by an electrical contractor licensed in this behalf by the state government and under direct supervision of a person holding a valid certificate of electrical competency and by a person holding a valid workman permit issued or recognized by the Government.
2. All the aforesaid electrical works at site shall be carried by engaging competent & designated person having valid electrical workman permit issued or recognised by the Govt. of Assam.
3. The Contractor shall furnish list of designated and competent persons having valid electrical workman permits before execution of the electrical works at site to APDCL.
4. The contractor shall maintain a register of designated persons wherein the names of the designated persons and purpose for which they are designated shall be entered along with their valid registered electrical workman permit or certificate number.
5. The register of designated persons shall be produced before competent officials of APDCL/Electrical Inspector when required by him for verification or removal of names from the aforesaid register on direction by an electrical Inspector.
6. No person shall work on lines and apparatus and no person assist such person unless he is designated in this behalf and takes safety precautions as per the safety Regulations of CEA..
7. Only persons designated in this behalf by the APDCL shall be allowed to carry out works on live lines and apparatus of APDCL.
8. **In the event of any electrical accident occurring due to use of poor quality/sub-standard material/item or due to poor workmanship on the part of the contractor/supplier**

leading to death or injury of any person or livestock/animal, the contractor/supplier shall be held responsible and shall be liable to pay compensation for the same.

In such, APDCL may at its discretion debar the concerned contractor/supplier from participating in any future bid for such period deemed fit without prejudice to its authority to take any other legal action.

SECTION – 5

FORMS OF BID

PROFORMA OF BANK GUARANTEE FOR EARNEST MONEY
(To be stamped in accordance with Stamp Act)
The non-Judicial stamp paper shall be in the name of issuing bank

Ref…….. **Bank Guarantee No……..**
Date…….

To

The Chief General Manager (D&S),CAR
Assam Power Distribution Company Ltd.
Bijulee Bhawan, Paltanbazar
Guwahati-1

Dear Sirs/ Madam,

In accordance with invitation to bid under your Bid No……. M/s……. having its Registered/ Head Office at ……..(hereinafter called the 'Bidder') wish to participate in the said Bid or …… and you, as a special favour have agreed to accept an irrevocable and unconditional Bank Guarantee for an amount of …….. valid up to……. On behalf of Bidder in lieu of the Earnest Money deposit of the BID required to be made by the bidder, as a condition precedent for participation in the said Bid.

We, the ……. Bank at …… have our Head Office at……..(local address) guarantee and undertake to pay immediately on demand by Assam Power Distribution Company Limited, the Amount of ……

……..(in words & figures) without any reservation, protest, demur and recourse. Any such demand made by said 'Owner' shall be conclusive and
binding on us irrespective of any dispute or difference raised by the Bidder.

The Guarantee shall be irrevocable and shall remain valid up to and including ……..@..... if any further extension of this guarantee is required, the same shall be extended to such required period (not exceeding one year) on receiving instruction from M/s …… … ……. on whose behalf this guarantee is issued.

In witness whereof the Bank, through its authorized office, has set its hand and stamp on this
…… day of …….. 20…… at ……

WITNESS

……	…….
(Signature)	(Signature)
……..	……
(Name)	(Name)
…….	……
(Official Address)	(Official Address)

@ This date shall be thirty (30) days after the last date for which the bid is valid.

PROFORMA OF BANK GUARANTEE FOR CONTRACT PERFORMANCE
(To be stamped in accordance with Stamp Act)

Ref…….. **Bank Guarantee No……..**
Date…….

To

The Chief General Manager (D&S), CAR
Assam Power Distribution Company Ltd.
Bijulee Bhawan, Paltanbazar
Guwahati-1

Dear Sirs/ Madam,

In consideration of Assam Power Distribution Company Ltd., (herein after referred to as the 'Owner' which expression shall unless repugnant to the context or meaning thereof include its successors, administrators and assigns) having awarded to M/s…… ….…….with registered/ Head office at …….(hereinafter referred to as " Contractor" which expression shall unless repugnant to the context or meaning thereof include its successors, administrators, executors and assigns), a Contract by issue of Owner's Letter of Intent No…… dated…….. and the same having been acknowledged by the contractor, resulting in a contract and contractor having agreed to provide a Contract Performance Guarantee for the faithful performance of the entire Contract equivalent to 10(%) of the said value Contract to the Owner.

We…….. (Name & Address) having its Head Office at ……(hereinafter referred to as the " Bank" , which expression shall, unless repugnant to the context or meaning thereof, include its successors, administrators, executors and assigns) do hereby guarantee and undertake to pay the owner, on demand any or all monies payable by the contractor to be extent of ₹ ……. at any time up to ……..**(day/month/year) without any demur, reservation , contest , recourse or protest and / or without any reference to this contractor. Any such demand made by the owner on the bank shall be conclusive and binding notwithstanding any difference between the Owner the Contractor or any dispute pending before any Court, Tribunal, Arbitrator or any other authority. The bank undertakes not to revoke this guarantee during its currency without previous consent of the owner and further agrees that the guarantee herein contained shall continue to be enforceable till the owner discharges this guarantee.

The Owner shall have the fullest liberty without affecting in any way the liability of the Bank under the guarantee, from time to time to extend the time for performance or the contract by the contractor. The owner shall have the fullest liberty, without affecting this guarantee, to postpone from time to time the exercise of any power vested in them or of any right which they might have against the contractor, and to exercise the same at any time in any matter, and either to enforce or to for bear to enforce any covenants, contained or implied, in the contract between the owner and the contractor or any other course or remedy or security available to the owner. The Bank shall not be released to its obligations under these presents by any exercise by the owner of its liberty with reference to the matters aforesaid or any of them or by reason of any other act of omission or commission on the part of the owner or any other indulgences shown by the owner or by any other matter or thing whatsoever which under law would, but for this provision have the effect of relieving the Bank.

The bank also agrees that the owner at its option shall be entitled to enforce this guarantee against the Bank as a principal debtor, in the first instance without proceeding against the contractor and not withstanding any security or other guarantee the owner may have in relation to the Contractor's liabilities.

Notwithstanding anything contained herein above our liability under this guarantee is restricted to ……. And it shall remain in force up to an including …….. and shall be

extended from time to time for such period(not exceeding 1 year) as may be desired by M/s……on whose behalf this guarantee has been given.

Dated this……. Day of …….. 20…… at……

WITNESS

…….	……
(Signature)	(Signature)
……	……..
(Name)	(Name)
……..	……..
(Official address)	(Official address)

Attorney as per power
Of Attorney No……..
Date……..

NB: The stamp paper of appropriate value shall be purchased in the name of issuing bank.

PROFORMA OF EXTENSION OF BANK GUARANTEE

Ref…….. **Date…….**

To

The Chief General Manager (D&S),CAR
Assam Power Distribution Company Ltd.
Bijulee Bhawan, Paltanbazar
Guwahati-1

Dear Sirs/ Madam,

Sub: Extension of Bank Guarantee No…….. for Rs……. Favouring yourselves , expiring on ……. On account of M/S…….. in respect of contract no……. dated …….. (hereinafter called original Bank Guarantee).

At the request of M/s …… we …… bank, branch office at …….. and having its Head Office at ……. Do hereby extend our liability under the above mentioned Bank Guarantee No…… dated……for a further period of …… (Years / Months) from…….. to expire on…….. expect as provided above, all other terms and conditions of the original Bank Guarantee No……. dated ……. Shall remain unaltered and binding.

Please treat this as an integral part of the original Bank Guarantee to which it would be attached.

Yours faithfully

For……
Manager/ Agent/Accountant ……..
Power of attorney No……
Dated……
SEAL OF BANK

Note: The non-judicial stamp paper of appropriate value shall be purchased in the name of the Bank who has issued the Bank Guarantee.

PROFORMA OF "AGREEMENT"
(To be executed on non-Judicial stamp paper)

This Agreement made this …….. day of …… two thousand……. Between Assam Power Distribution Company Ltd. having its head office at Bijulee Bhawan, Paltanbazar, Guwahati-1 (hereinafter referred to as 'Owner' or 'APDCL', which expression shall include its administrators, successors and assign on one part and (hereinafter referred to as the 'Contractors 'X' (Name of the contracting Co.) which expression shall include its administrators, successors, executors and permitted assigns) on the other part.

WHEREAS APDCL desirous of …….. in ……. Circle associated with APDCL at …….(District) invited Bids for…….. ……. (Briefly describe scope of works) for the first state of the project as per its Bid Specification No……

AND WHEREAS……."X" ……. Had participated in the above referred Bidding vide their proposal No……. dated……. And awarded the Contract to……." X"…….. on terms and conditions documents referred to therein which have been acknowledged by……"X"……..resulting into a "Contract"

NOW THEREFORE THIS DEED WITNESS AS UNDER:-

1.0 **Article**

1.1 Award of Contract

APDCL awarded the contract to……."X"…… for the work of …… on the terms and conditions contained in its letter of Award No…….. ……. Dated…… and the documents referred to therein. The award has taken effect from aforesaid letter of award. The terms and expression used in this agreement shall have the same meaning as are assigned to them in the 'Contract Documents' referred to in this succeeding Article.

2.0 Documentation

2.1 The contract shall be performed strictly as per the terms and condition stipulated herein and in the following documents attached herewith(hereinafter referred to as "Contract Documents".)

i) Section 1-11 of the Bidding Document.

ii) Proposal Sheets, Data Sheets, Drawing work schedule submitted by "X".
APDCL's Letter of Award No…….. dated…….duly acknowledged by "X".
Quality Plans for manufacturing and field activities entitled as Quality Plan.

All the aforesaid Contract Documents shall form an integral part of this agreement , in so far as the same or any part conform to the bidding documents and what has been specifically agreed to by the Owner in its letter of Award. Any matter inconsistent therewith, contrary or repugnant thereto or any deviations taken by the Contractor in its 'Proposal' but not agreed to specially by the Owner in its Letter of Award shall be deemed to have been withdrawn b y the Contractor. For the sake of brevity, this agreement along with its aforesaid Contract Documents shall be referred to as the 'Agreement'.

3.0 Conditions & Covenants

3.1 The scope of Contract, Consideration, Terms of Payment, Price Adjustments, Taxes wherever applicable, Insurance, Liquidated Damage, Performance Guarantees and all other terms and conditions are contained in APDCL's Letter of Award No……..... dated…… read in conjunction with other aforesaid contract documents. The contract shall be duly performed by the Contract Documents, but which are needed for successful, efficient, safe and reliable operation of the equipment unless otherwise specifically excluded in the specification under 'exclusion' or Letter of Award.

3.2 The scope of work shall also include supply and installation of all such items which are not specifically mentioned in the contract Documents, but which are needed for successful, efficient, safe and reliable operation of the equipment unless otherwise specifically excluded in the specifications under 'exclusions' or

'Letter of Award'.

3.3 Time Schedule

3.3.1 Time is the essence of the Contract and schedules shall be strictly adhered to "X" shall perform the work in accordance with the agreed schedules.

3.4 Quality Plans

3.4.1 The Contractor is responsible for the proper execution of the Quality Plans mentioned in Section 4.8 of GTC. The work beyond the customer's hold points will progress only with the owners consent. The Owner will also undertake quality surveillance and quality audit of the Contractor's /Sub-contractor's works, systems and procedures and quality control activities. The Contractor further agrees that any change in the Quality Plan will be made only with the Owner's approval. The contractor shall also perform all quality control activities, inspection and tests agreed with the Owner to demonstrate full compliance with the contract requirements.

3.4.2 The contractor also agrees to provide the Owner with the necessary facilities for carrying out inspection, quality audit and quality surveillance of contractors and its Subcontractor's Quality Assurance Systems and Manufacturing Activities.

These shall include but not limited to the following:

- Relevant plant standards, drawing and procedures;
- Detailed Quality Assurance System manuals for manufacturing activities.
- Storage procedures and instructions weld, NDT, heat treatment prior to commencement of manufacture;
- Complete set of log sheets (blank) mentioned in the Quality Plans.

It is expressly agreed to by the contractor that the quality test and inspection by the owner shall not in any way relief the contractor of its responsibilities for quality standards and performance guarantee and their other obligations under the Agreement. 3.4.4 "X' agrees to submit quality Assurance Documents to APDCL for review and record after completion and within 3 weeks of dispatch of material.

The package will include the following :

- Factory test result, inspection report for testing required by this contract or applicable codes and standards.
- Two copies of inspection reports duly signed by Quality Assurance personnel of both APDCL and "X" for the agreed customer hold points.
- Report of the rectification works where and if applicable.

3.5 It is expressly agreed to by the Contractor that notwithstanding the fact that the Contract is termed as Supply-cum-Erection Contract or indicates the break-up of the Contract consideration, for convenience of operation and for payment of tax on supply portion, it is in fact one composite Contract on single source responsibility basis and the Contractor is bound to perform the total Contract in its entirely and non-performance of any part or portion of the Contract shall be deemed to be breach of the entire Contract.

3.6 The Contractor guarantees that the equipment package under the Contract shall meet the ratings and performance parameters as stipulated in the technical specifications (Section10) and in the event of any deficiencies found in the requisite performance figures, the Owner may at its option reject the equipment package or alternatively accept it on the terms and conditions and subject to levy of the liquidated damages in terms of Contract documents. The amount of liquidated damages so leviable shall be in accordance with the contract document and without any limitation.

3.7 It is further agreed by the contractor that the contract performance guarantee shall in no way be constructed to limit or restrict the owner's equipment right to recover the damages/compensation due to shortfall in the equipment performance figures as stated in Para 3.6 above or under any other clause of the agreement. The amount of damages/compensation shall be recoverable either by way of deduction from the contract price, contract performance guarantee and or otherwise. The contract performance guarantee furnished by the contractor is irrevocable and unconditional and the owner shall have the power to invoke it notwithstanding any dispute or difference between the owner and the contractor pending before any court tribunal, arbitrator or any other authority.

3.8 This Agreement constitutes full and complete understanding between the parties and terms of the payment. It shall supersede all prior correspondence terms and conditions contained in the Agreement. Any modification of the agreement shall be effected only by a written instrument signed by the authorized representative of both the parties.

4.0 **SETTLEMENT OF DISPUTES**

4.1 It is specifically agreed between parties that all the differences or disputes arising out of the agreement or touching the subject matter of the agreement shall be decided by process of settlement and Arbitration as specified in clause 41 of the General Condition of the Contract and provision of the Indian Arbitration Act, 1996 shall apply. Guwahati Courts alone shall have exclusive jurisdiction over the same.

4.2 NOTICE OF DEFAULT

Notice of default given by either party to the other under agreement shall be in writing and shall be deemed to have been duly and properly served upon the parties hereto if delivered against acknowledgement or by telex or by registered mail with acknowledgements due addressed to the signatories at the addresses mentioned at Guwahati.

IN WITNESS WHEROF, the parties through their duly authorized representatives have executed these presents (execution where of has been approved by the competent authorities of both the parties) on the day, month and year first above mentioned at Guwahati .

WITNESS:

1. …….. (Owner's signature) (Printed Name)
2. …… (Designation)(Company's Stamp)
3. …….. (Contractor's Signature)(Company's Name)
4. …….. (Designation)(Company's Stamp)

- Applicable in case of single award is placed on one party on Supply-cum- Erection basis. In two separate awards are placed on single party/two different parties this clause is to be modified suitably while signing the contract agreement to be signed separately for two awards to incorporate cross fall breach clause.

FORM OF POWER OF ATTORNEY FOR JOINT VENTURE

(On Non-judicial Stamp Paper of Appropriate value to be purchased in the Name of Joint Venture)

KNOW ALL MEN BY THESE PRESENTS THAT WE, the Partners whose details are given hereunder……..... have formed a Joint Venture under the laws of……..and having our Registered Office(s)/Head Office(s) at ……... ..(herein after called the 'Joint Venture' which expression shall unless repugnant to the context or meaning thereof, include its successors, administrators and assigns) acting thorough M/S…… …….. being the Partner in-charge do hereby' constitute, nominate and appoint M/S…… ……..a Company incorporated under the laws of arid having its Registered/Head Office at..as our duly 'constituted lawful Attorney (hereinafter called "Attorney" or" Authorized Representative" or "Partner In-charge") to exercise all or any of the powers for and on be.ha1f of, the Joint Venture in regard* to ----------(Name of the Package) (Specification No.----------)of Assam Power Distribution Company Ltd. Bijulee Bhawan, Paltan Bazar, GUWAHATI (hereinafter called the "Owner"). and the bids for which' have been invited by the Owner, to undertake the following acts:

i) To submit proposal and participate in the aforesaid Bid Specification of the Owner on behalf of the "Joint Venture".

ii) To negotiate with the Owner 'the terms and' conditions for award of the Contract pursuant to the aforesaid Bid and to sign the Contract with the Owner for and on behalf of the "Joint Venture'.

iii) To do any other act or submit any document rated to the above.

iv) To receive, accept and execute .the Contract for and on behalf of the "Joint Venture".

It is clearly understood that the Partner In-charge (Lead Partner) shall ensure performance of the Contract(s) and if one or more Partner fail to perform their respective portion of the Contract(s), the same shall be deemed to be a default by all the Partners.

It is expressly understood that this Power of Attorney shall remain valid binding and irrevocable till completion of the Defect Liability Period in terms of the Contract.

The Joint Venture hereby agrees and undertakes to ratify and confirm all the above whatsoever the said Attorney/ Authorized Representative/Partner In-charge quotes in the bid, negotiates and signs the Contract with the Owner and/or proposes to act on behalf of the joint Venture by virtue of this Power of Attorney and the same shall bind the Joint Venture as if done by itself.

* Strike which is not applicable.

IN WITNESS THEREOF the Partners Constituting the Joint Venture as aforesaid have executed these presents on this …….. day of ……..... under the Common Seal(s) of their Companies.

for and on behalf of
the Partners of Joint
Ventures

The Common Seal of the above Partners of the Joint Venture:
The Common Seal has been affixed there unto in the presence of :

WITNESS

1. Signature _____

Name_____

Designation_____

Occupation _____

2. Signature _____

Name_____

Designation_____

Occupation _____

FORM OF JOINT VENTURE AGREEMENT

(ON NON-JUDICIAL STAMP PAPER OF APPROPRIATE VALUE TO BE PURCHASED INTHE NAME OF JOINT VENTURE)

PROFORMA OF JOINT VENTURE AGREEMENT BETWEEN _____ _____ AND _____
FOR BID SPECIFICATION No_____OF ASSAM POWER DISTRIBUTION COMPANY LTD.

THIS Joint Venture agreement executed on this _____day of _____Two thousand eight and between M/S _____ a Company incorporated under the laws of _____ and having its registered office at _____ _____ (herein after called the "Lead Partner" which expression shall include its successors, executors and permitted assigns) and M/S _____ a Company incorporated under the laws of _____ and having its registered office at _____ (herein after called the "Partner" which expression shall include its successors, executors and permitted assigns) for purpose of making a bid and entering into a contract* (in case of award) for Construction of _____(name of the package) against the specifications No._____ of **APDCL BIJULEE BHAWAN, PALTAN BAZAR, GUWAHATI – 781001,** an Electricity Distribution Company registered under Indian Electricity Act, 2003 having its registered office at BijuleeBhawan, Paltan Bazar, Guwahati – 781001 (herein after called the "Owner")

WHEREAS the Owner invited bids as per the above mentioned Specification for the design manufacture, supply and erection, testing and commissioning of Equipment/Materials stipulated in the bidding documents under subject Package*
For_____ (Package Name) (Specification No.:_____)

AND WHEREAS Annexure – A (Qualification Requirement of the Bidder). Section-4, forming part of the bidding documents, stipulates that a Joint Venture of two or more qualified firms as partners, meeting the requirement of Annexure-A, Section 4 as applicable may bid, provided the .Joint Venture fulfills all other requirements of Annexure-A, Section 4 and in such a case, the BID shall be signed by all the partners so as to legally bind all the Partners of the .Joint Venture, who will be jointly and severally liable to perform the Contract and all obligations hereunder .

* Strike which is not applicable.

The above clause further states that the Joint Venture agreement shall be attached to the bid and the contract performance guarantee will be as per the format enclosed with the bidding document without any restriction or liability for either party.

AND 'WHEREAS the bid has been submitted to the Owner vide proposal
No ..... dated ..... by Lead Partner based on the Joint Venture agreement between all the Partners under these presents and the bid in accordance with the requirements of Annexure-A (Qualification Requirements of the Bidders), Section -4 has been signed by all the partners.

NOW THIS INDENTURE WITNESSETH AS UNDER:

In consideration of the above premises and agreements all the Partners to this, Joint Venture do hereby now agree as follows:

1. In consideration of the award of the Contract by the Owner to the Joint Venture partners, we, the Partners to the Joint Venture agreement do hereby agree that M/S_____ shall act as Lead Partner and further declare and confirm that we shall jointly and severally be bound unto the Owner for the successful performance of the Contract and shall be fully responsible for the design, manufacture, supply, and successful performance of the equipment in accordance with the Contract.

2. In case of any breach of the said Contract by the Lead Partner or other Partner(s) of the Joint Venture agreement, the Partner(s) do hereby agree to be fully responsible for the successful performance of the Contract and to carry out all the obligations and responsibilities under the Contract in accordance with the requirements of the Contract.

3. Further, if the Owner suffers any loss or damage on account of any breach in the Contract or any shortfall in the performance of the equipment in meeting the performance guaranteed as per the specification in terms of the Contract, tile Partner(s) of these presents undertake to promptly make good such loss or damages caused to the Owner, on its demand without any demur. It shall not be necessary or obligatory for the Owner to proceed against Lead Partner to these presents before proceeding against or dealing with the other Partner(s)

4. The financial liability of the Partners of this Joint Venture agreement to the Owner, with respect to any of the claims arising out of the performance of non-performance of the obligations set forth in the said Joint Venture agreement, read in conjunction with the relevant conditions of the Contract shall, however, not be limited in any way so as to restrict or limit the liabilities of any of the Partners of the Joint Venture agreement.

5. It is expressly understood and agreed between the Partners to this Joint Venture agreement that the responsibilities and obligations of each of the Partners shall be as delineated in Appendix-I (*To be incorporated suitably by the Partners) to this agreement. It is further agreed by the Partners that the above sharing of responsibilities and obligations shall not in any way be a limitation of joint and several responsibilities of the Partners under this Contract.

6. This Joint Venture agreement shall be construed and interpreted in accordance with the laws of India and the courts of Assam shall have the exclusive jurisdiction in all matters arising there under.

7. In case of an award of a Contract, We the Partners to the Joint Venture agreement do hereby agree that we shall be jointly and severally responsible for furnishing a contract performance security from a bank in favour of the Owner in the forms acceptable to purchaser for value of 10% of the Contract Price in the currency/currencies of the Contract.

8. It is further agreed that the Joint Venture agreement shall be irrevocable and shall form an integral part of the Contract, and shall continue to be enforceable till the Owner discharges the same. It shall be effective from the date first mentioned above for all purposes and intents.

IN WITNESS WHEREOF, the Partners to the Joint Venture agreement have through their authorized representatives executed these presents and affixed Common Seals of their companies, on the day, month and year first mentioned above.

IN WITNESS WHEREOF, the Partners to the Joint Venture agreement have through their authorized representatives executed these presents and affixed Common Seals of their companies, on the day, month and year first mentioned above.

Common Seal of_____
has been affixed in my/our presence

pursuant to the Board of Director's

resolution dated_____

Name
Signature
Designation

Name

Designation

For Lead Partner

(Signature of authorized representative)

Common Seal of the Company

Common Seal of_____
has been affixed in my/our presence

pursuant to the Board of Director's

resolution dated_____

Name
Signature

Designation

Name

Designation

For Other Partner

(Signature of authorized

Common Seal of the Company

WITNESSES

1. **Name** . **(Signature)**

(Official address)

2. **Name** . **(Signature)**

(Official address)

SECTION VI

TECHNICAL SPECIFICATION

33 KV AND 11KV ISOLATORS

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 earth blades and complete in all respect with bi-metallic connectors. Operating mechanism, fixing details etc. shall be as described herein.

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.

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) 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. 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 bidder shall be designed for a normal current rating of **630A for 11 KV & 800 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 kv/rms	Rated voltage of the Isolator	Standard withstand positive kV (peak)	Impulse Voltage polarity	One minute power frequency withstand voltage KV (RMS)	
		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 shall 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.

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.

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.

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 shall 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 aluminum 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 earth switch shall 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.

8) CONNECTORS

The connectors for 11KV isolator shall be made of Aluminum 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 shall be able to accommodate conductor size mentioned above smoothly.

The clamps to be offered shall 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 blisters, 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.

9) POST INSULATOR

11KV / 33KV insulators shall be of reputed make subject to owner approval. The post insulators for the above 11 KV isolators shall comprise of three numbers 11 KV insulators per stack and 9 such stack shall be supplied with each isolator. Similarly, for 33 KV isolators, two numbers 33 KV insulators per stack and 9 stacks shall be supplied with each isolator. The insulator stack shall conform to the latest applicable Indian or IEC standard and in particulars to the IS; 2544 specification for porcelain post insulators. The porcelain used for manufactures of insulators shall be homogeneous, free from flaws or imperfections that might affect the mechanical or dielectric quality, and they shall be thoroughly vitrified, tough and impervious to moisture. The glazing of the porcelain shall be uniform brown colour, free from glisters, burns and other similar defects. Insulators of the same rating and type shall be interchangeable.

The porcelain and metal parts shall be assembled in such a manner that any thermal expansion differential between the metal and the porcelain parts throughout the range of temperature variation shall not loosen the parts or create undue internal stresses which may affect the electrical or mechanical strength and rigidity. Each cap and base shall be of high-grade cast steel or malleable steel casting and they shall be machine faced and smoothly galvanised. The cap and base of the insulators shall be interchangeable with each other.

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 shall 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	1.3 times the actual dry flash over voltage of the uni	
6.	Impulse voltage withstand test KV (peak)	75	170
7.	Visible discharge test KV voltage	9	27
8.	Creepage distance mm (min)	300	900
9.	Tensile strength in KN	10KN	16KN
10.	Short time current rating for 3 Secs	25KA	25KA

For 33 KV Isolators: In place of 33 KV Post Insulator the composition of 2 units of 22KV Post Insulators per stack complying the following parameters are acceptable:

(a) Nominal system voltage	:	33 KV
(b) Highest system voltage	:	36 KV
(c) Impulse voltage withstand	:	170 KV
(d) Power frequency wet withstand voltage	:	75 KV
(e) Height of stack	:	500 mm
(f) Creepage distance (Minimum)	:	840 mm
(g) Tensile Strength	:	30KN
(h) Bending strength	:	4.5KN

Operating Mechanism for 11KV / 33KV Isolators :

All Isolators and earthing switches shall have separate dependent manual operation. The Isolator shall 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 shall be visible for isolators.

The Isolators and Isolators with earth switch inclusive of their operating mechanism shall 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 shall 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 shall 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.

10) PIPES

Tandem pipes operating handle shall be class B ISI marked type having atleast 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.

11) 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 at least 8mm thick with suitable nuts and bolts shall be provided for minor adjustment at site.

12) CLEARANCES

We have adopted the following minimum clearance for isolators in our system .The bidder shall 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

TECHNICAL SPECIFICATION FOR CONTROL & RELAY PANEL FOR 33 KV FEEDER WITH DIRECTIONAL OR NON-DIRECTIONAL O/C AND E/F PROTECTION AND 33/11 KV TRANSFORMER PANEL WITH & WITHOUT DIFFERENTIAL PROTECTION FOR VARIOUS 33/11 KV SUB-STATIONS

1.0 Scope :

This specification covers design, manufacture, assembly, testing before supply, inspection, packing and delivery and other basic technical requirements in respect of control and relay panels for 33 kV feeders, 33/11KV Power Transformers without differential protection and 33/11KV Power Transformers with differential protection and to be installed at various 33/11 kV sub-stations. The equipment to be supplied against this specification is required for vital installations where continuity of service is very important. The design, materials and manufacture of the equipment shall, therefore, be of the highest order to ensure continuous and trouble-free service over the years. The manufacturer has to design the schematics for protection and control of all equipment including monitoring indications, visual and audible alarm, interlocking schemes among different equipment. Any other requirement which are not specifically covered here but which are necessary for successful commissioning of the sub stations are also within the scope of the Contract.

The equipment manufactured shall conform to the relevant standards and of highest quality of engineering design and workmanship. The equipment manufactured shall ensure satisfactory and reliable performance throughout the service life. The Schedule of requirement of the panel is

furnished separately in details.

2.0 Service Conditions :

2.1. System particulars :

Nominal system voltage	33 kV & 11 kV
Corresponding highest system	36 kV & 12 kV
Frequency	50 Hz±3%
Number of phases	3
Neutral earthing	33 kV Grounded through Earthing Transformer 11 kV solidly earthed

2.2. Equipment supplied against the specification shall be suitable for satisfactory operation under the following tropical conditions :

Max. ambient air temperature	45 ° C
Max. relative humidity	100 %
Max. annual rainfall	3500 mm
Max. wind pressure	260 kg/sq.m.
Max. altitude above mean sea level	1000 mtrs.
Isoceraunic level	45
Reference Ambient Temperature for temperature rise	50 deg C
Climatic Condition	Moderately hot and humid tropical climate conducive to rust and fungus growth

2.3. The climatic conditions are prone to wide variations in ambient conditions and hence the equipment shall be of suitable design to work satisfactorily under these conditions.

2.4. Auxiliary supplies available at the various sub-stations are as follows :

A. C. Supply	230 volts with ± 10% variation, Frequency 50Hz ±3%
D.C. Supply	110 volts dc for new sub-stations, 110 volts dc or other voltages (to be verified by contractor) for earlier sub-stations. DC system is 2 (two) wire with necessary earth fault annunciation scheme. DC supply shall be normally fed from battery charger. In case of failure of AC supply to battery charger, DC supply voltage will be available from lead acid battery.

2.5. Unless otherwise specified all equipment and material shall conform to the latest IS applicable standards. Equipment complying with other internationally recognized standards will also be considered if it ensures performance equivalent or superior to Indian standards. In the event of supply of equipment conforming to any international / internationally recognized standards other than the standard listed below.

2.6. The equipment provided shall also comply with the latest revisions of Indian Electricity act and Indian Electricity rules and any other applicable statutory provisions, rules and regulations.

2.7. All equipment provided under the specification shall generally conform to the latest issue of the following :

a)	IS 12063/1987	Degree of Protection provided for enclosure of electrical equipment.
b)	IS 5/2004	Colour for ready mixed paints & enamels.
c)	IS 3231 / 1986 & 1987	Electrical relays for power system protection
d)	IEC 60255	Numerical protection relay
d)	IS 8686/1977	Static Protective Relays
e)	IS 1248/2003	Indicating instruments
f)	IS 14697/1999	HT Static Tri-vector TOD Energy meter
g)	IS 6875	Control switches
h)	IS 4794/1968 & 1986	Push buttons
i)	IEC 337 &337-1	Control switches (LV switching devices for control and auxiliary circuit)
j)	IEC : 60185	Current Transformers
k)	IEC : 60186	Voltage Transformer
l)	IS 375	Marking and arrangement for switchgear Bus
m)	IS 5578/1984	Marking of insulated conductors.

2.8. CT, PT Ratio and Transformer Details :

CIRCUIT	33KV CT RATIO/CLASS
33 kV Feeder	400-200 / 1-1 Amps, 10VA Class 0.5, 10 VA 5P10 for new S/S 400-200 / 5-5 Amps, 15VA Class 0.5, 15VA 5P10 for existing S/S
33 kV side of 33/11kV transformer	200-100 /1-1-1 Amp, 15VA Class 0.5, 15VA 5P10 & Class 'PS' for new S/S 200-100 /5-5-1 Amp or 200-100 /5-5-5 Amp , 15VA Class 0.5, 15VA 5P10 & Class 'PS' for existing S/S as specified in BOQ
11KV side CT for Transformer	600-300 /1-1-1 Amp, 15VA Class 0.5, 15VA 5P10 & Class 'PS' for new S/S 600-300 /5-5-1 Amp or 600-300 /5-5-5 Amp, 15VA Class 0.5, 15VA 5P10 & Class 'PS' for existing S/S as specified in BOQ
11kV feeder	200-100/1-1 Amps, 15 VA Class 0.5, 15VA 5P10 for new S/S 200-100/5-5 Amps, 15 VA Class 0.5, 15VA 5P10 for existing
11 kV transformer Bushing CT for REF protection	300/1A or 600/1A, Class 'PS' CT for REF shall be provided in the bushing turret of r, y & b phases and neutral of LV side of 5 & 10 MVA power transformer
33 kV PT ratio	33KV, single phase
Electro-magnetic PT ratio / class	33KV/√3 / 110V/√3 - 110V/√3 , 0.5 / 3P
Power Transformer	33/11KV,up to 12 MVA, Dyn11

3.0 CONSTRUCTIONAL DETAILS :

3.1. CONTROL AND RELAY PANEL :

The Control and Relay Panel shall be of Simplex type and the access door shall be provided at the

back of each panel where no instruments or relays shall be mounted. The indicating and signalling devices and relays etc. shall be mounted on the front side and the auxiliaries which shall be inside the panel. The access door shall be at the back side and of double door type of height 1900 mm.

In front of panel where relays and instruments are to be mounted shall be stretcher levelled steel plate 3 mm. thick and side panel, doors and top covers shall be of 2mm. thick steel plate. Light sections of structural steel shall be used for panel frame.

The individual panel shall be 2250 mm. in height with channel base, 610 mm. in depth and of suitable width limited to 1000mm to accommodate the equipment at a suitable height, suitable gaps to facilitate easy workability as specified hereafter. Individual piece of channel base of C & R panel is to be provided to obtain the flexibility of inter-changing the panel, if any.

The complete panel shall incorporate all necessary instruments, meters, relays, auxiliary relays, control switches, indicating lamps, mimic, annunciator, audible alarms, horizontal and vertical wiring trough, wiring supports, interior lighting system, terminal blocks , fuses and links etc.

3.2. CONSTRUCTIONAL FEATURES :

a. The Control and Relay Panel frame shall be suitable for erection of flush concrete floor and secured to it by means of evenly spaced grout bolt projecting through the base channels from members of the frame.

b. The manufacturer shall ensure that the equipment specified and such unspecified complementary equipment required for completeness of protection / control scheme be properly accommodated in the panels without congestion and if necessary to provide panels with larger width. No price increase at a later date on this account shall be allowed.

c. Panels shall be completely metal enclosed and shall be dust, moisture and vermin proof for tropical use. The enclosure shall provide a degree of protection not less than IP-41 in accordance with IS-2147. Type test report in this respect shall be furnished with offer.

d. Panels shall be free standing, floor mounting type and shall comprise structural frames enclosed completely with specially selected smooth finished, cold rolled sheet steel of thickness not less than 3 mm for weight bearing members of panels such as base frame, front sheets and door frames and not less than 2mm for sides, door, top & bottom portions. There shall be sufficient reinforcement to provide level surfaces, resistance to vibration and rigidity during transportation and installation.

e. Design, material selection and workmanship shall be such as to result in neat appearance, inside and outside with no welds, rivets or bolt head apparent front outside, with all exterior surfaces tuned and smooth.

f. All holes and extension windows in the panel shall be blanked and access doors shall be lined with compressible liners / gaskets at the edges. The Employer will shut off the bottom crevices with cream cement, the Cable Entry holes with weak concrete and the cable trench with preset R.C.C. slabs or chequered plates. All control and supply cables will be laid in a distribution trench running under the panel. The cable will branch off into each cubicle through entry holes in the concrete floor opening in the bottom cubicles. Necessary drawings for concrete floor and trench shall be supplied by the manufacturer to enable the Employer to construct the foundation floor for these panels. The drawings shall show details of the distributing trench, cable entry holes, glands and positions of grouting bolts. The Employer will prepare

foundation with pocket for grouting bolts. The manufacturer shall supply channel base, suitable grouting bolts, lock nut and washers.

g. Control cable entries to the panel shall be from the bottom. Bottom plates of the panels shall be fitted with detachable gland plates to allow cable entries from the bottom. **Gland plates shall be suitable for fixing the cable glands at an elevated height of at least 100 mm above the ground level.** Terminal connectors and test terminal blocks for cables shall be fixed at an elevated height of at least 200 mm above the Bottom plate. Side blocks cut out to be arranged at the top of both sides of panel for inter panel bus wires. Dimensions of the cut out will be 300 mm. x 50 mm., 255 mm from the top.

3.2.1 General :

a. Material shall be new and the best quality of their respective kinds. All material shall comply with the latest issues of the specified standard unless otherwise specified.

b. Workmanship shall be of the highest class throughout to ensure reliable and vibration free operations. The design, dimensions and material of all parts shall be such that the stresses to which they may be subjected shall not cause distortion, undue wear, or damage under the most severe conditions encountered in service.

c. All parts shall conform to the dimensions shown and shall be built in accordance with approved drawings. All joints, datum surfaces and meeting components shall be machined and all castings shall be spot faced for nuts. All machined finishes shall be shown on the drawings. All screw, bolts, studs and nuts and threads for pipe shall conform to the latest standards of the International Organization for Standardization covering these components and shall all conform to the standards for metric sizes.

d. All material and work that have cracks, flaws or other defects or inferior workmanship will be rejected by Employer.

3.2.2 Assembly :

Necessary items of equipment shall be assembled in the factory prior to shipment and routine tests shall be performed by the manufacturer as per the requirements of the latest issue of IEC/IS as specified under each equipment in these specifications to demonstrate to the satisfaction of EMPLOYER that the switchgear panels comply with the requirements of the relevant IEC/IS standards.

3.2.3 Casting :

Casting shall be true to pattern, of workmanlike finish and of uniform quality and condition, free from blowholes, porosity, hard spots, shrinkage defects, cracks or other injurious defects, shall be satisfactorily cleaned for their intended purpose.

3.2.4 Welding :

Wherever welding is specified or permitted, a welding process, including stress relieve treatment as required if necessary, conforming to an appropriate and widely recognized professional standard shall be used. All welders and welding operators shall be fully qualified by such a standard.

4.0 Mounting :

4.1 All equipment on and inside the panels shall be mounted and completely wired to the terminal blocks ready for external connection.

4.2 Equipment shall be mounted such that removal and replacement can be accomplished

individually without interruption of service to adjacent devices and are readily accessible without use of special tools. Terminal marking shall be clearly visible and of permanent nature.

4.3 The manufacturer shall carry out cutout, mounting and wiring of the bought out items which are to be mounted in the panel in accordance with the corresponding equipment manufacturer's drawings.

4.4 The centre line of switches, push buttons and indicating lamps shall be not less than 900 mm from the bottom of the panel. The centre line of relays and meters and recorders shall be not less than 600 mm from the bottom of the panel.

4.5 The centre lines of switches, push buttons and indicating lamps shall be matched to give a neat and uniform appearance. Likewise the top of all meters, relays and recorders etc. shall be in one line.

4.6 The control switches for circuit breakers shall be located on the mimic diagram corresponding to their exact position of the controlled equipment in the single line drawing. The location of the switches shall be within working height from the floor level for easy and comfortable operation.

4.7 No equipment shall be mounted on the doors.

4.8 All equipment connections and cabling shall be designed and arranged to minimize the risk of fire and damage.

The constructional details and mounting arrangement for various front mounted equipment shall be as per the enclosed drawings. The center lines of any relays, if additionally provided, shall not be less than 600 mm from ground level.

5.0 WIRING :

5.1 All wiring shall be carried out with 1100 volts grade single core, multi-stranded flexible tinned copper wires with flame resistant PVC insulation which has proved its utility in hot and moist climate and vermin (misc. white ant and cockroaches etc.). Rubber insulated wiring will not be accepted. Wire numbering and colour code for wiring shall be as per IS:5578/1984. The wiring shall be encased in PVC casing of suitable width. The wiring diagram for various schematics shall be made on thick and laminated durable white paper in permanent black ink and same shall be pasted on the inside surface of the door.

5.2 The sizes of wiring in different circuit shall not be less than these specified below :

TABLE-I

Circuit	**Permissible size of wire**
Metering and relaying circuits connected C.T.	2.5 mm^2
Potential Circuits for metering and relaying, control, visual audible alarms and signalling circuit	1.5 mm^2

The following colour schemes shall be used for the Wiring :

TABLE – II

Circuit where used	**Colour of Wire**
Red Phase of Instrument Transformer Circuits	Red

Yellow Phase of Instrument Transformer Circuits	Yellow
Blue Phase of Instrument Transformer Circuits	Blue
Neutral connection, earthed or not earthed in the instrument transformer circuit	Black
A.C. control wiring circuits using auxiliary supply and	Black
D.C. control wiring circuit using battery supply	Grey
Earth Connection	Green

5.3

a) All internal wiring shall be securely supported, neatly arranged, readily accessible and connected to equipment terminals and terminal blocks. Wiring gutters & trough shall be used for this purpose.

b) Longitudinal troughs extending throughout the full length of the panel shall be used for inter panel wiring. Inter connection wires to adjacent panels shall be brought out to a separate set of terminal block(s). All bus wiring for inter panel connection shall preferably be provided near the top of the panels running throughout the entire length of the panels.

c) Wiring connected to the space heaters in the cubicles shall have porcelain beaded insulation over a safe length from the heater terminals.

d) Wire termination shall be made with solder less crimping type and tinned copper lugs which firmly grip the conductor and insulation. Insulated sleeves shall be provided to all the wire terminations. Engraved core identification plastic ferrules marked to correspond with panel wiring diagram shall be fitted at both ends of each wire. Ferrules shall fit tightly on the wire and shall not fall off when the wire is disconnected for any purpose. Termination shall be such that no strand of a conductor shall be left loose or overhanging. Conductor termination shall be secured with holding nuts / screws, terminal blocks etc. with washers interposed between the terminals / holding nuts / screw heads. The terminals shall be so connected that no conductor ferrule code gets masked due to overlay of conductors.

e) All spare contacts of relays shall be wired up to terminal blocks.

f) Each wire shall be continuous from end to end and shall not have any joint within itself individually.

g) Wires shall be connected only at the connection terminals or studs of the terminal blocks, meters, relays, instruments and other panel devices.

Terminal ends of all wires shall be provided with numbered ferrules. At point of inter-connection where a change of number is necessary, duplicate Ferrules shall be provided with the appropriate numbers on the changing end.

h) For stud and nut type terminal connection, washers shall be interposed between terminals, wire terminals and the holding nuts. All holding nuts shall be secured by locking nuts. The connection stud shall project at least 6 mm from the lock nut surface. Wire ends shall be so connected at the terminal studs that no wire terminal numbered ferrule gets masked due to succeeding connections. All wires shall be suitable for bending to meet the terminal stud at right angles with the stud axis, and they shall not be skewed.

i) All studs, nuts, bolt_s screws etc. shall be metric threaded unless Employer's prior approval to any other practice of threading is obtained.

6.0 TERMINAL BLOCK CONNECTION :

Terminal blocks shall be of clip-on design made out of non-trackable insulating material of 1100 V grade. All terminals shall be stud type, with all current carrying and live parts made of tinned plated brass. The studs shall be of min 4 mm diameter brass. The washers, nuts, etc. used for terminal connectors shall also be of tinned plated brass. All blocks shall be shrouded by easily removable shrouds made of transparent die-electric materials.

The terminal connector / blocks shall be disconnecting link type terminal connectors for PT circuit and same with automatic shorting of C.T. secondary terminals shall be provided in CT secondary circuit. All other terminal connectors shall be non-disconnecting type. Terminal shall be shock protected in single moulded piece. Terminal block shall have screw locking design to prevent loosening of conductor. Provision shall be made on each pillar, for holding 10% extra connection (5% incoming + 5% outgoing).

At least 20% spare terminals for each type shall be provided. All terminals shall be provided with ferrules indelibly marked or numbered and identification shall correspond to the designations on the relevant wiring diagrams. The terminals shall be rated for adequate capacity which shall not be less than 10 Amps for control circuit. For power circuit it shall not be less than 15 Amps.

7.0 SPACE FOR CONTROL CABLES AND CABLE GLANDS :

Sufficient space for receiving the Control Cables inside the Panel at the bottom of the cubicles and mounting arrangement for the terminal cable glands shall be provided. Removable type separate cable entry plate (may be two) shall be fixed with bottom plate. The specification does not cover supply of control cables and cable glands for which the EMPLOYER will make separate arrangement.

8.0 SPACE HEATERS :

240 V, 50 Hz. tubular space heaters suitable for connection to single phase A.C. supply complete with On-Off Switches located at convenient position shall be provided at the bottom of the panel to prevent condensation of moisture. The Watt loss per unit surface of heater shall be low enough to keep surface temperature well below sensible heat. A thermostat control unit with variable temperature range of 30 to 90 degrees Celsius shall be installed to control the heater. The 240 V AC supply for the heater shall be controlled by a suitably rated single pole miniature circuit breaker compartment to be mounted on an insulator. One AC ammeter with 0-1.0 Amp range shall be provided in series with the heater to monitor the current drawal of the Heater.

9.0 DISTRIBUTION AND CONTROL OF AUX. POWER CIRCUIT :

9.1. D.C. CIRCUIT :

There shall be only one 110 volts D.C. for the entire Control and Relay Panel fed from a D.C. Distribution Panel. A continuous D.C. Bus shall be provided in the Control and Relay Panel and D.C. supply for control, protection, indication and supervision of circuit breaker and other equipment shall be teed off from D.C. bus through a set of 20 Amp rated H.R.C. fuses on positive and negative side. D.C. supply to be teed off shall be distributed within the Panel as below :

(a) Control DC scheme both positive and negative side with 16 Amp fuse
(b) Trip Ckt 1 and Trip Ckt 2 without fuse; closing circuit with 10A fuse.
(c) Indication Circuit through a set of 2 Amp. HRC Fuse both at +ve and –ve side.

(d) Protective relay circuits through 2A fuse both at +ve and –ve side.

(e) Annunciation ckt with 2 Amps fuse on both at +ve and –ve side.

(f) DC Emergency Lamp with 6Amp fuse both at +ve and –ve side

Three nos. of D.C. operated no-volt auxiliary relay(self reset type) provided with hand reset type flag with inscription ― Main D.C. Fail , Control DC fail & Protection DC fail with 4NO+4NC in each relay. 2-NC contact for DC fail alarm and Indication, 1-NO wired up to SCADA TB and 1-NO wired up to spare TB. One Push button having N/C Contact to be used in Series with the above relay for 'D.C. Fail Test' purpose.

9.2. A.C. CIRCUITS :

230 Volts, single phase A.C. Aux. Supply to the Control and Relay Panel will be fed from A.C. Distribution Panel through a 16 Amps MCB provided there. One 16 Amps rated HRC fuse shall be provided at the Control & Relay Panel for the Incoming A.C. Supply. Two A.C. operated no volt auxiliary relay (self reset type) rated for 230V shall be provided with hand reset flag with inscription 'A.C. Fail' & ' DC Fail Accept' with 4-NO+4-NC contacts for each relay. One push button having N/C contact is to be used in series with above relay for 'A.C. Fail Test' purpose.

9.3. P.T. SECONDARY CIRCUIT :

There may be two nos. 33KV bus PT, one in each bus section. P.T. supply shall be available from selected 33 KV Bus P.T through suitable PT selection scheme by switch with 'break-before-make' contacts. Two sets of fuse and link of suitable rating shall be provided for the Incoming P.T supplies and two sets (one set for each PT) of 3 nos. (red-yellow-blue) LED indicating lamps shall be provided for supervision of the fuse. Lamps shall be connected between respective phases and neutral. The arrangement of distribution of P.T. Secondary Circuit shall be as follows :

(a) Potential supply to the protective relay circuit for feeder, where necessary, shall be fed from selected Bus P.T. supply bus.

(b) Potential supply to meters, energy meters and indicating instrument of each panel shall be fed from selected Bus P.T. supply bus.

(c) Selected P.T. secondary supply to the protective relays of each panel shall be fed through 4-pole - MCB in each panel where necessary with two change over contacts for annunciation.

d) Selected P.T. secondary supply for metering and indicating instruments of each panel shall be fed through 4-pole MCB in each panel of 33KV system voltage.

e) Two position (PT-1/PT-2), minimum 4 (four) way PT selector switch, stay put type, minimum 16 Amps rating shall be provided in each panel for metering ckt. Additional 4 way PT selector switch is required for protection wherever applicable. The no. of way may increase during detailed engineering.

9.4. FUSE AND LINK :

Fuses shall be of cartridge type. Carrier and base for the fuse and links for all D.C. and A.C. Circuits shall have imprint of rating, voltage and circuit designation.

9.5. MIMIC DIAGRAMS :

a) Provision shall be made for 10 mm. wide painted and overall drawing mimic diagram on the exterior of the front panel to represent the single line arrangement of the station equipment. Provision shall be made in such a way that centre line of the mimic bus shall be at a suitable height

from the bottom of the C & R Panel.

b) Colour scheme for mimic diagram as follows :

KV Class	C o l o u r	Shade Index as per ISS
33 KV	Brilliant green	221
11 KV	Air Craft blue	108
400/230 V	Black	309
Earth	White	-
110 V	Canary yellow	

c) In 33 KV simplex type C&R panels, symbol marking for the position indication of isolators, earth switches etc, ON/OFF indication for Circuit breaker, PT supply indication, CB spring charge, auto trip, trip circuit healthy etc. shall be mounted along the mimic diagram at appropriate location. Non-discrepancy type control switch for the C.B. shall be mounted within the mimic, indicating the C.B. ON/OFF status.

10.0 Labeling :

All front mounted as well as internally mounted items including MCBs shall be provided with individual identification labels. Labels shall be mounted directly below the respective equipment and shall clearly indicate the equipment designation. Labelling shall be on aluminium anodised plates of 1 mm thickness, letters are to be properly engraved.

11.0 Earth Bus :

Each panel shall be provided with two earth bus of size 25 x 6 mm (min) each. The earth bus shall be of tinned plated copper, and all metallic cases of relays, instruments etc. shall be connected to this earth bus independently for their effective earthing. The wire used for earth connections shall have green insulation.

12.0 Circuit breaker Control Switch :

19.1 Pistol grip type non-discrepancy spring return type trip-neutral-close (T-N-C-) switch shall be provided for remote operation of circuit breaker to ensure that manual pumping of closing solenoid not possible. The switch shall be mounted in the mimic diagram itself such that the stay-put neutral ('N') position will render the continuity of the mimic. One green LED for 'breaker open' indication and one red LED for 'breaker closed' indication shall also be provided adjacent to the T-N-C switch.

19.2 Switches shall have finger touch proof terminals. For the convenience of maintenance, screw driver guide shall be from top/bottom of the switch and not from the side. Terminal wire shall be inserted from the side of the switch terminal.

19.3 Terminal screws must be captive to avoid misplace during maintenance.

19.4 Switch shall be with 48 mm x 48 mm escutcheon plate marked with Trip & Close.

19.5 Trip-neutral-close, with pistol grip handle must automatically spring return to neutral by spring action from either trip or close position for safety and not just turn to trip.

19.6 One contact to close in each position of Trip and Close. Contact rating shall be at least 12 Amps at 24V dc.

19.7 One spare contact is required in off & on position.

13.0 Local / Remote switch :

Local / Remote switch shall be 4-pole, 2 way Lockable and stay put type.

14.0 INDICATING LAMPS & CONTACT MULTIPLIER :

i) INDICATING LAMPS

L.E.D. type indicating lamps shall be provided on the Control Panel to indicate the following :

Sl. No.	Functions	Quantity	Colour of Lamp
1	C.B. Spring charged indication	1 No.	Blue
2	C.B. trip coil / circuit healthy indication	2 No.	White
3	C.B. Auto tripped indication	1 No.	Amber
4	Panel D.C. Fail indication	1 No.	Amber
5	P.T. Supply indicating Lamp	2 sets	Red / Yellow / Blue
6	C.B. ―ON indication	1 No.	Red
7	C.B. ―OFF indication	1 No.	Green

All the lamps shall be connected to the auxiliary D.C. supply of the sub-station except Sl. No. (4) & Sl. No. (5) which shall be connected to the auxiliary A.C. supply and P.T. Secondary supply respectively. **The LED lamps shall be suitable for operation at any supply voltage from 24 to 240 volts ac or dc and shall have low voltage glow protection (LVGP) circuit to prevent glowing up to 10 volts and surge suppressor circuit.** Power consumption of each lamp shall be less than 2.5 Watts. All indicators shall have bright cluster LEDs having long life and shall withstand 120% of rated voltage on a continuous basis.

Lamps for circuit breaker "ON", "OFF", "TRIP CKT HEALTHY" and "AUTO TRIP" indications. LED indicating lamp complete with static circuits and features shall be supplied with Low voltage protection circuit (LVGP) and surge suppressor circuit having LED indication. Lamp assembly shall 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 shall be minimum 100 mcd at 20 mA. Indication lamp shall be suitable to operate on 24 - 240 volts alternating or direct current supply source. Acceptable make are BINAY Opto Electronic Private Ltd. Or equivalent, subject to approval.

ii) Contact Multiplier :

230 Volts, Single Phase, 50 Hz. A.C.. Supply operated Contact Multiplier to be provided as required.

15.0 TERMINAL BLOCK / TEST TERMINAL BLOCK :

1. Terminal Blocks for incoming A.C. and D.C. circuit and C.T., P.T. & SCADA circuit shall be located on the left hand side and transformer supervision, breaker control and spare in right hand side of the wall of the Panel seen from back side respectively.
2. 3-Phase, 4-Wire link type Test Terminal Block having sealing provision shall be provided in metering circuit of each panel.

16.0 SAFETY EARTHING :

1. Earth connection of metallic parts or metallic bodies of the equipment on the panel shall be done with soft drawn single conductor bare copper tail connections shall have minimum area of 16 sq, mm. and the main earth connection 60 sq. mm. These wires shall be connected by suitable terminals and clamps junction. Soldered connections shall not be employed.
2. The neutral point of star connected LV winding of instrument transformers and one corner of the open delta connected LV side of instrument transformers shall be similarly earthed by tail connected with main earth wire of panel earth system. Multiple earth of any instrument

transformer circuit shall be avoided.

17.0 PANEL LIGHTING :

1. The Panel interior shall be illuminated by 18 Watt CFL lamps connected to 230 volts Single Phase A.C. The illumination of the interior shall be free from shadows and shall be planned to avoid any strain or fatigue to the wireman likely to be caused due to sub-normal or non-uniform illumination. **One emergency D.C. light shall be provided for each panel with individual switch with proper identification mark.**
2. A toggle switch or door operated switch shall be provided for control of A.C. lighting in each panel.
3. One combined 15 Amps. 3-Pin and 5 Amps. 2-Pin Power Socket outlet together with Plus Pins shall be provided at convenient points in each Panel for A.C. Supply.

18.0 ANNUNCIATOR :

A. ELECTRONIC ANNUNCIATOR :

1. Suitable multi-way Microprocessor based electronic annunciator for the visual and audible alarm on the control panel using bright LEDs shall be provided in each panel to indicate operation of over current, earth fault and other protections. In addition to above, each electronic annunciator of Transformer Control Panel shall have provision to indicate transformer trouble trip / alarm function operated. Also one window of the Annunciator shall have to be used for Non-Trip A.C. fail alarm indication and one window for trip circuit unhealthy indication. Each electronic annunciator shall have provision for connection with accept / reset / lamp test / mute push buttons for proper functions. Electronic annunciator shall have provision for connection with electronic buzzer / electronic bell for trip & non-trip audio alarm of common annunciation scheme. Electronic Annunciation shall have provision for flashing illuminating display with inscription for operation of respective protection relay. The microprocessor based electronic annunciator shall have separate coloured windows for trip & non-trip annunciation for easy detection.
2. Annunciator facia shall have translucent windows of minimum size 62mm. x 45 mm. for each.
3. Electronic Annunciator shall have first fault indication facilities & system watchdog.
4. Annunciator facia plate shall be engraved in black letters with respective alarm inscription as specified. Alarm inscriptions shall be engraved on each window in not more than three lines and size of the letters shall be minimum 5 mm. The inscriptions shall be visible only when the respective facia LED will glow.
5. Annunciator facia units shall be suitable for flush mounting on panels. Replacement of individual facia inscription plate and LED shall be possible from front of the panel.
6. Unless otherwise specified, one alarm buzzer meant for non-trip alarms and one bell meant for trip alarms shall be provided in each control panel (mounted inside).
7. Each annunciator shall be provided with external 'Accept', 'Reset' and 'Lamp Test' & 'Mute' push buttons.
8. Special precaution shall be taken by the manufacturer to ensure that spurious alarm conditions do not appear due to influence of external magnetic fields on the annunciator wiring and switching disturbances from the neighbouring circuits within the panels.

9. In case 'RESET' push button is pressed before abnormality is cleared, the LEDs shall continue to glow steadily and shall go out only when normal condition is restored.

10. Any new annunciation appearing after the operation of 'Accept' for previous annunciation, shall provide a fresh audible alarm with accompanied visual alarm, even if the process of "acknowledging" or "resetting" of previous alarm is going on or is yet to be carried out.

B. Provision for testing healthiness of visual and audible alarm circuits of annunciator shall be available.

16-Window Annunciation Scheme for 5 MVA & 10 MVA Transformer (individually controlled) to indicate following functions :		
1	Differential protection (87) operated	1 no.
2	Non-directional protection (O/C+E/F) operated	1 no.
3	Oil Temp. / Winding Temp	1 no.
4	Oil Temp. / Winding Temp Trip for transformer	1 no.
5	Main Tank PRV Trip for transformer	1 no.
6	REF 64R (LV side) tripped	1 no.
7	Buchholz Alarm for transformer	1 no.
8	Buchholz Trip for transformer	1 no.
9	OLTC Buchholz	1 no.
10	AC fail	1 no.
11	Trip Circuit / Coil 1 unhealthy	1 no.
12	Trip Circuit / coil 2 unhealthy	1 no
13	Non-directional O/C & E/F Relay Trouble	1 no.
14	Differential relay trouble	1 no.
15	MOG Alarm for transformer	1 no.
16	Spare	1 no.
	Mounting	Flush
	No. of facia windows	16
	Supply voltage	110 V DC
	No. of LEDs per window	2
	Lettering on facia plate	Properly engraved

12- Window Annunciation Scheme for Feeders to indicate following functions :		
i)	Non-directional O/C operated	1 No
ii)	Non-directional E/F operated	1 No
iii)	Panel D.C. Fail	1 No
iv)	Trip Circuit Coil 2 Unhealthy	1 no.
v)	Panel AC fail	1 no.
vi)	Trip Circuit/Coil 1 Unhealthy	1 no.
vii)	Non-directional O/C & E/F Relay Trouble	1 no.
viii)	PT MCB Tripped	1 No
ix)	Spare	1 no

x)	Spare	1 no.
xi)	Spare	1 no.
xii)	Spare	1 no.
Mounting		Flush
No. of facia windows		12
Supply voltage		110 V DC
No. of LEDs per window		2
Lettering on facia plate		Properly engraved

12 Window Annunciation Scheme for Parallel Feeders to indicate following functions:-		
i)	Directional O/C operated	1 no.
ii)	Directional E/F operated	1 no.
iii)	Panel DC Fail	1 no.
iv)	Trip Circuit/Coil 2 Unhealthy	1 no.
v)	Panel AC fail	1 no.
vi)	Trip Circuit/Coil 1 Unhealthy	1 no.
vii)	Directional O/C & E/F Relay Trouble	1 no.
viii)	PT MCB Tripped	1 no.
ix)	Spare	1 no.
x)	Spare	1 no.
xi)	Spare	1 no.
xii)	Spare	1 no.
Mounting		Flush
No. of facia windows		12
Supply voltage		110 V DC
No. of LEDs per window		2
Lettering on facia plate		Properly engraved

C. PANEL D.C. FAIL ALARM SCHEME :

Control & Relay Panel shall have a common — panel D.C. fail alarm Sscheme operated by 230 V Single phase A.C. aux. supply for audible as well as visual alarm in case of failure of D.C. incoming supply to the panel.

Another single element relay without flag and 1 no. self-reset type N/O & 1 no. N/C contact having inscription panel D.C. fail alarm accept Relay shall be provided. Besides above, 1 no. indicating lamp, 1 no. A.C. operated electric hooter and 2 nos. push button, one having 1 no. N/C contact, the other having 1 no. N/O contact shall also be provided for successful operation of the scheme. All auxiliary relays required to render Annunciation System operative and shall be considered to be within the scope of the tender.

AC fail, DC fail scheme shall be operated by relay not contactor.

19.0 INDICATING INSTRUMENT AND METERS :

a. All indicating instruments shall be digital type, flush mounted, back connected type and provided with dust tight cases for tropical use with dull black enamel finish. All fixing screws, nuts and threaded parts shall be designed to Indian Standards.

b. All instruments shall be of class 0.5 type. The calibration of the instruments shall function satisfactorily when mounted on steel panels or alternatively magnetically shielded instruments shall be used.

c. Instruments shall be capable of displaying freely when operated continuously at any temperature from 0 to 50 degree C.

d. All circuits of instruments shall be capable of withstanding applied load of 20% greater than the rated capacity for a period of eight hours.

e. The instruments shall be capable of withstanding the effect of shock vibration and a di- electric test of 2000 Volts r.m.s. to ground for one minute as per relevant ISS.

19.1 Ammeters :

All ammeters shall be digital and direct reading type, with measurement range 20% over the C.T. primary rating. The ammeters shall be connected to measuring C.T. Core. for. phase current measurements. The auxiliary power of the ammeters shall be 230V AC.

19.2 Voltmeters :

All voltmeters shall be digital and direct reading type with measurement range 20% over the nominal line voltage. The nominal supply voltage of the voltmeter shall be 110V A.C. The auxiliary power of the voltmeters shall be 230V AC.

a. Voltmeter Selector Switch :

One 6-way and off, 7-position, stay put type, voltmeter selector switch shall be provided for selecting phase-phase or phase-neutral voltages.

b. PT Selector Switch :

One PT selector switch, 2 position, stayput type shall be provided.

c. Energy Meters : Tri-vector meters shall be as per detailed specification separately provided.

20.0 NAME PLATES / IDENTITY PLATES :

a) All instruments, relays and such other similar electrical devices mounted on the control and relay panel shall be provided with name plates bearing the manufacturer's name, serial identifying number and the electrical rating data.

b) 3mm thick and 25mm x 150mm brass or acrylic plates bearing suitable identification marks shall be fixed under the terminal wiring of the test blocks, at the fuse blocks and at the cable terminals. Similar plates shall be fixed on the exterior of the panel in appropriate places to indicate function of control switches, push button etc. such as isolator control switch, breaker control switch, DC fail test, accept, reset etc. Suitable identification marks shall be provided for individual casing part of the relays and other equipment. Plates shall be screwed / riveted to the Panel.

c) 50mm wide brass or acrylic plate bearing suitable circuit description etched in 30 mm size letters shall be provided for each panel and mounted on the top of both outer of the front panels. These plates shall be removable type.

d) Schematic Diagram of CT, PT, CB circuitry & AC, DC Ckt, indication and

annunciation circuit along with protection circuitry giving the terminal nos. and Bus wire details shall be printed in laminated durable stickers and pasted inside the panel Door page wise of the respective panel.

e) Each unit of control and relay panel shall be provided with a label located at the bottom on the front and shall contain the following details :

i) Manufacturer's name

ii) P.O. no. and date

iii) Drg. ref. no. pertaining to the panel.

21.0 PAINTING :

Panel painting shall be done by the modern process of painting. All unfurnished surface of the steel panel and frame work shall be sand blasted or suitably cured to remove rust, scale, foreign adhering matter or grease. A suitable rust resisting primer shall be applied on the interior and exterior surface of steel, which shall be followed by application of an undercoat suitable to serve as base and binder forth finishing coat.

Details of Painting :

Surface treatment	by seven tank process
Paint type	Powder coated. Pure polyester base grade A structure finish
Paint shade	RAL 7032 for external & internal surface
Paint thickness	Minimum 80 microns

22.0 RELAYS :

A. GENERAL REQUIREMENT :

The main protective directional / non-directional O/C & E/F relays shall be numeric & communicable type (SCADA compatible), as per detailed specification of relay separately provided.. Multinational company manufacturing panel in India may import required / desired relays from their foreign counterpart with same brand name at their own risk, cost and responsibility without hampering the stipulated delivery schedule as stated in the tender notification.

All numerical relays shall be provided with **'**Relay Failure Annunciation contact**'**.

A-1 General requirements of numerical relays :

It is intended to automate the switchgears specified in the scope of supply and use communicable numeric relays for protection, control, metering and status monitoring. This specification is based on the understanding that an integrated Automation System along with protection shall be provided and same shall have provision for integration with SCADA system. All the feeders shall be remote controlled from EMPLOYER's SCADA and from the local console of the numerical relays.

Numerical multifunctional combined microprocessor based feeder protection and management relay will protect the 33kV or 11kV feeders and 33/11kV transformers from all electrical and other faults along with reporting system, disturbance record for fault analysis. Manufacturer shall comply with any special requirement or feature asked for retrofitting the relays. Relay shall be IEC 61850 compliant. Relay shall have 4 CT input for O/C and E/F protection. There shall be option for derivation of E/F internally.

The numerical relays in general shall comply with the following requirements :

1. The offered relay shall be completely numerical with Protection elements realized using software algorithm to protect Cables and Overhead lines deployed in MV/LV networks. It may

be used as a backup in HV systems, different types of earthing systems, MV industrial installations, public distribution networks and substations. It shall have essential protection functions for deployment in lower voltage systems.

2. Relay shall be flush mounted type. The module shall be draw-out type and there shall be CT shorting facility of make before break type. Galvanic isolation between field connection and relay hardware shall be there. The relays shall be housed in a robust metal case suitable for panel mounting conforming to IP 52 (Front face)
3. The relay shall be suitable for operation in ambient temperature of +55 degrees Celsius and relative humidity of 100%.
4. The relay shall conform to the IEC60255-5 or equivalent BS / ANSI for following :
   a. Overload withstand test
   b. Dielectric withstand: 2kV in common, 1 kV in differential mode
   c. Impulse Voltage: 5kV in common, 1kV in differential mode
   d. Insulation resistance>100 M-ohm.
   e. Vibration: Shock and bump and Seismic
   f. Storing and transportation
   g. Radio Interference: IEC 61000 for high frequency disturbance, Transient disturbance, Electrostatic discharge.
   h. KEMA Certification for the particular model offered with respect to IEC61850 Protocol.

   Relay shall meet the requirement for withstanding electromagnetic interference according to relevant parts of IEC 60255 / IEC 61850. Failure of single component within the equipment shall neither cause unwanted operation nor lead to a complete system breakdown.
5. The relay shall be rated for 50 Hz. +/- 5% system frequency.
6. The relay shall have software selectable options for CT input at site selectable 1 A or 5A
7. It shall be possible to energise the relay from auxiliary supply of 24V DC or 110V DC with variation of - 25% to + 10% (the aux. supply voltage will be specified during detailed engineering). The dc aux. supply will be 2 wire unearthed system. Necessary software shall be in-built for proper shutdown and restart in case of power failure. Auxiliary supply burden will be less than 20Watt.
8. The relay setting and programming shall be stored in EEPROM so that during auxiliary supply failure the said data is not lost.
9. The relay shall have facility to comprehensively monitor the healthiness of its circuits and components by own monitoring system. In case of any problem of hardware and software elements of the relay , the fault diagnosis information shall be displayed on the LCD and an alarm shall be generated by one of the output contacts. The alarm as soft signal to be sent to SCADA system as well. Necessary support documentation explaining the self-diagnostic feature shall be furnished. Watch dog contact shall be provided in addition to required 7 BI and 7 BO.
10. The relay shall be provided with at least 12 DI + 10 DO. DI for Trip Circuit Supervision function shall be over and above from mentioned DI/DO. Facility must exist to assign any of the logical/ physical statuses to BI/BO and programmable LEDs
11. The offered relay shall have a comprehensive local MMI (man-machine interface) for interface. It shall have the following minimum elements so that the features of the relay can be

accessed and setting changes can be done locally.

- At least 48 character alphanumeric backlit LCD display unit
- Fixed LEDs (for trip, Alarm, Relay available & Relay out of service) & twin colour programmable LEDs which can be assigned to any protection function for local annunciation.
- Tactile keypad or 4 navigation keys for browsing and setting the relay menu

12. The relay shall have the facility to programme the pickup threshold between 18 to 250V independently per digital input to prevent the spurious pick up of binary during inputs DC earth fault condition and shall be ESI 48- 4EB2 compliant

13. The relays provided shall comply with the international standards of NERC CIP for cyber security to provide protection against unauthorized disclosure, transfer, modification, or destruction of information and/or information systems, whether accidental or intentional.

14. All PCB used in relays shall have harsh environmental coating as per standard IEC 60068 (HEC) to increase the particle repellency and thereby increasing the life of relay. IED shall be manufactured using lead-free components.

15. The relay shall have a USB/RS232/RJ45 communication port for connecting to a local PC/Laptop for setting and viewing the data from the relay. Both IEC 103 (over RS485) and IEC 61850 (over RJ45) shall be available simultaneously in single relay. Use of any type of converter is not acceptable

16. **The relay shall have native IEC 61850 Communication Protocol on Ethernet** .

- **Relay shall comply to IEC 61850 protocol without any external protocol convertor. The relays shall generate GOOSE messages as per IEC 61850 standards for interlocking and also to ensure interoperability with third party relays**.
- Necessary user friendly configuration tool shall be provided to configure the relays. It shall be compatible with SCL/SCD files generated by a third party system.
- **Goose signals shall be freely configurable for any kind of signals using graphic tool/user friendly software.**

17. The relay shall have time synchronisation through SNTP / IRIG-B

18. The relays shall have the following tools for fault diagnostics :

- Fault record : The relay shall have the facility to store at least 125 last fault records with information on cause of trip, date, time, trip values of electrical parameters.
- Event record : The relay shall have the facility to store at least 1000 time stamped event records with 1ms resolution.
- Disturbance records : The relay shall have capacity to store at least 50 disturbance record waveforms at 1 sec..
- Event log, trip log and disturbance record shall go in to history.
- The relay settings shall be provided with adequate password protection with 5 alternative setting groups. The password of the relay shall be of 4 character to provide security to setting parameter.
- The numerical relays shall be provided with 1 set of common support software compatible with both Windows 98 and NT 4.0 which will allow easy settings of relays in addition to uploading of event, fault, disturbance records, measurements and troubleshooting purposes.
- Multiuser / corporate license for installation on minimum 7 no. of PCs shall be provided. The

relay settings shall also be changed from local or remote using the same software.

- Additional functions can be added to relay by software up-gradation and downloading this upgraded software to the relays by simple communication through PC.

19. Manufacturer of relays shall offer their own SAS so that they can provide a system solution if required in future.
20. Standard documentation per Relay, according to IEC 61850 :

a. MICS document (model implementation conformance statement)

b. PICS(protocol implementation conformance statement

c. Conformance Test certificate from KEMA.

d. PIXIT document

All the above mentioned certificates shall be submitted.

e. ICD file

f. SCD file

21. Offered relay must be type tested for the following tests :

- **Dielectric Withstand Test—IEC 60255-5**
- **High Voltage Impulse Test, class III --- IEC 60255-5(5kV peak, 1.2/50 micro Sec;3 Positive and 3 negative shots at interval of 5 Sec.)**
- **DC Supply Interruption ---- IEC 60255-11**
- **AC Ripple on DC supply ---- IEC 60255-11**
- **Voltage Dips and Short Interruptions --- IEC 61000-4-11**
- **High frequency Disturbance ---- IEC 60255-22-1, Class III**
- **Fast Transient Disturbance ---- IEC 60255-22-4, Class-IV**
- **Surge withstand capability ---- IEEE/ANSI C 37.90.1(1989)**
- **Degree of Protection**
- **Electromagnetic compatibility**
- **Mechanical stress/vibration test**
- **Temperature withstand**

Type test reports for the above tests shall be submitted for the approval of EMPLOYER along with Tender, failing which order may be rejected. Wherever the above mentioned standards and IEC 61850 overlap, the latter will prevail.

22. Relays will be guaranteed for satisfactory performance for a period of **five years** from the date of last dispatch. Any problem in the said period shall be attended free of charge inclusive of repair / replacement of relays / component (both hardware and software).

23. Suitable training to be imparted to employer persons on the following items :

a. Relay setting and parameterization

b. Relay configuration with respect to I/P, O/P and functional block for protection.

c. GOOSE configuration.

d. Configuration and Interfacing required for third party SCADA System Integration.

e. Diagnostic features.

24. The manufacturer shall provide all necessary software tools along with source codes to perform

addition of bays in future and complete integration with SCADA by the User. These software tools shall be able to configure relay, add analog variable, alarm list, event list, modify interlocking logics etc. for additional bays / equipment which shall be added in future.

25. The supplier shall mention following :

1. **Product maturity:** The Manufacturer shall mention the time period for which the product is in the market
2. Expected production life
3. Hardware / firmware change notification process. **Upgrades to be provided free of cost within the Guarantee period of 5 years, if needed.**
4. Lifespan of standard tools and processes for relay configuration, querying and integration.

26. All CT and PT terminals shall be provided as fixed (screwed) type terminals on the relay to avoid any hazard due to loose connection leading to CT opening or any other loose connection. Necessary amount of lugs shall be supplied along with each relay for CT connection and control wiring.

27. The relays shall be supplied with manuals with all technical and operating instructions. All the internal drawings indicating the logics and block diagram details explaining principle of operation shall be given at the time of supply. Mapping details shall be submitted in IEC format.

28. **Inter-operability test :** After fulfilment of the above Qualifying Requirements, inter-operability test of the offered relay (other than make & model already in use by the EMPLOYER) with the existing relay in EMPLOYER Network will be tested in EMPLOYER Distribution Testing Department, for which due intimation for supply of sample of offered relay will be given to the manufacturer. The manufacturer needs to submit the said relay to Distribution Testing Department of EMPLOYER within one week from the said intimation.

The offered relay will only be accepted after fulfilment of above Q.R. & successful inter-operability test at EMPLOYER system.

B. SCADA COMPATIBLE NUMERICAL DIRECTIONAL / NON DIRECTIONAL O/C & E/F RELAYS :

The primary requirements of the relays are to protect the respective single circuit or double circuit feeders and 33/11KV Power Transformers in the event of fault. The directional / non-directional E/F relays shall provide suitable sensitivity for limited earth fault current.

The relay shall be communicable type, suitable for substation automation and primary circuit breaker operation through SCADA from remote control room.

Detailed specification and requirements for non-directional and directional O/C and E/F relays are provided under sections ‘E-1’ and ‘E-2’.

C. OTHER PROTECTIVE RELAYS :

- Differential relay & REF protection relay shall be of numeric, communicable type.

D. OTHER PARTICULARS RELATED TO ALL RELAYS

1) All shall conform to the requirement of IS: 3231 / IEC 60255 and shall be suitable for operation within a temperature range 0ºC to 55ºC and 100% relative humidity. Relays shall be suitable for flush / semi flush mounting on the panel with connections from the rear, protected with dust tight cases for tropical use and with transparent cover removable from the front.
2) All A.C. relays shall be suitable for operation at 50Hz. The current coils shall be rated for a

continuous current of 1 amp and the voltage coil for 230V normal. The contacts of the relays shall be properly designed to prevent or minimise damage due to arcs which have to be broken successfully against 30V +/- 10% volt DC. When open, the contacts shall withstand a voltage of

115% of the normal circuit voltage. The relays shall be designed for satisfactory operation between 70% to 110% of rated D.C. voltage of the sub-station. The voltage operated relays shall have adequate thermal capacity for continuous operation. Low set OC 5% to 500% of In, High set OC 10% to 4000% of In, Low set EF 1% to 500% of In, High set EF 10% to 4000% of In

3) Timers shall be of static type. Pneumatic timers are not acceptable.

4) The relays shall preferably be provided with suitable seal-in devices. Relays shall be immune to all types of external influences like electrostatic, electromagnetic, radio interference, shock etc. as per IEC 60255.

5) All the numerical relays shall have provision for setting all the features available in the relay and viewing those settings as well as different other parameters through both built in display unit as well as through PC / laptop. All numerical relays shall have self monitoring feature with watch dog contact. **The supply of relay shall be inclusive of necessary software and hardware for interfacing with a PC / laptop, to be supplied by the manufacturer.**

E. PROTECTION SCHEMES :

E-1 <u>SCHEME FOR 33 KV FEEDER</u> : <u>NON-DIRECTIONAL OVER CURRENT AND E/F PROTECTION</u> :

This relay shall be used for 33KV radial feeder. The bidder shall be an original manufacturer of all the protection relays involved in this package. The bidder shall have manufacturing and after sales service facility available in India.

The relays shall be numerical protective & communicable type. Relays shall have USB / ethernet communication port and RS485 / RS232 serial communication port for communication through communication protocol IEC 61850 (with high speed GOOSE communication and certified by KEMA certificate level A for IEC 61850 compliance). Licensed version of the relay software shall be provided as per user's requirement.

The relay in general shall comply with the following requirements:

1. The offered relay shall be completely numerical with Protection elements realized using software algorithm to protect cables and overhead lines deployed in MV / LV networks. It may be used as a backup in HV systems, different types of earthing systems, MV industrial installations, public distribution networks and substations. It shall have essential protection functions for deployment in lower voltage systems.
2. The relays must have supervision features such as measurement, monitoring and recording functions.
3. The relay shall be provided with at least 12 no. Binary Inputs (BI) and 10 no. Binary Outputs (BO), apart from the watchdog contact. Facility must exist to assign any of the logical / physical statuses to BI / BO and programmable LEDs. The digital inputs shall be acquired by exception with 1ms resolution. Contact bouncing in digital inputs shall not be assumed as change of state.

The relay shall have provision for trip circuit supervision with DI status. There shall also be provision

for testing the output relays without any current injection.

4. The relay shall have the facility to program the pickup threshold between 24 and 250V independently per digital input to prevent the spurious pick up of binary inputs during DC earth fault condition and shall be ESI48-4EB2 compliant.
5. The relay shall have software selectable options for CT input at site selectable 1A or 5A.
6. The offered relay shall have a comprehensive local HMI for interface. It shall have the following minimum elements to enable viewing and setting the relay locally.
   - 16 x 3 backlit LCD display unit/ Graphical LCD with mimic for online bay status
   - 8 LEDs for status indication among that at least 4 shall be programmable
   - 4 navigation keys for setting and interrogation
7. The relay shall have a front USB communication port for connecting to a local PC / laptop for setting and viewing the data from the relay.
8. The relay shall support a menu option to allow the operator to issue open / close command to the circuit breaker through the relay HMI / MMI.
9. The relay shall have a RS485 rear port for connecting many relay in multi-drop fashion to connect to a remote master using IEC 60870-5-103 on serial communication.
10. The relay shall support IEC61850 protocol on Ethernet.
11. Manufacturer of relays shall offer their own SAS so that they can provide a system solution if required in future.
12. The relays shall have the following tools for following fault / event diagnostic records :

- Fault record – The relay shall have the facility to store at least 125 last fault records.
- Event record – The relay shall have the facility to store at least 2000 time tagged events
- Disturbance records – The relay shall have capacity to store at least 50 disturbance record waveforms each of 1 sec.

13. LED indication for numerical relays for different type of faults including phase identification.
14. The relay settings shall be provided with adequate password protection with 5 alternative setting groups.
15. The relay shall have comprehensive self-supervision & internal diagnostics feature. This feature shall continuously monitor the healthiness of all the hardware and software elements of the relay (watch dog function) with remote indication of relay failure and alarm shall be generated without tripping of circuit.
16. The numerical relays shall be provided with setting software which facilitates configuration and access to all the stored information for monitoring, maintenance and troubleshooting purposes.
17. The relays shall be housed in a robust metal case suitable for panel mounting conforming to IP52 (front face).
18. The relays provided shall be complied with the international standards of NERC CIP for cyber security to provide protection against unauthorized disclosure, transfer, modification, or destruction of information and/or information systems, whether accidental or intentional
19. The IED (relay) shall be manufactured using lead-free components.

The following protection functions must be available :

1. Timed and instantaneous phase and earth fault protection (non-directional) :

Relay shall have timed and instantaneous phase fault in all three phases and earth fault with minimum

3 independent stages (IDMT & DT) for OC & EF protection and shall support wide range of IEC / IEEE curves and with adjustable reset time.

Setting range :

Over current & earth fault : Current setting (DT) shall cover the range 5% to 3200%.

Over current & earth fault : Current setting shall cover the ranges 5% to 200% for timed protection (IDMT) and 100% to 2000% for instantaneous protection respectively.

Reset time : 0 - 100 seconds.

2. SEF protection : Definite time sensitive earth fault protection will be inbuilt function of numerical over-current relay and shall have a variable current setting range minimum 1% to 40% in very small steps of CT secondary current and wide range of definite time setting range minimum 0.1 to 10 sec. This feature shall be used in 33 KV feeder for detection of line to ground fault current particularly where the 33 kV system is grounded through earthing transformer.

3. Inrush blocking feature :

2nd harmonic blocking feature for over current and earth fault protection to be provided.

4. Thermal Overload :

The device shall incorporate a current-based thermal characteristic, using fundamental load current to model heating and cooling of the protected plant. The element shall be settable with both alarm and trip stages.

5. Loss of load :

Relay shall detect the loss of load by using the undercurrent protection function with the auxiliary contact of the CB status connected to the relay.

6. High impedance earth fault protection :

Relay shall have feature to detect high impedance earth faults which are characterized by low earth fault currents

7. Negative sequence overcurrent feature :

3 stages of negative sequence over current with DT & IDMT feature (user selectable) to be provided.

8. Broken conductor (BC) protection :

2 stages shall be supported – BC Alarm & BC trip and functions by calculating I2/I1.

9. Circuit breaker failure protection :

CB fail protection function by incorporating CB fail timer & criteria for resetting CBF timer shall be user selectable.

10. Cold load pickup feature :

To provide stability during start up after a long shutdown, cold load pickup (CLP) logic shall work by either :

a) Inhibiting one or more stages of the overcurrent protection for a set duration.

b) Raising the overcurrent settings of selected stages, for the cold loading period.

11. Trip circuit supervision :

Relay shall have TCS option for supervising trip coil both during CB open and CB closed condition.

12. Auto reclose :

Relay shall have auto reclose feature for phase over current, earth fault, and sensitive earth fault protection. Also the relay shall have feature to programme the dead time & reclaim time. The minimum auto reclose shots shall be 4.

The relay in addition to the above basic function shall also provide the following functions :

1. The relay shall have the facility to latch the trip output relay.
2. Relay shall have facility to control the CB in local/remote/ combination of both.
3. It shall have a test mode facility to test the relay operation during commissioning/maintenance activity which allows :

- Secondary injection testing to be performed on the relay without operation of the trip contacts.
- Binary inputs /output status monitoring
- Binary output contacts test and LED tests.

4. All measurements shall be in primary quantities. The default relay LCD shall be user defined to display primary circuit loading. As a minimum, the relay shall measure and display in alpha-numeric the following standard quantities :

- Phase currents
- Neutral currents - derived and measured
- Thermal state
- Positive and negative sequence current
- Ratio of negative to positive sequence current
- Breaker operation counter
- Breaker trip counter
- Breaker operating time

Resetting of display shall be selectable as hand reset or auto reset.

E-2 <u>SCHEME FOR 33KV PARELLEL FEEDERS AT RECEIVING ENDS : DIRECTIONAL PROTECTION</u> :

Directional O/C & directional instantaneous E/F numeric relays shall be required for 33 KV parallel feeders as specified in the schedule of requirement. Each feeder shall be provided with 3 elements IDMT voltage polarized O/C Relays and single element voltage polarized E/F Relay. The O/C Relays shall be IDMT type with high set element. The E/F Relay shall have directional sensitive E/F setting having wide range of setting (1-40%) & wide range of definite time setting range minimum. 0.1 to 10 Sec. The relay shall also have instantaneous unit. The relay shall have necessary P.T. fuse failure monitoring scheme.

The relays shall be numerical protective & communicable type. Relays shall have USB / ethernet communication port and RS485 / RS232 serial communication port for communication through communication protocol IEC 61850 (with high speed GOOSE communication and certified by KEMA certificate level A for IEC 61850 compliance). Licensed version of the relay software shall be provided as per user's requirement.

Characteristics :

O/C Element: IDMT with High Set Unit	Current Settings & Operating time	IDMT-50-200%,
MTA	Selectable MTA for Directional Relay shall cover 1st quadrant in a non-effectively grounded system	
Polarized P.T. Voltage	110 V A.C.	

E/F Element		
Current Setting	1-40% (minimum) in very small steps	
Operating Time of Relay	Instantaneous	
Operating Time of Timer	0.1 to 10 Sec in very small steps	
MTA	Selectable MTA for Directional Relay shall cover 1st quadrant in a non-effectively grounded system	
Open Delta P.T.	63.5 V A.C.	

The numerical directional relay shall have in-built feature for derivation of zero sequence voltage internally. If separate IVT is required for derivation of zero sequence voltage for directional earth fault element, the particulars shall be as per following Technical Parameters :

1	Insulation Level	1.1KV
2	Over Voltage	1.2 Cont./1.9 for 8 Hrs.
3	Transformation	110 V/√3 / 110/√3
4	VA Burden / Phase	7.5
5	Accuracy Class	3P
6	No. of Phase	Single
7	Type	Epoxy Cast Resin Indoor Single Phase Voltage Transformer
8	Formation	3 nos. single phase P.T. shall be connected in primary as star and secondary as open delta with neutral of primary and one end of open

E-3 PROTECTION OF 33 KV INDIVIDUAL TRANSFORMERS

Pre-qualification criteria :

The manufacturer of Control & Relay panel must also be a relay manufacturer. The offered relays involved in this package shall be of own make.

The bidder shall have experience of at least 5 years of design, engineering, supply and testing of control and relay panels in Indian utilities.

The bidder must also be a supplier of Substation Automation System (SAS).

The following protections shall be provided to power transformers by numeric relays :

- **Transformer differential protection :**

In addition to compliance with the 'general requirements of numerical relays' as detailed above, differential protection (87) for two winding transformer shall have the following features :

1) The relay shall be very fast in operation with operating time less than 40 ms at 5 times setting. The relay shall be inherently stable for external through fault conditions without affecting the speed of operation for internal faults.
2) The relay shall provide biased differential protection with triple slope tripping characteristics with faulty phase identification / indication. The range for the differential pick-up shall be from 0.1 to 2.5 pu. Its operating time shall not exceed 30 ms at 5 times rated current.
3) The relay shall have either a built in facility / software of ratio and phase angle correction or necessary interposing auxiliary current transformers of universal type, shall be provided in the respective panel.

4) The relay shall have 'no gap' detection technique to detect light CT saturation on a per phase basis. The no gap detection technique unblocks the low set differential element during light CT saturation, allowing the low set differential element to trip faster.

5) The relay shall be provided with 2nd harmonic restraint or any other inrush proof feature to ensure stability during inrush condition and to prevent operation due to magnetizing inrush current when the transformer is charged either from HV or LV side. The second harmonic blocking threshold shall be programmable one and it shall be possible to deactivate the 2^{nd} harmonic restraint feature. But this feature shall not affect the speed of operation for internal fault. The ratio of the second harmonic component to the fundamental wave for the differential currents of the measuring system shall serve as the criterion for this feature.

6) The relay shall provide restraint for over fluxing / over excitation condition for the transformer by measuring the ratio of the fifth harmonic to the fundamental for the differential current if subjected to transient over fluxing. The fifth harmonic restraint feature shall have variable percentage setting and it shall be possible to deactivate this feature. Furthermore, this feature shall also not affect the speed of operation for internal fault.

7) The relay shall have saturation discriminator as an additional safeguard for stability under through fault conditions.

8) All output relays of the differential relay shall be suitable for both signals and trip duties.

7) The relay shall be with 2-bias winding.

8) The relay shall have transient bias to enhance the stability of differential element during external fault condition.

9) The relay shall have adjustable bias slopes; slope m1 from 0 % to 150 % and slope m2 from 15% to 150 % so as to provide maximum sensitivity for internal faults with high stability for through faults. The relay shall have adjustable operating setting range of 10% to 50% at zero bias.

10) The relay shall have an unrestrained highset element to back up the biased differential function and the setting range for it shall have a minimum setting of 5pu and a maximum setting of 30pu.

11) The relay shall be such that there will not be any necessity of changing the setting of the relay whenever the transformer taps are changed from +5% to-10%.

12) The manufacturer has to furnish type test report of the relay from CPRI / NABL accredited test house and performance certificate from Power Utilities in India.

13) Differential relay shall have facility for setting, parameterization, downloading of stored data, data captured by disturbance recorder etc. locally through PC. Licensed version of the relay software shall be provided as per user's requirement. Necessary software, cables, connectors and other accessories as required for download, analyse data etc. shall be within the scope of successful manufacturer. **The necessary PC and Windows based licensed relay software has to be considered in the scope of the supply by the control panel manufacturer.**

14) The relay shall have disturbance recording (with time stamping) function with suitable no. of analog and digital channels, Memory size and number of disturbances stored in the relay shall be clearly indicated in the offer. No. of site selectable binary inputs, binary outputs, watchdog contact details, front and rear communication port details along with necessary hardware and software details shall be furnished.

- **Restricted Earthfault Protection (64 R) :**

This function shall be provided to maximize the sensitivity of the protection of earth faults. The REF function shall be selected separately for each winding and programmable as either high or low impedance. The REF function shall be able to share the same CTs with the biased differential function. As in traditional REF protections, the function shall respond only to the fundamental frequency component of the currents. The REF protection provided shall be suitable for auto transformer also.

The numeric REF protection relay shall provide the following functions :

a) Current / voltage operated high impedance type with a suitable setting to cover the maximum portion of transformer winding. Necessary calculation to prove the above winding coverage shall be furnished along with the tender.

b) Tuned to the system frequency.

c) Have suitable nonlinear resistor as required to limit the peak voltage and stabilizing resistance.

d) Operating time shall be less than 40 ms.

e) Have suitable stabilizing resistor to prevent mal operation during external faults, if necessary.

- **Over-fluxing Protection (99) :**

The relay shall provide over-fluxing protection, i.e. Volts/Hertz protection to the transformer. By pairs of v/f and t , it shall be possible to plot the over-fluxing characteristics in the relay so that accurate adaptation of the power transformer over-fluxing characterisitic is ensured. In addition the relay shall have a definite time element for alarm. The reset ratio for over-fluxing protection shall be 98%.

- **Overload Protection :**

Shall have thermal overload protection for alarm and trip condition with continuously adjustable setting range of 10-400% of rated current.

- **Overcurrent Protection (50,51) :**

The relay shall have three stages of definite time overcurrent protection as backup operating with separate measuring systems for the evaluation of the three phase currents ,the negative sequence current and the residual current. In addition the relay shall have three stages of Inverse time overcurrent protection operating on the basis of one measuring system each for the three phase currents ,the negative sequence current and the residual current.

- **Over / Under Frequency Protection :**

The relay shall have four stages of frequency protections where eah stage can be set as under/over frequency, under / over frequency with df/dt

- **Local Breaker Back-Up Protection :**

The relay9s) shall have in-built LBB protection to detect the failure in the local breaker using the undercurrent criteria and zero crossing detection and trip the upstream breaker.

E-4 A set of D.C. voltage operated auxiliary relays with coil cut-off arrangement and 4-N/O and 4-N/C contacts, hand reset with flag indicator type shall be provided for each Transformer for :

(a) Buchholz Alarm
(b) Buchholz Trip
(c) Winding Temp. Trip & winding temp. alarm
(d) Oil Temp trip & Oil Temp. Alarm
(e) Low Oil Level Alarm
(f) Pressure Release Device Trip
(g) OSR for OLTC trip

Each transformer panel shall be provided with a High Speed Tripping Relay with coil cut- off arrangement having 6 NO and 4 NC electrical reset with flag indicator type.

E-5 AUXILIARY RELAYS, TRIP RELAYS and TRIP COIL/ CIRCUIT SUPERVISION RELAYS :

Auxiliary relays : D.C. Voltage operated auxiliary relays provided with mechanically operated hand reset indicator and sufficient no. of hand reset contacts shall be provided for protection and supervision against transformer internal trouble / faults. Number of elements and number of relays shall be as per requirement of individual transformer.

For trip circuit supervision relays : All panels shall be provided with D.C. voltage operated trip circuit supervision relay having provisions for pre & post close supervision of trip circuit with set of self-reset contacts provided for trip circuit healthy indication and trip circuit unhealthy indication & alarm in respect of trip coil / circuits of respective VCBs.

Tripping Relays : All panels shall be provided with D.C. voltage operated high speed tripping relays having electrical-reset contacts capable to make, carry and break trip coil current. Sets of trip contacts shall be provided for inter-tripping function of corresponding 11kV incoming switchgear and closing blocking function of 33 KV & 11 KV Breakers in respect of transformer control panels. Each set of trip relay shall have minimum 2 no. N/O and 1 no. N/C contact as spare. The operating time of master trip relay shall be less than 40 ms.

E-6 TRIP CIRCUIT/COIL SUPERVISION SCHEME :

Trip circuit supervision scheme shall be such that testing of trip circuit healthiness is possible irrespective of whether the C.B. is in the closed or open position. The trip circuit healthy LED shall glow continuously in CB 'ON' position and on demand in C.B. 'OFF' position. The rating of dropping resistance in series with trip circuit healthy LED shall be such that the trip coil shall not get damaged because of continuous current flowing through it.

E-7 Principal requirements of protective relays, metering equipment, auxiliary relays, breaker control switches etc. are as follows :

E-7-1 Ammeter :

For each circuit, one ammeter shall be provided with the following :

Mounting	Flush
Size	96 x 96 mm. case
Response Time	1 second
Operating Temperature	Up to 55°C
Dielectric Strength	2 kV RMS for 1 minute
Auxiliary Supply	230 volt A.C, 50 Hz
Operating Current	1 Amp / 5 Amps from CT Secondary.
Type	Panel Mounting with 31/2 digit display.

E-7-2 Volt Meter :

Mounting	Flush
Size	96 x 96 mm. Case
Response Time	1 second

Operating Temperature	Up to 55°C
Dielectric Strength	2 kV RMS for 1 minute
Auxiliary Supply	230 V A.C., 50 Hz
Frequency	50 Hz
Operating Voltage	110 V ac from PT Secondary.
Type	Panel Mounting with 31/2 digit display.

E-7-3 Buzzer :

One DC buzzer shall be provided in the panel for non-trip alarm. One DC Bell shall be provided for Trip alarm and one AC Bell for Panel DC fail alarm.

E-7-4 High speed tripping relay electrically resettable type confirming to IS – 3231

Aux. voltage	110 V D.C to be decided during detailed engineering stage
Coil rating	110V D.C., voltage band for satisfactory operation : 50 to 120% of rated voltage
Operating Time	40 m. seconds nominal at rated voltage
Burden of relay coil watts (Max)	Low burden 40 Watt at rated voltage
Operating temp	-10 deg C to 55 deg C.
Operational indication for each element	Mechanical red colour Flag : Electrical Reset Type
Contact Configuration	6 NO + 4 NC combination with additional hand reset coil cut of contact (Seal in contact)

Contact ratings :

Make and carry	A.C. 1250 VA with max 5 amp & 660 Volts D.C. 1250 W dc with max 5 amp & 660 Volts
Make and carry for 3 sec.	A.C. 7500 VA with max 30 amp & 660 Volts D.C. 7500 W dc with max 30 amp & 660 Volts
Break	A.C. 1250 VA with max 5 amp & 660 Volts D.C. – 100 W resistive 50 watt inductive with max 5 amp & 660 Volts
Insulation	2 KV RMS, 50Hz for 1 min. 2.5 KV/1 sec between all terminals & case as per IS3231. 1 KV RMS, 50Hz for 1 min. across open contact
Type of mounting	Flush

E-7-5 Numerical based differential protection relay with inbuilt current amplitude & vector group compensation feature & also with differential high set element for two winding power transformer compliant to IEC 60255.

Aux. voltage	110 V or other voltages to be decided during detailed engineering stage
C.T. secondary	Selectable 1 Amp / 5 Amps for both HV & LV sides
Online display of HV & LV phase currents & differential current	

Adjustable bias setting	10 to 50% In.
Operation based on fundamental frequency	
Programmable HV/LV CT ratio of T/F vector group	
Inbuilt REF protection	
Inbuilt HV & LV side over current & earth fault protection	
Inbuilt transformer trouble auxiliary relay	
Backlit LCD display	
Harmonic restrain feature	
Storing facility of latest 5 fault events with real time clock	
Password protection	
DC burden	Quiescent condition – approx 4 watt Under trip condition – 110 Volt - approx 4 watt, 110 Volt - approx 7 watt.
AC burden	Through current only : approx 0.15 VA for 1 amp & 0.30 VA for 5 amp (per bias circuit) Bias & differential Ckt only: 2.8 VA for 1 amp & 3.2 VA for 5 amp.
Contact	Two change over self reset tripping contacts & two annunciation contacts
Contact rating	Make & carry 7500VA for 0.2 sec. with max 30 A & 300 V AC or DC carry continuously 5 amp AC or DC break 1250 VA AC or 50 W DC resistive, 25 W L/R – 0.04 s subject to max. 5 amp & 300 Volts
Current Input	Six for differential & one for REF
Self diagnosis feature for healthiness of relay	
Flush mounted / draw out type	

23.0 Guarrantee:-

The panels shall be delivered to the various consignees of the EMPLOYER and shall be suitably packed to avoid damages during transit.

The C&R Panel with relays with all integral parts of the Equipment will be guaranteed for the period of five years from the date of last dispatch. In the event of any defect in any equipment, relay, any integral part of the equipment arising out of faulty design, materials, workmanship within the above period, the supplier shall guarantee to replace or repair to the satisfaction of EMPLOYER.

If the supplier fails to do so, within one month of receipt of intimation, EMPLOYER reserves the right to effect repair or replacement by any other agency and recover charges for repair or replacement from the supplier.

24.0 TESTS :

24.1 Type Test :

24.1.1 The manufacturer shall submit the Type test report including functional test for all the protective relays and C&R panels carried out within five years from the due date of submission of tender from CPRI / NABL accredited Laboratory / Govt. recognized test house or laboratory on the tendered items as per relevant standards & tender specification with the purchase order failing which the lot shall be rejected. The Type tests for Numerical Relays is to be submitted as specified in Annexure-I & II of Relays specification.

24.1.2 Tests at Factory:

The following tests shall be carried out 6 copies of Test certificates shall be submitted for approval and the equipment shall only be dispatched after approval of the test certificates :

1. Checking of wiring of circuits and the continuity.
2. One minute applied voltage test. All Equipment on panel and small wiring shall be tested for withstand voltage of 2000Volts to earth & between different voltage circuits.
3. Insulation resistance of the complete wiring, circuit by circuit with all equipment mounted on the Board before and after H.V. test mentioned under 2 above.
4. Routine tests according to relevant National standard are on the Instruments, relays & other devices.

25.0 INSPECTION :

25.1 Acceptance test at manufacturer‘s works in presence of purchaser‘s representatives shall be carried out. The supplier shall give **at least 15 days notice** of the date when the tests are to be carried out. Purchasers shall give the right to select any quantity of the item wise offered lot for testing, offered for inspection and in the event of failure in test(s), the purchaser shall have the right to reject the offered equipment.

25.2 All relays, meters & annunciators provided in the control & relay panels are to be accepted only after successful hundred percent performance testing at testing department of EMPLOYER.

25.3 The inspection may be carried out by the EMPLOYER at any stage of manufacturing. The manufacturer shall grant free access to the EMPLOYER's representative/s at a reasonable notice when the work is in progress. Inspection and acceptance of any equipment under this specification by the EMPLOYER, shall not relieve the supplier of his obligation of furnishing equipment in accordance with the specification and shall not prevent subsequent rejection if the equipment is found to be defective.

25.4 The manufacturer shall keep the EMPLOYER informed in advance, about the manufacturing programme so that arrangement can be made from stage inspection.

25.5 The EMPLOYER reserves the right to insist for witnessing the acceptance/routine testing of the bought out items. The supplier shall keep the EMPLOYER informed, in advance, about such testing programme.

26.0 SPARES :

The manufacturer shall quote item-wise Unit Prices for all type of relays and other consumable spares recommended by him. Such spare shall include Fuse Holders, Fuses, Indicating Lamps, essential spare parts of Relays, Instrument, extra Control Switches etc. EMPLOYER may procure these items from the successful manufacturer.

27.0 DRAWING & LITERATURE :

Triplicate copies of the following drawings and literature shall be submitted along with the order copy :

(a) Principal dimension details of each unit cubicles, complete assembly of panel and proposed arrangement of the Panel in a Control Room.

(b) Front and rear views of the Panel with instrument and device positions marked.

(c) Pictorial views of the Control Switches Terminal Blocks, Indication Instruments, Test Blocks and exploded views of draw out type instructions and Fuse Blocks.

(d) Schematic Wing Diagram for Test Terminal Block.

(e) Illustrative, descriptive literature, General Technical Data & Specification of Devices.

(f) Make, type, particulars, literatures of each and every relay (protective & auxiliary), meters, annunciators, switches, lamps, TBS, TTBS etc. along with bill of material in line with specification.

28.0 CONTRACT DRAWINGS & LITERATURE :

The manufacturer shall also submit four prints of each drawing for approval of the EMPLOYER along with 2 sets of literature as mentioned in the spec. The Contract drawings shall cover the followings :

(a) Details of construction and dimensions of a cubicle and of the complete Panel.

(b) Template for foundation and details of cable trench and cable entry holes in the foundation platform.

(c) Elementary diagrams of all controls, metering, protection annunciation and other circuits. All devices shall be numbered according to ASA or international usage, which shall be separately coded.

(d) Cabling and wiring diagram of the cubicles and inter-connections between them. Ferrule numbers, device number and grouping for cable take off shall be distinctly shown.

(e) Dimensional outline drilling diagram and special mounting arrangement if any, of such type of various devices on the Panel.

(f) Inter-connection diagram between control panel and C.B. power and instrument transformer etc.

(g) Wiring Schedule for control & relay panel.

(h) Internal wiring diagram of all devices and elementary wiring diagram of relays where internal wiring is in triplicate. Construction details of switches, terminal blocks and test blocks etc.

(i) After approval, 10 sets of the final contract drawing for each set of Control & Relay Panels are to be supplied by the Manufacturer. One set reproducible tracing of the above drawings in soft format shall also be supplied.

4 copies of the following literature shall be supplied along with the drawings as mentioned :

(a) Literature describing construction, operation, adjustment and rating specifications of all the protective and auxiliary relays, recording instruments, metering instruments and control switches.

(b) Literature giving rating data, details and adjustments for calibration of the indicating instruments.

(c) Calibration instruments for the metering instruments.

(d) List of spare parts, identification number of renewable parts of relays, instruments and switches etc. with the help of which the EMPLOYER will be able to procure spare parts from the manufacturer at any subsequent time.

(e) It is desired that the complete schematic drawing is provided on a permanently laminated/engraved plate of suitable thickness which has to be bolted/riveted at the four corners on the inside face of rear door. In addition, one more plate of similar type and dimension shall be provided on the outside of the rear door providing guidelines and instructions for operation. The guidelines and schematic to be provided on the plates shall be as per approved drawings.

29.0 DOCUMENTS TO BE SUBMITTED ALONGWITH THE OFFER :

The contractor shall invariably submit the following documents, failing which the offers are liable for rejection :

29.1 Bill of Material (schedule-IA/IB/IC).

29.2 Documents supporting the qualifying requirements / past performance reports schedule-III).

29.3 Undertakings from relay manufacturer regarding (Schedule-IV) :

29.3.1 Non-phasing out of the relays for at least 10 years from the date of supply

29.3.2 For extending technical support and back-up guarantee

29.4 Detailed catalogue/technical literature in respect of all components/accessories including bought-out items.

29.5 Names of supplier of bought out item.

29.6 List of testing equipment available with the manufacturer.

30.0 QUALITY ASSURANCE PLAN :

30.1 The Manufacturer shall invariably furnish QAP as specified in Annexure-III along with his offer the QAP adopted by him in the process of manufacturing.

30.2 Precautions taken for ensuring usages of quality raw material and subcomponent shall be stated in QAP.

31.0 GUARANTEED TECHNICAL PARTICULARS :

Manufacturer shall furnish Guaranteed Technical Particulars of equipment offered mentioning thereon make & technical particulars of each device as per schedule specified. Performance Guarantee will be based on the Guaranteed Technical Particulars.

Schedule-II : GTP for C&R Panel

Schedule-V : GTP for Non Directional/ Directional O/C & E/F Relay

Schedule-VI : GTP for Master Trip Relay

Schedule- VII : GTP for Differential Protection Relay

The discrepancies, if any, between the specification and the catalogue and / or literature submitted as part of the offer by the manufacturers, the same shall not be considered and representations in this regard will not be entertained.

32.0 **Bus Configuration and Bill of material**

32.1 33/11KV, delta- star, individual control, transformer panel having HV side control and protection, single main bus with bus section isolator scheme :

2 nos.	Circuit label engraved suitably at front and inner side
1 no.	Section of painted and overlaid mimic diagram
1 no.	Circuit breaker control switch.
6 nos.	Indicating lamps for circuit breaker ON/OFF, spring charged, trip circuit 1 & 2 healthy and auto trip indication.
2 nos.	Trip circuit supervision relay to supervise the TC 1 & 2 both under pre close and post close
3 nos.	Digital ammeter of 96 mm x 96 mm of suitable range
1 no.	Digital voltmeter of 96 mm x 96 mm of suitable range
1 no.	Suitable space and wiring for non-tariff TVM for energy management.
1 set	Three phase 4 wire test terminal block for above.
1 no	Auxiliary relay with test push button for panel DC supervision relay.

16	Facia window type annunciator complete with accept reset and test PB but without audible bell.
1 no	Triple pole, IDMTL, non-directional over current protection numeric relay covering setting range 5% - 200% for IDMTL units and 100% - 2000% for high set unit.
2 nos	Restricted Earth Fault protection numeric relay current operated numeric relay covering setting range 10% to 40% both for HV & LV side of transformer.
1 no	High speed master tripping relay with contacts as required with lock out and coil supervision scheme complete.
1 set	Two bias transformer differential protection relay (for 10 MVA only) with interposing CTs (universal type) if necessary.
1 no.	PT selector switch, two position PT-1 / PT-2 switch, stay put type (16 A)
1 no.	Space heater with On / OFF switch and thermostat.
1 no.	Two element DC operated auxiliary relay having hand reset type contact with hand reset operating flag for transformer Buchholz trip and Buchholz alarm function. Each element with 4-NO+2-NC contact.
1 no.	Two element DC operated auxiliary relay having hand reset type contact with hand reset operating flag for transformer winding temp. trip and alarm function. Each element with 4NO+2NC contact.
1 no.	Two element DC operated auxiliary relay having hand reset type contact with hand reset operating flag for transformer Low Oil Level(Main Tank) and OSR(OLTC) alarm function. Each element with 4-NO+2-NC Contact.
1 no.	Two element DC operated auxiliary relay having hand reset type contact with hand reset operating flag for transformer Oil Temp. Trip and alarm function. Each element with 4-NO+2-NC Contact.
1 no.	Two element DC operated auxiliary relay having hand reset type contact with hand reset operating flag for transformer Main tank PRV trip and OLTC PRV Trip function. Each element with 4NO+2NC Contact.
1 no	Two element DC operated auxiliary relay having hand reset type contact with hand reset operating flag for OLTC Buchholz trip and spare. Each element with 4NO+2NC Contact.
1 no.	DC operated emergency lamp with switch.
1 no.	Cubicle illumination lamp operated from door switch.
1 no.	15A, 3 phase plug & socket with switch.
1 set	Panel accessories as necessary.
1 set	Other equipment, relays etc. as required to fulfil the scheme requirement.
1 no	Local/Remote switch

Note : **Multiple protection functions may be combined in a single numeric relay.**

32.2 33KV single feeder line C&R Panel with non-directional O/C & E/F protection and 33KV parallel feeder line C& R Panel with directional O/C & E/F protection, single main bus with bus section isolator scheme.

2 no.	Circuit label engraved suitably at front and inner side
1 no.	Section of painted and overlaid mimic diagram
1 no.	Circuit breaker control switch.
6 nos.	Indicating lamps for circuit breaker ON/OFF, spring charged, trip circuit 1 & 2 healthy and auto trip indication.
2 nos.	Trip circuit supervision relay to supervise the TC 1 & 2 both under pre-close and post-close condition.
3 nos.	Digital ammeter of 96 mm x 96 mm of suitable range
1 no	Digital voltmeter of 96 mm x 96 mm of suitable range
1 no.	Suitable space and wiring for non-tariff TVM for energy management.
1 no.	Three phase 4 wire test terminal block for above.
1 no.	Auxiliary relay with test push button for panel DC supervision relay.
12 way	Facia window type annunciator with accept reset and test PB but without audible bell.
1 no	Triple pole, IDMTL, non-dir- over current relay as per clause 23
1 no.	Single pole definite time sensitive E/F relay current operated having wide setting range for single circuit line.
1 no	Triple pole, IDMTL, directional O/C relay covering setting range 5% - 200% for IDMTL units and instantaneous high set unit 100% - 2000% applicable for parallel line feeder as per schedule
1 no	Single pole directional definite time sensitive E/F relay current operated having wide setting range for single circuit line, INCLUDING NECESSARY IPTs.
1 no.	High speed master tripping relay with contacts as required with lock out and coil supervision scheme complete.
1 no.	PT selector switch, two position PT-1/PT-2 switch, stay put type (16 A)
1 no.	Space heater with On/OFF switch and thermostat.
1 no.	DC operated emergency lamp with switch.
1 no.	Cubicle illumination lamp operated from door switch.
1 no.	15A, 3 phase plug & socket with switch.
1 set	Panel accessories as necessary.
1 no	Local / Remote switch
1 set	Other equipment, relays etc. as required to fulfil the scheme requirement.

Note **: Multiple protection functions may be combined in a single numeric relay.**

32.3 Common items (where ever mentioned) :

1 no.	96 mm x 96 mm voltmeter scaled suitably.
3+3 no.	PT supply Indicating lamps, red-yellow-blue for each PT.
1 no	Voltmeter selector switch, 7-position (for line & phase voltages) and OFF.
1 set	Audible bell and hooter for trip and non-trip fascia annunciation.
1 no	AC operated single element, auxiliary relay having only self reset contacts and with reverse flag for incoming AC supply supervision with test push button.

1 no	DC operated, two element, auxiliary relay having only self reset contact and with reverse flag for incoming DC and alarm bus DC fail supervision.
2 nos.	Test push button for above.
1 no	Single element AC operated auxiliary relay having self reset contact only for incoming DC and alarm bus DC fail alarm cancellation.
1 no	Push button for incoming DC and alarm bus DC fail alarm accept.
1 no	Indicating lamp for incoming DC and Alarm bus DC fail indication.
1 no	AC operated buzzer for incoming DC and Alarm bus DC fail audible alarm.

Annexure – IV : Standard Make of Relay and Fitments

1.	**Relays**	**Schneider, ABB, Siemens, Alstom**
2.	**Breaker Control Switch/ Local- Remote switch**	**Kaycee/Recom/Switron**
3.	**Ammeter/Voltmeter Selector switch**	K**aycee/ Recom**
4.	**Static Ammeter/ voltmeter**	**AE/RISHAV/Secure**
5.	**Push Buttons**	**Vaishno/Teknic/Lumen/STS**
6.	**Indicating Lamps with lenses**	**Vaishno/Teknic/Lumen/STS**
7.	**Panel wiring**	**Finolex/Havels/ KEI/ R. R. Kables**
8.	**Hooter/Buzzer/Bell**	**Vaishno/STS/JVS/Bharani**
9.	**Annunciator**	**MINILEC/ALAN/ INSTALARM/EAPL**

Annexure-V : Legend of Devices associated with 33kV C & R Panel

Symbol Reference	Description	Particulars
A1-A2-A3, Ah	Digital ammeter 96mm. x 96mm.	As specified
V	Digital voltmeter 96mm. x 96mm.	As specified
VS	Manual Voltmeter Selector Switch (6-way and off)	As specified
EM	Tri-Vector Meter	As specified
CS	Control switch T-A/T-N-A/C-C spring return type	As specified
L/R	Local/Remote switch	As specified
IL-R	CB „ON" Indication Red lamp	As specified
IL-G	CB „OFF" Indication Green lamp	As specified
IL-W	„Trip /Close signal received from Remote Indication white lamp	As specified
IL-B	"Spring charged" Indication Blue lamp	As specified
IL-A	CB " Auto trip" Indication Amber lamp	As specified
PB	Push Button	As specified
ANN	DC operated Buzzer and Microprocessor based Electronic annunciator with built in watch dog and first fault indication facility. The annunciator shall have provision for trip and non-trip alarm functions and Accept / Test / Reset /	As specified
H, HS, TH	Heater, Heater Switch, Thermostat	As specified
FS	Fuse	As specified

LK	Link	As specified
MCB1	MCB 2 pole 32 A for DC supply	As specified
MCB2	MCB 2 pole 16 A for AC supply	As specified
MCB3	MCB 2 pole for spring charging motor supply	As specified
MVS	Manual PT selector switch	As specified
IR-I	Remote inter tripping contact from 33 kV Transformer Control and relay	As specified
TC	Tripping Coil	As specified
CC	Closing Coil	As specified
86	Tripping Relay for Tripping function	As specified
52	Vacuum Circuit breaker	As specified
52a, 52b	NO and NC contacts of Breaker Auxiliary switch respectively	As specified
PT	Potential Transformer	As specified
CT	Current Transformer	As specified
TTB	Test Terminal Block	As specified
51/50 R-Y-B-	O/C and E/F protection	As specified
67 R-Y-B-N	Directional O/C and E/F protection	As specified
64	Restricted Earth Fault Protection	As specified
87	Differential Protection	As specified

SCHEDULE – IA : Bill of material for 33 KV feeder C&R panels :

(To be submitted, duly filled in, along with the offer)

Sl. No.	Description	Quantity	Make, type & design
1	Circuit label	1 No.	
2	Mimic section (brilliant green paint to shade No. 221 of IS 5 to be	1 No.	
3	T-N-C type control switch for circuit breaker.	1 No.	
4	Indicating LEDs for : Spring charge indication (Blue) Trip circuit healthy indication (white) for Trip ckt 1 and Trip ckt 2 Breaker 'ON' indication(Red) Breaker 'OFF' indication (Green)	 1 No. 2 Nos. 1 No. 1 No.	
5	Push button for : Trip circuit test Alarm Accept / Reset / Test / Mute	 1 No. 4 Nos.	
6	Numerical non-directional IDMT over current and earth fault relay with high set instantaneous trip feature	1 No.	
7	High speed master tripping relay (electrically resettable)	1 No.	
8	12-window annunciation scheme with accept, reset and LED test push button with self resetting audible alarm.	1 Set	
9	Digital ammeter (96 mm x 96 mm.)	3 Nos.	
10	Digital voltmeter (96 mm x 96 mm.) & selector switch.	1 Set	
11	Local / Remote switch	1 Set	

Internally mounted :			
1	Space heater and control switch	1 set	
2	Cubical illumination lamp and door switch	1 set	
3	Power Plug, socket and control switch	1 set	
4	Alarm bell for trip	1 No.	
5	Alarm cancellation relay	1 No.	
6	Alarm buzzer for non-trip with auto-stop feature (with variable time setting 0-60 seconds)	1 No.	
7	MCBs	As	
8	Fuse and Links	As	
9	Control wire	As	

SCHEDULE - IB : B.O.M. for 33/11KV Transformer C&R panels with differential protection :

(To be submitted duly filled in along with the offer)

Sl. No.	Description	Quantity	Make, type and
1	Circuit label	1 No.	
2	Mimic section (brilliant green paint to shade No. 221 of IS 5 to be	1 Set	
3	T-N-C type control switch for circuit breaker.	1 No.	
4	Indicating LEDs for :		
	Spring charge indication (blue)	1 No.	
	Trip circuit healthy indication(white)) one each for Trip	1 No.	
	Breaker 'ON' indication(Red)	1 No.	
	Breaker 'OFF' indication(Green)	1 No.	
5	Push button for Trip Circuit Healthy Test, Alarm Accept / Reset / Test / Mute	5 No.	
6	Trip circuit Healthy test	1 No.	
7	Numerical non-directional IDMT over current and earth fault relay with high set instantaneous trip feature	1 No.	
8	High speed master tripping relay (electrically resettable)	1 No.	
9	Space for HT Static TOD Tri-vector Energy meter and TTB.	1 No.	
10	Digital ammeter (96 mm x 96 mm.)	3 Nos. and 1 No.	
11	Digital voltmeter (96 mm x 96 mm.) & selector switch.	1 Set	
12	Transformer differential protection numerical relay	1 No.	
13	16-window annunciation scheme with accept, reset and LED test push button with self resetting audible alarm.	1 No.	
14	Auxiliary relay for main tank Buchholz Alarm/trip (2- element)	1 Set	

15	Aux. relay for winding temp Alarm/trip (2-element)	1 Set	
16	Aux. relay for OLTC Buchholz Alarm/trip (2-element)	1 Set	
17	Aux. relay for low oil level alarm (Main Tank) & OSR (OLTC) Trip (2-element)	1 Set	
18	Aux. relay for oil temp alarm/trip (2-element)	1 Set	
19	Aux. relay for Main tank PRV & OLTC PRV Trip (2- element)	1 Set	
Internally mounted :			
1	Space heater and control switch	1 No.	
2	Cubicle illumination lamp with door switch.	1 No.	
3	Power plug with control switch	1 No.	
4	MCB.	As	
5	Fuse and Links	As	
6	Control wire	As	

NOTE : THE MANUFACTURERS MUST HAVE TO SUBMIT SEPARATE BILL OF MATERIAL FOR DIFFERENT TYPE OF PANELS WITH THE GUIDELINE AS MENTIONED ABOVE, FURNISHING THE TYPE AND MAKE OF EACH ITEM.

SCHEDULE – II

DETAILS OF RELAYS, METERS, EQUIPMENT& DEVICES AS OFFERED IN SCHEDULE OF 33KV SIMPLEX TYPE CONTROL AND RELAYS PANEL : TO BE FILLED UP BY THE MANUFACTURERS ALONG WITH SUBMISSION OF SUPPORTING DOCUMENTS

Sl. No.	**Description**	**Make And Country Of Man**	**Type (Catalogue to be enclosed)**	**Brief Description, with CT/PT details, contact configuration, Input / Output details, characteristics, range, suitability etc. for clear perspective.**
A	**SURFACE MOUNTING DEVICES**			
1	**Circuit Label**			
2	**Mimic Diagram**			
3	**Circuit Breaker Control Switch Spring return lost motion type**			
4	**Digital ammeter 96mm. x 96mm. of suitable range for 1A / 5A C.T. secondary**			
5	**Digital voltmeter 96mm. x 96mm. of suitable range, for P.T. ssecondary 110V AC (L/L) KV**			

6	**Voltmeter selector switch 6 way & off position having break before make contact**			
7	**Test Terminal Block suitable for 3-phase 4-wire system with wire rear connecting studs having provision of sealing arrangement**			
8	**12-window / 16-window micro-processor based Electronic Annunciator with building-system watchdog first fault indications and red & yellow coloured windows with inscription for Trip & Non Trip Alarm functions**			
9	**Indicating lamps LED type 63.5V AC for P.T. supply indication with RED / YELLOW / BLUE Colours**			
10	**Indicating lamp LED type 230 VAC for Panel D.C. Fail Common Indication**			
11	**Indicating lamp LED type 110V DC for CB ON/OFF, Auto trip, Spring Charged, Trip Circuit Healthy Indications with RED/GREEN/ AMBER /BLUE / WHITE Colours**			
12	**Push Button for panel DC fail test**			
13	**Push Button for including AC fail test**			
14	**Push Button for non-trip panel DC fail Alarm Accept**			
15	**Push Buttons for Annunciator Alarm Test / Mute / Accept / Reset**			
16	**Numeric, communicable type non-directional IDMTL over current & earth fault relay with instantaneous high set unit**			
17	**Numeric, communicable type instantaneous sensitive earth fault relay with timer**			
18	**Triple pole directional voltage polarized over-current & earth fault relay with high-set unit on all elements**			

19	**Single pole directional voltage polarized instantaneous sensitive E/F relay with timer**			
20	**Hi balance Instantaneous Restricted Earth Fault Circulatory Current Fault Relay** **(a) HV side of Power Transformer** **(b) LV side of Power Transformer**			
21	**Single Element High Speed Tripping Relay with electrically resettable contacts & H/R flag / indication with required number of contacts**			
22	**2-element 110V DC voltage actuated auxiliary relay with HR Contacts & HR flag / LED indication for transformer internal trouble functions**			
23	**Single Element 110V DC voltage actuated auxiliary relay with self reset contact & reverse flag indication for panel DC supply fail function**			
24	**Single Element 230V AC voltage actuated auxiliary relay with self reset contacts & reverse flag indication for incoming AC supply fail function**			
25	**110V DC voltage operated relay for trip circuit supervision purpose with self reset contact**			
26	**Single element 230V AC voltage actuated auxiliary relay with self reset contacts without flag indication for panel DC fail alarm and alarm accept**			
27	**Additional involvement of single element 110V DC voltage actuated auxiliary relay**			
28	**Extra involvement of auxiliary relay for contact multiplication**			
29	**Projection mounting type tri-vector energy meter**			

30	**Common electronic DC bell / buzzer trip & non-trip alarm functions**			
31	**Common electronic AC bell for panel DC fail alarm functions**			
32	**Biased differential protection relay for 10 MVA Transformer Control & Relay panel**			
B	**Inside Mounting Devices**			
1	**230V AC cubicle illuminating lamp with door operated switch / toggle switch**			
2	**110V DC emergency lamp with toggle switch**			
3	**230V AC 60W space heater with thermostat & Toggle Switch**			
4	**16A Double V AC combined 2/3 pin plug and socket with switch**			
5	**16A double pole MCB for Incoming AC Supply**			
6	**Fuse**			
7	**Links**			
8	**Terminals**			
9	**Earthing Arrangement**			
10	**Interposing P.T. for Directional Relay if required**			
11	**Interposing Universal type CT for Differential Relay if required**			

Note : All surface mounting devices excepting Energy meter, TTB & bells / buzzers will be flush mounting type as per schedule of requirement.

Schedule-III : GTP for Numerical Feeder Protection Relay

Sl. No.	Feature and Function	Supplier's details
1.1	Make, Type, Model No and Version No. and Ordering Code	
1.2	Conformance to : i. IEC60255-4	
	ii. IEC 61850	
1.3	No. of CT inputs for O/C and E/F protection	
1.4	Type test report submitted (yes / no)	
1.5	Relay shall be of numeric design	
1.6	Relay designed for bay protection and control	
1.7	Size of relay LCD screen	
1.8	Relay is equipped with CB close and open key / push buttons	
1.9	Relay has following protection functions : a. Three phase over current b. Earth fault c. Thermal overload function d. Broken conductor protection function e. Circuit Breaker Maintenance function	
2.	a. One time delayed element and two high set elements b. Setting range and step for IDMT element for both current and time multiplier setting	
	c. Selectable current / time curve for IDMT element	
	d. Setting range and step for high-set elements for both current and time delay	
10.	Sampling rate and frequency of analog signal	
11.	Whether remote controllable from SCADA	
12.	a. No. of Digital Inputs b. Voltage rating of Digital Inputs c. Provision of testing without current injection	
13.	Supervision for CB open and closed status	
14.	No. of programmable LEDs & no. of latched	
15.	Analog measurement and display supported	
16.	Fault Record storage capacity	
17.	Event storage capacity	
18.	Disturbance record storage capacity	
19.	MMI with keypad and LCD provided	
20.	Rated DC supply and tolerance band	

21.	Rating of CT / PT secondary	
22.	Rated frequency	
23.	a. Operating ambient temperature & humidity	
	b. Withstanding capability of electromagnetic interference as per relevant part of IEC 60255	
24.	Mounting	
25.	Watchdog	
26.	a. Nominal Feeder current	
	b. CT Ratio setting	
	c. Earth fault current with time delay IEC curves, 2nd stage for instantaneous trip (less than 50 ms)	
	d. High set with delay	
	e. IEC Curves for all O/C and E/F are user selectable?	
27.	a. No. of Digital Output contacts	
	b. Contact rating	
28.	Mode of Time Synchronization	
29.	Type of lugs and terminators	
30.	Mean Time Between failures (MTBF)	
31.	Lifespan	
32.	Compliance to Type Test	
33.	Communication port a. Rear port- details b. Front port-details	
34.	Whether communication ports are native to the relay	
35.	Protocol supported for rear port	
36.	Protocol supported for front port	
37.	Start and trip output contacts are freely programmable	
38.	Cable for connection of relay to laptop (USB port) along power supply if required for relay local setting provided ?	
39.	Basic application software for setting change, parameterisation	
40.	CD with software (licensed) to download disturbance recorder, event log and evaluation of those records	

41.	Graphical configuration tool for I/P, O/P and functional building block for protection & control	
	Any other software required for integration with SCADA.	

Schedule-IV : GTP for Master Trip Relay

Sl. No.	Description	Manufacturer's Response
01.	**Manufacturer Name**	
02.	**Type and designation**	
03.	**Electrical reset**	
04.	**Mounting**	
04.	**High Burden relay**	
05.	**Operating time**	
06.	**Rated DC supply and tolerance**	
07.	**No. of N/O contacts**	
08.	**No. of N/C contacts**	

Schedule-V : GTP for Numerical Biased Differential Relay

Description	Manufacturer's Response
Manufacturer Name	
Type and designation	
Rated DC supply and tolerance	
C.T. secondary current	
Adjustable bias setting	
Operation philosophy	
Whether programmable HV / LV CT ratio of T/F vector group provided	
Inbuilt REF protection provided	
Inbuilt HV & LV side over-current & earth fault protection provided	
Inbuilt transformer trouble auxiliary relay provided	
Display Type and details	
Whether Harmonic restraint feature available	
Details of Event Recording and storing facility	

Password protection	
DC burden	
AC burden	
Contact arrangements	
Contact rating	
Current Input	
Self diagnosis feature provided	
Mounting Arrangement	
Communication port Details	

QUALITY ASSURANCE PLAN :

The manufacturer shall invariably furnish following information along with his offer.

(1) Statement giving list of important raw materials including but not limited to

(a) Contact material

(b) Insulation

(c) Sealing material

(d) Contactor, limit switches, etc. in control cabinet.

Name 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 materials in presence of Manufacturer's representative, copies of test certificates.

2) Information and copies of test certificates as in (i) above in respect of bought out accessories.

3) List of areas in manufacturing process, where stage inspections are normally carried out for quality control and details of such tests and inspections.

4) Special features provided in the equipment to make it maintenance free.

5) List of testing equipment available with the Manufacturer for final testing and associated combinations vis-à-vis, the type, special, acceptance and routine tests specified in the relevant standards. These limitations shall be very clearly brought out in the relevant schedule i.e. schedule of deviations from specified test requirements. The supplier shall, within 15 days from the date of receipt of Purchase Order submit following information to the EMPLOYER :

i) List of raw materials as well bought out accessories and the names of sub- suppliers selected from those furnished along with offer.

ii) Necessary test certificates of the raw material and bought out accessories.

iii) Quality Assurance Plan (QAP) with hold points for EMPLOYER's inspection. The quality assurance plan and hold points shall be discussed between the EMPLOYER and supplier before the QAP is finalized.

iv) The supplier shall submit the routine test certificates of bought out items and raw material, at the time of routine testing of the fully assembled Panel.

TECHNICAL SPECIFICATION FOR 33 & 11 KV STATION CLASS LIGHTNING ARRESTOR & 11 KV DISTRIBUTION CLASS SURGE ARRESTORS

1. 33kV VOLTAGE CLASS SURGE ARRESTORS

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

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.

1.2. 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.

1.3. GENERAL REQUIREMENT

1.3.1. 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.

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

1.3.3. 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.

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

1.3.5. 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.

1.3.6. 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.

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

1.3.8. 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.

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

1.3.10. 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.

1.3.11. 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.

1.4. ARRESTOR HOUSING

1.4.1. The arrestor housing shall be made up of **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 Grey **(for silicon polymeric)** colour, free from blisters, burrs and other similar defects.

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

1.4.2. 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.

1.4.3. Sealed housings shall exhibit no measurable leakage.

1.5. FITTINGS & ACCESSORIES

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

1.5.2. 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.

1.6. **SURGE MONITOR :**A self-contained discharge counter suitably enclosed for outdoor use and requiring no auxiliary or battery supply for operation shall be provided for each single pole unit.Leakage current meter with suitable scale range to measure leakage current of surge of surge arrestor shall also be supplied within the same enclosure.The number of operations performed by the arrestor shall be recorded by the suitable cyclometric counter and surge monitor shall be provided within the inspection window.There shall be a provision for putting ammeter to record the current/alarm contacts in the control room if the leakage current exceeds the permitted value.Similar provision shall be considered for the surge counter also..Surge monitor shall be mountrd on the support structure at a suitable height so that the raeding can be taken from the ground level through the inspection window and length connecting leads up to grounding point for 33kV class only.

1.7. TESTING:

1.7.1. Test on Surge Arrestors

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 following :

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)
	Residual Voltage Test a) Steep current impulse residual voltage test b) Lightning impulse residual voltage test
	Long duration current impulse withstand test
	Switching surge operating duty test
	Power frequency voltage Vs. Time characteristics
	Accelerated Ageing test
	Pressure relief test a) High Current b) Low Current
	Artificial pollution test (for porcelain housing)
	Seismic Test
	Partial Discharge test
	Bending test
	a) Temperature cycle test (for porcelain housing) b) Porosity test (for porcelain housing)
	Galvanising test on metal parts
	Seal Leakage test (for porcelain housing)
	Seal leak test and operation tests (for surge monitor)
	Weather ageing test (for polymer housing)

1.7.2. 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.**

1.7.3. 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.

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

1.7.5. 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.

1.8. NAME PLATE

1.8.1. 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 Manufacture
- Name of the manufacture
- Name of Client : " "
- Purchase Order Number along with date

1.9. 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) 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.

1.0 TECHNICAL PARTICULARS

1.1.1 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.

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

1.1.2 Surge Arrestors

Type of Surge Arrestor	Gapless Metal oxide
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

1.1.3 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 mm

1.1.4 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 g/m^2

2.0 11kV VOLTAGE CLASS SURGE ARRESTORS

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.

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.

2.3 GENERAL REQUIREMENT

2.3.1 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.

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

2.3.3 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.

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

2.3.5 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.

2.3.6 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.

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

2.3.8 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.

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

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

2.3.11 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.

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

2.4 **ARRESTOR HOUSING**

2.4.1 The arrestor housing shall be made up of **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 **Grey** (**for silicon polymeric**) colour, free from blisters, burrs and other similar defects.

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

2.4.2 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.

2.4.3 Sealed housings shall exhibit no measurable leakage.

2.5 **SURGE MONITOR :**A self-contained discharge counter suitably enclosed for outdoor use and requiring no auxiliary or battery supply for operation shall be provided for each single pole unit.Leakage current meter with suitable scale range to measure leakage current of surge of surge arrestor shall also be supplied within the same enclosure.The number of operations performed by the arrestor shall be recorded by the suitable cyclometric counter and surge monitor shall be provided within the inspection window.There shall be a provision for putting ammeter to record the current/alarm contacts in the control room if the leakage current exceeds the permitted value.Similar provision shall be considered for the surge counter also..Surge monitor shall be mountrd on the support structure at a suitable height so that the raeding can be taken from the ground level through the inspection window and length connecting leads up to grounding point for 11kV class only.

2.6 **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.

2.7 FITTINGS & ACCESSORIES

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

2.7.2 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.

2.8 TESTS

2.8.1 Test on Surge Arrestors

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 following :

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 c) Switching 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)

2.8.2 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.

2.8.3 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.

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

2.8.5 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.

2.9 NAME PLATE

2.9.1 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

2.10 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.

2.11 TECHNICAL PARTICULARS

2.11.1 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.

System Parameters

i)	Nominal system voltage	11kV
ii)	Highest system voltage	12 kV
iii)	System earthing	Effectively earthed system
iv)	Frequency (Hz)	50
v)	Lightning Impulse withstand	75 Voltage (kVP)
vi)	Power frequency withstand	28 Voltage (kV rms)
vii)	Arrestor duty	

--	Connection to system	Phase to earth
--	Type of equipment to be protected	transformers & switchgear

2.11.2 Surge Arrestors

i)	Type	Gapless Metal oxide outdoor
ii)	Arrestor rating (kV rms)	9
iii)	Continuous Operating voltage	7.65 (kV rms)
iv)	Standard Nominal Discharge Current	10 Rating (kA) (8x20 micro impulse shape)
v)	Degree of protection	IP **67**
vi)	Line discharge Class	2
vii)	Steep current at 10 kA	45
viii)	Lightning Impulse at 10 kA	40
ix)	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

2.11.3 **Insulator Housing**

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

2.11.4 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.

3.0 DISTRIBUTION CLASS SURGE ARRESTORS

Distribution class surge arrestors are generally used in distribution Transformer Substations only.

3.1 INTRODUCTION

This section covers the specification of Distribution class Surge Arrestor for 11kV transmission lines, transformers etc.

3.2 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
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.

IS3070-1993 (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 (1982) Circuits.
IEC –60099-4	Surge Arrestors

3.2.1 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.

3.3 GENERAL REQUIREMENT

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

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

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

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

3.3.5 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 contractor shall also recommend the procedure which shall be followed in providing the earthing/system to the Surge Arrestor.

3.3.6 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.

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

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

3.3.9 The Surge Arrestor shall be thermally stable and the contractor shall furnish a copy of thermal stability test with the bid.

3.3.10 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.

3.4 **ARRESTOR HOUSING**

3.4.1 The arrestor housing shall be made up of ***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 **Grey (for silicon polymeric)** colour, free from blisters, burrs and other similar defects.

3.4.2 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.

3.4.3 Sealed housings shall exhibit no measurable leakage.

3.5 ARRESTOR MOUNTING

The arrestors shall be suitable for mounting on 4 pole/2 pole structure used for pole mounted transformer and for incoming and outgoing lines.

3.6 FITTINGS & ACCESSORIES

3.6.1 The surge arrestor shall be complete with disconnector and terminal connectors and all other accessories.

3.6.2 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.

3.7 TESTS

3.7.1 Test on Surge Arrestors

The Surge Arrestors offered shall be type tested and shall be subjected to routine and acceptance tests in accordance with IS : 3070 (Part-3)-1993. In addition, the suitability of the surge arresters shall also be established for the following :

a) **Acceptance tests :**

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

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

iii) Internal ionization or partial discharge test.

b) **Special Acceptance tests :**

i) Thermal stability test (IEC clause 7.2.2)

c) **Routine tests :**

Measurement of reference voltage

i) Residual voltage test of arrester unit.

ii) Internal ionization or partial discharge test.

iii)Sealing test.

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

d) **Type tests :** Following shall be type test As per IS 3070 (Part 3)-/IEC;60094 or its latest amendment :

1.	Insulation Withstand test a) Lightning Impulse voltage test 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.	High current impulse operating duty test
5.	Power frequency voltage Vs. Time characteristics
6.	Accelerated Ageing test
7.	Artificial pollution test (for porcelain housing)
8.	Partial discharge test
9.	Visual Examination (for porcelain housing)
10.	a) Temperature cycle test (for porcelain housing)
11.	Mechanical Failing Load test (Bending Strength test)
12.	Uniformity of Zinc coating, Mass of zinc coating
13.	Time versus current curve (for disconnector)

14.	Weather ageing test (for polymer housing)

3.7.2 The maximum residual voltages corresponding to nominal discharge current of 5 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.

3.7.3 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 alongwith the GTP.

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

3.7.5 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.

3.7.6 TEST ON SURGE ARRESTOR DISCONNECTORS

The test shall be performed on surge arrestors which are fitted with arrestor disconnector or on the disconnector assembly alone if its design is such as to be un-affected by the heating of adjacent parts of the arrestor in its normally installed portion in accordance with IS:3070 (Part-3).

3.8 NAME PLATE

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

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

3.9 DRAWINGS AND INSTRUCTION MANUALS

The successful bidder 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.

3.10 TECHNICAL PARTICULARS

3.10.1 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.

System Parameters

i)	Nominal system voltage	11kV
ii)	Highest system voltage	12 kV
iii)	System earthing	Solidly earthed system
iv)	Frequency (Hz)	50
vii)	Lightning Impulse withstand	75 Voltage (kVP)
viii)	Power frequency withstand	28 Voltage (kV rms)
vii)	Arrestor duty	
	-- Connection to system	Phase to earth
	-- Type of equipment to be protected	11 kV transformers & switchgear

3.10.2 Surge Arrestors

i)	Type	Gapless Metal oxide outdoor
ii)	Arrestor rating (kV rms)	9
iii)	Continuous Operating voltage (kV rms)	7.65
v)	Nominal Discharge Current	5 Rating (kA) (8x20 micro impulse shape)
v)	Long Duration discharge class	Distribution class
vi)	Maximum residual voltage (kV peak)	
	a) at 5 kA	27
vii)	Partial discharge at 1.05 COV not greater than	50 (PC)
viii)	High current impulse withstand voltage at 5 kA (kVp)	65

3.11 INSULATOR HOUSING

i)	Power frequency withstand test voltage (Wet) (kV rms)	28
ii)	Lightning impulse withstand/tests voltage (kVP)	75
iii)	Creepage distance not less than (mm)	300

3.12 GALVANISATION

i)	Fabricated Steel Articles	
	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

TECHNICAL SPECIFICATION FOR 33 KV OUTDOOR TYPE CURRENT TRANSFORMER

4.1 INTRODUCTION

This section covers the specification of 33 kV Current Transformer suitable for outdoor service. Any other parts not specifically mentioned in this specification but otherwise required for proper functioning of the equipment shall be included by the tender in the offer. The CTs shall normally be installed above VCB. The VCB & CT shall be installed on common mounting structure. In places, where VCB are not provided in the substation, separate CT mounting structure shall be provided with CTs.

4.2 APPLICABLE STANDARDS

Unless otherwise modified in this specification, the Current Transformer shall comply with the latest version of relevant standards (IS 2165, IS 2705(I-IV), IS 2099, IS 5621, IS 2071, IS 335, IS 13947(part I), IEC 185, IEC 270, IEC 44(4), IEC 171, IEC 60, IEC 8263, IEC 815, Indian electricity Rules 2003) or better international standards. This list of standards is for guidance only. The contractor shall be solely responsible to design & manufacture the CT suitable for 33kV system.

4.3 AMBIENT CONDITIONS

The CT supplied against these specifications shall be suitable for satisfactory continuous operation under the tropical conditions, as mentioned for power transformers.

4.4 SYSTEM PARTICULARS

a)	Nominal System Voltage	33kV
b)	Highest system Voltage	36kV
c)	Rated Frequency	50Hz
d)	No of phases	Three
e)	System neutral earthing	-Solidly Earthed-
f)	One minute Power Freq. withstand voltage (rms)	70kV
g)	Lighting Impulse withstand Voltage	170kVp
i)	System fault level	-25kA for 3sec-

4.5 TECHNICAL PARAMETERS OF CT

a)	Type	Single phase, dead tank, outdoor, oil filled & hermetically sealed
b)	Type of mounting	Pedestal type
c)	Rated primary current	As per BPS
d)	Rated Continuous thermal current Primary current	120 % of rated
e)	Rated short time withstand Requirement for sec. Winding	As per IS 2705 Pt. I
f)	Rated short time withstand Current	25kA(RMS)
	i) Duration (for primary current of 150amps and above)	3Sec
	ii) Duration (for primary current below 150amps)	1Sec

g)	Rated dynamic withstand Current (KA rms)	62.5	
h)	Max temp rise	As per IEC-185/ IS 2705	
i)	Minimum creepage distance of porcelain housing(mm)	25 mm /KV	
j)	One minute power frequency Withstand voltage between Secondary terminal & earth	3 kV	
k)	Detail of Secondary Cores	Metering	Protn.
	Current ratio	(As per BPS)	
	Accuracy class	0.5	5P10
	Burden (VA)	15	15
	Instrument security Factor	≤5	-
	Accuracy Limit Factor	-	≥10

Note: The ratings indicated for instrument transformer are tentative only and may be changed to meet the requirements.

4.6 PORCELAIN HOUSING

It shall be single piece of homogeneous, vitreous porcelain of high mechanical & dielectric strength. It will be glazed with uniform Brown or Dark brown colour with smooth surface finish. The creepage distance for the porcelain housing shall be at least 25 mm per kV.

4.7 WINDING

1 PRIMARY WINDING

It shall be made of high conductivity rigid copper wire. The primary winding current density shall not exceed the limit of 1.6 Amp per sq. mm for normal rating.

The design current density for short circuit current as well as conductivity of metal used for primary winding shall be as per IS 2705. The calculation for the selection of winding cross section shall be furnished by contractor.

The primary terminal shall be of standard size of 30 mm dia x 80 mm length of heavily tinned (min. thickness 15 micron) electrolytic copper of 99.9 % conductivity.

2 SECONDARY WINDING

Shall be made of insulated copper wire of electrolytic grade. Type of insulation used shall be described in the offer. For multi ratio design, the multi ratio will be achieved by reconnection of the primary winding or secondary winding. The excitation current of the CT shall be as low as possible. The contractor shall furnish the magnetization curves for all the cores.

The terminal box shall be dust free & vermin proof. The size of the terminal box shall be big enough to enable easy access and working space with the use of normal tools.

The secondary terminals studs shall be provided with at least 3 nuts and two plain washers, these shall be made of brass duly nickel plated. The min. stud outer dia shall be 6 mm & length 15 mm. The min spacing between the centres of the adjacent studs shall be 1.5 time the outer dia of the stud.

3 POLARITY

The polarity shall be marked on each CT at the primary and secondary terminals.

4.8 TANK & HARDWARES

The CT will be dead tank type. The tank shall be fabricated of MS steel sheet of min. 3.15 mm for sides & 5 mm for top & bottom. The tank will be finished with min. 2 coats of zinc rich epoxy paint externally. The inner surface shall be painted with oil resistance white enamel paint.

All ferrous hardwares , exposed to atmosphere shall be hot dipped galvanized.

4.9 INSULATION OIL

The first filling of oil in CT shall be in contractor's scope. The oil shall be as per IS 335.

To ensure prevention of oil leakage, the manufacturer will give following details supported by drawings:

i) Location of emergence of Primary & Secondary terminals
ii) Interface between porcelain & metal tanks
iii) Cover of the secondary terminal box

Any nut & bolt and screw used for fixation of the interfacing porcelain bushing for taking out the terminals shall be provided on flanges cemented to the bushings & not on the porcelain.

If gasket joints are used, Nitrite Butyl Rubber gasket shall be used. The grooves shall be machined with adequate space for accommodating gasket under pressure.

The CT shall be vacuum filled with oil after processing. It will be properly sealed to eliminate breathing & to prevent air & moisture from entering the tank. The sealing methods/arrangement shall be described by the contractor & be approved by the owner.

4.10 OIL LEVEL INDICATOR

The CT shall be fitted with prismatic type oil sight window at suitable location so that the oil level is clearly visible with naked eye to an observer standing at ground level.

To compensate oil volume variation due to temperature variation, Nitrogen cushion or the stainless steel bellows shall be used. Rubber diaphragms are not permitted for this purpose.

4.11 EARTHING

Two earthling terminals shall be provided on the metallic tank of size 16 mm dia & 30 mm length each with one plain washer & one nut for connection to the station earth mat.

4.12 Junction Box

The junction box shall be of MS sheet having thickness of 2mm, synthetic enamel painted as per procedure mentioned in General Technical Requirement (Min. thickness 55 micron). The shade of junction box shall be 697 of IS: 5. Disconnecting type terminal blocks for CT secondary lead shall be provided. The junction boxes shall be weather proof type with gaskets, as per section-I (Introduction and general technical requirements) conforming to IP-55 as per IS-13947 (Part-I)

4.13 LIFTING & MOUNTING ARRANGEMENT

The CT shall be provided with two lifting eyes to lift the CT. This shall be so positioned so as to avoid any damage to the CT during lifting for instillation or transportation purpose. This shall be detailed in General Arrangement drawing.

The CT shall be of pedestal mounting type suitable for outdoor installation on steel/cement concrete structures. All the clamps, bolts, nut and washers etc. required for mounting the CT on the structure shall be supplied along with the CT and shall be galvanized. The contractor shall supply all the terminal connectors etc. required for connection to the CT.

4.14 TESTING

All Type and Routine Tests shall be as per relevant IS and/or IEC.

TECHNICAL SPECIFICATION FOR OUTDOOR TYPE 11 kV AND 33 KV VACUUM CIRCUIT BREAKERS

1) SCOPE

This specification covers design, manufacturing, testing at manufactures works, supply of 11KV and 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.

2) TYPE AND RATING

The circuit breakers shall be suitable for outdoor operation under the climatic conditions, as specified under 'Service Conditions' for power transformers, without any protection from sun and rain.

The circuit breakers shall have the following rating:

Sl.No.	PARTICULARS	33 KV	11 KV
i)	Number of Poles	3 Nos.	
ii)	Frequency	50 Cycles	
iii)	Nominal System Voltage	33 KV	11 KV
iv)	Highest System Voltage	36 KV	12 KV
v)	Interrupting Capacity at nominal system voltage	1800 MVA	500 MVA
vi)	Rated Continuous Current	1250 Amps	1250 Amps
vii)	Short-time Current Rating for 3 Secs.	31.5 KA	25 KA
viii)	Basic Insulation Level	170 KV	75 KV
ix)	Power Frequency Withstand Voltage for one Minute	70 KV	28 KV
x)	Total Break-time for any Current up to the rated breaking current	3 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)	Mechanical Endurance	M2class	
xiv)	Electrical Endurance	E2 class	
xv)	Capacitor Switching Duty	C2 class	
xvi)	The VCBs shall be suitable for one reclosing followed by one delayed reclosing and lock out		
	Minimum clearances		
a)	Between Phases	430 mm	280 mm
b)	Between Live Parts & Ground	4000 mm	3700 mm
c)	Creepage Distance	900 mm	300 mm

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

3) STANDARDS

The circuit breakers shall comply with the requirements of IEC 62271 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 equipment complies-with. A copy of such

standard may also be enclosed.

4) GENERAL

The circuit breaker shall be of porcelain clad, arc interruption in 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 re-striking voltage (R.R.R.V.) 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. **Strongly supported bracket or frame, for mounting associated 3 nos.11 KV / 33 KV CTs, shall also be provided.** 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 and dynamic load of the breaker during fault / normal ON OFF operations in all three directions.

The owner intends to operate 11 KV and 33 KV feeders with automatic reclosing scheme, the arrangement envisaged is as under :

On the occurrence of a fault the concerned protective relay will open the circuit breaker as per its own characteristic. Thereafter, the breakers shall re-close but after pre-set time delay, which shall be adjustable (say range 4 – 10 sec. or near about). There shall be no further automatic reclosing. A simple type of reclosing relay (reputed make) for this purpose shall be provided under this kind of operation. It is also necessary that the breaker shall be suitable for this reclosing duty. The auto-recloser relay is to be installed in respective indoor control panels.

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 shall be confirmed and furnished with the tender :

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

ii) Type, make & source of vacuum interrupters 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 shall be stated and type test report shall be furnished).

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

6) VACUUM INTERRUPTER

Interrupters shall be rated for minimum 30,000 mechanical or load operations

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 shall have high mechanical strength and it shall 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 shall be resistant to arc erosion and the contact shall have no tendency to get cold-welded under the high vacuum in the interrupter. Silicone encapsulated Interrupters to avoid tracking due to condensation

The interrupter design shall 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 shall be provided at the moving contact and shall have a long fatigue life.

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

7) MOUNTING OF 11 KV / 33 KV CTs

The offered steel structures for breakers to be supplied by the bidders shall have provision and adequate strength to accommodate 3 nos. 11 KV / 33 KV CTs on it after provision of suitable supports from ground.

8) 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 maximum daily average 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.

9) 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.

10) 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.

11) 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 and operable 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 shall 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 / minus 20 percent**. The A.C. Motor shall have overload protection. Provision shall also be made for mounting of mechanism box at an adequate height and gear ratios shall be so chosen that one man shall be able to charge the spring, without any additional efforts.

12) 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 30 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 shall 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 shall 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 f the control cubicle from inside.

13) 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.

14) 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.

15) TERMINAL CONNECTORS

6 Nos. Terminal bi-metallic connector suitable for Dog conductors 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 earth connections shall also be supplied. The connector drawing shall be got approved from the owner.

16) 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.

17) 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 (nominal 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 N/O + 8 N/C)	1 Set
11	Anti-pumping device suitable for 110 V DC	1 No.
12	Terminal connectors suitable for connecting Dog 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 lamps : The indicating LED lamps shall have in-built low voltage protection Circuit (LVGP) and surge suppressor circuit. Lamp assembly shall 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 shall be minimum 100 mcd at 20 mA . Indication lamp shall be suitable to operate on 30 V Direct Current supply source.

18) 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& Electrical operation 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.

19) 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 program of type testing, the manufacturers shall give, fifteen days advance intimation to the owner, to enable him depute his representative for witnessing the tests.

20) 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.

TECHNICAL SPECIFICATION FOR 33 & 11 KV OUTDOOR TYPE POTENTIAL TRANSFORMER

1 INTRODUCTION

This chapter covers specification of 33kV and 11kV Potential Transformer suitable for outdoor service. Any other parts not specifically mentioned in this specification but otherwise required for proper functioning of the equipment shall be included by the tender in the offer.

2 APPLICABLE STANDARDS

Unless otherwise modified in this specification, the Potential Transformer shall comply with the latest version of relevant standards (IS 3156, IS 2099, IS 5621, IS 335, IS 13947(Part I), IEC 186, Indian electricity Rules 2003, IEC 815) or better international standards. This list of standards is for guidance only. The contractor shall be solely responsible to design & manufacture the PT suitable for 33 kV/11kV systems.

3 AMBIENT CONDITIONS

The PT supplied against this specification shall be suitable for satisfactory continuous operation under the tropical conditions as detailed for power transformers.

4 SYSTEM PARTICULARS

a)	Nominal System Voltage	33kV	11kV
b)	Highest system Voltage	36kV	12kV
c)	Rated Frequency	50Hz	50Hz
d)	No of phases	Three	Three
e)	System neutral earthing	---Solidly Earthed--	
f)	One minute Power Freq. Withstand voltage (rms)	70kV	28kV
g)	Lighting Impulse withstand Voltage	170kVp	75kVp
h)	System fault level	---25 kA for 3sec---	

5 TECHNICAL PARAMETERS OF PT

a)	Rated primary Voltage	36 KV	12 KV
b)	Type	Single phase potential transformer	
c)	Voltage/ Ratio(kV)	33/0.11	11/0.11
d)	Rated voltage factor	1.2continuous	1.5 – 30seconds-
e)	One minute power freq. Withstand voltage for		
	Primary Terminals	70 kV(rms)	28 kV
	Secondry winding	36 kV	12 KV
f)	Min. Creepage Distance	25 mm/kV of Highest System Voltage	
g)	Detail of secondaries	Core I Application Metering	
	Accuracy	0.5	0.5
	Burdan (VA)	100	100

Note: The ratings indicated for instrument transformer are tentative only and may be changed to meet the requirements.

6 PORCELAIN HOUSING

It shall be single piece of homogeneous, vitreous porcelain of high mechanical & dielectric strength. It will be glazed with uniform Brown or Dark brown colour with smooth surface finish. The creepage distance for the porcelain housing shall be at least 25mm per kV.

The contractor shall clearly detail in his bid the details of attaching the metallic flange to porcelain, pressure release valve and also how primary & secondary terminals shall be brought out.

7 WINDING

PRIMARY WINDING

It shall be made of insulated electrolytic copper wire. The neutral end of the winding shall be brought outside for earthing.

The primary terminal shall be of standard size of 30 mm dia x 80 mm length of heavily tinned (min. thickness 15 micron) electrolytic copper of 99.9 % conductivity.

SECONDARY WINDING

It shall be made of insulated copper wire of electrolytic grade. The terminal box shall be dust free & vermin proof. The size of the terminal box shall be big enough to enable easy access and working space with the use of normal tools.

The secondary terminals studs shall be provided with at least 3 nuts and two plain washers. These shall be made of brass duly nickel plated. The min. stud outer dia shall be 10 mm & length 15 mm. The min spacing between the centres of the adjacent studs shall be 1.5 time the outer dia of the stud.

POLARITY

The polarity shall be marked on each PT at the primary and secondary terminals.

8 TANK & HARDWARES

It shall be fabricated of MS steel sheet of min. 3.15 mm for sides & 5 mm for top & bottom. The tank will be finished with min. 2 coats of zinc rich epoxy paint externally. The inner surface shall be painted with oil resistance white enamel paint.

All ferrous hardwares, exposed to atmosphere shall be hot dipped galvanized.

9 INSULATION OIL

The first filling of oil in PT shall be in contractor's scope. The oil shall be as per IS 335.To ensure prevention of oil leakage, the manufacturer will give following details supported by drawings:

i) Location of emergence of Primary & Secondary terminals
ii) Interface between porcelain & metal tanks
iii) Cover of the secondary terminal box

Any nut & bolt and screw used for fixation of the interfacing porcelain bushing for taking out the terminals shall be provided on flanges cemented to the bushings & not on the porcelain.

If gasket joints are used, Nitrite Butyl Rubber gasket shall be used. The grooves shall be in machined with adequate space for accommodating gasket under pressure.

The PT shall be vacuum filled with oil after processing. It will be properly sealed to eliminate breathing & to prevent air & moisture from entering the tank. The sealing methods/arrangement shall be described by the contractor & be approved by the owner.

10 OIL LEVEL INDICATOR

The PT shall be fitted with prismatic type oil sight window at suitable location so that the oil level is clearly visible with naked eye to an observer standing at ground level.

To compensate oil volume variation due to temperature variation, Nitrogen cushion or the stainless steel bellows shall be used. Rubber diaphragms are not permitted for this purpose.

11 EARTHING

Two earthling terminals shall be provided on the metallic tank of size 16 mm dia & 30 mm length each with one plain washer & one nut for connection to the station earth mat.

12 Junction Box

The junction box shall be of MS sheet having thickness of 2mm, synthetic enamel painted as per procedure mentioned in General technical Requirement (Min. thickness 55 micron). The shade of junction box shall be

697 of IS: 5. Disconnecting type terminal blocks for PT secondary lead shall be provided. The junction boxes shall be weather proof type with gaskets as per section-I (Introduction and general technical requirements) conforming to IP-55 as per IS-13947 (Part-I).

One junction box shall be provided for 3 numbers of single phase CT's and PT's.

13 LIFTING & MOUNTING ARRANGEMENT

The PT shall be provided with two lifting eyes to lift the PT. This shall be so positioned so as to avoid any damage to the PT during lifting for installation or transportation purpose. This shall be detailed in General Arrangement drawing.

The PT shall be of pedestal mounting type suitable for outdoor installation on steel/cement concrete structures. All the clamps, bolts, nut and washers etc. required for mounting the PT on the structure shall be supplied along with the PT and shall be galvanized. The contractor shall supply all the terminal connectors etc. required for connection to the PT.

14 TESTING

All Type and Routine Tests shall be as per relevant IS and /or IEC.

TECHNICAL SPECIFICATION FOR GALVENISED CHANNEL CROSS ARM ANGLE AND FLAT

1.0 SCOPE :

This specification covers the design, manufacture, testing at manufacturer's works, transport to site, insurance, storage, erection and commissioning of Galvanized Cross Arm and channel used for 33KV, 11 KV & line complete with all accessories as specified.

2.0 Standards

The M.S Cross Arm and channel supplied under this specification shall conform the latest issue of the relevant Indian Standards IS – 226:1975, Regulations etc. except where specified otherwise.

The rolling and cutting tolerance for steel product conforming to IS: 266 shall be those specified in the IS: 1852-1973 with latest revision.

Galvanization conforming to latest version of 1S:2629

In the event of conforming to any standards other than the Indian Standards, the salient features of comparison shall be clearly set out separately

3.0 **GENERAL REQUIREMENT** :

i. The cross arm shall be fabricated grade of mild steel of channel section as per requirement.
ii. All steel members and other parts of fabricated material as delivered shall be free of warps, local deformation, unauthorized splices, or unauthorized bends.
iii. Bending of flat strap shall be carried out cold. Straightening shall be carried out by pressure and not by hammering. Straightness is of particular importance if the alignment of bolt holes along a member is referred to its edges.
iv. Holes and other provisions for field assembly shall be properly marked and cross referenced. Where required, either by notations on the drawing or by the necessity of proper identification and fittings for field assembly, the connection shall be match marked.
v. A tolerance of not more than 1mm shall be permitted in the distance between the center lines of bolt holes. The holes may be either drilled or punched and, unless otherwise stated, shall be not more than 2mm greater in diameter than the bolts.
vi. When assembling the components force may be used to bring the bolt holes together (provided neither members nor holes are thereby distorted) but all force must be removed before the bolt is inserted. Otherwise strain shall be deemed to be present and the structure may be rejected even though it may be, in all other respects, in conformity with the specification.
vii. The back of the inner angle irons of lap joints shall be chamfered and the ends of the members cut where necessary and such other measures taken as will ensure that all members can be bolted together without strain or distortion. In particular, steps shall be taken to relieve stress in cold worked steel so as

to prevent the onset of embitterment during galvanizing.

viii. Similar parts shall be interchangeable.

ix. Shapes and plates shall be fabricated and assembled in the shop to the greatest extent practicable. Shearing flame cutting and chipping shall be done carefully, neatly and accurately. Holes shall be cut, drilled or punched at right angles to the surface and shall not be made or enlarged by burning. Holes shall be clean-cut without torn or ragged edges, and burrs resulting from drilling or reaming operations shall be removed with the proper tool.

x. Shapes and plates shall be fabricated to the tolerance that will permit fielderection within tolerance, except as otherwise specified. All fabrication shall be carried out in a neat and workmanlike manner so as to facilitate cleaning,
painting, galvanizing and inspection and to avoid areas in which water and other matter can lodge.

xi. Contact surfaces at all connections shall be free of loose scale, dirt, burrs, oil and other foreign materials that might prevent solid seating of the parts.

xii. Welded joints not permissible.

xiii. The rolling and cutting tolerance for steel product conforming to IS: 266 shall be those specified in the IS: 1852-1973 with latest revision.
all dimensions are subject to the following tolerances:
a) dimensions up to and including 50mm:+1mm: and
b) dimensions greater than 50mm: +2%

xiv. The channel cross arm shall be properly brushed to make it free from rust.

xv. For galvanized channel :
All ferrous parts including all sizes of nuts, bolts, plain and spring washers, support channels, structures, shall; be hot dip galvanized conforming to latest version of 1S:2629 or any other equivalent authoritative standard. The zinc coating shall be smooth, continuous and uniform. It shall be free from acid spot and shall not scale, blister or be removable by handling or packing. There shall be no impurities in the zinc or additives to the galvanic bath which could have a detrimental effect on the durability of the zinc coating. Before picking, all welding, drilling, cutting, grinding and other finishing operations must be completed and all grease, paints, varnish, oil, welding slag and other foreign matter completely removed. All protuberances, which would affect the life of galvanizing shall also be removed.
The weight of zinc deposited shall be in accordance with that stated in Standard IS 2629 and shall not less than 0.61kg/m² with a minimum thickness of 86 microns for items of thickness more than 5mm, 0.46kg/m² (64 microns) for items of thickness between 2mm and 5mm and 0.33kg/m² (47 microns) for items less than 2mm thick.

xvi. The raw materials and fabrication thereof in respect of cross arm shall be furnished along with dimension.

xvii. The hole for fixing of insulator and pole clamp shall be provided as per requirement.

xviii. One copy of the drawing of cross arm for each size shall be furnished along with the technical bid.

a. <u>REQUIRED TECHNICAL SPECIFICATION FOR GI CHANNEL CROSS ARM [100x50x6x3200]</u>

Sl No.	Description	Particular
1	Type of cross arm	G.I Channel cross arm
2	Size	100 x 50x 6 x 3200 mm
3	Material	Mild Steel channel
4	Length	3200 mm
5	Breath	100 mm
6	Width	50 mm
7	Thickness	6 mm
8	Hole for fixing of insulator	26 mm
9	Center to center distance of hole	1525 mm
10	Hole for pole clamp	18 mm
11	Weight	29.5 kg (approx)
12	Galvanization	The cross arm shall be properly brushed to make it free from rust and hot dip galvanized confirming to IS: 2629.

13	Standard applicable	IS: 266; IS: 1852-1973:

Sl No.	Description	Particular
1	Type of cross arm	GI Channel cross arm
2	Size	75 x 40x 40x6 x 2200 mm
3	Material	Mild Steel channel(galvanized)
4	Length	2200 mm
5	Breath	75 mm
6	Width	40 mm
7	Thickness	6 mm
8	Hole for foxing of insulator	20 mm
9	Center to center distance for hole	1070mm
10	Weight	16 kg (approx)
11	Galvanization	The cross arm shall be properly brushed to make it free from rust and hot dip galvanized confirming to IS: 2629.

TECHNICAL SPECIFICATION FOR ACSR CONDUCTORS

A. ACSR CONDUCTOR

1. SCOPE

This section covers design, manufacture, testing before dispatch, packing, supply and delivery for destination of Kms of “WEASEL” " RABBIT", "RACOON", "DOG", “WOLF” and "PANTHER" ACSR Conductor of size 6/1/2.59mm, 6/1/3.35mm, 6/1/4.09 mm, 6/4.72mm, 7/1.57mm, 30/7/2.59 mm and 30/7/3.00mm respectively.

2. STANDARDS

The Conductor shall also comply in all respects with the IS: 398 (Part-II) - 1996 with latest amendments unless otherwise stipulated in this specification or any other International Standards which ensure equal or higher quality material.

Sl. No.	Indian Standards	Title	International
1	IS:209-1979	Specification for Zinc	BS-3436-1961
2	IS:398-1996	Specification for Aluminum conductors for overhead transmission purposes.	
	Part-II	Aluminum conductors	IEC-209-1966
		Galvanized steel reinforced	BS-215(Part-II)
3	IS:1521-1972	Method of Tensile Testing of Steel wire	ISO/R89-1959
4	IS:1778-1980	Reels and Drums for Bare conductors	BS-1559-1949
5	IS:1841-1978	E.C. Grade Aluminum rod produced by rolling	
6	IS:2629-1966	Recommended practice for Hot Dip Galvanizing of iron and steel	
7	IS:2633-1986	Method of testing uniformity of coating of zinc coated articles.	
8	IS:4826-1968	Galvanized coatings on round steel wires.	ASTM A472-729

9	IS:5484-1978	E.C. Grade Aluminum rod produced by continuous casting and rolling.	
10	IS:6745-1972	Methods of determination of weight of zinc-coating of zinc coated iron and steel articles	BS-443-1969

The ACSR Conductor shall also conform to the following standards: Offer Conforming to standards other than IS-398 shall be accompanied by the English version of relevant standards in support of the guaranteed technical particulars to be furnished as per format enclosed.

3. GENERAL TECHNICAL REQUIREMENTS

The General Technical Requirements are given in Section-II. The Conductor shall conform to these technical requirements.

The Bidder shall furnish guaranteed technical particulars in Section-III.

3.1. **MATERIALS/WORKMANSHIP**

3.1.1. The material offered shall be of best quality and workmanship. The steel cored Aluminum conductor strands shall consist of hard drawn Aluminum wire manufactured from not less than 99.5% pure electrolytic Aluminum rods of E.C. grade and copper content not exceeding 0.04%. They shall have the same properties and characteristics as prescribed in IEC: 889-1987. The steel wire shall be made from material produced either by the acid or basic open hearth process or by electric furnace process or basic oxygen process. Steel wire drawn from Bessemer process shall not be used.

3.1.2. The steel wires shall be evenly and uniformly coated with electrolytic high grade, 99.95% purity zinc complying with the latest issue of IS-209 for zinc. The uniformity of zinc coating and the weight of coating shall be in accordance with Section-II and shall be tested and determined according to the latest IS-2633 or any other authoritative standard.

3.1.3. The steel strands shall be hot dip galvanized and shall have a minimum zinc coating of 250 gm/sq.m after stranding. The coating shall be smooth, continuous, and of uniform thickness, free from imperfections and shall withstand minimum three dips after stranding in standard preece test. The steel strands shall be preformed and post-formed in order to prevent spreading of strands in the event of cutting of composite core wire. The properties and characteristics of finished strands and individual wires shall be as prescribed in IEC: 888-1987.

4. CONDUCTOR PARAMETERS

The Parameters of individual strands and composite steel cored aluminium conductor, shall be in accordance with the values given in Section-II.

Creep in a conductor is attributed partly due to settlement of strands and partly due to non-elastic elongation of metal when subjected to load. The manufacturer of conductor shall furnish the amount of creep which will take place in 10, 20, 30, 40 and 50 years along with the supporting calculations. The calculations shall be based on everyday temperature of 32 ºC and everyday tension of 25% of UTS of

conductor of 11/33 KV Lines.

5. TOLERANCES

The tolerances on standard diameter of Aluminium and Steel wires shall be as detailed in specific technical requirements.

The cross-section of any wire shall not depart from circularity by more than an amount corresponding to the tolerance on the standard diameter.

The details of diameters, lay ratios of Aluminium and steel wires shall be in accordance with the Section-II "Technical Requirements".

6. SURFACE CONDITIONS

All Aluminum and steel strands shall be smooth, and free from all imperfections, spills/and splits. The finished conductor shall be smooth, compact, uniform and free from all imperfections including spills and splits, die marks, scratches, abrasions, scuff marks, kinks (protrusion of wires), dents, pressmarks, cut marks, wire cross-over, over-riding looseness, pressure and/or unusual bangle noise on tapping, material inclusions, white rust, powder formation or black spots (on account of reaction with trapped rain water etc.,), dirt, grit, etc. The surface of conductor shall be free from points, sharp edges, abrasions or other departures from smoothness or uniformity of surface contour that would increase radio interference and corona losses. When subjected to tension upto 50% of the ultimate strength of the conductor, the surface shall not depart from the cylindrical form nor any part of the component parts or strands move relative to each other in such a way as to get out of place and disturb the longitudinal smoothness of the conductor.

7. JOINTS IN WIRES

7.1. **Aluminum wires**

During stranding, no Aluminum wire welds shall be made for the purpose of achieving the required conductor length.

No joint shall be permitted in the individual Aluminum wires in the outer most layer of the finished Conductor. However, joints in the 12 wire & 18 wire inner layer of the conductor are permitted but these joints shall be made by the cold pressure butt welding and shall be such that no two such joints shall be within 15 meters of each other in the complete stranded conductor.

7.2. **Steel wires**

There shall be no joints in finished steel wires forming the core of the steel reinforced Aluminium conductor.

8. STRANDING

The wires used in construction of the stranded conductor, shall, before stranding, satisfy all requirements of IS-398 (Part-II) 1996.

In all constructions, the successive layers shall be stranded in opposite directions. The wires in each layer shall be evenly and closely stranded round the underlying wire or wires. The outer most layer of wires shall have a right hand lay. The lay ratio of the different layers shall be within the limits given under Section-II.

9. PACKING

9.1. The conductor shall be supplied in non-returnable strong wooden drums provided with lagging of adequate strength constructed to protect the conductor against any damage and displacement during transit, storage and subsequent handling and stringing operations in the field. The drums shall generally conform to IS-1778-1980 and latest version except as otherwise specified hereinafter. The conductor drums shall be adequate to wind one standard length of 2500 meters of WEASEL/RABIT/RACOON/DOG/PANTHERACSR conductor.

9.2. The drums shall be suitable for wheel mounting and for letting off the conductor under a minimum

controlled tension of the order of 5KN. The conductor drums shall be provided with necessary clamping arrangements so as to be suitable for tension stringing of power conductor.

9.3. The bidders shall submit their drawings of the conductor drums along with the bid. After placement of letter of intent the Manufacturer shall submit four copies of fully dimensioned drawing of the drum for Employer's approval. After getting approval from the Employer, Manufacturer shall submit 30 more copies of the approved drawings for further distribution and field use.

9.4. All wooden components shall be manufactured out of seasoned soft wood free from defects that may materially weaken the component parts of the drums. Preservative treatment for anti-termite/anti fungus shall be applied to the entire drum with preservatives of a quality which is not harmful to the conductor.

9.5. All flanges shall be 2-ply construction with 64 mm thickness. Each ply shall be nailed and clenched together at approximately 90 degrees. Nails shall be driven from the inside face of the flange, punched and then clenched on the outer face. Flange boards shall not be less than the nominal thickness by more than 2 mm. There shall not be less than 2 nails per board in each circle.

9.6. The wooden battens used for making the barrel of the conductor shall be of segmental type. These shall be nailed to the barrel supports with at least two nails. The battens shall be closely butted and shall provide a round barrel with smooth external surface. The edges of the battens shall be rounded or chamfered to avoid damage to the conductor.

9.7. Barrel studs shall be used for construction of drums. The flanges shall be holed and the barrel supports slotted to receive them. The barrel studs shall be threaded over a length on either end, sufficient to accommodate washers, spindle plates and nuts for fixing flanges at the required spacing.

9.8. Normally, the nuts on the studs shall stand protruded of the flanges. All the nails used on the inner surface of the flanges and the drum barrel shall be countersunk. The ends of the barrel shall generally be flushed with the top of the nuts.

9.9. The inner cheek of the flanges and drum barrel surface shall be painted with bitumen based paint.

9.10. Before reeling, card board or double corrugated or thick bituminized waterproof bamboo paper shall be secured to the drum barrel and inside of flanges of the drum by means of a suitable commercial adhesive material. The paper shall be dried before use. Medium grade craft paper shall be used in between the layers of the conductor. After reeling the conductor the exposed surface of the outer layer of conductor shall be wrapped with thin polythene sheet across the flanges to preserve the conductor from dirt, grit and damage during transportation and handling and also to prevent ingress of rain water during storage/transport.

9.11. A minimum space of 75 mm shall be provided between the inner surface of the external protective lagging and outer layer of the conductor. Outside the protective lagging, there shall be minimum of two binders consisting of hoop iron/galvanised steel wire. Each protective lagging shall have two recesses to accommodate the binders.

9.12. Each batten shall be securely nailed across grains as far as possible to the flange edges with at least 2 nails per end. The length of the nails shall not be less than twice the thickness of the battens. The nail shall not protrude above the general surface and shall not have exposed sharp edges or allow the battens to be released due to corrosion.

9.13. The conductor ends shall be properly sealed and secured with the help of U-nails on one side of the flanges.

9.14. Only one standard length of conductor shall be wound on each drum. The method of lagging to be employed shall be clearly stated in the tender.

9.15. As an alternative to wooden drum Bidder may also supply the conductors in non-returnable painted steel drums. The painting shall conform to IS:9954-1981,reaffirmed in 1992. Wooden/ steel drum will be treated at par for evaluation purpose and accordingly the Bidder shall quote the package.

10. LABELLING AND MARKING

The drum number shall be branded or gauged or stencilled into the flange. An arrow shall be marked on the sides of the drum, together with the words "Roll this way". Each drum shall have the following information provided on the outside of the flange stencilled with indelible ink.

i) Manufacturer's name and address.
ii) Contract/Specification number.
iii) Size and type of conductor.
iv) Net weight of the conductor.
v) Gross weight of the conductor and drum.
vi) Length of the conductor.
vii) Position of the conductor end.
viii) Drum and lot number.
ix) Name and address of the consignee.
x) Month and year of manufacture.
xi) The drum may also be marked with standard specification as per which the conductor is manufactured.

11. STANDARD LENGTHS

11.1. The standard length of the conductor shall be 2500 metres. Bidder shall indicate the standard length of the conductor to be offered by them. A tolerance of plus or minus 5% on the standard length offered by the bidder shall be permitted. All lengths outside this limit of tolerance shall be treated as random lengths.

11.2. Random lengths will be accepted provided no length is less than 70% of the standard length and total quantity of such random length shall not be more than 10% of the total quantity order. When one number random length has been manufactured at any time, five (5) more individual lengths, each equivalent to the above random length with a tolerance of +/-5% shall also be manufactured and all above six random lengths shall be dispatched in the same shipment. At any point, the cumulative quantity supplied including such random lengths shall not be more than 12.5% of the total cumulative quantity supplied including such random lengths. However, the last 20% of the quantity ordered shall be supplied only in standard length as specified.

11.3. Bidder shall also indicate the maximum single length, above the standard length, he can manufacture in the guaranteed technical particulars of offer. This is required for special stretches like river crossing etc. The Employer reserves the right to place orders for the above lengths on the same terms and conditions applicable for the standard lengths during the pendency of the Contract.

12. QUALITY ASSURANCE PLAN

A Quality Assurance Plan including customer hold points covering the manufacturing activities of the material shall be required to be submitted by the tenderer to the Employer along with the tender. The Quality Assurance Plan after the same is found acceptable, will be approved by the Employer.

The contractor shall follow the approved Quality Assurance Plan in true spirit. If desired by the Employer, he shall give access to all the documents and materials to satisfy the Employer that the Quality Assurance Plan is being properly followed.

SECTION - II

SPECIFIC TECHNICAL REQUIREMENTS

1. SCOPE

This section of the specification covers climatic and isoceraunic conditions, specific technical particulars, schedule of requirements & desired deliveries, for conductor for 11/33 kV lines.

2. CLIMATIC & ISOCERAUNIC CONDITIONS :

	2.1 Maximum Temperature	
	a) Conductor	ºC.
	2.2Minimum Temperature	ºC.
	2.3 i)Max. ambient temperature	ºC
	ii) Mean annual / every day temperature	ºC
	2.4Basic wind speed m/s	
	2.5Relative humidity	
	i) Maximum	%
	ii) Minimum	%
	2.6Average Rainfall (Max.) mm per annum	
	2.7a)Rainy months	May to Sept. 15 Rainy days in a year (days)

CONDUCTOR

1. Conductor: Raccoon ACSR
2. IS applicable: IS-398 (part-II) 1996 latest revision

3. Wire Diameter	**Raccoon**
Aluminium (mm)	6/4.09
Steel(mm)	1/4.09
4. Number of strands:	
Steel centre	1
1st steel layer	
1st Aluminium layer	6
2nd Aluminium layer	
5. Sectional Area of Aluminium (sq. mm.)	78.83
6. Total Sectional Area(sq.mm.)	91.97
7. Overall diameter(mm)	12.27
8. Approximate weight(Kg./Km.)	319
9. Calculated D.C rersistance at 20 degrees C., maximum. (Ohms/Km)	0.371
10. Ultimate tensile strength (KN)	26.91
11. Final modulas of elasticity (GN/sq.m)	79
12. Coefficient of linear expansion x 10-6 per◦C	19.1
13. Lay ratio	Max /Min
Steel core 6 wire layer	
Aluminium Ist layer	14 10

2nd layer		
14. Technical Particulars		
a. Diameter-mm	Al	Steel
Standard(mm)	4.09	4.09
Maximum (mm)	4.17	4.17
Minimum (mm)	4.01	4.01
b. Cross-sectional area of nominal diameter wire ($mm^{2)}$	13.14	13.14
c. Weight (Kg./Km)	102.48	35.51
d. Min. breaking load (KN)		
Before stranding	17.27	2.08
After Stranding	16.4	1.98
e. D.C resistance at 20℃ min. (Ohm/Km)	0.371	

15. Zinc coating of steel core:

(i) Number of 1 minute dips: 3

(ii) Minimum weight of Zinc: 260 gms/sqm Coating

(iii) Process of Galvanizing: Hot dip.

(iv) Quality of Zinc: IS-209/1979 or latest edition.

16. Joints in strands

16.1 Steel : Not permitted

16.2 **Aluminium:** No joint shall be permitted in the Aluminium wires in the outer most layer of the ACSR conductor. But permitted in the inner layers such that no two such joints are within 15 meters of each other in the complete stranded conductor.

17 Chemical composition of high carbon steel wire:

Element	**% Composition**
i) Carbon	0.5 to 0.85
ii) Manganese	0.5 to 1.10
iii) Phosphorus	Not more than 0.035
iv) Sulphur	Not more than 0.045
v) Silicon	0.10 to 0.35

TECHNICAL SPECIFICATION FOR COMPOSITE POLYMERIC INSULATORS FOR USE IN 11KV AND 33 KV SYSTEM

SCOPE

This section covers the specifications for design, manufacture, shop & laboratory testing, supply before dispatch & supply of Composite polymeric insulator consisting of a load bearing cylindrical insulating solid core consisting of fibres usually glass in a resin based matrix, a housing (outside the insulating core) made of polymeric material and end fittings permanently attached to the insulating core for a.c system with a nominal voltage greater than 1000 V for overhead lines.

The Composite insulator shall be pin insulator for straight line location and Long rod insulator for conductors in tension application at angle/ cut point. The composite tension / suspension insulator

shall be of suitable for boll and socket type or tongue & Clevis type fittings.

1. **APPLICABLE STANDARD:** Following international standard are applicable for composite polymeric insulation with latest amendment and other relevant national & internal standard also been application with latest amendment.

The composite insulators including the end fitting connection shall be of standard design suitable for use with the hardware fittings of any make conforming to relevant IEC/IS standards.

Sl. No.	Indian Standard	Title	International Standard
1.	IEC	Definition, test method and acceptance criteria for composite insulators for a. c. overhead lines above.	IEC:61109
2.	IS:731	Porcelain insulators for overhead power lines with a nominal voltage greater than 1000V	IEC:60383
3.	IS:2071	Methods of High voltage testing	IEC:60060-1
4.	IS:2486	Specification for insulator fitting for overhead power lines with a nominal voltage greater than 1000V General Requirements and tests Dimensional Requirements locking devices.	IEC:60120 IEC:60372
5.		Thermal mechanical performances test on string insulator units.	IEC:60575
6.	IS:13134	Guide for the selection of insulators in respect of polluted conditions.	IEC:60815
7.		Characteristics of string insulator units of the long rod type.	IEC:60433
8.		Hydrophobicity classification	STRI GUIDE 1.92/1
9.		Radio interference characteristics of overhead power lines and high-voltage equipment	CISPR:18-2 PART2
10.	IS:8263	Methods of RI test of HV insulators	IEC:60437
11.		Standard for insulators- composite distribution dead end type	ANSI c29.13-2000
12.	IS:4759	Hot dip Zinc coatings on structural steel & other allied products.	ISO:1459 ISO:1461
13.	IS:2629	Recommendation of weight for hot, dip galvanization for iron and steel	ISO:1461(E)
14.	IS:6745	Determination of weight of Zinc coatings on zinc coated iron and steel articles	ISO:1460
15.	IS:3203	Method of testing of local thickness of electroplated coating	ISO:2178
16.	IS:2633	Testing of uniformity of coating of zinc coated articles	
17.		Standard specification for glass fiber standards	ASTM D 578-05
18.		Standard test method for compositional analysis of thermogravimetry	ASTME 1131- 03
19.	IS:4699	Specification for refined secondary Zinc	

2. **SERVICE CONDITION**

Maximum ambient temperature : *48^0 C
Minimum ambient temperature : - 5^0 C
Relative humidity : 0 to 100%

The size of composite insulator, minimum creepage distance and mechanical strength along with hardware fittings shall be as follows.

3. TERMS AND DEFINITION:

I. The polymeric insulator whose insulating body consists of organic base materials also known as non ceramic insulator and coupling device shall be attached to the end of the insulating body.

II. The composite polymeric insulator shall be made two insulating part- namely a core and a housing part. The core consisting of fibres (e.g glass) which are position in a resin based matrix or a homogeneous insulating material (resin)

III. The insulator trunk which is the central insulating part of an insulator from which the sheds project.

IV. The housing which is the external insulating part of a composite insulator providing the necessary creapage distance and protecting core from environment.

V. The shed of the insulator which is the insulating part projecting from the insulator trunk , intended to increase the creepage distance.

VI. The interface which is the surface between housing and fixating device, between various parts of the housing e.g between shed or between sheath and shes, between core and housing.

VII. The end fitting which provide integral component or formed part of an insulator intended to connect it to a supporting structure , or to a conductor or to an item of equipment or to another insulator.

Sl. No.	Type of composite insulator	Nominal system voltage KV (rms)	Highest system voltage KV (rms)	Visible discharge test voltage KV (rms	Wet power frequency withstand voltage KV (rms	Impulse withstand voltage KV (rms	Minimum Creepage distance (mm)		Min. Failing load KN	Pin ball shankdiameter mm
							Normal & moderately polluted (20mm/ KV)	Heavily polluted (25mm/ KV)		
i	Long rod insulator	11	12	9	35	75	240	320	45	16
		33	36	27	75	170	720	900	45/70**	
ii	Post/ pin insulator	11	12	9	35	75	240	320	5	
		33	36	27	75	170	720	900	10	

Dimensional Tolerance of composite insulators

±(0.04d=1.5) mm when d < 300 mm

±(0.025d=6) mm when d < 300 mm

4. Inter changeability

The composite insulators including the end fitting connection shall be of standard design suitable for use with the hardware fittings of any make conforming to relevant IEC/IS standards.

5. Corona and RI performance

All surfaces shall be clean, smooth without cuts, abrasions or projections. No parts 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.

6. Core

It shall be a glass – fiber reinforce 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.

Housing (Sheath)

The FRP rod shall be covered by a seamless sheath of a silicon elastometric compound or silicon alloy compound of a thickness of 3 mm minimum.

It shall protect the FRP rod against environment influences, external pollution and humidity. It shall be excluded or directly moulded 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 in the sealing/ bonding area shall be free from voids.

7. Weather sheds

The composite polymer weather sheds made of silicon elastomeric compound of silicon alloy shall be firmly bounded to the sheath, vulcanized to the sheath or moulded as part of the sheath and shall be free from imperfections. The weather sheds shall have silicon content of minimum 30% by weight. The strength of the weather sheds 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.

8. End Fittings

End fittings transmit then mechanical load to the core. They shall be made of spheroid graphite cast iron, malleable cast iron or forged steel or aluminium alloy. They shall be connected to the rod by means of a controlled compression technique. The gap between fitting and sheath shall be sealed by a flexible silicon elastomeric compound or silicon alloy compound sealant. System of attachment of end fitting to the rod shall provide superior sealing performance between housing, i.e. seamless sheath and metal connection. The sealing must be moisture proof.

The dimensions of end fittings of Insulators shall be in accordance with the standard dimensions stated in IS:2486/IEC:60120

9. Equipment Marking

I. Each insulator unit shall be legibly and marked with the following details as per IEC-61109

(a) Month & Year of manufacture

(b) Min. Failing load/ guaranteed mechanical strength in kilo Newton followed by the word KN to facilitate easy identification.

(c) Manufacture's name / trade mark.

II. One 10mm thick ring or 20mm thick spot of suitable quality of paint shall be marked on the end fitting of each composite long rod of [particular strength in case of 33 KV insulators for identification in case both type of insulators are procured by the utility. The paint shall be not have deteriorating effect on the insulator performance, following codes shall be used as identification mark:

For 45 KN Long unit : Blue

For 70 KN Long unit : Red

10. Bid Drawings

I. The full description and illustration of the materials offered.

II. The bidder furnish alongwith the bid the outline drawing (3 copies) of each insulator unit including a cross sectional view of the long rod insulator unit. The drawing shall include but not be limited to the following information.

(a) Long rod diameter with manufacturing tolerance.

(b) Minimum creepage distance with positive tolerance.

(c) Protected creepage distance.

(d) Eccentricity of the long rod unit

(i) Axial run out

(ii) Radial run out

(e) Unit mechanical and electrical characteristics

(f) Size and weight of ball and socket/ tongue & cleaves

(g) Weight of composite long rod units

(h) Materials

(i) Identification Mark

(ii) Manufacturer's catalogue number

Type tests

Sl. No.	Description of type test	Test procedure / standard
1.	Dry lightning impulse withstand voltage test	As per IEC 61109 (Clause 6.1)
2.	Wet power frequency test	As per IEC 61109 (Clause 6.2)
3.	Mechanical load- time test	As per IEC 61109 (Clause 6.4)
4.	Radio Interference test	As per IEC 61109 (Clause 6.5) revised
5.	Recovery of Hydrophobicity test	Annexure-B This test may be repeated every 3 yrs by the manufacturer
6.	Chemical composition test for silicon content	Annexure-B or any other test method acceptable to the owner
7.	Brittle fracture resistance test	Annexure-B

11. Acceptance (Sample) Tests

A. For Composite Insulators

A	Verification of dimensions	Clause 7.2 IEC:61109
B	Verification of the locking system (if possible)	Clause 7.3 IEC:61109
C	Galvanizing Test	IS 2633 / IS 6745
D	Verification of the specified mechanical load	Clause 7.4 IEC:61109

B. Routine Tests

Sl. No.	Description	Standard
1.	Identification of marking	As per IEC:61109 Clause 8.1
2.	Visual Inspection	As per IEC:61109 Clause 8.2
3.	Mechanical routine test	As per IEC:61109 Clause 8.3

C. Tests During Manufacture

Following tests shall also be carried our

A	Chemical analysis of zinc used for galvanizing
B	Chemical analysis, mechanical, metallographic test and magnetic particle inspection for malleable castings
C	Chemical analysis, hardness and magnetic particle inspection for forigngs

TECHNICAL SPECIFICATION FOR G.I. WIRE

1.0 **Scope** This specification covers the manufacturing, testing at works, transport to site, insurance, storage, erection and commissioning of Galvanised Iron Wire of sizes 4 mm and 5 mm diameter.

2.0 **General requirements** It relating to the supply of mild steel wire shall be as per IS: 1387/1967 and the wire shall be drawn from the wire rods conforming to IS: 7887/1975.

The requirements for chemical composition for the wires shall conform to IS:7887/1975. Mild steel wire for General Engineering purpose shall be of following sizes:

I) 4mm - diameter (8 SWG)

II) 5mm - diameter (6 SWG)

Tolerance permitted on the diameter of wire shall be as per Table -1 of IS:280/1978.

3.0 **Climatic Conditions** The cross arms shall be suitable for the climatic condition mentioned In these bidding documents:

Mechanical Properties

Tensile Test: Tensile strength of wire when tested in accordance with IS: 1521-1972, shall be within the limits given in Table-2 of IS: 280/1978.

Wrapping Test: Wires shall be subjected wrapping test in accordance with IS: 1755-1961. The wire shall withstand without breaking or splitting. being wrapped eight times round its own diameter and subsequently straightened.

Surface finish

a. The wire shall have galvanized finishes. The galvanized coating of steel wire shall conform to the requirements for anyone of the types of coatings given in IS: 4826-1968 as per agreement with the purchaser.

b. The coating test for finishes other than galvanized, copper coated or tinned shall be subject to between the purchaser and the manufacturer.

c. Unless otherwise agreed to the method of drawing representative samples of the material and the criteria for conforming shall be as prescribed in Appendix (A) of IS: 280/1978.

d. All finished wires shall be well and cleanly drawn to the dimensions specified. The wire shall be sound, free from splits, surface flaws, rough jagged and imperfect edges and other harmful surface defects.

e. Each coil of wire shall be suitably bound and fastened compactly and shall be protected by suitably wrapped.

4.0 **Marking Each** coil of wire shall be marked legibly with the finish size of wire, lot number and trade mark of the name of the manufacturer. The material may also be marked with the ISI certification mark and name of the project.

5.0 **INSPECTION:** Inspection may be carried out by the purchaser or third party nominee at any stage of manufacture. The supplier shall grant free access to the purchaser's representative or third party nominee at a reasonable time when the work is in progress. Inspection and acceptance of any equipment under this specification by the purchaser shall not relieve the supplier of his obligation of furnishing equipment in accordance with the specification and shall not prevent subsequent rejection if the equipment is found defective.

TECHNICAL SPECIFICATION FOR 33 & 11 KV COMPOSITE POLYMERIC DISC INSULATORS 70/45 KN

1.0 SCOPE

This specification cover the design, manufactures, testing at manufacturer's works, transport to site, insurance, storage, erection and commissioning of 33 kV composite polymeric disc insulator for 33 kV line.

STANDARD

Strain insulators Tongue and Clevis type/ ball and socket type, suitable for 33 KV lines shall be conforming to IEC : 1109 with its latest amendments and revision and having mechanical failing load of 70 K.N. Insulators conforming to any other internationally accepted standards which ensure equal or higher quality than the standard mentioned would also be acceptable. A high class quality, corrosion resistant, fiberglass reinforced rod is the core of every insulator with ultimate mechanical strength at least twice the maximum working load.

Where the material is offered according to the inter-national accepted standard a copy of the specification shall be attached with the tender.

GENERAL REQUIREMENT:

The composite polymer insulator shall be uni-body design and injection molded directly to the rod and sealed to the end fittings with bead of silicon to give the insulator high dielectric strength and protect it from all environmental conditions. The design of the insulator shall be such that stress due to expansion and contraction in any part of the insulator shall not lead to deterioration.

The insulator shall be in one piece.

CLIMATIC CONDITIONS.:

i. Maximum ambient temperature in shade	40°C
ii. Minimum daily average ambient air temperature	35°C
iii. Maximum yearly average ambient air temperature	30°C
iv. Maximum ambient temperature	2°C
v. Maximum relative humidity	93%
vi. Average number of thunder storms days per annum	45 days
vii. Average number of rainy days per annum	150 days
viii. Average annual rainfall	2280 mm
ix. Number of months of tropical monsoon conditions	5 months
x. Maximum wind pressure	150 Kg/sq.m
xi. Altitude not exceeding	1000 M

2.4 BASIC INSULATION LEVEL

The test voltage (minimum requirement) of the insulator shall be as follows:

a) Highest system voltage : 36 KV(rms)
b) Min. Creepage distance : 900mm
c) Rated mechanical tensile load : 70 KN
d) Wet frequency 1 min. withstand voltage : 75KV
e) Dry lighting impulse withstand voltage : 170 KV

MARKING

Each insulator shall be legibly and indelibly marked to show the following:

a) Name or trade mark of the manufacturer
b) Month and year of manufacture
c) Minimum failing load in KN
d) Country of manufacture
e) ISI certificate mark and name of the project under "TDF 2010-11" The marking on insulator shall be printed and shall be applied before suitably.

TEST

Type test

The following type tests shall be conducted on a suitable number of individual insulator unit, components, materials or complete strings:
Verification of dimensions
Thermal mechanical performance test
Power frequency voltage withstand and flashover test (i) dry (ii) wet
Impulse voltage withstand and flashover test (dry)
Visible discharge test (dry)
RIV test (dry)
Mechanical failing Load Test (for pin insulator only)
24 hrs. mechanical strength test (for strain I string insulator only)

Acceptance Tests

a) Visual examination
b) Verification of dimensions
c) Temperature cycle test
d) Galvanizing test
e) Mechanical performance test
f) Test on locking device for ball and socket coupling
g) Eccentricity test
h) Metallurgical test
i) Grain size
j) Inclusion rating
k) Chemical analysis
l) Microstructure
m) Mechanical failing load test (for Pin Insulator only)
n) Electro-mechanical strength test (for Strain insulator only)
o) Porosity test
p) Puncture test (for strain Insulator only)

Routine Tests

a. Visual Inspection
b. Mechanical routine test for Strain Insulator only)
c. Electrical routine test (for Strain Insulator only)

Tests During Manufacture
On all components as applicable

a) Chemical analysis of zinc used for galvanizing
b) Chemical analysis, mechanical, metallographic test and magnetic particle inspection for malleable castings.
c) Chemical analysis hardness tests and magnetic particle inspection for forgings
d) Hydraulic Internal Pressure tests On disc insulator shells

Test Reports

Copies of type test reports shall be furnished in at least six (6)' copies along with one original. One copy shall be returned duly certified by the Owner only after which the commercial production of the concerned materials shall start.
Copies of acceptance test reports shall be furnished in at least six (6) copies. One copy shall be returned duly certified by the Owner, only after which the material shall be despatch.
Record of routine test reports shall be maintained by the Contractor at his works for periodic inspection by the Owner's representative.
Test certificates of test during manufacture shall be maintained by the Contractor. These shall be produced for verification as and 'When desired by the Owner.

INSPECTION

The Owner's representative or third party nominee shall at all times be entitled to have access to the works and all places of manufacture, where insulator, and its component parts shall be manufactured and the representatives shall have full facilities for unrestricted inspection of the Contractor's and sub Contractor's works, raw materials, manufacture of the material and for conducting necessary test as detailed herein.

The material for final inspection shall be offered by the Contractor only under packed condition as

detailed in the specification. The Owner shall select samples at random from the packed lot for carrying out acceptance

After placement of award, the Contractor shall submit fully dimensioned insulator drawings containing all the details, in four (4) copies to Owner for approval. After getting approval from Owner and successful completion of all the type tests, the Contractor shall submit 20 more copies of the same drawing to the Owner for further distribution and field use at Owner's end.

TECHNICAL SPECIFICATION FOR ACSR CONDUCTORS

A. ACSR CONDUCTOR

13. SCOPE

This section covers design, manufacture, testing before dispatch, packing, supply and delivery for destination of Kms of “WEASEL” " RABBIT", "RACOON", "DOG", “WOLF” and "PANTHER" ACSR Conductor of size 6/1/2.59mm, 6/1/3.35mm, 6/1/4.09 mm, 6/4.72mm, 7/1.57mm, 30/7/2.59 mm and 30/7/3.00mm respectively.

14. STANDARDS

The Conductor shall also comply in all respects with the IS: 398 (Part-II) - 1996 with latest amendments unless otherwise stipulated in this specification or any other International Standards which ensure equal or higher quality material.

Sl. No.	Indian Standards	Title	International
1	IS:209-1979	Specification for Zinc	BS-3436-1961
2	IS:398-1996	Specification for Aluminum conductors for overhead transmission purposes.	
	Part-II	Aluminum conductors	IEC-209-1966
		Galvanized steel reinforced	BS-215(Part-II)
3	IS:1521-1972	Method of Tensile Testing of Steel wire	ISO/R89-1959
4	IS:1778-1980	Reels and Drums for Bare conductors	BS-1559-1949
5	IS:1841-1978	E.C. Grade Aluminum rod produced by rolling	
6	IS:2629-1966	Recommended practice for Hot Dip Galvanizing of iron and steel	
7	IS:2633-1986	Method of testing uniformity of coating of zinc coated articles.	
8	IS:4826-1968	Galvanized coatings on round steel wires.	ASTM A472-729
9	IS:5484-1978	E.C. Grade Aluminum rod produced by continuous casting and rolling.	
10	IS:6745-1972	Methods of determination of weight of zinc-coating of zinc coated iron and steel articles	BS-443-1969

The ACSR Conductor shall also conform to the following standards: Offer Conforming to standards other than IS-398 shall be accompanied by the English version of relevant standards in support of the guaranteed technical particulars to be furnished as per format enclosed.

15. GENERAL TECHNICAL REQUIREMENTS

The General Technical Requirements are given in Section-II. The Conductor shall conform to these

technical requirements.

The Bidder shall furnish guaranteed technical particulars in Section-III.

15.1. **MATERIALS/WORKMANSHIP**

15.1.1. The material offered shall be of best quality and workmanship. The steel cored Aluminum conductor strands shall consist of hard drawn Aluminum wire manufactured from not less than 99.5% pure electrolytic Aluminum rods of E.C. grade and copper content not exceeding 0.04%. They shall have the same properties and characteristics as prescribed in IEC: 889-1987. The steel wire shall be made from material produced either by the acid or basic open hearth process or by electric furnace process or basic oxygen process. Steel wire drawn from Bessemer process shall not be used.

15.1.2. The steel wires shall be evenly and uniformly coated with electrolytic high grade, 99.95% purity zinc complying with the latest issue of IS-209 for zinc. The uniformity of zinc coating and the weight of coating shall be in accordance with Section-II and shall be tested and determined according to the latest IS-2633 or any other authoritative standard.

15.1.3. The steel strands shall be hot dip galvanized and shall have a minimum zinc coating of 250 gm/sq.m after stranding. The coating shall be smooth, continuous, and of uniform thickness, free from imperfections and shall withstand minimum three dips after stranding in standard preece test. The steel strands shall be preformed and post-formed in order to prevent spreading of strands in the event of cutting of composite core wire. The properties and characteristics of finished strands and individual wires shall be as prescribed in IEC: 888-1987.

16. CONDUCTOR PARAMETERS

The Parameters of individual strands and composite steel cored aluminium conductor, shall be in accordance with the values given in Section-II.

Creep in a conductor is attributed partly due to settlement of strands and partly due to non-elastic elongation of metal when subjected to load. The manufacturer of conductor shall furnish the amount of creep which will take place in 10, 20, 30, 40 and 50 years along with the supporting calculations. The calculations shall be based on everyday temperature of 32 ºC and everyday tension of 25% of UTS of conductor of 11/33 KV Lines.

17. TOLERANCES

The tolerances on standard diameter of Aluminium and Steel wires shall be as detailed in specific technical requirements.

The cross-section of any wire shall not depart from circularity by more than an amount corresponding to the tolerance on the standard diameter.

The details of diameters, lay ratios of Aluminium and steel wires shall be in accordance with the Section-II "Technical Requirements".

18. SURFACE CONDITIONS

All Aluminum and steel strands shall be smooth, and free from all imperfections, spills/and splits. The finished conductor shall be smooth, compact, uniform and free from all imperfections including spills and splits, die marks, scratches, abrasions, scuff marks, kinks (protrusion of wires), dents, pressmarks, cut marks, wire cross-over, over-riding looseness, pressure and/or unusual bangle noise on tapping, material inclusions, white rust, powder formation or black spots (on account of reaction with trapped rain water etc.,), dirt, grit, etc. The surface of conductor shall be free from points, sharp edges, abrasions or other departures from smoothness or uniformity of surface contour that would increase radio interference and corona losses. When subjected to tension upto 50% of the ultimate strength of the conductor, the surface shall not depart from the cylindrical form nor any part of the component parts or strands move relative to

each other in such a way as to get out of place and disturb the longitudinal smoothness of the conductor.

19. JOINTS IN WIRES

19.1. **Aluminum wires**

During stranding, no Aluminum wire welds shall be made for the purpose of achieving the required conductor length.

No joint shall be permitted in the individual Aluminum wires in the outer most layer of the finished Conductor. However, joints in the 12 wire & 18 wire inner layer of the conductor are permitted but these joints shall be made by the cold pressure butt welding and shall be such that no two such joints shall be within 15 meters of each other in the complete stranded conductor.

19.2. **Steel wires**

There shall be no joints in finished steel wires forming the core of the steel reinforced Aluminium conductor.

20. STRANDING

The wires used in construction of the stranded conductor, shall, before stranding, satisfy all requirements of IS-398 (Part-II) 1996.

In all constructions, the successive layers shall be stranded in opposite directions. The wires in each layer shall be evenly and closely stranded round the underlying wire or wires. The outer most layer of wires shall have a right hand lay. The lay ratio of the different layers shall be within the limits given under Section-II.

21. PACKING

21.1. The conductor shall be supplied in non-returnable strong wooden drums provided with lagging of adequate strength constructed to protect the conductor against any damage and displacement during transit, storage and subsequent handling and stringing operations in the field. The drums shall generally conform to IS-1778-1980 and latest version except as otherwise specified hereinafter. The conductor drums shall be adequate to wind one standard length of 2500 meters of WEASEL/RABIT/RACOON/DOG/PANTHERACSR conductor.

21.2. The drums shall be suitable for wheel mounting and for letting off the conductor under a minimum controlled tension of the order of 5KN. The conductor drums shall be provided with necessary clamping arrangements so as to be suitable for tension stringing of power conductor.

21.3. The bidders shall submit their drawings of the conductor drums along with the bid. After placement of letter of intent the Manufacturer shall submit four copies of fully dimensioned drawing of the drum for Employer's approval. After getting approval from the Employer, Manufacturer shall submit 30 more copies of the approved drawings for further distribution and field use.

21.4. All wooden components shall be manufactured out of seasoned soft wood free from defects that may materially weaken the component parts of the drums. Preservative treatment for anti-termite/anti fungus shall be applied to the entire drum with preservatives of a quality which is not harmful to the conductor.

21.5. All flanges shall be 2-ply construction with 64 mm thickness. Each ply shall be nailed and clenched together at approximately 90 degrees. Nails shall be driven from the inside face of the flange, punched and then clenched on the outer face. Flange boards shall not be less than the nominal thickness by more than 2 mm. There shall not be less than 2 nails per board in each circle.

21.6. The wooden battens used for making the barrel of the conductor shall be of segmental type. These shall be nailed to the barrel supports with at least two nails. The battens shall be closely butted and shall provide a round barrel with smooth external surface. The edges of the battens shall be rounded or chamfered to avoid damage to the conductor.

21.7. Barrel studs shall be used for construction of drums. The flanges shall be holed and the barrel supports

slotted to receive them. The barrel studs shall be threaded over a length on either end, sufficient to accommodate washers, spindle plates and nuts for fixing flanges at the required spacing.

21.8. Normally, the nuts on the studs shall stand protruded of the flanges. All the nails used on the inner surface of the flanges and the drum barrel shall be countersunk. The ends of the barrel shall generally be flushed with the top of the nuts.

21.9. The inner cheek of the flanges and drum barrel surface shall be painted with bitumen based paint.

21.10. Before reeling, card board or double corrugated or thick bituminized waterproof bamboo paper shall be secured to the drum barrel and inside of flanges of the drum by means of a suitable commercial adhesive material. The paper shall be dried before use. Medium grade craft paper shall be used in between the layers of the conductor. After reeling the conductor the exposed surface of the outer layer of conductor shall be wrapped with thin polythene sheet across the flanges to preserve the conductor from dirt, grit and damage during transportation and handling and also to prevent ingress of rain water during storage/transport.

21.11. A minimum space of 75 mm shall be provided between the inner surface of the external protective lagging and outer layer of the conductor. Outside the protective lagging, there shall be minimum of two binders consisting of hoop iron/galvanised steel wire. Each protective lagging shall have two recesses to accommodate the binders.

21.12. Each batten shall be securely nailed across grains as far as possible to the flange edges with at least 2 nails per end. The length of the nails shall not be less than twice the thickness of the battens. The nail shall not protrude above the general surface and shall not have exposed sharp edges or allow the battens to be released due to corrosion.

21.13. The conductor ends shall be properly sealed and secured with the help of U-nails on one side of the flanges.

21.14. Only one standard length of conductor shall be wound on each drum. The method of lagging to be employed shall be clearly stated in the tender.

21.15. As an alternative to wooden drum Bidder may also supply the conductors in non-returnable painted steel drums. The painting shall conform to IS:9954-1981,reaffirmed in 1992. Wooden/ steel drum will be treated at par for evaluation purpose and accordingly the Bidder shall quote the package.

22. LABELLING AND MARKING

The drum number shall be branded or gauged or stencilled into the flange. An arrow shall be marked on the sides of the drum, together with the words "Roll this way". Each drum shall have the following information provided on the outside of the flange stencilled with indelible ink.

xii) Manufacturer's name and address.

xiii) Contract/Specification number.

xiv) Size and type of conductor.

xv) Net weight of the conductor.

xvi) Gross weight of the conductor and drum.

xvii) Length of the conductor.

xviii) Position of the conductor end.

xix) Drum and lot number.

xx) Name and address of the consignee.

xxi) Month and year of manufacture.

xxii) The drum may also be marked with standard specification as per which the conductor is manufactured.

23. STANDARD LENGTHS

23.1. The standard length of the conductor shall be 2500 metres. Bidder shall indicate the standard length of the conductor to be offered by them. A tolerance of plus or minus 5% on the standard length offered by the

bidder shall be permitted. All lengths outside this limit of tolerance shall be treated as random lengths.

23.2. Random lengths will be accepted provided no length is less than 70% of the standard length and total quantity of such random length shall not be more than 10% of the total quantity order. When one number random length has been manufactured at any time, five (5) more individual lengths, each equivalent to the above random length with a tolerance of +/-5% shall also be manufactured and all above six random lengths shall be dispatched in the same shipment. At any point, the cumulative quantity supplied including such random lengths shall not be more than 12.5% of the total cumulative quantity supplied including such random lengths. However, the last 20% of the quantity ordered shall be supplied only in standard length as specified.

23.3. Bidder shall also indicate the maximum single length, above the standard length, he can manufacture in the guaranteed technical particulars of offer. This is required for special stretches like river crossing etc. The Employer reserves the right to place orders for the above lengths on the same terms and conditions applicable for the standard lengths during the pendency of the Contract.

24. QUALITY ASSURANCE PLAN

A Quality Assurance Plan including customer hold points covering the manufacturing activities of the material shall be required to be submitted by the tenderer to the Employer along with the tender. The Quality Assurance Plan after the same is found acceptable, will be approved by the Employer.

The contractor shall follow the approved Quality Assurance Plan in true spirit. If desired by the Employer, he shall give access to all the documents and materials to satisfy the Employer that the Quality Assurance Plan is being properly followed.

SECTION - II

SPECIFIC TECHNICAL REQUIREMENTS

2. SCOPE

This section of the specification covers climatic and isoceraunic conditions, specific technical particulars, schedule of requirements & desired deliveries, for conductor for 11/33 kV lines.

2. CLIMATIC & ISOCERAUNIC CONDITIONS :

	2.1 Maximum Temperature	
	b) Conductor	ºC.
	2.2Minimum Temperature	ºC.
	2.3 i)Max. ambient temperature	ºC
	ii) Mean annual / every day temperature	ºC
	2.4Basic wind speed m/s	
	2.5Relative humidity	
	i) Maximum	%
	ii) Minimum	%
	2.6Average Rainfall (Max.) mm per annum	
	2.7a)Rainy months	May to Sept. 15 Rainy days in a year (days)

CONDUCTOR	
1. Conductor:	Raccoon ACSR
2. IS applicable:	IS-398 (part-II) 1996 latest revision
3. Wire Diameter	**Raccoon**

Aluminium (mm)	6/4.09	
Steel(mm)	1/4.09	
4. Number of strands:		
Steel centre	1	
1st steel layer		
1st Aluminium layer	6	
2nd Aluminium layer		
5. Sectional Area of Aluminium (sq. mm.)	78.83	
6. Total Sectional Area(sq.mm.)	91.97	
7. Overall diameter(mm)	12.27	
8. Approximate weight(Kg./Km.)	319	
9. Calculated D.C rersistance at 20 degrees C., maximum. (Ohms/Km)	0.371	
10. Ultimate tensile strength (KN)	26.91	
11. Final modulas of elasticity (GN/sq.m)	79	
12. Coefficient of linear expansion x 10-6 per◦C	19.1	
13. Lay ratio	Max /Min	
Steel core 6 wire layer		
Aluminium Ist layer	14 10	
2nd layer		
14. Technical Particulars		
c. Diameter-mm	Al	Steel
Standard(mm)	4.09	4.09
Maximum (mm)	4.17	4.17
Minimum (mm)	4.01	4.01
d. Cross-sectional area of nominal diameter wire ($mm^{2)}$	13.14	13.14
c. Weight (Kg./Km)	102.48	35.51
d. Min. breaking load (KN)		
Before stranding	17.27	2.08
After Stranding	16.4	1.98
e. D.C resistance at 20℃ min. (Ohm/Km)	0.371	

15. Zinc coating of steel core:

(v) Number of 1 minute dips: 3

(vi) Minimum weight of Zinc: 260 gms/sqm Coating

(vii) Process of Galvanizing: Hot dip.

(viii) Quality of Zinc: IS-209/1979 or latest edition.

16. Joints in strands

16.3 Steel : Not permitted

16.4 **Aluminium:** No joint shall be permitted in the Aluminium wires in the outer most layer of the ACSR conductor. But permitted in the inner layers such that no two such joints are within 15 meters of each other in the complete stranded conductor.

17 Chemical composition of high carbon steel wire:

Element	**% Composition**
i) Carbon	0.5 to 0.85
ii) Manganese	0.5 to 1.10
iii) Phosphorus	Not more than 0.035
iv) Sulphur	Not more than 0.045
v) Silicon	0.10 to 0.35

TECHNICAL SPECIFICATION FOR COMPOSITE POLYMERIC INSULATORS FOR USE IN 11KV AND 33 KV SYSTEM

SCOPE

This section covers the specifications for design, manufacture, shop & laboratory testing, supply before dispatch & supply of Composite polymeric insulator consisting of a load bearing cylindrical insulating solid core consisting of fibres usually glass in a resin based matrix, a housing (outside the insulating core) made of polymeric material and end fittings permanently attached to the insulating core for a.c system with a nominal voltage greater than 1000 V for overhead lines.

The Composite insulator shall be pin insulator for straight line location and Long rod insulator for conductors in tension application at angle/ cut point. The composite tension / suspension insulator shall be of suitable for boll and socket type or tongue & Clevis type fittings.

1. **APPLICABLE STANDARD:** Following international standard are applicable for composite polymeric insulation with latest amendment and other relevant national & internal standard also been application with latest amendment.

The composite insulators including the end fitting connection shall be of standard design suitable for use with the hardware fittings of any make conforming to relevant IEC/IS standards.

Sl. No.	Indian Standard	Title	International Standard
1.	IEC	Definition, test method and acceptance criteria for composite insulators for a. c. overhead lines above.	IEC:61109
2.	IS:731	Porcelain insulators for overhead power lines with a nominal voltage greater than 1000V	IEC:60383
3.	IS:2071	Methods of High voltage testing	IEC:60060-1

4.	IS:2486	Specification for insulator fitting for overhead power lines with a nominal voltage greater than 1000V General Requirements and tests Dimensional Requirements locking devices.	IEC:60120 IEC:60372
5.		Thermal mechanical performances test on string insulator units.	IEC:60575
6.	IS:13134	Guide for the selection of insulators in respect of polluted conditions.	IEC:60815
7.		Characteristics of string insulator units of the long rod type.	IEC:60433
8.		Hydrophobicity classification	STRI GUIDE 1.92/1
9.		Radio interference characteristics of overhead power lines and high-voltage equipment	CISPR:18-2 PART2
10.	IS:8263	Methods of RI test of HV insulators	IEC:60437
11.		Standard for insulators- composite distribution dead end type	ANSI c29.13-2000
12.	IS:4759	Hot dip Zinc coatings on structural steel & other allied products.	ISO:1459 ISO:1461
13.	IS:2629	Recommendation of weight for hot, dip galvanization for iron and steel	ISO:1461(E)
14.	IS:6745	Determination of weight of Zinc coatings on zinc coated iron and steel articles	ISO:1460
15.	IS:3203	Method of testing of local thickness of electroplated coating	ISO:2178
16.	IS:2633	Testing of uniformity of coating of zinc coated articles	
17.		Standard specification for glass fiber standards	ASTM D 578-05
18.		Standard test method for compositional analysis of thermogravimetry	ASTME 1131- 03
19.	IS:4699	Specification for refined secondary Zinc	

2. SERVICE CONDITION

Maximum ambient temperature : *48^0 C
Minimum ambient temperature : - 5^0 C
Relative humidity : 0 to 100%

The size of composite insulator, minimum creepage distance and mechanical strength along with hardware fittings shall be as follows.

3. TERMS AND DEFINITION:

I. The polymeric insulator whose insulating body consists of organic base materials also known as non ceramic insulator and coupling device shall be attached to the end of the insulating body.
II. The composite polymeric insulator shall be made two insulating part- namely a core and a housing part. The core consisting of fibres (e.g glass) which are position in a resin based matrix or a homogeneous insulating material (resin)
III. The insulator trunk which is the central insulating part of an insulator from which the sheds project.
IV. The housing which is the external insulating part of a composite insulator providing the necessary creapage distance and protecting core from environment.
V. The shed of the insulator which is the insulating part projecting from the insulator trunk , intended to increase the creepage distance.
VI. The interface which is the surface between housing and fixating device, between various parts of the housing e.g between shed or between sheath and shes, between core and

housing.

VII. The end fitting which provide integral component or formed part of an insulator intended to connect it to a supporting structure , or to a conductor or to an item of equipment or to another insulator.

Sl. No.	Type of composite insulator	Nominal system voltage KV (rms)	Highest system voltage KV (rms)	Visible discharge test voltage KV (rms	Wet power frequency withstand voltage KV (rms	Impulse withstand voltage KV (rms	Minimum Creepage distance (mm)		Min. Failing load KN	Pin ball shankdiameter mm
							Normal & moderately polluted (20mm/ KV)	Heavily polluted (25mm/ KV)		
i	Long rod insulator	11	12	9	35	75	240	320	45	16
		33	36	27	75	170	720	900	45/70**	
ii	Post/ pin insulator	11	12	9	35	75	240	320	5	
		33	36	27	75	170	720	900	10	

Dimensional Tolerance of composite insulators

±(0.04d=1.5) mm when d < 300 mm

±(0.025d=6) mm when d < 300 mm

4. Inter changeability

The composite insulators including the end fitting connection shall be of standard design suitable for use with the hardware fittings of any make conforming to relevant IEC/IS standards.

5. Corona and RI performance

All surfaces shall be clean, smooth without cuts, abrasions or projections. No parts 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.

6. Core

It shall be a glass – fiber reinforce 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.

Housing (Sheath)

The FRP rod shall be covered by a seamless sheath of a silicon elastometric compound or silicon alloy compound of a thickness of 3 mm minimum.

It shall protect the FRP rod against environment influences, external pollution and humidity. It shall be excluded or directly moulded 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 in the sealing/ bonding area shall be free from voids.

7. Weather sheds

The composite polymer weather sheds made of silicon elastomeric compound of silicon alloy shall be firmly bounded to the sheath, vulcanized to the sheath or moulded as part of the sheath

and shall be free from imperfections. The weather sheds shall have silicon content of minimum 30% by weight. The strength of the weather sheds 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.

8. End Fittings

End fittings transmit then mechanical load to the core. They shall be made of spheroid graphite cast iron, malleable cast iron or forged steel or aluminium alloy. They shall be connected to the rod by means of a controlled compression technique. The gap between fitting and sheath shall be sealed by a flexible silicon elastomeric compound or silicon alloy compound sealant. System of attachment of end fitting to the rod shall provide superior sealing performance between housing, i.e. seamless sheath and metal connection. The sealing must be moisture proof.
The dimensions of end fittings of Insulators shall be in accordance with the standard dimensions stated in IS:2486/IEC:60120

9. Equipment Marking

III. Each insulator unit shall be legibly and marked with the following details as per IEC-61109
(a) Month & Year of manufacture
(b) Min. Failing load/ guaranteed mechanical strength in kilo Newton followed by the word KN to facilitate easy identification.
(c) Manufacture's name / trade mark.

IV. One 10mm thick ring or 20mm thick spot of suitable quality of paint shall be marked on the end fitting of each composite long rod of [particular strength in case of 33 KV insulators for identification in case both type of insulators are procured by the utility. The paint shall be not have deteriorating effect on the insulator performance, following codes shall be used as identification mark:

For 45 KN Long unit : Blue
For 70 KN Long unit : Red

10. Bid Drawings

I. The full description and illustration of the materials offered.
II. The bidder furnish alongwith the bid the outline drawing (3 copies) of each insulator unit including a cross sectional view of the long rod insulator unit. The drawing shall include but not be limited to the following information.
(i) Long rod diameter with manufacturing tolerance.
(j) Minimum creepage distance with positive tolerance.
(k) Protected creepage distance.
(l) Eccentricity of the long rod unit
(i) Axial run out
(ii) Radial run out
(m) Unit mechanical and electrical characteristics
(n) Size and weight of ball and socket/ tongue & cleaves
(o) Weight of composite long rod units
(p) Materials
(i) Identification Mark
(ii) Manufacturer's catalogue number

Type tests

Sl. No.	Description of type test	Test procedure / standard
1.	Dry lightning impulse withstand voltage test	As per IEC 61109 (Clause 6.1)
2.	Wet power frequency test	As per IEC 61109 (Clause 6.2)
3.	Mechanical load- time test	As per IEC 61109 (Clause 6.4)
4.	Radio Interference test	As per IEC 61109 (Clause 6.5) revised
5.	Recovery of Hydrophobicity test	Annexure-B This test may be repeated every 3 yrs by the manufacturer

6.	Chemical composition test for silicon content	Annexure-B or any other test method acceptable to the owner
7.	Brittle fracture resistance test	Annexure-B

11. Acceptance (Sample) Tests

D. For Composite Insulators

A	Verification of dimensions	Clause 7.2 IEC:61109
B	Verification of the locking system (if possible)	Clause 7.3 IEC:61109
C	Galvanizing Test	IS 2633 / IS 6745
D	Verification of the specified mechanical load	Clause 7.4 IEC:61109

E. Routine Tests

Sl. No.	Description	Standard
1.	Identification of marking	As per IEC:61109 Clause 8.1
2.	Visual Inspection	As per IEC:61109 Clause 8.2
3.	Mechanical routine test	As per IEC:61109 Clause 8.3

F. Tests During Manufacture

Following tests shall also be carried our

A	Chemical analysis of zinc used for galvanizing
B	Chemical analysis, mechanical, metallographic test and magnetic particle inspection for malleable castings
C	Chemical analysis, hardness and magnetic particle inspection for forigngs

TECHNICAL SPECIFICATION FOR 33 & 11 KV COMPOSITE POLYMERIC DISC INSULATORS 70/45 KN

1.0 SCOPE

This specification cover the design, manufactures, testing at manufacturer's works, transport to site, insurance, storage, erection and commissioning of 33 kV composite polymeric disc insulator for 33 kV line.

STANDARD

Strain insulators Tongue and Clevis type/ ball and socket type, suitable for 33 KV lines shall be conforming to IEC : 1109 with its latest amendments and revision and having mechanical failing load of 70 K.N. Insulators conforming to any other internationally accepted standards which ensure equal or higher quality than the standard mentioned would also be acceptable. A high class quality, corrosion resistant, fiberglass reinforced rod is the core of every insulator with ultimate mechanical strength at least twice the maximum working load.
Where the material is offered according to the inter-national accepted standard a copy of the specification shall be attached with the tender.

GENERAL REQUIREMENT:

The composite polymer insulator shall be uni-body design and injection molded directly to the rod and sealed to the end fittings with bead of silicon to give the insulator high dielectric strength and protect it from all environmental conditions. The design of the insulator shall be such that stress due to expansion and contraction in any part of the insulator shall not lead to deterioration.
The insulator shall be in one piece.

CLIMATIC CONDITIONS.:

i. Maximum ambient temperature in shade	40°C
ii. Minimum daily average ambient air temperature	35°C
iii. Maximum yearly average ambient air temperature	30°C
iv. Maximum ambient temperature	2°C
v. Maximum relative humidity	93%
vi. Average number of thunder storms days per annum	45 days
vii. Average number of rainy days per annum	150 days
viii. Average annual rainfall	2280 mm
ix. Number of months of tropical monsoon conditions	5 months
x. Maximum wind pressure	150 Kg/sq.m
xi. Altitude not exceeding	1000 M

2.4 BASIC INSULATION LEVEL

The test voltage (minimum requirement) of the insulator shall be as follows:

a) Highest system voltage : 36 KV(rms)
b) Min. Creepage distance : 900mm
c) Rated mechanical tensile load : 70 KN
d) Wet frequency 1 min. withstand voltage : 75KV
e) Dry lighting impulse withstand voltage : 170 KV

MARKING

Each insulator shall be legibly and indelibly marked to show the following:

a) Name or trade mark of the manufacturer
b) Month and year of manufacture
c) Minimum failing load in KN

d) Country of manufacture
e) ISI certificate mark and name of the project under "TDF 2010-11" The marking on
insulator shall be printed and shall be applied before suitably.

TEST

Type test

The following type tests shall be conducted on a suitable number of individual insulator unit, components, materials or complete strings:
Verification of dimensions
Thermal mechanical performance test
Power frequency voltage withstand and flashover test (i) dry (ii) wet
Impulse voltage withstand and flashover test (dry)
Visible discharge test (dry)
RIV test (dry)
Mechanical failing Load Test (for pin insulator only)
24 hrs. mechanical strength test (for strain I string insulator only)

Acceptance Tests

a) Visual examination
b) Verification of dimensions
c) Temperature cycle test
d) Galvanizing test
e) Mechanical performance test
f) Test on locking device for ball and socket coupling
g) Eccentricity test
h) Metallurgical test
i) Grain size
j) Inclusion rating
k) Chemical analysis
l) Microstructure
m) Mechanical failing load test (for Pin Insulator only)
n) Electro-mechanical strength test (for Strain insulator only)
o) Porosity test
p) Puncture test (for strain Insulator only)

Routine Tests

d. Visual Inspection
e. Mechanical routine test for Strain Insulator only)
f. Electrical routine test (for Strain Insulator only)

Tests During Manufacture

On all components as applicable

a) Chemical analysis of zinc used for galvanizing
b) Chemical analysis, mechanical, metallographic test and magnetic particle inspection for malleable castings.
c) Chemical analysis hardness tests and magnetic particle inspection for forgings
d) Hydraulic Internal Pressure tests On disc insulator shells

Test Reports

Copies of type test reports shall be furnished in at least six (6)' copies along with one original. One copy shall be returned duly certified by the Owner only after which the commercial production of the concerned materials shall start.
Copies of acceptance test reports shall be furnished in at least six (6) copies. One copy shall be returned duly certified by the Owner, only after which the material shall be despatch.
Record of routine test reports shall be maintained by the Contractor at his works for periodic inspection by the Owner's representative.

Test certificates of test during manufacture shall be maintained by the Contractor. These shall be produced for verification as and 'When desired by the Owner.

INSPECTION

The Owner's representative or third party nominee shall at all times be entitled to have access to the works and all places of manufacture, where insulator, and its component parts shall be manufactured and the representatives shall have full facilities for unrestricted inspection of the Contractor's and sub Contractor's works, raw materials, manufacture of the material and for conducting necessary test as detailedherein.

The material for final inspection shall be offered by the Contractor only under packed condition as detailed in the specification. The Owner shall select samples at random from the packed lot for carrying out acceptance

After placement of award, the Contractor shall submit fully dimensioned insulator drawings containing all the details, in four (4) copies to Owner for approval. After getting approval from Owner and successful completion of all the type tests, the Contractor shall submit 20 more copies of the same drawing to the Owner for further distribution and field use at Owner's end.

TECHNICAL SPECIFICATION FOR 33 & 11 KV STATION CLASS LIGHTNING ARRESTOR & 11 KV DISTRIBUTION CLASS SURGE ARRESTORS

2. 33kV VOLTAGE CLASS SURGE ARRESTORS

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

2.1. 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.

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 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.

2.3. GENERAL REQUIREMENT

2.3.1. 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.

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

2.3.3. 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.

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

2.3.5. 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.

2.3.6. 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.

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

2.3.8. 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.

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

2.3.10. 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.

2.3.11. 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.

2.4. ARRESTOR HOUSING

2.4.1. The arrestor housing shall be made up of **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 Grey **(for silicon polymeric)** colour, free from blisters, burrs and other similar defects.

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

2.4.2. 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.

2.4.3. Sealed housings shall exhibit no measurable leakage.

2.5. FITTINGS & ACCESSORIES

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

2.5.2. 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.

2.6. SURGE MONITOR :A self-contained discharge counter suitably enclosed for outdoor use and requiring no auxiliary or battery supply for operation shall be provided for each single pole unit.Leakage current meter with suitable scale range to measure leakage current of surge of surge arrestor shall also be supplied within the same enclosure.The number of operations performed by the arrestor shall be recorded by the suitable cyclometric counter and surge monitor shall be provided within the inspection window.There shall be a provision for putting ammeter to record the current/alarm contacts in the control room if the leakage current exceeds the permitted value.Similar provision shall be considered for the surge counter also..Surge monitor shall be mountrd on the support structure at a suitable height so that the raeding can be taken from the ground level through the inspection window and length connecting leads up to grounding point for 33kV class only.

2.7. TESTING:

2.7.1. Test on Surge Arrestors

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 following :

v) **Acceptance tests**

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

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

f) Internal ionization or partial discharge test

vi) **Special Acceptance tests**

c) Thermal stability test (IEC **99-4**clause 7.2.2)

d) Watt loss test.

vii) **Routine tests**

f) Measurement of reference voltage

g) Residual voltage test of arrester unit

h) Internal ionization or partial discharge test

i) Sealing test

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

viii) **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)
	Residual Voltage Test a) Steep current impulse residual voltage test b) Lightning impulse residual voltage test
	Long duration current impulse withstand test
	Switching surge operating duty test
	Power frequency voltage Vs. Time characteristics
	Accelerated Ageing test
	Pressure relief test a) High Current b) Low Current
	Artificial pollution test (for porcelain housing)
	Seismic Test
	Partial Discharge test
	Bending test
	a) Temperature cycle test (for porcelain housing) b) Porosity test (for porcelain housing)
	Galvanising test on metal parts
	Seal Leakage test (for porcelain housing)
	Seal leak test and operation tests (for surge monitor)
	Weather ageing test (for polymer housing)

2.7.2. 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.**

2.7.3. 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.

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

2.7.5. 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.

2.8. NAME PLATE

2.8.1. 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 Manufacture
- Name of the manufacture
- Name of Client : " "
- Purchase Order Number along with date

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 :

(xi) Outline dimensional drawings of Surge Arrestor and all accessories.

(xii) Assembly drawings and weights of main component parts.

(xiii) Drawings of terminal clamps.

(xiv) Arrangement of earthing lead.

(xv) Minimum air clearance to be maintained of line components to ground.

(xvi) Name plate.

(xvii) Instructions manual.

(xviii) Drawing showing details of pressure relief valve.

(xix) Volt-time characteristics of surge arrestors.

(xx) Detailed dimensional drawing of porcelain housing/Silicon polymeric i.e. internal diameter, external diameter, thickness, height, profile, creepage distance, dry arcing distance etc.

4.0 TECHNICAL PARTICULARS

4.1.1 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.

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

4.1.2 Surge Arrestors

Type of Surge Arrestor	Gapless Metal oxide
Arrestor rating (kV rms)	30
Continuous Operating voltage (kV rms)	25
Standard Nominal Discharge Current Rating (kA) (8x20 micro impulse	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

4.1.3 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 mm

4.1.4 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 g/m^2

5.0 11kV VOLTAGE CLASS SURGE ARRESTORS

5.1 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.

5.2 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.

5.3 GENERAL REQUIREMENT

5.3.1 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.

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

5.3.3 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.

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

5.3.5 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.

5.3.6 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.

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

5.3.8 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.

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

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

5.3.11 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.

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

5.4 ARRESTOR HOUSING

5.4.1 The arrestor housing shall be made up of **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 **Grey** (**for silicon polymeric**) colour, free from blisters, burrs and other similar defects.

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

5.4.2 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.

5.4.3 Sealed housings shall exhibit no measurable leakage.

5.5 **SURGE MONITOR :**A self-contained discharge counter suitably enclosed for outdoor use and requiring no auxiliary or battery supply for operation shall be provided for each single pole unit.Leakage current meter with suitable scale range to measure leakage current of surge of surge arrestor shall also be supplied within the same enclosure.The number of operations performed by the arrestor shall be recorded by the suitable cyclometric counter and surge monitor shall be provided within the inspection window.There shall be a provision for putting ammeter to record the current/alarm contacts in the control room if the leakage current exceeds the permitted value.Similar provision shall be considered for the surge counter also..Surge monitor shall be mountrd on the support structure at a suitable height so that the raeding can be taken from the ground level through the inspection window and length connecting leads up to grounding point for 11kV class only.

5.6 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.

5.7 FITTINGS & ACCESSORIES

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

5.7.2 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.

5.8 TESTS

5.8.1 Test on Surge Arrestors

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 following :

v) **Acceptance tests :**

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

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

f) Internal ionization or partial discharge test

vi) **Special Acceptance tests :**

c) Thermal stability test (IEC clause 7.2.2).

d) Watt loss test.

vii) **Routine tests :**

f) Measurement of reference voltage.

g) Residual voltage test of arrester unit.

h) Internal ionization or partial discharge test.

i) Sealing test.

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

viii) **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 c) Switching 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 c) High Current d) 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)

5.8.2 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.

5.8.3 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.

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

5.8.5 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.

5.9 NAME PLATE

5.9.1 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

5.10 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 :

(xii) Outline dimensional drawings of Surge Arrestor and all accessories.

(xiii) Assembly drawings and weights of main component parts.

(xiv) Drawings of terminal clamps.

(xv) Arrangement of earthing lead.

(xvi) Minimum air clearance to be maintained of line components to ground.

(xvii) Name plate.

(xviii) Surge monitor, if applicable.

(xix) Instructions manual.

(xx) Drawing showing details of pressure relief valve.

(xxi) Volt-time characteristics of surge arrestors.

(xxii) Detailed dimensional drawing of porcelain housing/Silicon polymeric i.e. internal diameter, external diameter, thickness, height, profile, creepage distance, dry arcing distance etc.

5.11 TECHNICAL PARTICULARS

5.11.1 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.

System Parameters

i)	Nominal system voltage	11kV
ii)	Highest system voltage	12 kV
iii)	System earthing	Effectively earthed system
iv)	Frequency (Hz)	50
ix)	Lightning Impulse withstand	75 Voltage (kVP)
x)	Power frequency withstand	28 Voltage (kV rms)
vii)	Arrestor duty	
	-- Connection to system	Phase to earth
	-- Type of equipment to be protected	transformers & switchgear

5.11.2 Surge Arrestors

i)	Type	Gapless Metal oxide outdoor
ii)	Arrestor rating (kV rms)	9
iii)	Continuous Operating voltage	7.65 (kV rms)
vi) shape)	Standard Nominal Discharge Current	10 Rating (kA) (8x20 micro impulse
v)	Degree of protection	IP **67**
vi)	Line discharge Class	2
vii)	Steep current at 10 kA	45
viii)	Lightning Impulse at 10 kA	40
x)	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

5.11.3 **Insulator Housing**

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

5.11.4 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

iv) Castings

Grey Iron, malleable iron	610 g/m^2

v) 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.

6.0 DISTRIBUTION CLASS SURGE ARRESTORS

Distribution class surge arrestors are generally used in distribution Transformer Substations only.

6.1 INTRODUCTION

This section covers the specification of Distribution class Surge Arrestor for 11kV transmission lines, transformers etc.

6.2 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
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.
IS3070-1993 (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 (1982) Circuits.
IEC –60099-4	Surge Arrestors

6.2.1 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.

6.3 GENERAL REQUIREMENT

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

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

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

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

6.3.5 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 contractor shall also recommend the procedure which shall be followed in providing the earthing/system to the Surge Arrestor.

6.3.6 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.

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

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

6.3.9 The Surge Arrestor shall be thermally stable and the contractor shall furnish a copy of thermal stability test with the bid.

6.3.10 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.

6.4 ARRESTOR HOUSING

6.4.1 The arrestor housing shall be made up of ***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 **Grey (for silicon polymeric)** colour, free from blisters, burrs and other similar defects.

6.4.2 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.

6.4.3 Sealed housings shall exhibit no measurable leakage.

6.5 ARRESTOR MOUNTING

The arrestors shall be suitable for mounting on 4 pole/2 pole structure used for pole mounted transformer and for incoming and outgoing lines.

6.6 FITTINGS & ACCESSORIES

6.6.1 The surge arrestor shall be complete with disconnector and terminal connectors and all other accessories.

6.6.2 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.

6.7 TESTS

6.7.1 Test on Surge Arrestors

The Surge Arrestors offered shall be type tested and shall be subjected to routine and acceptance tests in accordance with IS : 3070 (Part-3)-1993. In addition, the suitability of the surge arresters shall also be established for the following :

e) **Acceptance tests :**

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

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

vi) Internal ionization or partial discharge test.

f) **Special Acceptance tests :**

ii) Thermal stability test (IEC clause 7.2.2)

g) **Routine tests :**

Measurement of reference voltage

v) Residual voltage test of arrester unit.

vi) Internal ionization or partial discharge test.

vii) Sealing test.

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

h) **Type tests :** Following shall be type test As per IS 3070 (Part 3)-/IEC;60094 or its latest amendment :

1.	Insulation Withstand test c) Lightning Impulse voltage test d) Power Frequency (Dry & Wet)
2.	Residual Voltage Test c) Steep current impulse residual voltage test d) Lightning Impulse Residual Voltage Test
3.	Long duration current impulse withstand test
4.	High current impulse operating duty test
5.	Power frequency voltage Vs. Time characteristics
6.	Accelerated Ageing test
7.	Artificial pollution test (for porcelain housing)
8.	Partial discharge test
9.	Visual Examination (for porcelain housing)
10.	a) Temperature cycle test (for porcelain housing)
11.	Mechanical Failing Load test (Bending Strength test)
12.	Uniformity of Zinc coating, Mass of zinc coating
13.	Time versus current curve (for disconnector)
14.	Weather ageing test (for polymer housing)

6.7.2 The maximum residual voltages corresponding to nominal discharge current of 5 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.

6.7.3 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 alongwith the GTP.

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

6.7.5 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.

6.7.6 TEST ON SURGE ARRESTOR DISCONNECTORS

The test shall be performed on surge arrestors which are fitted with arrestor disconnector or on the disconnector assembly alone if its design is such as to be un-affected by the heating of adjacent parts of the arrestor in its normally installed portion in accordance with IS:3070 (Part-3).

6.8 NAME PLATE

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

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

6.9 DRAWINGS AND INSTRUCTION MANUALS

The successful bidder shall furnish to the purchaser the following drawings and literature for approval :

(xi) Outline dimensional drawings of Surge Arrestor and all accessories.

(xii) Assembly drawings and weights of main component parts.

(xiii) Drawings of terminal clamps.

(xiv) Arrangement of earthing lead.

(xv) Minimum air clearance to be maintained of line components to ground.

(xvi) Name plate

(xvii) Instructions manual

(xviii) Drawing showing details of pressure relief valve

(xix) Volt-time characteristics of surge arrestors

(xx) Detailed dimensional drawing of porcelain housing/Silicon polymeric i.e. internal diameter, external diameter, thickness, height, profile, creepage distance, dry arcing distance etc.

6.10 TECHNICAL PARTICULARS

6.10.1 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.

System Parameters

i)	Nominal system voltage	11kV
ii)	Highest system voltage	12 kV
iii)	System earthing	Solidly earthed system
iv)	Frequency (Hz)	50
xi)	Lightning Impulse withstand	75 Voltage (kVP)
xii)	Power frequency withstand	28 Voltage (kV rms)
vii)	Arrestor duty	
	-- Connection to system	Phase to earth
	-- Type of equipment to be protected	11 kV transformers & switchgear

6.10.2 Surge Arrestors

i)	Type	Gapless Metal oxide outdoor
ii)	Arrestor rating (kV rms)	9
iii)	Continuous Operating voltage (kV rms)	7.65
vii) shape)	Nominal Discharge Current	5 Rating (kA) (8x20 micro impulse
v)	Long Duration discharge class	Distribution class
vi)	Maximum residual voltage (kV peak)	
	a) at 5 kA	27
vii)	Partial discharge at 1.05 COV not greater than	50 (PC)
viii)	High current impulse withstand voltage at 5 kA (kVp)	65

6.11 INSULATOR HOUSING

i)	Power frequency withstand test voltage (Wet) (kV rms)	28
ii)	Lightning impulse withstand/tests voltage (kVP)	75
iii)	Creepage distance not less than (mm)	300

6.12 GALVANISATION

iv)	Fabricated Steel Articles	
	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
v)	Castings	
	Grey Iron, malleable iron	610 g/m^2
vi)	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

TECHNICAL SPECIFICATION FOR XLPE POWER CABLES (11KV &33 KV)

SECTION I

STANDARD TECHNICAL REQUIREMENT

1.0 SCOPE:

This section covers the standard technical requirements of design, manufacturing, testing, packing and dispatching of 11 kV and 33 kV XLPE HT Power Cable.

2.0 APPLICABLE STANDARDS

The materials shall conform to the latest editions of the following Indian/International Standards :

IS 7098 Part 2 : 1985 XLPE insulated PVC sheathed cables For working voltages from 3.3 kV up to and including 33 kV

IS 5831 : 1984 PVC Insulation and Sheath of electric Cables

IS 8130:1984 Conductors for insulated electric cables and flexible cords. IS 613:1984 Copper rods and bars for electrical purposes.

IS 3975:1988 Mild steel wires, formed and tapes for armouring of cable. IS 10810:1984 Method of tests for cables.

IEEE-383:1974 Standard for type test of class IE electric cables, field splices, and connections for nuclear power generating stations.

ASTM-D2843,1993 Standard test method for density of smoke from burning or decomposition

of plastics.

ASTM-D2863, 1991 Standard test method for measuring minimum oxygen concentration to support candle - like combustion of plastics (oxygen index).

NEMA-WC5,1992 Thermoplastic Insulated Wire and cable for the transmission and distribut ion of Electrical Energy.

IEC:754 Test on gases evolved during combustion of electric cables -

(Part-1):1994 Determination of the amount of halogen acid gas evolved during combustion of polymeric mat erials taken from cables.

IEC:332 Test on electric cables under fire conditions

(Part I):1993 Test on a single vertical insulated wire or cable. IS 3961 Recommended current rating for cables -

(Part II):1967 PVC insulated and PVC sheathed heavy duty cables. IS

10418:1982 Drums for electric cables.

3.0 GENERAL REQUIREMENTS

All cables shall be suitable for high ambient, high humid tropical Indian Climatic conditions. Cables shall be designed t o w it hst and t he mechanical, elect rical and t hermal st resses under t he unforeseen steady state and transient conditions and shall be suitable for proposed method of installation.

Conductor shall be of uniform, of good quality, free from defects Aluminium copper. Insulat

ion shall be Cross Linked Polyethylene (XLPE) .

For 33 kV and 11 kV cables, conductor screen and insulation screen shall both be extruded, semi-conducting compound and shall be applied along-with XLPE insulation in a single operat ion by triple extrusion process. Method of curing for 33 kV cable shall be "Dry curing/ gas curing " only, whereas for 11 kV and 3.3 kV cables it shall be "Dry curing/ gas curing / Steam curing".

Extruded Semi-conducting screening and metallic screening of copper tape shall be generally as per IS 7098 (Part-II) with latest amendments. The semi conducting compound shall be suitable for t he operating temperature of the cable and compatible with the insulating material.

The insulation screen shall be an extruded layer of black semi-conducting compound and cont inuously covers the whole area of insulation. The semi-conducting screens should be effectively cross linked t o achieve 90 ◦ C cable rating. The contact surface between insulat ion and insulat ion screen shall be smooth and free from protrusion and irregularities.

The interface between insulation and insulation screen shall be free of any voids. Insulation screen shall be strippable type.

The metallic screen shall consist of a layer of copper cable applied in helical form.

Inner sheath - All armoured and multi-core un-armoured cables shall have distinct extruded inner PVC sheath of black colour.

Armouring - Material for armour for Single Core Cable shall be Aluminum wire. For Multicore cable it shall be GS wire / flat. Armouring shall be as per relevant IS and it shall have minimum 90% coverage.

Breaking Load of the joints shall be minimum 95% of the normal armour.

Outer Sheath – It shall be of black colour PVC (type ST2 as per IS 5831) with Cable size and Voltage grade embossed on it. Sequential marking shall be at every 1 (one) Meter distance. Word "FRLS" shall also be embossed on it at every 5 (Five) meter distance.

FRLS Properties - All cable shall be Flame Retardant, Low Smoke (FRLS) type. Outer sheath shall have the following properties –

Acid Gas Generation – Max 20% (as per IEC 754-1) Smoke density rat

ing: 60% (As per ASTMD 2843)

Flammability test - As per Swedish chimney test F3 as per SEN 4241475

As per IEC 332 part-3 (Category B) Minimum bending

radius shall be 10 D Repaired cables shall not be accept

able.

4.0 CURRENT RATING OF CABLES

1) Normal current rating shall not be less than that covered by IS 3961. Vendor shall submit data in respect of all cables in the prescribed format.

2) Tables given de-rating factors for various conditions of cable installation including the following, for all types of cables shall be furnished.

- Variation in ambient air temperature. - Variation in ground temperature.
- Depth of laying.
- Cables laid in the ground - Cables laid in trench
- Cables laid in ducts - Soil resistivity.
- Grouping of cables.

3) The value of short circuit withstand current ratings of all cables shall be indicated for a short circuit for 1 second duration and should also specify the maximum temperature during short circuit.

4) The following factors shall also be accounted for, while specifying the maximum short circuit withstand of t he cables.

5) Deformation of the insulation, due to thermo-mechanical forces produced by the short circuit conditions, can reduce the effective thickness of insulation.

6) Conductor and core screens can be adversely affected with loss of screening effect.
Likewise the thermal properties of the outer sheath material can be the limitation.

7) It is essential that the accessories which are used in the cable system with mechanical and/or soldered connections are suitable for the temperature adopted for the cables.

8) Formula for calculating short circuit current for different duration or curve showing short time current v/s time for different sizes of cables shall be furnished by vendor.

5.0 CABLE DRUMS

5.1 Cables shall be supplied in non-returnable wooden or steel drums of heavy construction and drum shall be properly seasoned, sound and free from defects. Wood preservative shall be applied to the entire drum.

5.2 All Power Cables shall be supplied in drum length of 1000 m. Each drum shall contain one continuous length of cable. Owner shall have the option of rejecting cable drums with shorter lengths. The cable length per drum is allowed a tolerance of ±5%. The tolerance allowed on total quantity of each size is as given below.

3.150 meters for cable length upto 10 kms.
3.2100 meters for cable length more than 10 kms. and up to 20 kms.
3.3150 meters for cable length more than 20 kms.

Where the ordered quantity is not multiple of 1000 m and the incremental quantity is very small, the same may be included in one of the drums. Otherwise, an additional length for the incremental quantity will be supplied.

5.3 A layer of water proof paper shall be applied to the surface of the drums and over the outer most cable layer.

5.4 A clear space of at least 40mm shall be left between the cables and the logging.

5.5 Each drum shall carry manufacturer's name, purchaser's name, address and contract number, item number and type, size and length of the cable, net and gross weight stenciled on both sides of drum. A tag containing the same information shall be attached to the leading end of the cable. An arrow and suitable accompanying wordings shall be marked on one end of the reel indicating the direction in which it should be rolled.

5.6 Packing shall be sturdy and adequate to protect the cables, from any injury due to mishandling or other conditions encountered during transportation, handling and storage. Both cable ends shall be sealed with PVC/Rubber caps so as to eliminate ingress of water during transportation and erection.

6.0 TESTS

6.1 Type Tests

The following shall constitute type tests:

i) Tests on conductor

a. Annealing test (for copper)
b. Tensile tests (for aluminium)
c. Wrapping tests (for aluminium)
d. Resistance test

ii) Tests for armouring wires/strips

iii) Test for thickness of insulation and sheath iv) Physical tests for insulation

a. Tensile strength and elongation at break b. Ageing in air oven
c. Hot test
d. Shrinkage test
e. Water absorption (gravimetric)

v) Physical tests for out sheath

a. Tensile strength and elongation at break b. Ageing in air oven
c. Hot test
d. Shrinkage test

vi) Bleeding and blooming tests (for outer sheath)

vii) Partial discharge test viii) Bending t

est

ix) Dielectric power factor test

a. As a function of voltage
b. As a function of temperature

x) Insulation resistance (volume receptivity) tests xi) Heating

cycle test

xii) Impulse withstand test xiii) High volt

age test

xiv) Flammability test

6.2 Acceptance tests

The following shall constitute acceptance tests:

a. Annealing test (for copper)

b. Tensile test (for aluminium)

c. Wrapping tests (for aluminium)

d. Conductor resistance test,

e. Test for thickness of insulation f. Hot set test for

insulation,

g. Tensile strength and elongation at break test for insulation and sheath h. Partial discharge t

est (for screened cables only)

i. High voltage test and

j. Insulation resistance (volume resistively) test

6.3 Routine test

The following shall constitute routine tests:
i) Conductor resistance test
ii) Partial discharge test (for screened cables only) and iii) High voltage test
s.

6.4 Optional tests
Cold impact tests for outer sheath (IS:5831-1984) shall constitute the optional tests.

SECTION II

SPECIFIC TECHNICAL REQUIREMENTS AND QUANTITIES.

1.0 **SCOPE**

This section of the specification covers project information, site condition, desired Technical parameters and quantity of XLPE Cable.

1.1 Project Information a.
Customer :
b. Engineer/Consultant :
c. Project Location :
d. Transport facilities
i) Nearest Railway station : /Gauge ii) Dist
ance from site :
e. Access Roads :

1.2 **SITE CONDITIONS**

(i) Ambient air temp. (max.) °C : **(ii)** Ambient air temp. (min.) °C : **(iii)** Design ambient temp. °C :

1.2.1 Relative humidity for design : purposes
1.2.2 Height above mean sea level in : meters
1.2.3 Earth quake data

i) Seismic zone : IS:1893-84
ii) Seismic acceleration : As per IS 2.2.4

1.2.4 Wind data
Site Wind Pressure Kgf/m^2 : As per IS 2.3
1.3 System Particulars

a	Line Voltage (kV)	11/33
b	Highest System Voltage (kV)	12/36
c	Number of Circuits	1
d	Frequency	HZ50
e	Neutral	effectively earthed
f	Short circuit level (KA)	22.77 KA, 31.8KA / 22.5KA,45KA

1.4 **SPECIFIC TECHNICAL REQUIREMNTS**
Technical Parameters of the cable shall be as follows:

S.	PARTICULAR	Unit	DATA	DATA
1	Rated Voltage	kV	6.35/11	19.0/33
2	Type of Insulation	-	XLPE	XLPE
3	Single core/ Multi core	-	Single/Three core	Single/Three core

4	Armoured / Unarmoured	-	Armoured	Armoured
5	Material of Conductor	-	Aluminium/Copper	Aluminium/Copper
6	System	-	11 kV Earthed	33 kV Earthed
7	Highest System Voltage	kV	12	36
8	Conductor size	sq. mm	120, 150, 185, 240, 300	150, 185, 240, 300,
9	Material		Stranded Aluminium/copper	Stranded Aluminium/copper
10	Shape of Conductor		Circular	Circular
11	Short Circuit Current	kA	13.12 , 18.35 for 3 secs.	13.12, 26.24 for 3
12	Power Frequency Withstand	KV rms	28	70
13	Lightning Impulse Withstand	kVp	75	170
14	Continuous Withstand	Deg C	90	90
15	Short Circuit withstand	Deg C	250	250
16	Oxygen Index		Min 29 (as per ASTMD 2863)	Min 29 (as per ASTMD 2863)
17	Acid Gas Generation		Max 20% (as per IEC 754 -	Max 20% (as per IEC
18.	Smoke Density Generation		60% (As per ASTMD 2843)	60% (As per ASTMD
19.	Flammability Test		As per Swedish Chimney	As per Swedish Chimney test

SECTION-III

GUARANTEED TECHNICAL PARTICULARS

Sl. No.	Item Particulars	Unit
1	Manufacturers Name & Address	
2	Country of manufacturer	
3	Type of cable	
4	Applicable standards for manufacturing	
5	Applicable standards for testing	
6	Rated voltage	kV
7	Maximum service voltage	kV
8	Maximum continuous current carrying capacity per cable when lain in air at an ambient air temperature of 50 deg. (single core cables solid bonded)	A

9	Maximum continuous current carrying capacity per cale when lain in ground at a depth of 1.0 m (ground temp. 40 deg. C and soil thermal resistivity of 150 deg.c/watt/cm max. Conductor temp. 90 deg. C) (single core cables solid bonded)	A
10	Maximum continuous current carrying capacity per cable when drawing into duct./pipes (single core cables solid bonded)	A
11	Maximum continuous current carrying capacity per cable when lain in covered RCC trenches at an ambient temperature of 50 Deg. C laying conditions to be specified (Single core cables solid bonded)	A
12	Short circuit withstand capacities for 1 second of (With a conductor temperature of 90 Deg. C at the commencement	
i)	Conductor	KA
ii)	Screen	KA
iii)	Armour	KA
13	Conductor	
i)	Material & Grade	
ii)	Nominal cross – sectional area	sq.mm
iii)	No. of strands	
iv)	Diameter of each strand (Nominal)	mm
v)	Max. DC resistance of conductor at 20 Deg. C	ohm/km
vi)	Max. AC resistance of conductor at 90 Deg. C	ohm/km
14	Reactance of cable at normal frequency (Approx)	ohm/km
15	Electrostatic capacitance at normal frequency	mircorfarads per km
16	Charging current	
17	Loss tangent at normal frequency at Uo	
18	Conductor screen	
i)	Material	
ii)	Nominal thickness	mm
19	XLPE Insulation	
i)	Composition	

ii)	Type of curing	
iii)	Thickness of insulation (nominal)	mm
iv)	Tolerance on thickness	mm
v)	Dielectric constant at normal frequency	
vi)	Specific insulation resistance at 20 deg. C	ohm/km
vii)	Min. Volume resistivity at 20 deg. C	
viii)	Min. volume resistivity at 90 deg. C	
ix)	Min. Tensile strength	kg/sq.cm
x)	Min. Elongation percentage at rapture	%
xi)	Identification of cores	
20	1.2/50 microsecond impulse wave withstand voltage	kVp
21	5 min. power frequency withstand voltage	kV
22	Max. Dielectric stress at the conductor	kV/cm
23	Max. Dielectric stress at the conductor screen	kV/cm
24	Insulation screen	
i)	Material	
ii)	Extruded/wrapped	
iii)	Nominal thickness	mm
iv)	Colour	
25	Metallic screen	
i)	Material / composition	
ii)	Nominal radial thickness / dia	
26	Nominal diameter over metallic screen	mm
27	Nominal radial clearance allowed under metal sheath	mm
28	Type and material of filler	
29	Armour	
i)	Material and type	
ii)	Dia	