ASSAM POWER DISTRIBUTION COMPANY LTD.

BID DOCUMENT

FOR

Construction of 33 KV line to provide power supply to Numaligarh Refinery Limited, C/O Lakhyadhar Kalita, Vill: Patgirichuba, P.O. Dhekipara, Sipajhar, Dist: Darrang (Assam) under Sipajhar ESD under deposit work on Full Turnkey Mode.

SCHEME: "DEPOSIT SCHEME"

NIT No. CGM (D)/APDCL/LAR/NRL/Dhekijhara, Sipajhar/2025-26/

INDEX

SECTION-I
(Notice Inviting Tender)

NIT No. CGM (D)/APDCL/LAR/NRL/Dhekijhara, Sipajhar/2025-26/ 02

E-tenders are invited for Construction of 33 KV line to provide power supply to Numaligarh Refinery Limited, C/O Lakhyadhar Kalita, Vill: Patgirichuba, P.O. Dhekipara, Sipajhar, Dist: Darrang (Assam) under Sipajhar ESD under deposit work on Full Turnkey Mode.

KEY Dates:

1.	Tender download start date	: 22.05.2025
2.	Pre-Bid meeting date	: 1400hrs. on 27.05.2025
3.	Bid Submission start date	: 30.05.2025
4.	Bid Submission end date	: 1700hrs. on 06.06.2025
5.	Technical Bid opening date	: 1300hrs. on 09.06.2025

For details please visit www.apdcl.org & **https://www.assamtenders.gov.in**

Chief General Manager (D&S)
APDCL, LAR.

M. No: CGM (D)/APDCL/LAR/NRL/Dhekijhara, Sipajhar/2025-26/02 (1-7) Dated: 21-05-2025

Copy to:-

1. The P.S. to Chairman, APDCL, Bijulee Bhawan, Guwahati-1 for kind appraisal of the Hon'ble Chairman.
2. The P.S. to the MD, APDCL, Bijulee Bhawan, Guwahati-1 for kind appraisal of Hon'ble MD.
3. The General Manager, Rangia Zone, APDCL, LAR, Rangia for information.
4. The Chief Executive Officer, Mangaldoi Electrical Circle, APDCL, LAR, Mangaldoi, for information.
5. The OSD to Chairman, APDCL, Bijulee Bhawan, Guwahati-1 for uploading the above notice in the APDCL's Website.
6. The Public Relation Officer, APDCL, Bijulee Bhawan, Paltanbazar, Guwahati-1 for publication of the above NIT in one issue of "The Assam Tribune" and one in vernacular daily.
7. The Assistant General Manager, Mangaldoi Electrical Division, APDCL, LAR, Mangaldoi for information.

Chief General Manager (D&S)
APDCL, LAR.

ASSAM POWER DISTRIBUTION CO. LTD.
APDCL, LAR
NOTICE INVITING TENDER

NIT No. CGM (D)/APDCL/LAR/NRL/Dhekijhara, Sipajhar/2025-26/

The Chief General Manager (D&S), LAR, Assam Power Distribution Co. Ltd., Bijulee Bhawan, Paltanbazar, Guwahati-1, invites E- tenders from valid Electrical Contractors holding license up to 33 KV issued by the competent authority, for the following works under Mangaldoi Electrical Circle, APDCL on full 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. With GST
Construction of 33 KV line to provide power supply to Numaligarh Refinery Limited, C/O Lakhyadhar Kalita, Vill: Patgirichuba, P.O. Dhekipara, Sipajhar, Dist: Darrang (Assam) under Sipajhar ESD under	2794	25	365	13,440.00

1. **Source of fund**: **"Deposit Scheme"**
2. **Estimated Project Cost: Rs. 11,17,52,967.00 (Rupees Eleven Crore Seventeen Lakhs Fifty-Two Thousand Nine Hundred and Sixty-Seven only).**
3. **Download of Tender:** The Bid document can be downloaded from the APDCL's websites. www.assamtenders.gov.in or www.apdcl.org for tender submission purpose. Interested bidders can download the bidding document and commence preparation, download of bidding document is free of cost. However, the bidder must deposit on line non-refundable tender processing fee of Rs. 13,440.00 (Incl. of GST @ 12%) (Rupees Thirteen Thousand Four Hundred and Forty) while online submission of the tender in www.assamtenders.gov.in**. Any bid without payment of cost of tender for package as above will be rejected outright.**
4. **Earnest money**: As shown in the table above.
5. **Eligibility Criteria**:

a) The intending Bidder 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 2021-22, FY 2022-23, FY 2023-24 against 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, line of credit and other financial means, net current commitments, 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.

6. **Bid validity: 460 days** from the last date of submission of Bid

1.	Tender download start date	: 22.05.2025
2.	Pre-Bid meeting date	: 1400hrs. on 27.05.2025
3.	Bid Submission start date	: 30.05.2025
4.	Bid Submission end date	: 1700hrs. on 06.06.2025
5.	Technical Bid opening date	: 1300hrs. on 09.06.2025

Note:

1. The work shall be carried out as per latest APDCL specification and construction.
2. Bids must be submitted electronically through e-tender portal www.assamtenders.gov.in in two parts as **Techno Commercial bid** and **Price bid.** 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.
   Earnest money EMD should be submitted online through portal https://assamtenders.gov.in The earnest money for the work is Rs. 25,00,000.00 (Rupees Twenty Five Lacs) only. Any tender without EMD will be rejected outright.
3. Only those bidders who are found acceptable in Part-I Bid with adequate bid capacity shall 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 qualified for opening.
4. The Company reserves the right to accept or reject any tender in part or in full or split the work of any package without showing any reason thereof.
5. Bidders are not allowed to withdraw bid after last time of submission of bid and he/she shall be considered as active bidder throughout the bidding process.

Chief General Manager (D&S)
APDCL, LAR, Paltan bazar, Guwahati-01

Memo No. CGM (D)/APDCL/LAR/NRL/Dhekijharn, Sipajhar/2025-26/12 (1-7) Dated: 21-05-2025

Copy to:-

1. The P.S. to Chairman, APDCL, Bijulee Bhawan, Guwahati-1 for kind appraisal of the Hon'ble Chairman.
2. The P.S.to Managing Director, APDCL Bijulee Bhawan Paltan Bazar for information.
3. The Chief Executive Officer, Mangaldoi Electrical Circle, APDCL, LAR, Mangaldoi, for information.
4. 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.

Chief General Manager (D&S)
APDCL, LAR, Paltan bazar, Guwahati-01

SECTION 2

TENDER INVITING PROPOSAL

ASSAM POWER DISTRIBUTION CO. LTD. APDCL, LAR

TENDER INVITING PROPOSALS WITH TERMS & CONDITIONS

Name of work:

1. E-tenders are invited for Construction of 33 KV line to provide power supply to Numaligarh Refinery Limited, C/O Lakhyadhar Kalita, Vill: Patgirichuba, P.O. Dhekipara, Sipajhar, Dist: Darrang (Assam) under Sipajhar ESD under deposit work on Full Turnkey Mode.

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.

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.

v) Site fabrication work as per requirement.

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

- Erection, testing and commissioning of all materials/equipment supplied/system installed.

vii) Project management and site organization.

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

ix) Submission of technical specification/Test Certificate/Drawings etc. of all materials supplied.

x) 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.

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

xii) Required jungle cutting.

xiii) Prior to starting of the physical work, the successful bidder shall carry out route survey & prepare Layout diagram and shall submit (in A4 paper) to office of the CGM (D&S), APDCL, LAR for approval.

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 specification and 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 equipment supplied and installed shall provide easy and effective:

- Maintainability
- Reliability
- Availability
- Long life

All equipment 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 work.

vi. It is necessary to ensure utilization of CBuD app in all the digging works and must have to be used the CBuD clause.

5. Basic qualifying requirement:

To be qualified for the package the bidder must compulsorily meet the following minimum criteria.

A. Technical.

The prospective bidder must fulfill the following qualifying requirements

a. The bidder must register themselves in the **Contractor Management System (CMS)** portal before submission of bid and shall furnish the Provisional Registration Certificate issued from the portal.

b. The bidder must have valid Electrical Contractor's and Supervisor's License (HT minimum up to 33 KV) issued by any Licensing Authority of Govt. of Assam. In case, the bidder does not have the licenses from the Licensing Authority of Govt. of Assam but has valid licenses from other Licensing Authority under the Electricity Act 2003, the bidder will have to obtain the same from the Licensing Authority of Govt. of Assam in case of award of contract.

c. **The Bidder must have experience of:**

(i) Successful Construction and commissioning of minimum 5 (five) Circuit Km. of new 33 KV overhead lines with covered conductor (MVCC), minimum 1 (One) Circuit Km of 33 KV overhead lines with ACSR Wolf conductor, minimum 1 (One) Circuit Km of 11 KV overhead lines with ACSR Racoon conductor and minimum 1 (One) Circuit Km of LT overhead lines with ACSR Rabbit conductor, all in a single work order, during the last 5 (five) FY under electrical network of a Discom along with the same nature of work as per NIT.

(ii) Successful Installation of minimum 1 (one) set of 33KV Isolator with GI mounting structure and minimum 1 (one) set of 33KV Lightning Arrestor with surge monitor, GI mounting structure (station type) during the last 5 (five) FY under electrical network of a Discom along with the same nature of work as per NIT.

d. The Bidder shall submit ***certificates of satisfactory operation*** of the works submitted to fulfill as required above as on date of opening of bid.

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

f. The bidder shall furnish details of the work / works along with its value already in hand either of ASEB or in any other successor companies of APDCL or any other Electrical Utilities within India along with date of completion as per Letter of Award and likely date of completion duly certified by the competent authority. **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.**

g. **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 by him/her, and if the delay is solely because of fault of contractor or reasons attributable to him/her, then he/she is barred from participating in this bid and the bid shall be considered as non-responsive**.

B. Financial

a. Average annual turnover of the bidder for the last three consecutive financial years shall be as per NIT and the annual turnover must be certified by a registered Chartered Accountant. This shall be supported by the copy of audited balance sheet, for last three consecutive 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 each 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.

c. The bidder shall furnish GST registration certificate, Employee Provident fund and valid Labour License (wherever applicable).

d. The bidder 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 copy of Pan Card of both the partner/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.

C. Bid Capacity:

The Bidders who meet the minimum qualification criteria mentioned against the A) Technical & B) Financial section will be qualified only if their available bid capacity at the time of bidding is more than the estimated cost of the tender. The available capacity will be calculated as under:

Assessed available bid capacity = (A*N*2-B)

Where,

A = Maximum value of Electrical works executed in any one year during the last five years (updated to the price level of the year as indicated in Annexure 1(E) rate of inflation may be taken as 10% per year taking into account the completed as well as works in progress.

N = Number of years prescribed for completion of the works for which bids are invited. (Value of N=1/2 Up to 6 Months & N=1 above 6 Months)

B = Value (updated to the price level) of existing commitments and ongoing works to be completed during period of completion of works for which bids are invited. In support of this the intending bidder has to submit an affidavit as per the format indicated in the annexure 1(F) along with all the relevant supporting documents mention therein.

N.B The statements showing the value of existing commitments and ongoing works as well as the stipulated period of completion remaining for each of the works listed shall be countersigned by the Engineer in charge, not below the rank of **CEO/DGM/Superintending Engineer** of electrical utilities.

- APDCL reserves the right to carry out the Bid Capacity assessment of the Bidders and the owner's decision shall be final and binding to the bidder.
- 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

  Record 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 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) failing which the LOA shall be treated as cancelled without further communication from APDCL end.

7. Performance Guarantee:

The successful bidders shall have to make an agreement with the CGM (D), APDCL, LAR and shall have to ***deposit security money in the form of Bank Guarantee*** issued by any Nationalized Bank or scheduled bank of RBI in Company's standard Performa on non-judicial stamp of appropriate value for an amount equal to 10 % of the contract value at the time of execution of agreement in favour of **"CGM (F&A), APDCL",to the CGM(D),APDCL(LAR) as per companys terms and condictions,valid for a period of 60(sixty) days beyond the stipulated date of completion of the project as per LoA.**. The security deposit is liable to be forfeited in case of non-execution of contract / work order. The security deposit will be released on successful commissioning and testing of the materials ordered and after depositing performance B/G for an amount equal to 10% of the contract value in the form of Bank Guarantee issued by any Nationalized Bank or scheduled bank of RBI in Company's standard Performa with a **validity of 20 (18+2) (Eighteen + Two) months beyond the completion period** in favour of **"CGM (F&A), APDCL".**

8. Additional Performance Guarantee in the event of ALB :

In the event that an Abnormally Low Bid has been accepted for award of contract, the successful bidder shall be required to submit an additional Performance Security along with the regular Contract Performance Guarantee for an amount calculated as under:

i) If the Bid Price offered by the shortlisted Bidder is lower than 10% but up to 20% of the estimated Project cost, then the Additional Performance guarantee shall be calculated @ 5% of the Contract Price.

ii) If the Bid Price offered by the shortlisted Bidder is below 20% of the estimated Project cost, then the Additional Performance guarantee shall be calculated @ 15% of the Contract Price.

1.1. The additional Performance guarantee shall be treated as part of the Performance guarantee and shall be valid for a period coextensive with the Contract Performance guarantee

1.2. Non-submission of the additional Performance guarantee shall constitute sufficient ground to reject the bid and similar assessment pursuant to clause 1 will be made for the next ranked bidder.

1.3. The additional Performance guarantee shall be treated as part of the Performance guarantee and shall be valid for a period coextensive with the Contract Performance guarantee

1.4. Non-submission of the additional Performance guarantee shall constitute sufficient ground to reject the bid and similar assessment pursuant to clause 1 will be made for the next ranked bidder.

9. Joint Venture Requirement

i. In case of successful Bidder, one form of agreement (at annexure) shall be signed by the both partners so as to be legally binding on both.

ii. 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.

iii. 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.

iv. 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).

v. A copy of the joint venture agreement shall be submitted with the bid.

vi. 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.

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

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

viii. The submission of E-tender shall be digitally signed by the lead partner of JV only

10. Other requirements:

The Bidder

i) Shall be acquainted himself with relevant conditions of the local geography and socio-economic setup of the different location of the State and being capable accordingly to mobilize, organize and expedite the activities.

ii) Shall have adequate working personnel comprising of Electrical/ Mechanical engineers, 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. ISS guidelines

11. Submission of bid:

Bids must be submitted electronically through e-tender portal https://assamtenders.gov.in in two parts as Techno Commercial bid and Price bid.

EMD should be submitted online through portal https://assamtenders.gov.in The earnest money for the work is Rs. 25,00,000.00 (Rupees Twenty Five Lakh) only. Any tender without EMD will be rejected outright.

The EMD to the successful bidders will be released on submission of 10% Performance Security Deposit to the undersigned as per the clause of the bid document. The EMD of the successful bidder will be forfeited on non-acceptance of Letter of Intent (LOI) within the stipulated period mentioned in LOI.

12. 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 bidder 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 APDCL. 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) GTP'S of major items as described in BOQ. such as poles, conductors, insulators, surge arrestor, stay set, earth pipe etc. as per bid requirements shall invariably be submitted along Price bid shall be with the tender otherwise tender is liable to be rejected.

xiv) The bidder must submit manufacturer's authorization for supply of the offered materials along with warranty pledged by the Original Equipment Manufacturer.

Note:-

a. If the price of any item is kept blank, the highest rate quoted among the techno-commercial qualified bidder will be loaded for evaluation purpose. However, if the bidder happens to be L-1 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.

c. **Pre-bid meeting**: Prospective bidders are requested to be present in the Pre-bid meeting on the date mentioned in the NIT without fail, so that all kind of queries can be discussed. APDCL will not accept any complaint, request for correction/modification etc. after pre-bid meeting is over.

A. **Estimated amount:** The total quantity of materials required is indicated in the BOQ. The estimate is prepared on the basis of latest Schedule of Rate of APDCL and the same is available in the official website of APDCL.

xv) **Quantity Variation**: There may be increase or decrease in quantity of individual item 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 labor 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), APDCL, LAR

xvi) 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 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. **In no case, the contract shall be awarded to any bidder whose bid capacity is less than the estimated cost of the project put to the tender.**

iv. Work shall be started within Ten (10) days from the date of issue of the work order, failing which order will be cancelled without further correspondence.

v. The successful bidder must have to complete survey works Twelve (12) days from the date of issue of work order & submit quantity variation within that period.

vi. All the materials installed shall be under custody of the contractor till the date of commissioning and charging. The properties will be taken over by APDCL, only after satisfactory commissioning and charging.

xvi) **All quoted rate shall be inclusive of all taxes as applicable as per prevailing rate.**

xvii) **Period of completion: 365 days from the date of issue of work order.**

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

xviii) **Implementation schedule:**

Comprehensive implementation schedule of work for the mentioned works

Sl. No	Description	EXECUTION PERIOD				
		7 days	15 days	90 days	243 days	10 days
1	Signing of Agreement					
2	Survey works & submission of drawings/GTP					
3	Manufacture & supply of materials					
4	Erection of equipments					
5	Testing & commissioning					

xix) **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.

xx) **Terms of Payment:**

1. During the continuance of the Contract, Maximum 2 (two) nos. of Progressive bills shall be entertained. The progressive payments shall be made for the actual volume of work including supply as well as erection of the materials under the following conditions:

2. **1st Progressive Bill: -** 80% (eighty percent) payment against 1st progressive bill shall be released retaining the balance 20% (twenty percent) amount, subject to the condition that minimum 40% (forty percent) BOQ materials of the LOA have been erected successfully. The bill shall be supplemented by the following documents, satisfactory verification and acceptance of which shall make the Contractor eligible for receipt of payment against the progressive bill:

i) Unconditional acceptance of the Letter of Award (LOA) and signing of Contract Agreement by the Contractor.
ii) Submission of an unconditional and irrevocable Bank Guarantee for 10% (ten percent) of the Contract price in pursuant terms and condition of the bid.
iii) Submission of GST invoice/GST E-invoice (if applicable) consisting the GSTIN & PAN No. of the Contractor as well as APDCL must be mentioned in the Bill in printed form along with the Name of Work, LOA No., HSN/SAC code etc.
iv) **In consonance to the Office order no. APDCL/GST/OTHERS/669/02 Dtd. 04-09-2021, the contractor shall mandatorily submit the copy of GSTR1 (respective pages only – B2B Receiver wise summary, B2B Invoice Summary), wherein their invoice wise details shall be available and GSTR 3B filed.**
The payment shall be suspended in the event of non-compliance of the said office order.
v) Copy of the Material Inspection & Clearance Certificate (MICC) and Material Receipt and Handing Over Voucher (MRHOV) duly signed by the concerned consignee location and duly countersigned by the CEO of the Electrical Circle.
vi) Manufacturer's copy of the Delivery Challan.
vii) Manufacturer's Warranty Certificate for the materials under bill submission.
viii) Photographic evidences of the supplied materials duly signed by the concerned consignee location and duly countersigned by the CEO of the Electrical Circle.
ix) Submission of Physical Progress Report as per the proforma provided along with the LOA duly signed by the concerned consignee location and duly countersigned by the CEO of the Electrical Circle.
x) Upload the photographic evidence of actual physical progress through APDCL Work Master app for relevant BOQ of the materials. The information received through this app will be verified with the supply and erected quantities before releasing of the bills.

3. 2nd Progressive Bill: - 80% (eighty percent) payment against 2nd progressive bill shall be released retaining the balance 20% (twenty percent) amount, subject to the condition that minimum 40% (forty percent) BOQ materials of the LOA have been erected successfully in addition to the 40% materials erected earlier against the 1st progressive bill. The documents indicated against point XX.2 above (Sl No. i to x) shall also require to be submitted along with the bill, satisfactory verification and acceptance of which shall make the Contractor eligible for receipt of the progressive payment.

4. 3rd and Final Bill: - 100% (hundred percent) payment against 3rd and final bill shall be released along with the 20% (twenty percent) retention amount of respective 1st and 2nd Progressive bills after successful completion and commissioning of the project subject to acceptance and validity of the Performance Bank Guarantee in accordance to clause of the ITB. The documents indicated against point XX.2 above (Sl No. i to x) shall also require to be submitted along with the bill, satisfactory verification and acceptance of which shall make the Contractor eligible for receipt of final payment.

5. All the aforesaid bills after due verification by the concerned Sub-divisional Engineer, 100% of the bill passed by the concerned Electrical Division and countersigned by the concerned Chief Executive Officer (CEO) of

the Electrical Circle, shall be placed before the CGM (D&S), APDCL for payment.

6. All the material and billing related transactions must be executed through ERP system only. In this context, the respective consignee locations are requested to undertake necessary steps to perform the goods receipt/service acceptance related transactions against the PO/WO number. No supply/erection bills shall be processed for payment unless the necessary transactions in ERP are performed by the concerned consignee locations.

7. 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 referred to the appropriate authority within 6(Six) months from the date of completion or deemed completion as per clause of Company's GCSE.

8. The Payment shall be made **subject to availability of Fund.**

xxi) **Project Management and site Organizations:**

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, Senior 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 Work's/offices.

xxii) **Guarantees and Penalties:**

a) **Liquidated Damages (LD)** The proposed work is on top priority of Government of Assam and therefore has to be completed within stipulated/agreed schedule. Any delay beyond that will attract penalty as per Company's General condition of supply and erection.

b) **Defect liability period: 18** months from the date of commissioning.

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 will lead to forfeiture of the BG against the equipments in full or in part which is at the absolute discretion of APDCL.

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

e) 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 three years.

f) The critical components like circuit breaker, transformer, CR panel shall be covered under the extended defect liability for a period of 60 (sixty) months from the date of commissioning.

xxiii) **Approvals/Clearances:**

a) APDCL, concerned CEO shall approve all site and documents prepared by the contractor for construction of the Line.
b) GTP and drawings of all equipment/ materials shall be approved from the O/o the CGM (D), APDCL, LAR.
c) The contractor shall obtain all statutory approvals and clearances from the statutory authorities before charging the system at his/her own cost and effort.

xxiv) **Testing & Inspection:**

All the equipment's / 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), APDCL, LAR sufficiently in advance (at least 15 days) regarding the date of inspection of materials/ equipment's at manufacturer's works. The materials to be dispatched to site only after receipt of dispatch clearance issued by the CGM (D), APDCL, LAR after satisfactory testing of the same. Each lot of materials have to be inspected by the concerned field officials of APDCL before deploying in the site.

xxv) **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 licensed Authority.

xxvi) **Submission of documents**

a) With bids.

i) Detail list of makes and materials offered with catalogues, technical specification, type test, performance certificate, 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 writ-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 and supervisor's license, etc.
viii) Certificate from Registered Charted Accountant in support of Annual turn over
ix) Solvency certificate from Bank
x) Earnest money deposit along with Techno- Commercial bid
xi) 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.

xxvii) **Funding of the project: The proposed work is funded by Deposit Scheme.**

xxviii) **Abnormally Low Bids (ALB)**

1.5. An abnormally Low Bid is one in which the Bid price, in combination with other elements of the Bid, appears to be so low that it raises concerns as to the capability of the Bidder to perform the contract for the offered price.

1.6. For the purpose of identification and dealing with the ALBs, the MD, APDCL shall act as ex-officio Chairman of the Tender Evaluation Committee. The Committee shall undertake the following three-stage review process to check the possibility of an ALB by a potential successful bidder and take necessary action, as deemed fit. The decision of the Committee shall be conclusive and binding on all.

i. identify abnormally low costs and unit rates by comparing them with the APDCL estimate or other substantially responsive bidders, or recently awarded similar contracts;
ii. clarify and analyze the Bidder's resource inputs and pricing, including overheads, contingencies and profit margins; and
iii. Decide whether to accept or reject the Tender.

1.7. The ALBs shall be identified using any of the following 2(two) methodologies, as applicable:
When Estimated Cost is disclosed:
In this case, the ALB shall be identified based on the comparison with the Estimated Cost of the Project. The bids with quoted price below 10% (ten percent) of the Estimated Cost shall be treated as ALB by the Committee.

1.8. Once a potential ALB has been identified, the Committee will seek a written explanation from the bidder of the reasons for the offered Tender price, including a detailed price analysis, proposed methodology, schedule, and allocation of risks and responsibilities. This may also include information regarding the economy of the manufacturing process; the services to be provided, or the construction method to be used; the technical solutions to be adopted; and any exceptionally favorable conditions available to the bidder for the works, equipment or services proposed.

1.9. Failure to furnish the required information against point 1.4 above within the stipulated time period will lead to the rejection of the bidder. In that case, the Committee will resort to the next lowest ranked bidder and reiterate the process, in case that bidder also happens to come under ALB.

1.10. On receiving the Bidder's justification, the Committee will meticulously examine the information provided by the bidder while taking into account all the relevant evidences produced in response to the request for clarification.

1.11. After examining the explanation given and the detailed price analyses presented by the bidder, the Committee may at its sole discretion:

i. accept the Tender subject to requiring the bidder to submit an Additional Performance Security in pursuant to the Clause 2.1 to protect the Employer from any financial loss in the event of default of the successful bidder under the contract; or
ii. reject the Tender, if the evidence provided does not satisfactorily account for the low Tender price and make a similar determination for the next lowest ranked bid, if required.

xxix) **Termination of contract on Contractor's default**

If the Contractor shall neglect to execute the Works with due diligence and expertise or shall refuse or neglect to comply with any reasonable order given to him, in the Contract 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 and in such case 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 of 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.

xxx) **Extension of time for Completion:**

Primarily, there shall not be any extension of time for project completion irrespective of size & volume of work except under the following circumstances: -

a) If at any time during performance of the Contract, the Contractor encounters conditions impeding timely delivery of the Goods or completion of related Services under the purview of the contract, the Contractor shall promptly notify APDCL in writing of the delay, its likely duration, and its cause. As soon as practicable after receipt of the Contractor's notice, APDCL shall evaluate the situation and may at its discretion extend the Contractor's time for performance, in which case the extension shall be ratified by the Parties by amendment of the Contract.

b) Any occurrence of Force Majeure as provided under sub-section xxxi) under this section of the Bid Document.

xxxi) **Force Majeure**

The Contractor shall not be liable for forfeiture of its Performance Security, liquidated damages, or termination for default if and to the extent that it's delay in performance or other failure to perform its obligations under the Contract is the result of an event of Force Majeure. For purposes of this Clause, "Force Majeure" means an event or situation beyond the control of the Contractor that is not foreseeable, is unavoidable, and its origin is not due to negligence or lack of care on the part of the Contractor. Such events may include, but not be limited to wars or revolutions, earthquake, fires, floods, epidemics, quarantine restrictions, and freight embargoes. If a Force Majeure situation arises, the Contractor shall promptly and no later than 10 (ten) days from the first occurrence thereof, notify APDCL in writing of such condition and the cause thereof. Unless otherwise directed by APDCL in writing, the Contractor shall continue to perform its obligations under the Contract as far as is reasonably practical, and shall seek all reasonable alternative means for performance not prevented by the Force Majeure event. The decision of APDCL with regard to the occurrence, continuation, period or extent of Force Majeure shall be final and binding on the Contractor.

xxxii) **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.

xxxiii) **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 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.

xxxiv) **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.

xxxv) **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.**

xxxvi) **If for any reason the date of pre-bid discussion is a declared holiday, then the next working day will be considered for pre bid discussion.**

xxxvii) **Terms and conditions, which are not specified herein above will be governed by the APDCL's General Conditions of supply and erection in force.**

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. CGM (D)/APDCL/LAR/NRL/Dhekijhara, Sipajhar/2025-26/

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 another successor Companies of APDCL) - 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 / Notarized Joint venture Agreement if JV			
3	Registered / Notarized 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 2021-22, FY 2022-23& FY 2023-24)			
2	CA Certified Turnover of bidder during the last 3(three) years.			
3	Evidence of adequacy of working capital for this contract (access to line (s) 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			
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 in any one year (12 months)			
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 APDCL &

(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 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 named above, in accordance with ITB 4.1 and 4.2.
- ❑ 2. Authorization to represent the firm or JV named in above, in accordance with ITB 22.2.
- ❑ 3. In case of JV, letter of intent to form JV or JV agreement, in accordance with ITB 4.1.
- ❑ 4. In case of a government-owned entity, any additional documents not covered less than 1 above required to comply with ITB 4.5.

ANNEXURE 1(E)

Format for assessing the Bid Capacity of the Bidders To calculate the value of "A"

The following table contains the value of Electrical Works/Projects (Turnkey projects / Item rate contract/Construction works) undertaken by the Bidder during the last 5 years.

SL No.	Financial Year	Total Value of Electrical works done during the year (excluding advance such as mobilisation advance etc.) ** In Rs.	Factor for updating to current price level	Updated Value of the Work In Rs.
		A	***B***	***C=AxB***
1	2023-24		1.00	
2	2022-23		1.10	
3	2021-22		1.21	
4	2020-21		1.331	
5	2019-20		1.464	
Maximum Value of work in one FY during last 5 FYs (In Rs.)				

** Figures to be mentioned in the Column A shall be supported by relevant copies of the Work Order/LOA as well as the corresponding Completion Certificates issued by the officer not below the rank of **CEO/DGM/Superintending Engineer** of electrical utilities.

Maximum value of projects that have been undertaken during the F.Y. _____ out of the last 5 years and the value of the projects updated to the current price level (i.e. FY 2023-24) thereof is Rs. _____ (Rupees in words).

ANNEXURE 1(F)

Format for assessing the Bid Capacity of the Bidders to calculate the value of "B"

A table containing value of all the existing commitments and on-going works to be completed during the next 3 years is as follows:

SL No	Name of Project/ Work	Percentage of participation of Bidder in the project	Date of commencement of Project	Stipulated date of Completion	Value of the contract as per Contract Agreement/LOA	Value of work completed**	Balance value of work to be completed	Balance value of work at current price level (FY 2023-24)
					Rs. in Lakhs	Rs. in Lakhs	Rs. in Lakhs	Rs. in Lakhs
1	2	3	4	5	6	7	8= (6-7)	9 (3x 8 x #)

** All relevant Certificates will be required to be duly signed by the officer not below the rank of **CEO/DGM/Superintending Engineer** of electrical utilities.

Updation Factor as given below:

F.Y.	Updation Factor
2023-24	1.00
2022-23	1.10
2021-22	1.21
2020-21	1.331
2019-20	1.464

The Statement showing the value of all existing commitments and ongoing works as well as the value of work completed for each of the works mentioned above is verified from the certificate issued by the Engineer not below the rank of CEO/DGM in respect of APDCL Projects **or** Superintending Engineer in respect of Projects in other utilities. No awarded/ ongoing works has been left in the aforesaid statement which has been awarded to M/s……individually/and through JV partners (in case of Joint Venture), as on due date of submission for this NIT.

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

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

Date:

Place

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

BOQ for Construction of 33 KV line to provide power supply to Numaligarh Refinary Limited,C/O Lakhyadhar Kalita,Vill: Patgirichuba,P.O.Dhekipara,Sipajhar,Dist:Darrang(Assam)under Sipajhar ESD under deposit work on Full Turnkey Mode.

Sl. No	Item Description	Unit	Qty
1	MVCC Mid Span Jointing Kit ACCESSORIES Mid Span Jointing Kit for 33 KV-1C-241-Sq-MM-AAAC Covered Conductor	No	90
2	CONDCUTORS BARE CONDUCTORS ACSR RABBIT Conductor	KM	1
3	LT GI Shackle Strap with Bolts	No	50
4	INSULATORS 1.1KV LT GRADE Shackle Insulator Porcelain	No	50
5	INSULATOR FITTINGS LT GI Pin	No	200
6	INSULATORS 1.1KV LT GRADE LT Pin Insulator Porcelain	No	200
7	IRON MATERIALS GI Angle 50X50X6mm	Mtr.	2552
8	CONDCUTORS BARE CONDUCTORS ACSR RACCON Conductor	Km	1
9	IRON MATERIALS Hot Dip GI Wire Stay Wire 7 14 SWG For LT	Kg	950
10	INSULATORS 33KV GRADE Guy Insulator Porcelain	No	190
11	IRON MATERIALS HT Stay Set	Set	190
12	H W fitting for Disc Insulator BS 70kN tension type	No	600
13	INSULATORS 11KV GRADE Disc Insulator Polymer 70kN BS Type	No	600
14	INSULATORS 11KV GRADE Pin Insulator Polymer 5KN FRP 24mm	No	975
15	CONDUCTOR ACCESSORIES PG Clamp for ACSR Wolf	No	75
16	CONDCUTORS BARE CONDUCTORS ACSR WOLF Conductor	KM	1.32.0
17	ENERGY METERS Metering Cabinet	No	2
18	ARMOURED 10Cx2.5 sqmm	Mtr.	50
19	PETTY ITEMS 11KV Danger Plate	No	10
20	PETTY ITEMS 33KV Danger Plate	No	150
21	CI Earth Pipe 1.8m Inner dia 100mm outer dia 110mm with perforated holes of 15mm dia at 30 cm interval along length of the pipe	No	540
22	LIGHTNING ARRESTOR 33KV 10KA Lighting Arrestor with Surge Monitor GI Mounting Structure Station Type	Set	2
23	INSULATORS 33KV GRADE Polymeric Pin Insulator FRP 34mm	No	172

24	Tension Insulator 33 KV 1C 241 Sq MM AAAC Covered Conductor	No	790
25	Termination Kit for 33 KV-1C 241-Sq-MM-AAAC-Covered Conductor	No	6
26	Tension Hardware 33 KV 1C 241 Sq MM AAAC Covered Conductor	No	790
27	Cable Tie 33 KV 1C 241 Sq MM AAAC Covered Conductor	No	318
28	MVCC 33KV GRADE 33-KV-1C-241Sq-MM-AAAC triple etruded Covered Conductor	Mtr.	66000
29	Tubular Rail Joist Pole GI Steel Tubular Pole SP 80 16.00	No	20
30	Tubular Rail Joist Pole GI Steel Tubular Pole SP 76 14.50	No	618
31	IRON MATERIALS GI Channel Cross Arm 100X50X6X3200mm	No	920
32	IRON MATERIALS GI Channel Cross Arm 100X50X6X2200mm	No	525
33	CONDUCTOR ACCESSORIES Pole Clamp of GI Flat 50X6mm	No	1276
34	IRON MATERIALS GI Nuts Bolts with Washer Assorted	Kg.	1100
35	IRON MATERIALS Hot Dip GI Wire 6 SWG	Kg.	620
36	ISOLATORS 33KV GRADE TPGO DBCR with earth switch and GI Mounting Structure 1250 Amps	Set	1
37	Grouting of Stay Set with PCC and Boulder	Job	190
38	Grouting mufflering of steel tubular pole of type SP76 and SP66 as per specification and drawing with minimum planting depth of 2.15 m using PCC	Job	618
39	Grouting mufflering of steel tubular pole of type SP80 and SP66 as per specification and drawing with minimum planting depth of 2.45 m using PCC	Job	20

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 recognized 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 CONTRACT PERFORMANCE

(To be stamped in accordance with Stamp Act)

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

To

The Chief General Manager (D)
Assam Power Distribution Company Ltd., LAR
Bijulee Bhawan, Paltan Bazar
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)
Assam Power Distribution Company Ltd., LAR
Bijulee Bhawan, Paltan Bazar
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 especially 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 owner's 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

Sl. No.	Item
1	33 kV 1250A 31.5 KA/3 sec GIS panel
2	33 KV & 11 KV Post Insulator
3	33 KV & 11 KV Isolator
4	33 KV C.R. Panel
5	11 KV D.O Fuse set
6	33 KV GOAB
7	DCDB
8	ACDB
9	XLPE Power Cable, 33 KV & 11 KV
10	33 KV & 11 KV L.A
11	33 KV O/D CT
12	Outdoor VCB
13	Outdoor PT
14	Battery Bank & Charger
15	Steel Tubular Pole
16	ACSR Conductor
17	Composite Polymeric Insulator
18	G.I. Wire
19	33KV & 11 KV Polymeric Disc Insulator
20	Civil Works
21	33 kV 1250A 31.5 KA/3 sec GIS panel

TECHNICAL SPECIFICATION FOR 10 MVA/5 MVA POWER TRANSFORMER

1 SCOPE

1.1 This Specification provides for design, engineering, manufacture, assembly, stage inspection, final inspection and testing before dispatch, packing and delivery at destination Sub-station by road transport, transit insurance, unloading at site /stores of 5 MVA and 10 MVA, 33/11 KV Power Transformer(s) with on load tap changer, complete with all fittings, accessories, associated equipment's, spares, 10% extra Transformer Oil, required for its satisfactory operation in any of the sub-stations of the purchaser

1.2 The core shall be constructed either from high grade, non-aging Cold Rolled Grain Oriented (CRGO) silicon steel laminations conforming to M-4 grade of BIS certified with lamination thickness not more than 0.23mm to 0.27mm or better(Quoted grade and type shall be used). The maximum flux density in any part of the cores and yoke at normal voltage and frequency shall be such that under 10% over voltage condition it shall not be more than 1.9 Tesla. The supplier shall provide saturation curve of the core material, proposed to be used. Laminations of different grade(s) and different thickness (s) are not allowed to be used in any manner or under any circumstances..

1.3 The scope of supply includes the provision of type test. The equipment offered shall have been successfully type tested within five years from date of tender and the designs shall have been in satisfactory operation for a period not less than three years as on the date of order. Compliance shall be demonstrated by submitting, (i) authenticated copies of the type test reports and (ii) performance certificates from the users, specifically from Central Govt./State Govt. or their undertakings.

1.4 The Power Transformer shall conform in all respects to highest standards of engineering, design, workmanship, this specification and the latest revisions of relevant standards at the time of offer and the employer shall have the power to reject any work or material, which, in his judgment, is not in full accordance therewith. The Transformer(s) offered, shall be complete with all components, necessary for their effective and trouble free operation. Such components shall be deemed to be within the scope of supply, irrespective of whether those are specifically brought out in this specification and / or the commercial order or not.

2. SPECIFIC TECHNICAL REQUIREMENTS

Sl.No.	Particulars	33/11 KV Power Transformer
1	Rated MVA (ONAN rating)	5MVA & 10 MVA
2	Number of Phases	Three
3	Vector group	Dyn-11
4	Type of installation	Outdoor
5	Frequency	50HZ (+/-)5%

6	Cooling Medium	Insulating Oil (ONAN)
7	Type of Cooling	ONAN (Oil natural / Air natural)
8	MVA Rating corresponding to ONAN	100%
9	Rated Voltage :-	
	High Voltage winding	33kV
	Low Voltage winding	11kV
10	Highest continuous system voltage	
	a) Maximum system voltage ratio (HV / LV)	36.3KV / 12 KV
	b) Rated voltage ratio (HV / LV)	33KV /11 KV
11	Winding Material	Electrolytic Copper
12	Winding Connection :-	
	High Voltage Winding	DELTA
	Low Voltage Winding	STAR
13	Vector group reference	Dyn11
14	No. of windings	Two winding Transformers
15	Method of System Earthing	Solidly grounded on LV side
16	Neutral terminal to be brought out	On LV side only
17	Core Material	**CRGO (M-4 / higher grade)**
18	Core Assembly	Boltless type
19	Type of Tap Changer	On-load tap changer (OLTC)
20	Range of Tapping	+ 5% to – 15% in 17 equal steps of 1.25% each on HV winding
21	Intended regular cyclic overloading of windings	As per IEC –76-1, Clause 4.2
22	a) Anticipated unbalanced loading	Around 10%
	b) Anticipated continuous loading of windings (HV / LV)	110 % of rated current
23	Over Voltage operating capability and duration	112.5 % of rated voltage (continuous)
24	Withstand time for three phase short circuit	2 Seconds

25	Maximum current density for HV and LV winding for rated current	2.4 Amp/ Sq.mm.		
26	Maximum flux density in any part of the core and yoke at rated MVA, rated voltage i.e 33kV / 11kV and system frequency of 50 Hz	1.55 Tesla		
27	Maximum Flux Density in any part of the core and yoke at 112.5 % of rated voltage i.e 33 KV /11 KV and system frequency of 50 HZ	1.9 Tesla		
28	Insulation	33kV	11kV	
	a) Type of insulation	Uniform	Uniform	
	b) One minute power frequency withstand Voltage(kV rms)	70kV	28kV	
	c) 1.2 / 50 microsecond wave shape Lighting Impulse withstand voltage (KVP)	170	75	
29	Nominal short circuit level (Basing on apparent power)	31.5KA	25KA	
30	Insulation level of bushing			
	a) Lightning Impulse withstand (KVP)	170	75	
	b) 1 Minute Power Frequency withstand voltage (KV –rms)	70	28	
31	Minimum clearances in air (mm)	Phase to Phase	Phase to ground	
	a) HV	400	320	
	b) LV	280	140	
32	c) Creepage distance (mm) (minimum)	972	324	
33	Percentage impedance voltage on normal tap and MVA base at 75^{o} C corresponding to HV/ LV rating and applicable tolerances: (No negative tolerance shall be allowed)	MVA Rating	%Impedance	Tolerance %
		5	7.15	10
		10	8.35	10
34	Permissible Temperature Rise over ambient temperature of 40 / 45˚C			
	a) Of top oil measured by thermometer	40˚C		
	b) Of winding measured by resistance	45˚ C		

35	Noise level at rated voltage and frequency	As per NEMA Publication No. TR-1
36	Terminal Details	
	a) HV winding line end	36 KV oil filled communicating type porcelain bushings (Anti-fog type)
	b) LV winding	17.5 KV porcelain type of bushing (Anti-fog type)
37	Polarization index (HV to LV, HV to Earth & LV to earth)	IR Test = 1 minute value/ 15 secs. value will not be less than 1.5 IR Test = 10 minutes value / 1 minute value will not be more than 5 and less than 1.5
38	Temperature Indicator	
	a) Oil (SCADA compatible)	One number
	b) Winding (SCADA compatible)	One number
39	33kV Termination	Terminal connector of HV and LV shall be vertical take off type and suitable for ACSR Panther
	11 KV Termination	
40	Type of mounting	On Wheels, Mounted on rails.

Terminals

(11KV Power cables shall be used for extending supply to 11KV breakers in case of indoor circuit breakers. The termination of 11 KV cables on LV bushing shall be through extended copper bus bars suitable to hold power cables termination. A metallic cable termination box, completely sealed, shall be installed on LV side of the transformer in which cables shall enter from bottom gland plates.)

41. **Losses**:- The losses shall not exceed the value given below

MVA Rating	**No-load losses (Fixed loss) KW**	**Load losses at 75°C KW**	**Percentage impedance voltage on normal tap and MVA base at 75° C**
5	4	21	7.15
10	6	41	8.35

The above mentioned losses are maximum permissible and there shall not be any plus tolerance above this limit.

The bidder shall submit design calculation of No load and Load losses along with complete technical details and factors assumed along with the GTP in tender documents. In case during testing, the actual losses are found within guaranteed figure, the transformers shall be accepted without any advantage to the bidder for lower losses. Measurement of losses shall form part of type test/routine test. The purchaser reserves the right to reject the transformers if on testing, the losses exceed the declared losses or the temperature rise in oil and/or winding exceeds the value guaranteed in technical particular or impedance value differ from the guaranteed value and if any test results do not match with the values given in the guaranteed technical particulars and as per technical specification

2.1 **MARSHALLING BOX**

A metal enclosed, weather, vermin and dust proof marshalling box fitted with required glands, locks, glass door, terminal Board, heater with switch, illumination lamp with switch etc. shall be provided with each transformer to accommodate temperature indicators, terminal blocks etc. It shall have degree of protection of IP 55 or better as per IS: 2147

2.2 **CAPITALIZATION OF LOSSES AND LIQUIDATED DAMAGES**

Not applicable for bid evaluation purpose.

2.3 **PERFORMANCE**

i) Transformer shall be capable of withstanding for two seconds without damage to any external short circuit, with the short circuit MVA available at the terminals.

ii) The maximum flux density in any part of the core and yoke at rated MVA. Voltage and frequency shall be 1.55 Tesla (maximum).

iii) Transformer shall under exceptional circumstances due to sudden disconnection of the load, be capable of operating at the voltage approximately 25% above normal rated voltage for a period of not exceeding one minute and 40% above normal for a period of 5 seconds.

iv)The transformer may be operated continuously without danger on any particular tapping at the rated MVA± 1.25% of the voltage corresponding to the tapping.

v) The thermal ability to withstand short circuit shall be demonstrated by calculation.

vi)Transformer shall be capable of withstanding thermal and mechanical stress caused by any symmetrical and asymmetrical faults on any winding.

2.4 **DRAWINGS/ DOCUMENTS INCORPORATING THE FOLLOWING PARTICULARS SHALL BE SUBMITTED WITH THE BID**

a) General outline drawing showing shipping dimensions and overall dimensions, net weights and shipping weights, quality of insulating oil, spacing of wheels in either direction of motion, location of coolers, marshalling box and tap changers etc.
b) Assembly drawings of core, windings etc. and weights of main components / parts.
c) Height of center line on HV and LV connectors of transformers from the rail top level.
d) Dimensions of the largest part to be transported.
e) GA drawings / details of various types of bushing
f) Tap changing and Name Plate diagram
g) Type test certificates of similar transformers.
h) Illustrative & descriptive literature of the Transformer.
i) Maintenance and Operating Instructions.

2.5 **MISCELLANEOUS**

i) Padlocks along with duplicate keys as asked for various valves, marshalling box etc. shall be supplied by the contractor, wherever locking arrangement is provided.

ii) Foundation bolts for wheel locking devices of Transformer shall be supplied by the Contractor.

2.6 **DELIVERY**

The full quantity of the equipments shall be delivered as per the delivery schedule appended to this specification.

2.7 **SCHEDULES**

All Schedules annexed to the specification shall be duly filled by the bidder separately.

2.8 **ALTITUDE FACTOR**

If the equipment is to be installed in the hilly area, necessary correction factors as given in the Indian Standard for oil temperature rise, insulation level etc. shall be applied to the Standard Technical Parameters given above.

2.9 **NAME PLATE**

Transformer rating plate shall contain the information as given in clause 15 of IS-2026 (part-I). The details on rating plate shall be finalized during the detailed engineering. Further, each transformer shall have inscription of Employer's name. The name plate shall also include (i) The short circuit rating , (ii) Measured no load current and no load losses at rated voltage and rated frequency, (iii) measured load losses at 75° C (normal tap only), (iv) D.C resistance of each winding at 75° C.

3. SERVICE CONDITIONS

maximum altitude above sea level	1000m
maximum ambient air temperature	45° C
maximum daily average ambient air temperature	40° C
minimum ambient air temperature	2° C
maximum temperature attainable by an object exposed to the sun	60 ° C
maximum yearly weighted average ambient temperature	32° C
maximum relative humidity	100%
average number of thunderstorm days per annum (isokeraunic level)	45
average number of rainy days per annum	120
average annual rainfall	2200 mm
maximum annual rainfall	3500 mm
maximum wind pressure	260 Kg/m²

Environmentally, the region where the equipment will be installed is subject to high relative humidity, which can give rise to condensation. Outdoor material and equipment shall be designed and protected for use in exposed, heavily polluted, corrosive, tropical and humid atmosphere.

4 SYSTEM CONDITIONS

The equipment shall be suitable for installation in supply systems of the following characteristics.

Frequency		50 Hz ± 5%
Nominal system voltages		33 KV
		11 KV

Maximum system voltages	33KV System	36.3 KV
	11 KV System	12 KV
Nominal short circuit level (Based on apparent power)	33KV System	31.5KA
	11 KV System	25KA
Insulation levels :	33KV System	170KV (peak)
1.2/50 μ sec impulse withstand voltage	11 KV System	75 KV (peak)
Power frequency 1 minute withstand (wet and dry) voltage	33KV System	70KV (rms)
	11 KV System	28KV (rms)
Neutral earthing arrangements	11 KV System	Solidly earthed

5 CODES & STANDARDS

5.1 (i) The design, material, fabrication, manufacture, inspection, testing before dispatch and performance of power transformers at site shall comply with all currently applicable statutory regulations and safety codes in the locality where the equipment will be installed. The equipment shall also conform to the latest applicable standards and codes of practice. Nothing in this specification shall be construed to relieve the contractor of this responsibility.

5.2 The equipment and materials covered by this specification shall conform to the latest applicable provision of the following standards.

IS:5	Colour for ready mixed paints
IS:325	Three Phase Induction Motors
IS:335	New insulating oil for transformers, switch gears
IS:1271	Classification of insulating materials for electrical machinery and apparatus in relation to their stability in services
IS:2026(Part I to IV)	Power Transformer
IS:2071	Method of high voltage testing
IS:2099	High voltage porcelain bushings
IS:2147	Degree of protection
IS:2705	Current Transformers
IS:3202	Code of practice for climate proofing of electrical equipment
IS:3347	Dimensions for porcelain Transformer Bushings
IS:3637	Gas operated relays
IS:3639	Fittings and accessories for power Transformers
IS:5561	Electric Power Connectors
IS:6600/BS:CP‟10:0	Guide for loading of oil immersed Transformers

IS:10028	Code of practice for selection, installation and maintenance of transformers, Part I. II and III
C.B.I.P. Publication	Manual on Transformers

If the standard is not quoted for any item, it shall be presumed that the latest version of Indian Standard shall be applicable to that item.

The equipment complying other internationally accepted standards, may also be considered if they ensure performance superior to the Indian Standards.

5.3 **DRAWINGS**

a) The contractor shall furnish, within fifteen days after issuing of Letter of Award. Six copies each of the following drawings/documents incorporating the transformer rating for approval.

i) Detailed overall general arrangement drawing showing front and side elevations and plan of the transformer and all accessories including radiators and external features with details of dimensions, spacing of wheels in either direction of motion, net weights and shipping weights, crane lift for un-tanking, size of lugs and eyes, bushing lifting dimensions, clearances between HV and L.V terminals and ground, quantity of insulating oil etc.

ii) Assembly drawings of core and winging and weights of main components / parts

iii) Foundation plan showing loading on each wheel land jacking points with respect to centre line of transformer.

iv) GA drawings details of bushing and terminal connectors.

v) Name plate drawing with terminal marking and connection diagrams.

vi) Wheel locking arrangement drawing.

vii) Transportation dimensions drawings.

Viii) Details of C.T particulars of Neutral &WTI CT and Magnetization characteristic curves of PS class neutral and phase side current transformers.

ix) Interconnection diagrams.

x) Over fluxing withstand time characteristic of transformer.

xi) GA drawing of marshalling box.

xii) Control scheme/wiring diagram of marshalling box.

xiii) Technical leaflets of major components and fittings.

xiiv) As built drawings of schematics, wiring diagram etc.

xv) Setting of oil temperature indicator, winding temperature indicator.

xvi) Completed technical data sheets. xvii) Details including write-up of tap changing gear.

xviii) HV conductor bushing. xix) Bushing Assembly.

xx) Bi-metallic connector suitable for connection to 100 mm2 up to 232 mm2 AAAC Conductor.

xxi) GA of LV cable Box.

xxii) Radiator type assembly.

b) All drawings, documents, technical data sheets and test certificates, results calculations shall be furnished.

5.4 Any approval given to the detailed drawings by the Employer's shall not relieve the contractor of the responsibility for correctness of the drawing and in the manufacture of the equipment. The approval given by the employer shall be general with overall responsibility with contractor.

6. GENERAL CONSTRUCTIONAL FEATURES

6.1 All material used shall be of best quality and of the class most suitable for working under the conditions specified and shall withstand the variations of temperature and atmospheric conditions without distortion or deterioration or the setting up of undue stresses which may impair suitability of the various parts for the work which they have to perform.

6.2 Similar parts particularly removable ones shall be interchangeable.

6.3 Pipes and pipe fittings, screws, studs, nuts and bolts used for external connections shall be as per the relevant standards. Steel bolts and nuts exposed to atmosphere shall be galvanized.

6.4 Nuts, bolts and pins used inside the transformers and tap changer compartments shall be provided with lock washer or locknuts.

6.5 Exposed parts shall not have pockets where water can collect.

6.6 Internal design of transformer shall ensure that air is not trapped in any location.

6.7 Material in contact with oil shall be such as not to contribute to the formation of acid in oil. Surface in contact with oil shall not be galvanized or cadmium plated

6.8 Labels, indelibly marked, shall be provided for all identifiable accessories like Relays, switches current transformers etc. All label plates shall be of in corrodible material.

6.9 All internal connections and fastenings shall be capable of operating under overloads and over-excitation, allowed as per specified stands without injury.

6.10 Transformer and accessories shall be designed to facilitate proper operation, inspection, maintenance and repairs.

6.11 No patching, plugging, shimming or other such means of overcoming defects, discrepancies or errors will be accepted.

6.12 Schematic Drawing of the wiring, including external cables shall be put under the prospane sheet on the inside door of the transformer marshalling box.

6.13 Painting

6.13.1 All paints shall be applied in accordance with the paint manufacturer's recommendations. Particular attention shall be paid to the following:

a) Proper storage to avoid exposure as well as extremes of temperature.

b) Surface preparation prior to painting.

c) Mixing and thinning

d) Application of paints and the recommended limit on time intervals between coats.

e) Shelf life for storage.

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

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

6.13.1.3 The supplier shall, prior to painting, protect nameplates, lettering gauges, sight glasses, light fittings and similar such items.

6.13.2 Cleaning and Surface Preparation

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

6.13.2.2 Steel surfaces shall be prepared by Sand/Shot blast cleaning or Chemical cleaning by Seven tank process including Phosphating to the appropriate quality.

6.13.2.3 The pressure and Volume of the compressed air supply for the blast cleaning shall meet the work requirements and shall be sufficiently free from all water contamination prior to any painting.
6.13.2.4 Chipping, scraping and steel wire brushing using manual or power driven tools cannot remove firmly adherent mill-scale and shall only be used where blast cleaning is impractical.

6.13.3 Protective Coating As soon as all items have been cleaned and within four hours of the subsequent drying, they shall be given suitable anticorrosion protection.

6.13.4 Paint Material

Followings are the type of paints that may be suitably used for the items to be painted at shop and supply of matching paint to site:

i) Heat resistant paint (Hot oil proof) for inside surface.

ii) For external surfaces one coat of Thermo Setting Paint or 2 coats of Zinc chromate followed by 2 coats of POLYURETHANE . The color of the finishing coats shall be dark admiral grey conforming to No.632 or IS 5:1961.

6.13.5 Painting Procedure

6.13.5.1 All painting shall be carried out in conformity with both specifications and with the paint manufacture's recommendations. All paints in any one particular system. Whether shop or site applied, shall originate from one paint manufacturer.

6.13.5.2 Particular attention shall be paid to the manufacturer's instructions on storage, mixing, thinning and pot life. The paint shall only be applied in the manner detailed by the manufacturer e.g. brush, roller, conventional or airless spray and shall be applied under the manufacturer's recommended conditions. Minimum and maximum time intervals between coats shall be closely followed.

6.13.5.3 All prepared steel surfaces shall be primed before visible re-rusting occurs or within 4 hours whichever is sooner. Chemical treated steel surfaces shall be primed as soon as the surface is dry and while the surface is warm.

6.13.5.4 Where the quality of film is impaired by excess film thickness,(wrinkling, mud cracking or general softness) the supplier shall remove the unsatisfactory paint coatings and apply another. As a general rule, dry film thickness shall not exceed the specified minimum dry film thickness by more than 25% . In all instances, where two or more coats of the same paints are specifies, such coatings may or may not be of contrasting colors.

6.13.5.5 Paint applied to items that are not be painted, shall be removed at supplier's expense, leaving the surface clean, un-stained and undamaged.

6.13.6 Damages to Paints Work

6.13.6.1 Any damage occurring to any part of the painting scheme shall be made good to the same standard of corrosion protection and appearance as that originally employed.

6.13.6.2 Any damaged paint work shall be made as follows:

a) The damaged area, together with an area extending 25mm around its boundary, shall be cleaned down to bare metal.
b) A priming coat shall immediately applied, followed by a full paint finish equal to that originally applied and extending 50mm around the perimeter of the originally damaged.

6.13.6.3 The repainted surface shall present a smooth surface. This shall be obtained by carefully chamfering the paint edges before & after priming.

6.13.7 Dry Film Thickness

6.13.7.1 To the maximum extent practicable, the coats shall be applied as a continuous film of uniform thickness and free of pores. Over-spray, skips, runs, sags and drips shall be avoided. The different coats may or may not be same color.

6.13.7.2 Each coat of paint shall allowed to hardened before the next is applied as per manufacture‟s recommendations.

6.13.7.3 Particular attention must be paid to full film thickness at edges.

6.13.7.4 The requirement for the dry film thickness (DFT) of paint and the material to be used shall be as given below:

Sl. No.	Paint Type	Area to be painted	No of Coats	Total Dry film thickness(Min)
a)	Liquid paint Zinc Chromate(Primer)	Out side	02	45 micron
b)	POLYURETHANE Paint (Finish Coat)	Out side	02	35 micron
c)	Hot Oil paint	inside	01	35 micron

7.0 DETAILED DESCRIPTION

7.1 Tank

7.1.1 The Transformer tank and cover shall be fabricated from high grade low carbon plate steel of tested quality. The tank and the wall shall be of welded construction.

7.1.2 Tank shall be designed to permit lifting by crane or jacks of the complete transformer assembly filed with oil. Suitable lugs and bossed shall be provided for this purpose.

7.1.3 All breams, flanges, lifting lugs, braces and permanent parts attached to the tank shall be welded and where practicable, they shall be double welded.

7.1.4 The main tank body of the transformer, excluding tap changing compartments and radiators, shall be capable of withstanding pressure of 760mm of Hg.

7.1.5 Inspection hole(s) with welded flange(s) and bolted cover(s) shall be provided on the tank cover. The inspection hole(s) shall be of sufficient size to afford easy access to the lower ends of the bushings, terminals etc.

7.1.6 Gaskets of nitrile rubber or equivalent shall be used to ensure perfect oil tightness. All gaskets shall be closed design (without open ends) and shall be of one piece only. Rubber gaskets used for flange type connections of the various oil compartments shall be laid in grooves or in groove-equivalent sections on bolt sides of the gasket, throughout their total length. Care shall be taken to secure uniformly distributed mechanical strength over the gaskets and retains throughout the total length. Gaskets of neoprene and / or any kind of impregnated / bonded core or cork only which can easily be damaged by over-pressing are not acceptable. Use of hemp as gasket material is also not acceptable.

7.1.7 Suitable guides shall be provided for positioning the various parts during assemble or dismantling. Adequate space shall be provided between the cores and windings and the bottom of the tank for collection of any sediment.

7.2 Tank Cover

The transformer top shall be provided with a detachable tank cover with bolted flanged gasket joint. Lifting lugs shall be provided for removing the cover. The surface of the cover shall be suitable sloped so that it does not retain rain water.

7.3 UNDER CARRIAGE

7.3.1 The transformer tank shall be supported on steel structure with detachable plain rollers completely filled with oil. Suitable channels for movement of roller with transformer shall be space accordingly, rollers wheels shall be provided with suitable rollers bearings, which will resist rust and corrosion and shall be

equipped with fittings for lubrication. It shall be possible to swivel the wheels in two directions, at right angle to or parallel to the main axis of the transformers.

7.4 CORE

7.4.1 Each lamination shall be insulated such that it will not deteriorate due to mechanical pressure and the action of hot transformer oil.

7.4.2 The core shall be constructed either from high grade, non-aging Cold Rolled Grain Oriented (CRGO) silicon steel laminations conforming to M-4 or higher grade with lamination thickness not more than 0.23mm to 0.27mm or better(Quoted grade and type shall be used). The maximum flux density in any part of the cores and yoke at normal voltage and frequency shall not be more than 1.5 Tesla. The Bidder shall provide saturation curve of the core material, proposed to be used. Laminations of different grade(s)_ and different thickness (s) are not allowed to be used in any manner or under any circumstances.

7.4.3 The bidder shall offer the core for inspection starting from the destination port to enable Employer for deputing inspecting officers for detail verification as given below and approval by the Employer during the manufacturing stage. Bidder‟s call notice for the purpose shall be accompanied with the following documents as applicable as a proof towards use of prime core material: The core coils, if found suitable, are to be sealed with proper seals which shall be opened in presence of the inspecting officers during core- cutting at the manufacturer's or it's sub-vendor's premises as per approved design drawing.

a) Purchase Order No. & Date.
b) Invoice of the supplier
c) Mills test certificate
d) Packing list
e) Bill of lading
f) Bill of entry certificate to customs

Core material shall be directly procured either from the manufacturer or through their accredited marketing organization of repute, but not through any agent.

7.4.4 The laminations shall be free of all burrs and sharp projections. Each sheet shall have an insulting coating resistant to the action of hot oil.

7.4.5 The insulation structure for the core to bolts and core to clamp plates, shall be such as to withstand 2000 V DC voltage for one minute.

7.4.6 The completed core and coil shall be so assembled that the axis and the plane of the outer surface of the core assemble shall not deviate from the vertical plane by more than 25mm.

7.4.7 All steel sections used for supporting the core shall be thoroughly shot or sand blasted, after cutting, drilling and welding.

7.4.8 The finally assembled core with all the clamping structures shall be free from deformation and shall not vibrate during operation.

7.4.9 The core clamping structure shall be designed to minimize eddy current loss.

7.4.10 The framework and clamping arrangements shall be securely earthed.

7.4.11 The core shall be carefully assembled and rigidly clamped to ensure adequate mechanical strength.

7.4.12 Oil ducts shall be provided, where necessary, to ensure adequate cooling inside the core. The welding structure and major insulation shall not obstruct the free flow of oil through such ducts.

7.4.13 The design of magnetic circuit shall be such as to avoid static discharges, development of short circuit paths within itself or to the earth clamping structure and production of flux component at right angle to the plane of the lamination, which may cause local heating. The supporting framework of the cores shall be so designed as to avoid the presence of pockets, which would prevent complete emptying of the tank through the drain valve or cause trapping of air during filling.

7.4.14 The construction is to be of boltless core type. The core shall be provided with lugs suitable for lifting the complete core and coil assembly. The core and coil assemble shall be so fixed in the tank that shifting will not occur during transport or short circuits.

7.4.15 The temperature gradient between core & surrounding oil shall be maintained less than 20 deg. Centigrade. The manufacturer shall demonstrate this either through test (procurement to be mutually agreed) or by calculation.

7.5 INTERNAL EARTHING

7.5.1 All internal metal parts of the transformer, with the exception of individual laminations and their individual clamping plates shall be earthed.

7.5.2 The top clamping structure shall be connected to the tank by a copper strap. The bottom clamping structure shall be earthed by one or more the following methods:

a) By connection through vertical tie-rods to the top structure.

b) By direct metal to metal contact with the tank base.

c) By a connection to the structure on the same side of the core as the main earth connection to the tank.

7.5.3 The magnetic circuit shall be connected to the clamping structure at one point only and this shall be brought out of the top cover of the transformer tank through a suitably rated insulator. A disconnecting link shall be provided on transformer tank to facilitate disconnections from ground for IR measurement purpose.

7.5.4 Coil clamping rings of metal at earth potential shall be connected to the adjacent core clamping structure on the same side as the main earth connections.

7.6 WINDING

7.6.1 Winding shall be subjected to a shrinking and seasoning process, so that no further shrinkage occurs during service. Adjustable devices shall be provided for taking up possible shrinkage in service.

7.6.2 All low voltage windings for use in the circular coil concentric winding shall be wound on a performed insulating cylinder for mechanical protection of the winding in handling and placing around the core.

7.6.2 Winding shall not contain sharp bends which might damage the insulation or produce high dielectric stresses. No strip conductor wound on edge shall have width exceeding six times the thickness.

7.6.3 Materials used in the insulation and assembly of the windings shall be insoluble, non catalytic and chemically inactive in the hot transformer oil and shall not soften or the otherwise affected under the operating conditions.

7.6.4 Varnish application on coil windings may be given only for mechanical protection and not for improvement in dielectric properties. In no case varnish or other adhesive be used which will seal the coil and prevent evacuation of air and moisture and impregnation by oil.

7.6.5 Winding and connections shall be braced to withstand shocks during transport or short circuit.

7.6.6 Permanent current carrying joints in the windings and leads shall be welded or brazed. Clamping bolts for current carrying parts inside oil shall be made of oil resistant material which shall not be affected by acidity in the oil steel bolts, if used, shall be suitably treated.

7.6.7 Terminals of all windings shall be brought out of the tank through bushings for external connections.

7.6.7.1 The completed core and coil assemble shall be dried in vacuum at not more than 0.5mm of mercury absolute pressure and shall be immediately impregnated with oil after the drying process to ensure the elimination of air and moisture within the insulation. Vacuum may be applied in either vacuum over or in the transformer tank.

7.6.7.2 The winding shall be so designed that all coil assembles of identical voltage ratings shall be interchangeable and field repairs to the winding can be made readily without special equipment. The coils shall have high dielectric strength.

7.6.7.3 Coils shall be made of continuous smooth high grade electrolytic copper conductor, shaped and braced to provide for expansion and contraction due to temperature changes.

7.6.7.4 Adequate barriers shall be provided between coils and core and between high and low voltage coil. End turn shall have additional protection against abnormal line disturbances.

7.6.7.5 The insulation of winding shall be designed to withstand voltage stress arising from surge in transmission lines due to atmospheric or transient conditions caused by switching etc.

7.6.7.6 Tapping shall not be brought out from inside the coil or from intermediate turns and shall be so arranged as to preserve as far as possible magnetic balance of transformer at all voltage ratios.

7.6.7.7 Magnitude of impulse surges transferred from HV to LV windings by electromagnetic induction and capacitance coupling shall be limited to BIL of LV winding.

7.6.7.8 The current density adopted in all winding shall not exceed 2.4 A/mm2. The total net cross sectional area of the strip conductors for calculating current density for each winding shall be obtained after deducting the copper area lost due to rounding up of the sharp edges of the rectangular conductors.

7.7 INSULATING OIL

7.7.1 The insulating oil for the transformer shall be of EHV grade, generally conforming to IS: 335. No inhibitors shall be used in the oil.

7.7.2 The quantity of oil required for the first filling of the transformer and its full specification shall be stated in the bid. transformer shall supplied complete with all fittings, accessories and new transformer oil required for first filling plus 10% extra oil. The extra quantity of oil shall be supplied in non-returnable drums along with the oil required for the radiator banks.

7.7.3 The design and materials used in the construction of the transformer shall be such as to reduce the risk of the development of acidity in the oil.

7.7.4 The contractor shall warrant that oil furnished is in accordance with the following specifications :

Sl.	Characteristic	Requirement	Method of Test
1	Appearance	The oil shall be clear &transparent& free From Suspended matter or sediment	A representative sample of oil shall be examined in a 100 mm thick layer at ambient temp.
2	Density at 20°c	0.89 g/cm3 Max.	IS:1448
3	Kinematic Viscosity at 27 deg. C Max	27 CST	IS:1448
4	Interfacial tension at 27 °C Min.	0.03 N/m	IS:6104
5	Flash Point	136 °C	IS:1448
6	Pour Point Max.	72.5 KV	IS:1448
7	Nautralisation Value (Total Acidity) Max.	0.03 mg KOH/gm	IS:335
8	Electric strength Breakdown (voltage) Min.	72.5 KV	IS:6792
9	Dielectric dissipation factor tan delta at 90°C	0.03 Max	IS:6262
10	Min specific resistance(resistively) at 90°C	35X1012 ohm cm (min.)	IS:6103
11	Oxidation stability		
12	Neutralization value after oxidation	0.40mg KOH/g	
13	Total sludge after oxidation	0.10% by weight max.	
14	Presence of oxidation Inhibitor	The oil shall not contain anti- oxidant Additives.	IS:335
15	Presence of oxidation Inhibitor	The oil shall not contain anti- oxidant Additives	IS:335

7.8 VALVES

i) Valves shall be of forged carbon steel upto 50mm size and of gun mental or of cast iron bodies with gun metal fittings for sizes above 50mm. They shall be of full way type with screwed ends and shall be opened by turning counter clockwise when facing the hand wheel. There shall be no oil leakage when the valves are in closed position.

ii) Each valve shall be provided with an indicator to show the open and closed positions and shall be provided with facility for padlocking in either open or closed position. All screwed valves shall be furnished with pipe plugs for protection. Padlocks with duplicate keys shall be supplied along with the valves.

iii) All valves except screwed valves shall be provided with flanges having machined faced drilled to suit the applicable requirements, Oil tight blanking plates shall be provided for each connection for use when any radiator is detached and for all valves opening to atmosphere. If any special radiator valve tools are required the contractor shall supply the same.

iv) Each transformer shall be provided with following valves on the tank:

a) Drain valve so located as to completely drain the tank & to be provided with locking arrangement.

b) Two filter valves on diagonally opposite corners of 50mm size & to be provided with locking arrangement.

c) Oil sampling valves not less than 8mm at top and bottom of main tank & to be provided with locking arrangement.

d) One 15mm air release plug.

e) Valves between radiators and tank. Drain and filter valves shall be suitable for applying vacuum as specified in the specifications.

7.9 ACCESSORIES

7.9.1 Bushing

i) All porcelain used in bushings shall be homogeneous, non-porous, uniformly glazed to brown colour and free from blisters, burns and other defects.

ii) Stress due to expansion and contraction in any part of the bushing shall not lead to deterioration.

iii) Bushing shall be designed and tested to comply with the applicable standards.

iv) Bushing rated for 630 A and above shall have non-ferrous flanges and hardware.

v) Fittings made of steel or malleable iron shall be galvanized

vi) Bushing shall be so located on the transformers that full flashover strength will be utilized. Minimum clearances as required for the BIL shall be realized between live parts and live parts to earthed structures.

vii) All applicable routine and type tests certificates of the bushings shall be furnished for approval.

viii) Bushing shall be supplied with bi-metallic terminal connector/ clamp/ washers suitable for fixing to bushing terminal and the Employers specified conductors. The connector/clamp shall be rated to carry the bushing rated current without exceeding a temperature rise of 550 C over an ambient of

45 deg C. The connector/clamp shall be designed to be corona free at the maximum rated line to ground voltage.

ix) Bushing of identical voltage rating shall be interchangeable.

x) The insulation class of high voltage neutral bushing shall be properly coordinated with the insulation class of the neutral of the low voltage winding.

xi) Each bushing shall be so coordinated with the transformer insulation that all flashover will occur outside the tank.

xii) The extended bushing bus bars shall be used for termination of 11 KV cables. LV busing shall be housed in completely sealed metallic enclosure.

xiii) Sheet steel, weather, vermin and dust proof cable box fitted with required glands, locks, glass door, terminal Board, heater with switch, illumination lamp with switch, water- tight hinged and padlocked door of a suitable construction shall be provided with each transformer to accommodate 11 KV cables etc. The box shall have slopping roof and the interior and exterior painting shall be in accordance with the specification. Padlock along with duplicate keys shall be supplied for marshalling box. The degree of protection shall be IP-55 or better. To prevent internal condensation, a metal clad heater with thermostat shall be provided. The heater shall be controlled by a MCB of suitable rating mounted in the box. The ventilation louvers, suitably padded with felt, shall also be provided. The louvers shall be provided with suitable felt pads to prevent ingress of dust. All incoming cables shall enter the kiosk from the bottom and the minimum 4mm thick, non-magnetic, gland plate shall not be less than 600 mm from the base of the box. The gland plate and associated compartment shall be sealed in suitable manner to prevent the ingress of moisture from the cable trench – **for those transformers which are used in partly indoor substation**,

7.9.2 **Protection& Measuring Devices**

i) Oil Conservator Tank

a) The Conservator tank shall have adequate capacity between highest and lowest visible levels to meet the requirement of expansion of the total cold oil volume in the transformer and cooling equipment.

b) The conservator tank shall be bolted into position so that it can be removed for cleaning purposes.

c) The conservator shall be fitted with magnetic oil level gauge with low level electrically insulated alarm contact.

d) The conservator shall be provided with an air cell/ flexi separator to prevent direct contact of transformer oil with atmospheric air for retarding oxidation or contamination of oil. The Air cell shall be made from suitable material with inner coating resistant to transformer oil & outer coating resistant to ozone & weathering.

e) **All breathers shall be mounted at approximately 1400 mm above ground level and shall be connected to the air cell of the conservator through pipe for the purpose of breathing during contraction or expansion of the air cell**.

ii) Pressure Relief Device

The pressure relief device provided shall be of sufficient size for rapid release of any pressure that may be generated in the tank and which may result in damage of the equipment. The device shall operate at a static pressure of less than the hydraulic test pressure of transformer tank. It shall be mounted direct on the tank. A pair of electrically insulated contract shall be provided for alarm and tripping.

iii) Buchholz Relay

A double float type Buchholz relay shall be provided., Any gas evolved in the transformer shall collect in this relay. The relay shall be provided with a test cock suitable for a flexible pipe connection for checking its operation. A copper tube shall be connected from the gas collector to a valve located about 1200 mm above ground level to facilitate sampling with the transformer in service. The device shall be provided with two electrically independent potential free contracts, one for alarm on gas accumulation and the other for tripping on sudden rise of pressure.

iv) Temperature Indicator

1. OTI and WTI shall be a compact system where both local and remote instrument are integrated and supplied as Hybrid Instrument and a self-powered local indication with switch controls and an externally powered remote indication for SCADA purposes.
2. Both the OTI and WTI shall have remote reading capability compatible to be connected to SCADA system.
3. It shall have no change in overall dimension of OTI and WTI and no additional Thermometer pockets are required.

4. OTI/ WTI shall have embedded PT-100 sensors in the sensing bulb of the local OTI/ WTI and Current Converter Unit (CCU) shall be mounted inside the Local OTI/WTI. The output from which can be connected to remote indicator or SCADA to provide a standard single or dual 4-20mA DC current output corresponding to measured temperature.

5. The WTI instruments shall have a built in Thermal imaging system for transformer's hot spot indication and shall be provided with gradient adjustment through a shunt for CT 5A secondary input. For the WTIs additional Winding temperature simulator shall be provided.

6. Remote indicator for both OTI and WTI shall be digital type with minimum 4 digits LED display and resolution shall be within limit of $O.1^0C$. Remote indicators shall have minimum 2 sets of 4 - 20mA DC output (Optional RS 485) for SCADA connection.

7. Oil temperature indicator and winding temperature indicator with two electrical contacts for alarm and trip purposes and repeater for remote indication shall be provided with anti-vibration mounting. All switch contacts are potential free micro switches. The oil temperature indicator shall be housed in the existing marshalling box.

8. The oil and winding temperature indicator shall be of 'Pecimeasure' or 'Perfect Control' only. The scale on the dial of the thermometer shall be 0-150°C. The angular displacement of thermometer shall be 270°. The signaling contact of WTI & OTI shall be set to operate at the following temperature:

OIL: Alarm-85 deg. C, Trip – 95 deg. C
WINDING: Alarm-100 deg. C, Trip – 110 deg. C

9. The tripping contacts of indicator shall be adjustable to close the winding temperature indicator between 60°C and 120°C. The alarm contacts of indicator shall be adjustable to close between

50°C and 100°C. All contacts shall be adjustable on a scale and shall be accessible on removal of the cover. The temperature indicators shall be so designed that it shall be possible to check the operation of contacts and associated equipments.

10. Accuracy class of both OTI and WTI shall be ±1% or better and weather Proof Protective Class IP-55

v. THERMO-SIPHON FILTER ARRANGEMENT

Thermo-siphon filter arrangement shall be provided with the transformer for preserving the quality of transformer oil. Suitable instructions required to be followed for commissioning, dismantling and maintenance of the filter arrangement, re-generation and storage of the absorbent etc, must be included in the instruction manual. A detailed drawing showing internal arrangement of the filter shall also be submitted

Provision of Current Transformer in L.V. side of Power Transformer.

In order to achieve Restricted Earth fault in star connected L.V. Side of Power Transformer, current transformer having following particulars shall have to be provided in the bushing turret of r, y & b phases and neutral of LV side of 5 & 10 MVA power transformer**.**

	CT Particulars	For 5 MVA Transformer	For 10 MVA Transformer
i)	Type	Suitable for installation in L.V. side of Power Transformer for REF protection	Suitable for installation in L.V. side of Power Transformer for REF protection
ii)	Ratio	300/1A at all phases and Neutral	600/1A at all phases and Neutral
iii)	Accuracy Class	PS.	PS.
iv)	Knee Point Voltage Vk	>250 V	>250 V
v)	RCT at 75 Deg. C at Lower & Higher Taps.	RCT <4 Ohm at 75 Deg.C and	RCT <4 Ohm at 75 Deg.C
vi)	Magnetising current at knee point voltage	< 30 mA at VK	< 30 mA at VK

7.9.3 **Oil Preservation Equipment**

7.9.3.1 **Oil Sealing**

The oil preservation shall be diaphragm type oil sealing in conservator to prevent oxidation and contamination of oil due to contact with atmospheric moisture.

The conservator shall be fitted with a dehydrating filter breather. It shall be so designed that.

i) Passage of air is through a dust filter & Silica gel.

ii) Silica gel is isolate from atmosphere by an oil seal.

iii) Moisture absorption indicated by a change in colour of the crystals of the silica gel can be easily observed from a distance.

iv) Breather is mounted not more than 1400 mm above rail top level.

7.10 MARSHALLING BOX

i) Sheet steel, weather, vermin and dust proof marshalling box fitted with required glands, locks, glass door, terminal Board, heater with switch, illumination lamp with switch, water- tight hinged and padlocked door of a suitable construction shall be provided with each transformer to accommodate temperature indicators, terminal blocks etc. The box shall have slopping roof and the interior and exterior painting shall be in accordance with the specification. Padlock along with duplicate keys shall be supplied for marshalling box. The degree of protection shall be IP-55 or better.

ii) The schematic diagram of the circuitry inside the marshalling box be prepared and fixed inside the door under a prospone sheet.

iii) The marshalling box shall accommodate the following equipment:

a) Temperature indicators.

b) Space for accommodating Control & Protection equipment in future for the cooling fan **(for ONAF type cooling, may be provided in future).**

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

All the above equipments except c) shall be mounted on panels and back of panel wiring shall be used for inter-connection. The temperature indicators shall be so mounted that the dials are not more than 1600 mm from the ground level and the door (s) of the compartment(s) shall be provided with glazed window of adequate size. The transformer shall be erected on a plinth which shall be 2.5 feet above ground level.

iv) To prevent internal condensation, a metal clad heater with thermostat shall be provided. The heater shall be controlled by a MCB of suitable rating mounted in the box. The ventilation louvers, suitably padded with felt, shall also be provided. The louvers shall be provided with suitable felt pads to prevent ingress of dust.

v) All incoming cables shall enter the kiosk from the bottom and the gland plate shall not be less than 450 mm from the base of the box. The gland plate and associated compartment shall be sealed in suitable manner to prevent the ingress of moisture from the cable trench.

7.11 TAPCHANGER

7.11.1 ON-LOAD TAP-CHANGERS WITH REMOTE TAP CHANGE CONTROL

i) The 5MVA and 10MVA transformers shall be provided with On-load Taps.

ii) The Transformer with on-load tap changing gear shall have taps ranging from +5% to -15% in equal steps of 1.25% each on HV winding for voltage variation.

TECHNICAL SPECIFICATION FOR 33 KV AND 11 KV POST INSULATOR

1 GENERAL REQUIREMENTS

I. The porcelain shall be sound and free from defects, thoroughly vitrified and smoothly glazed.

II. Unless otherwise specified the glaze shall be brown in colour. The glaze shall cover all the expose porcelain part of the insulator except those area which serve as support or required to be left un-glazed.

III. Precaution shall be taken during design and manufacture to avoid the following :

a) Stress due to expansion and contraction which may lead to deterioration.

b) Stress concentration due to direct engagement of the porcelain with the metal fittings.

c) Retention of water in the recesses of metal fitting and

d) Shapes which do not facilitate easy cleaning by normal methods.

IV. Cement used in the construction of the post insulator shall not cause fracture by expansion or loosening by contraction and proper care shall be taken to locate the individual parts correctly during cementing. Further, the cement shall not give rise to chemical reaction with metal fittings and its thickness shall be as uniform as possible.

V. All ferrous metal parts except those of stainless steel, shall be hot dip galvanized and the uniformity of zinc coating shall satisfy the requirements of IS : 2633. The parts shall be galvanized after mechanising . The finished galvanized surface shall be smooth.

VI. The threads of the tapped holes in the post insulators metal fittings shall be cut after giving anti-corrosion protection and shall be protected against rest by greasing or by other similar means. All other threads shall be cut before giving anti-corrosion protection. The tapped holes shall be suitable for bolts with threads having anti - corrosion protection and shall confirm to IS : 4218(Part-I to VI). The effective length of thread shall not be less than the nominal diameter of the bolt.

VII. The post insulator unit shall be assembled in a suitable jig to ensure the correct positioning of the top and bottom metal fitting relative to one another. The faces of the metal fittings shall be parallel and at right angles to the axis of the insulator and the corresponding holes in the top and bottom metal fittings shall be in a vertical plan containing the axis of insulator.

2 CLASSIFICATION :

The post insulators shall be of type 'B' according to their construction, which is defined here under:

A post insulator or a post insulator unit in which the length of the shortest puncture path through solid insulating material is less than half the length of the shortest flash over path through air outside the insulator.

3 Standard insulation levels :

I. The standard insulator levels of the post insulator or post insulator unit shall be as under :

Highest system voltage	Visible discharge test	Dry one minute power frequency withstand test.	Wet one minute power frequency withstand test.	Power frequency puncture withstand test.	Impulse voltage withstand test.

12 KV (rms)	9 KV(rms)	35 KV(rms)	35 KV(rms)	1.3 times the actual dry flash over voltage of the unit (KVrms)	75 KV peak
36 KV (rms)	27 KV(rms)	75 KV(rms)	75 KV(rms)	1.3 times the actual dry flash over voltage of the unit (KVrms)	170 KV peak

II. In this standard, power frequency voltage are expressed as peak values divided by √2. The impulse voltages are expressed as peak values.

III. The withstand and flashover voltage are referred to the atmospheric condition.

4 TESTS

I. The insulators shall comply with the following constitute the type tests :

a) Visual examination.

b) Verification of dimensions.

c) Visible discharge test.

d) Impulse voltage withstand test.

e) Dry power frequency voltage withstand test.

f) Wet power frequency voltage withstand test.

g) Temperature cycle tests.

h) Mechanical strength tests.

i) Puncture test.

j) Porosity test.

k) Galvanising test.

Type test certificates for the tests carried out on prototype of same specifications shall be enclosed with the tender and shall be subjected to the following acceptance test in the order indicated below.

II. Acceptance test :

The test samples after having withstood routine test shall be subjected to the at least following acceptance test in the order indicated below :

a) Verification of dimensions.

b) Temperature cycle tests.

c) Mechanical strength tests.

d) Puncture test.

e) Porosity test.

f) Galvanising test.

III. Routine tests :

The following shall must be covered under routine tests on each post insulator or post insulator unit.

a) Visual examination as per Cl. No.- 9.12 of IS : 2544/1973

b) Mechanical routine test as per Cl. No.- 9.14 of IS : 2544/1973

c) Electrical routine test as per Cl. No.- 9.13 of IS : 2544/1973

5 MARKING

I. Each post insulator shall be legibly and indelibly marked to show the following :

a) Name or trade mark of the manufacturer.

b) Month & year of manufacture.

c) Country of manufacture.

II. Marking on porcelain shall be printed and shall be applied before firing.

III. Post insulator or post insulator units may also be mark with I.S.I. certification mark.

6 PACKING

All post insulators shall be pack in wooden crates suitable for easy but rough handling and acceptable for rail, transport. Where more than one insulator is packed in a crate wooden separators shall be fixed between the insulators to keep individual insulator in position without movement within the crate.

Table-I

Highest System Voltage in kV	**Minimum Creepage distance in mm**
	Post insulator
12	300
36	900

ANNEXURE – A

1 **Hydraulic Internal Pressure Test on Shells (if applicable)**

The test shall be carried out on 100% disc strain insulator shells before assembly. The details regarding test will be as discussed and mutually agreed to by the Contractor and Owner in Quality Assurance Programme.

2 **Thermal Mechanical Performance Test**

Thermal Mechanical Performance Test shall be performed in accordance with IEC-383-1-1993 Clause 20 with the following modifications :

(1) The applied mechanical load during this test shall be 70% of the rated electromechanical or mechanical value.

(2) The acceptance criteria shall be :

(a) X greater than or equal to R+ 3S.

Where,

X Mean value of the individual mechanical failing load.

R Rated electro-mechanical / mechanical failing load.

S Standard deviation.

(b) The minimum sample size shall be taken as 20 for disc insulator units.

(c) The individual electromechanical failing load shall be at least equal to the rated value. Also puncture shall not occur before the ultimate fracture.

3 **Electromechanical / Mechanical Failing Load Test**

This test shall be performed in accordance with clause 18 and 19 of IEC 383 with the following acceptance:

(i) X greater than or equal to R + 3S

Where,

X = Mean value of the electro-mechanical/mechanical/ failing load.

R = Rated electro-mechanical / mechanical failing load.

S = Standard deviation.

(ii) The minimum sample size shall be taken as 20 for disc insulators units. However, for larger lot size, IEC 591 shall be applicable.

(i) The individual electro-mechanical/mechanical failing load shall be at least equal to the rated value. Also electrical puncture shall not occur before the ultimate fracture.

4 **Chemical Analysis of Zinc used for Galvanizing**

Samples taken from the zinc ingot shall be chemically analyzed as per IS:209. The purity of zinc shall not be less than 99.95%.

5 **Tests for Forgings**

The chemical analysis, hardness tests and magnetic particle inclusion test for forgings, will be as per the internationally recognized procedures for these tests. The sampling will be based on heat number

and heat treatment batch. The details regarding test will be as discussed and mutually agreed to by the Contractor and Owner in Quality Assurance Programme.

6 **Tests on Castings**

The chemical analysis, mechanical and metallographic tests and magnetic particle inclusion for castings will be as per the internationally recognized procedures for these tests. The samplings will be based on heat number and heat treatment batch. The details regarding test will be as discussed and mutually agreed to by the Contractor and Owner in Quality Assurance Programme.

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

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 S/S
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
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, and 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 synchronization 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 SCHEME FOR 33KV PARELLEL FEEDERS AT RECEIVING ENDS : DIRECTIONAL PROTECTION :

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	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	 1 No. 2 Nos.	
5	Push button for : Trip circuit test	 1 No.	
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**	**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)**			

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 f lag / 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**			
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	
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	
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 11 KV DROP OUT FUSE CUT OUTS

1. SCOPE

This specification covers outdoor, open, drop-out expulsion type Fuse Cutouts suitable for installation in 50 Hz, 11 KV distribution system.

2. APPLICATION

The distribution fuse cutouts are intended for use in distribution transformers and have no inherent load break capacity.

3. APPLICABLE STANDARD

Unless otherwise modified in this specification, the cutout shall conform to IS:9385 (Part-I to III) as amended from time to time.

4. RATED VOLTAGE

The rated voltage shall be 12 KV.

5. RATED CURRENT

The rated current shall be 100 A.

6. RATED LIGHTNING IMPULSE WITHSTAND VOLTAGE VALUES FOR THE FUSE BASE

The rated lightning impulse withstand voltages both for positive and negative polarities shall be as given below :

a) To earth and between poles 75 KV (Peak)

b) Across the isolating distance of fuse base 85 KV (Peak)

7. RATED 1 MINUTE POWER FREQUENCY WITHSTAND VOLTAGE (DRY & WET) VALUES FOR THE FUSE BASE

a) To earth and between poles 28 KV (rms)

b) Across the isolating distance 32 KV (rms)

8. TEMPERATURE RISE LIMIT (In Air)

a) Copper contacts silver faced 65^{o}C

b) Terminals 50^{o}C

c) Metal parts acting as springs. The temp. shall not reach such a value that elasticity of metal is changed

9. RATED BREAKING CAPACITY

The rated breaking capacity shall be 8 KA (asymmetrical).

10. GENERAL REQUIREMENTS/CONSTRUCTIONAL DETAILS

10.1 The cutouts shall be of single vent type (downward) having a front connected fuse carrier suitable for angle mounting.

10.2 All ferrous parts shall be hot dip galvanised in accordance with the latest version of IS:2633. Nuts and bolts shall conform to IS:1364. Spring washers shall be electro-galvanised.

10.3 Typical constructional details of the fuse cutout are shown in Fig. 1

11. FUSE BASE TOP ASSEMBLY

11.1 The top current carrying parts shall be made of a highly conductive copper alloy and the contact portion shall be silver plated for corrosion resistance and efficient current flow. The contact shall have a socket cavity for latching and holding firmly the fuse carrier until the fault interruption is completed within the fuse.

11.2 The top contact shall be actuated by a strong steel spring which keeps it under sufficient pressure to maintain a firm contact with the fuse carrier during all operating conditions. The spring shall also provide flexibility and absorbs most of the stresses when the fuse carrier is pushed into the closing position.

11.3 The current carrying parts of the assembly shall be protected from water and dust formation by a stainless steel top cover.

11.4 The top contact assembly shall have a robust galvanised steel hook to align and guide the fuse carrier into the socket latch even when the fuse carrier is closed at an off-centre angle.

11.5 The top assembly shall have an Aluminium alloy terminal connector (refer clause 19).

11.6 The top assembly shall be robust enough to absorb bulk of the forces during the fuse carrier closing and opening operations and shall not over-stress the spring contact. It shall also prohibit accidental opening of the fuse carrier due to vibrations or impact.

12. FUSE BASE BOTTOM ASSEMBLY

12.1 The conducting parts shall be made of high strength highly conductive copper alloy and the contact portion shall be silver plated for corrosion resistance and shall provide a low resistance current path from the bottom fuse carrier contacts to the bottom terminal connector.

12.2 The bottom assembly shall have hinge contacts made from highly conductive, anti-corrosive copper alloy and shall accommodate and make a firm contact with the fuse carrier bottom assembly. The fuse carrier shall be placed easily in or lifted from The hinges without any maneuvering. In addition, the bottom assembly shall perform the following functions :

i) When opened manually or after fault interruption the fuse carrier shall swing through 180^{o} to the vertical and its further travel shall be prevented by the fuse base bottom assembly.

ii) The fuse carrier shall be prevented from slipping out of the self locking hinges during all operating conditions and only when the fuse carrier has reached its fully open position can it be removed from the hinge support.

12.3 The assembly shall have an aluminium alloy terminal connector (refer clause 19).

13. FUSE CARRIER TOP ASSEMBLY

13.1 The fuse carrier top contact shall have a solid replaceable cap made from highly conductive, anti-corrosive copper alloy and the contact portion shall be silver plated to provide a low resistance current path from the Fuse Base Top Contact to the Fuse Link. It shall make a firm contact with the button head of the fuse link and shall provide a protective enclosure to the fuse link to check spreading of arc during fault interruptions.

13.2 The fuse carrier shall be provided with a cast bronze opening eye (pull ring) suitable for operation with a hook stick from the ground level to pull-out or close-in the fuse carrier by manual operation.

14. FUSE CARRIER BOTTOM ASSEMBLY

14.1 The fuse carrier bottom assembly shall be made of bronze castings with silver plating at the contact points to efficiently transfer current to fuse base. It shall make smooth contact with the fuse base bottom assembly during closing operation.

14.2 The bottom assembly shall have a lifting eye for the hook stick for removing or replacing the fuse carrier.

14.3 The bottom assembly shall have a suitable ejector which shall perform the following functions :

i) It shall keep the fuse link in the centre of fuse tube and keep it tensioned under all operating conditions.

ii) It shall be capable of absorbing the shock when the fuse carrier is pushed into the closed position and shall not allow the fuse link to be damaged. This is specially important when the fuse link is of low-ampere rating.

iii) The ejector at the instant of interruption shall retain the fuse carrier in the closed position long enough to ensure that the arc is extinguished within the fuse tube thereby excluding the possibility of arcing and subsequent damage at the contact surfaces.

iv) The ejector shall help the fuse link separation after fault interruption, allowing the fuse carrier to drop out and clearing the pigtail of the blown fuse link through the bore of fuse tube.

15. FUSE BASE (PORCELAIN)

The fuse base shall be a bird-proof, single unit porcelain insulator with a creepage distance (to earth) not less than 320mm. The top and bottom assemblies as also the middle clamping hardwares shall be either embedded in the porcelain insulator with sulphur cement or suitably clamped in position. For embedded components, the pull out strength shall be such as to result in breaking of the porcelain before pull out occurs in a test. For porcelain insulators, the beam strength shall not be less than 1000 Kg.

16. FUSE TUBE

The fuse tube shall be made of fibre glass coated with ultraviolet inhibitor on the outer surface and having arc quenching bone fibre liner inside. The tube shall have high bursting strength to sustain high pressure of the gases during fault interruption. The inside diameter of the fuse tube shall be 17.5mm. The solid cap of the fuse carrier shall clamp the button head of the fuse link, closing the top end of the fuse tube and allowing only the downward venting during fault interruption.

17. TYPE TESTS

The cutout shall be subjected to the following type tests :

i) Dielectric tests (rated impulse withstands and rated one minute power frequency with stand test voltages)

ii) Temperature rise test

The above tests shall be carried out in accordance with IS:9385 Part I & II.

For Porcelain Fuse Base only :

iii) Pull out test for embedded components of the fuse base.

iv) Beam strength of porcelain base.

18. MOUNTING ARRANGEMENT

18.1 The cutouts shall be provided with a suitable arrangement for mounting these on 75x40mm or 100x50mm channel cross arm in such a way that the centre line of the fuse base is at an angle of 15^{o} to 20^{o} from the vertical and shall provide the necessary clearances from the support. Mounting arrangement shall be made of high strength galvanised steel flat and shall be robust enough to sustain the various stresses encountered during all operating conditions of the cutout. For more details see enclosed figure 2.

18.2 Strength of the component marked 1 (see figure) shall be determined by clamping the member with the shorter leg at the top to a rigid support by M-10 carriage bolts. A downward force shall be applied along the axis of M-14 carriage bolt parallel to the longer leg and in the direction of longer leg of the member under test. A load of 50 Kg. shall be applied and then removed to take up any slack in the mounting arrangement before the measurement of position is taken, the permanent set measured at the axis of the M-14 carriage bolt shall not exceed 1.6mm when a load of 425 Kg. is applied and removed.

18.3 The strength of M-14 bolt shall not be less than1900 Kg. and strength of M-10 bolts not less than 3500 Kg.

19. TERMINAL CONNECTIONS

The cut-out shall be provided with two aluminium alloy (alloy designation 2280 (A-11) as per IS:617-1975) terminal connectors at top and bottom of fuse base assemblies to receive aluminium conductors of diameters between 6.3mm to10.05mm. These terminals shall be easily accessible irrespective of the cut-out location with respect to the pole. The terminals shall meet the test requirements of REC Construction Standard.

20. INSPECTION

All tests and inspection shall be made at the place of manufacture unless otherwise especially agreed upon by the manufacturer and the purchaser at the time to purchase. The manufacturer shall afford the inspector representing the purchaser all reasonable facilities without charge, to satisfy him that the material is being furnished in accordance with this specification.

The purchaser has the right to have the tests carried out at his own cost by an independent agency whenever there is dispute regarding the quality of supply.

TECHNICAL SPECIFICATION OF 33 KV AND 11 KV GANG OPERATED SWITCH

1.0 SCOPE

1.1. This specification is intended to cover design manufacture, testing at manufacturer's works, transport to site, insurance, storage, erection and commissioning of 33 KV and11 KV gang operated switch (Isolators) with all fittings and accessories.

1.2. The Gang operated air break switch/ isolator/ disconnector are for outdoor installation suitable for both vertically and horizontally mounting on mounting structures or M.S. Channel and for use at sectionalizing/tapping points of 33 KV lines, 11KV line and at 33/11 KV sub-stations.

1.3. The successful bidders shall supply the necessary drawings and instructions for installation and commission of the Isolators.

2.0 CONSTRUCTIONAL DETAILS

2.1. The vertically mounted gang switches shall be manually operated triple pole type with single break operation. The operation of the equipment shall be through forward and backward motion of the mid-pole post insulator. The contacts shall be made of silver faced hard drawn copper.

2.2. The horizontally mounted switches, with or without earth switches shall have rotating blade features and pressure reliving features. Such isolators are required to be double break; three posts per phase, single through, gang operated three phase type. All isolators with/without earth switch shall operate through 90^0 from their fully closed position to fully open position

2.3. The switch shall be fitted with arcing horns and the horns shall be easily replaceable.
All isolators shall be provided with suitably rated terminal connectors to directly receive ACSR conductor of required size. The termination shall have at least 3 pairs of holes to hold the conductor tight with nuts & bolts The terminals shall conform to all the test requirements of IS: 5561 and shall be designed as to avoid bimetallic corrosion.

2.4. The operating rod shall comprise of not less than 40 mm (nominal bore) Galvanised steel pipe as per IS 1161-1979. The length of the operating rod shall be suitable for operation as per installation methods. The rod shall be so threaded that the length can be adjusted.

2.5. The horizontal operation shaft shall be of solid Galvanised steel of square section suitable for fitting the insulator base of the switch. Length of the rod shall be such as to maintain the phase clearance as per I.S.

2.6. The operating handle shall have OFF/ON locking arrangement and provision for earthing the equipment.

2.7. The gang operating switch shall be provided with three post insulators per phase conforming to IS 5350 (Pt-III)-1971. The cast iron post shall be embedded in the insulators with sulphur cement. For embedded components, pull out strength shall be such as to result in breakings of the porcelain insulators, the beam strength shall be as per relevant T.S. Creepage distance shall not be less than 900 mm and 300 mm for 33KV and 11 KV isolators respectively.

2.8. All similar materials and removable parts of similar equipments shall be interchangeable with each other.

3.0 APPLICABLE STANDARD

3.1. Unless otherwise stipulated in this specification, the Gang operated switch shall conform to IS. 9920 (Pt-I to Pt-IV).

4.0 Failure to meet guarantees and requirement of specification

4.1. If after installation, the operation of the switch proven to be unsatisfactory, to the purchaser, the tenderer shall have to take back or replace.

5.0 TEST AND INSPECTION

5.1. The switches shall be subjected to the following type test in accordance to with IS: 9920.

I) Dielectric test (impulse and one minute) power frequency withstands voltage.
II) Temperature rise test
III) Rated off load breaking current capacity
IV) Rated active load breaking capacity
V) Rated line charging breaking capacity
VI) Rated short time current
VII) Rated peak withstand current
VIII) Mechanical and Electrical Endurance

5.2. **The equipment shall be subjected to the following routine test**.

I) Power frequency voltage dry test
II) Measurement of resistance of the main circuit
III) Operating test.

5.3. The porcelain will have pull out test for embedded component and beam strength of porcelain base.

5.4. The manufacturer shall afford the inspection representing the purchaser or third party nominee all reasonable facilities, with charge, to satisfy him that the material is being furnished in accordance with this specification.

The purchaser has the right to have the test carried out at his own cost by an independent agency whenever there is dispute regarding the quality of supply.

6.0 GUARANTEE

The Bidder shall offer equipment performance guarantee for a minimum period of 18 months from the date of commissioning.

Any damaged part or defective part of the equipment, the bidder has to replace at his cost.

7.0 TECHNICAL SPECIFICATION

Sl No	Particular	33 KV GOAB	11 KV GOAB
1	Nominal system voltage, KV	33 KV	11 KV
2	Highest system voltage, KV	36 KV	12 KV
3	Nominal frequency, Hz	50HZ	50HZ
4	Rated normal current, Amp	400A, 630A	400A
5	Short time current rating & duration	25 KA for 3sec	16KA for 3 sec
6	Power frequency one minute withstand voltage,		
i	To earth and between pole, KV (RMS)	70	28
ii	Across the isolating distance, KV (RMS)	80	28
7	Rated lightning impulse withstand voltage		
i	To earth and between pole, KV (Peak)	170 KV	75
ii	Across the isolating distance, KV (Peak)	190KV	85
8	Minimum Clearance Between phase to phase	1350 mm	750 mm
	Minimum insulator creepage distance, mm	900 mm	320mm
	Electrical endurance	200 operation	200 operation
	Mechanical endurance	1000 operation	1000 operation
	Temperature rise		

	Applicable Standard	IS: 9921, IS;2544 &5350	IS: 9921, IS;2544 &5350

TECHNICAL SPECIFICATION FOR DC DISTRIBUTION BOARD

1.0 General Features

1.1. The D.C. distribution boards shall be indoor, floor mounting of self supporting, sheet metal clad, and cubicle type. The panels shall be totally enclosed, dust tight and vermin proof and shall be made of 2.0mm cold rolled sheet steel. The boards shall be provided with double leaf hinged doors at the back. All doors and covers shall be fitted with rubber gaskets. The doors shall be provided with locks and duplicated covers.

2.0 Bus bars

2.1. The bus bars shall be of electrolytic copper of ample cross-section. The bus bars shall be insulated from the structure by means of durable, non-hydroscopic, non-combustible and non tracking materials.

3.0 Detail Requirements

The 110 Volts D.C. distribution boards shall be provided with the following:

a. One mains failure alarm relay.
b. One earth fault alarm relay.
c. One 110 Volts D.C. bell to be operated by the mains failure alarm relay.
d. One 110 Volts D.C. buzzer to be operated by the earth failure alarm relay.
e. One double pole air-break circuit breaker of 200 amp capacity with thermal overload tripping arrangement to act as incoming breaker of the load bus.
f. One 0-150 volts D.C. moving coil voltmeter to measure the bus-bar voltage. The display is to be in digital.
g. One pilot lamp to indicate D.C. on conditions.
h. 250 volts, double pole double throw make before break switch with H.R.C. fuses of following ratings for outgoing feeders.
    i. 16 Amp, 4 Nos.
    ii. 32 Amp, 3 Nos.
    iii. 63 Amp, 1 Nos.
i. One terminal Board/block for all feeder outlets including cable glands.
j. Automatic double pole changeover contactor complete with rectifier for emergency load with red and green indicating lamps

TECHNICAL SPECIFICATIONS FOR A.C. DISTRIBUTION BOARD

1.0 SCOPE

1.1. This section of the specification covers the design, manufacture, testing at works, transport to site, insurance, storage, erection and commissioning of 415 volts, A.C. 50 Hz A.C. Distribution Board complete with all equipments and accessories as described in subsequent clauses.

2.0 CONSTRUCTIONAL FEATURES

2.1 The L.T.AC. panels shall be outdoor, sheet metal clad type comprising of combination switch fuse units and bus bar chambers. and equipped with the circuits and equipments as specified later. The different circuits shall be mounted above and below the bus bar chamber to form a suitable arrangement, except that the incomings will be located at the front and mounted below the bus bar chambers. All equipments shall be suitable for the reception of the cables rising from the ground level. The switch boards shall be so designed as to be readily extensible.

2.2 **Required technical particulars of ACDB**

1.	Manufacturers Name & Co		
2	Bus Bars		
	a)	Make	
	b)	Continuous Current rating in Amps	200A
	c)	Material	Aluminium
	d)	Current Density	0.9 Amps/sqmm
3	Incoming Switch Fuse Unit		
	a)	Make	Havell's/ Schinder
	b)	Type	SFU
	c)	Rated Voltage	415 Volts AC
	d)	Continuous Current carrying Capacity in Amps	200A
4	Indication Lamps		
	a)	Make	STD
	b)	Type	LED
	c)	Voltage	220Volts
5	Fuse		
	a)	Make	Havell's/ Schinder
	b)	Type	HRC
	c)	Rupturing Capacity	80 KA
6	Switch (triple/double pole)		

	a)	Make	Havell's/ Schinder/ EQV
	b)	Type	SF UNIT
	c)	Rated Continuous Current carrying Capacity in Amps	63A/32A/16A
7	Current Transformer		
	a)	Make	
	b)	Type	Bar primary and ring type
	c)	Ratio	100-200/5A
	d)	VA burden rating	15 VA
	e)	Accuracy class	1
	f)	Type of Insulation	PVC
	g)	Security factor	<5
8	AC Meters/ Energy Meters (Details for Ammeters Voltmeters, Energy Meters shall be furnished separately)		AM VM KWH
	a)	Make	M/S SML,or M/S L&T
	b)	Type	MI 96 mm sq. 3 ph, 4W
	c)	Range	0-100 A ,200/5 0-200 A 0-500 0-300A
	d)	Accuracy	1.5
9	Internal Wiring		
	a)	Make	Supercab/ EQV
	b)	Type	PVC Insulated Copper
	c)	Voltage Grade	1100 Volts
	d)	Size	Recommended
	e)	Material used	Copper
10	Cable Glands		
	a)	Make	Standard

	b)	Type	Compression type
	c)	Size	As per cable size
	d)	Material used	Brass
11	Terminal Block		
	a)	Make	Eleco/ STD
	b)	Type	STUND Type
	d)	Material used	Bakelite DMC
12	Switch Board		
	a)	Overall Dimension	1500x900x500 mm(for nine feeders ACDB)
	b)	Thickness of Steel metal	1.6 mm
	c)	Finish	Light Grey
	d)	Approximate Weight	250Kg

3.0 COMBINATION MCCB UNIT

3.1. All MCCB shall be of triple pole rotary operated type and shall open and close with snap action. The series combination MCCB shall conform to the provisions of latest issue of IS – 13947-2.

3.2. The MCCB shall be suitable for rated voltage of 415 volts AC., 50 Hz. The rated current of each unit shall be as specified before.

4.0 BUS BARS

The phase and neutral bus bars shall be of high conductivity (as per IS 5082) aluminum of adequate uniform cross section. The bus bars shall be insulated from the structure by means of durable non-hygroscopic, noncombustible and non-tracking materials. Bus bar joints shall be bolted type.

5.0 The 415 Volts, L.T.A.C. switchgear shall have following circuits and equipments:

(a) INCOMING: - One number fitted with following:

(i) One 400/300 Amps. as required , unit fitted with cable glands suitable for 4 core XLPE cable labeled "Incoming".

(ii) One voltmeter, 0-500 volts.

(iii) One Ammeter, 0-500 Amps.

(iv) One KWH Static Electronic Three phase Trivector meter having facility of downloading the data with connected CTs as mentioned.

(b) OUTGOING :- Nos. 1 and 2 each comprising of:

One 300/200 Amps. as required, unit fitted with complete with direct connected round protecting pattern ammeter, scaled 0-300 Amps, and cable gland suitable for 4 core XLPE cable labeled as “outgoing”.

Name Plate

The board shall be provided with nameplate covering all technical data and also name of the project shall be clearly mentioned

7.0 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.

TECHNICAL SPECIFICATION FOR XLPE POWER CABLES (11KV &33 KV)

SECTION I : STANDARD TECHNICAL REQUIREMENT

1.0 SCOPE:

The specification covers the design, testing, supply and delivery in proper packed condition of different grade of 1 or 3 core. Aluminium Conductor, Cross-linked polyethylene (XLPE) insulated, PVC sheathed, armoured, screened Power Cables.

2.0 LOCATION:

1.1 The cables may be laid buried directly in ground at a depth of one metre in average, any where in Assam and terminate for outdoor connection to a power transformer or to overhead lines and also indoor connection for indoor switchgear.

1.2 The cables may also be laid within covered cable trenches, in cable racks or open-air ladder trays etc. for certain portion of lengths.

3.0 SYSTEM DETAILS:

3.1	Voltage grade (KV) of cable required	…	6.35/11
3.1	Service Voltage	…	11 KV
3.2	Highest Voltage	…	12 KV
3.3	Earthing System		Solidly Earthed
3.4	B.I.L. for Cables		75 KV for 11 KV
3.5	Fault Level (Maxim.) 50 C/S.	…	…

4.1 STARDARDS:

4.2 The cable shall conform to the following standards to the extent of LAEDCL requirement is fulfilled.

1) IS : 7098 (Part – II) (Latest) :Specification for cross-linked polyethylene Insulated PVC Sheathed Cables for working Voltage from 3.3 KV up to and including 33 KV.

2) IS:8130 – 1984 :Specification for Conductors for insulated electric cables and flexible cords.

3) IS:5830 – 1984 :PVC insulation & sheath of electric cables.

4) IS:3975 – 1979 : Armour for cables (for 3 Crore).

5) IS:10810 – 1984 : Methods for test for cables.

6) IS:10418 – 1982 : Cable Drum for Electric Cables.

1.3 The cable, joints, outdoor and indoor termination and their accessories and fittings may conform to other Indian and/or equivalent standards or important publications to improve upon their performance, but shall not fall short of the requirement of this specification. The tenderer shall clearly indicate such standards in their offers.

4.0 **ELECTRICAL CHARACTERISTICS & PERFORMANCE:**

4.1 Description of Cable:

a) 6.35/11 KV Grade 3-Crore : Same as above but insulation shielding with black semi-conducting tape not necessary. Inner sheath to be wrapped not extruded and strip armoured. The design shall fully conform to IS:7098 (Part – II).

b) SPECIFIC TECHNICAL REQUIREMENTS

Technical parameters of the cable shall be as follows:

Sl No	Particulars	Unit	11 KV
1	Rated voltage	KV	11
2	Type of insulation	-	XLPE
3	Single Core	-	Single , three
4	Armoured /Unarmoured	-	Armoured
5	Material of Conductor		Material to IS: 8130, H4 Grade Aluminium Conductor, Stranded compacted Circular
6	System	-	11 KV Earthed
7	Highest System Voltage	KV	12
8	Material	-	Stranded Aluminium
9	Voltage Grade		6.35/11 KV
10	Conductor Size	Sq. mm	1x185,3x120 1x300
11	Nominal dimention of Al. round wire		2.0mm[for 1x300sqmm], 2.0mm [for 1x185sqmm & 2.5mm[3x120 sqmm],
12	Nominal thickness of XLE insulationr sheath		3.6 mm
13	Approx overall cable diameter		61.50mm [for 3x120sqmm], 35.50mm [for 1x185sqmm] 40.00 mm [for 1x300 sqmm],
14	Current rating		
a	In ground at 30^{0C}		219A(3x120sqmm),

			296A(1x185sqmm) 381 A(1x300 sqmm)
b	In air at 40^{0C}		288A(1x120sqmm), 378A(1x185sqmm) 512 A(1x300 sqmm
15	Maxm. Conductor Temp		90 ^{o}C at maxm. Continuous current
16	Short Ckt.Current for 1 second duration		11.3KA-for120 sqmm, 17.5 KA-for 185 sqmm, 28.3 KA – for 300 sqmm.
17	Maxm.Permissible emergency overload temp. at 25% overload to 100 hrs. per year or 500 hrs. in life of cable		130 ^{o}C for one hour
18	Maxm. Permissible short circuit temperature		250 ^{o}C for one hour
19	Conductor Screening		Extruded, cross linked, semi-conducting compound of.5 mm for 11KV
20	Insulation Screening		
21	Conductor Screening	**:**	Extruded, cross linked, semi-conducting compound of.5 mm for 11KV
22	Insulation	**:**	XLPE of thickness, 3.6 mm (Nominal) for 11KV
a	Insulation Screening	**For 33 KV :**	Combination of black extruded semi-conducting tape as the non-metallic part and annealed copper 0.06 mm (minimum) thick tape lapping as metallic part. For 1 core cable, the non-magnetic metal Armour will act as metallic part insulation screening.
b		**For 11 KV :**	It is same but semi-conducting tape is not required
23	Inner Sheathing	**:**	Black extruded PVC, Type ST-2 compound for 33 KV and wrapped PVC tape for 11 KV as per ISS. For

			1 core there will be no inner sheath.
24	Armouring	:	Single layer of round galvanized steel wires/strip for 33 KV and galvanized steel strips/wire for 11 KV (3 core) as per IS. For 1 core, there will be non-magnetic metal Armour.
25	Overall Sheathing	:	Coloured PVC, type ST-2 compound to IS: 5831, extruded for both 33KV and 11KV thickness shall be as per ISS
26	Approx. length of cable in a Drum	:	250 metres with a tolerance of ± 5% (for 3 core), 500 metres ± 5% (for 1 core)
27	End Sealing		H.S. Caps (see **clause 4.13.1**) (Heat Shrinkable)
a	Max. 'Tan-delta' at room temp. At nominal phase to neutral voltage (Uo):		0.004
b	Maxm. Increment of 'tan-delta' between 0.5 Uo to 2 Uo at room temp:	:	0.002
28	Partial discharge value		20 Pc (Maxm.) at 1.6 Uo.
29	Impulse Tests		170 KV for 33 KV and as per ISS for 11 KV
30	H.V. Tests between Conductors & Screen/Armour		48 KV (rms) for 33 KV for 5 minutes and as per ISS for 11 KV
31	Maxm. D.C. Rtance/Km		As per relevant I.S.S

* NB the above parameters are applicable for three core and single core cable, if not otherwise specified.

CABLE CONSTRUCTION:

4.3 XLPE underground cable is to be manufactured in continuous catenaries process at controlled elevated temperature and pressure in inert atmosphere with use of suitable materials for XLPE semi-conducting, insulation and XLPE screen. The inner and outer semi-conducting sheaths and main polyethylene insulation between the sheaths are to be simultaneously extruded during the Triple Extrusion Process of manufacturing and main insulation of the Cable is to be extruded unified. The XLPE Cables in this specification does not have any metal sheath and the short circuit rating of the cable will depend on the conductivity and continuity of the strands of the armour wires, which shall be ensured by guarding against corrosion.

4.4 CONDUCTOR SCREENING

4.5 A semi-conducting cross-linked polyethylene (XLPE) screening shall be extruded over the conductor to act as an electrical shield which together with elimination of the so called "Strand Effect" prevents to a great extent air ionization on the surface of the conductor.

4.6 INSULATION:

The main insulation of the Cable shall be extruded unfilled, chemically cross-linked polyethylene (XLPE) inert gas cured satisfying the requirement of ISS: 7098 (Part- II)

4.7 INSULATING SCREEN:

The screen shall be made up as given in Clause 22the metal screen eliminates tangential stress electrostatic field surrounding the conductor and uniform electrical stress in the insulation.

The semi conducting polyethylene (XLPE) screen shall be extruded over the main poly ethylene-insulating wall to prevent partial discharge at the surface of the insulation. The copper tape shall be wrapped over the semi conducting tape or extrusion as mentioned earlier for 3 core cables. The metal screen so formed around the cores shall be in contact with one another as the cores are laid up at triangular configuration. For single core cable, Aluminium wires armoring shall constitute the metallic part of insulation screen. Conductor screening, insulation and insulation screening shall be extruded in triple extrusion processes so as to obtain continuously smooth interfaces.

4.8 The mechanical and chemical properties of the materials for semi conducting screens are much more important than their electrical properties, but for obtaining the high overall degree of electrical properties of an E.H.V. cable, the inner and outer semi conducting, sheaths and the main polyethylene insulation between the sheaths shall be simultaneously extruded during the manufacturing, process known as **"triple extrusion".** The advantages are:

i) The partial discharge level at the surface of the insulation is brought to a minimum.
ii) There will be no displacement of the semi conducting screen and insulation during expansion and contraction due to load cycles and bending.
iii) The semi conducting screens are easily removable during joining and termination operations.

Note: Manufacturers not having "triple extrusion" process will be disqualified. The Tenderer shall have to produce necessary process line at the time of bidding.

4.9 LAYING UP:

The phase identification of the cores shall be either by colour or numerals as per I.S.S. for 3 core cables only.

Core Colour	Numeral
Red	1
Yellow	2
Blue	3

The screen cores shall be laid up with interstices filled with PVC fillers and taped a binder tape as to obtain a reasonably circular cable.

4.10 INNER SHEATH:

The cable core shall be supplied with bedding of PVC (Inner sheath) in the form of extruded PVC sheath for 33 KV cables. Wrapped PVC tapes shall be used for 11KV thickness as per clause 23 of special technical parameters and as per relevant IS.

4.11 ARMOUR:

The cable shall be wire armoured /steel strip in case of 33KV and wire/strip armoured 11 KV, three core cables to insure an adequate return path for the flow of fault current and also provide suitable mechanical protection. Steel wires/aluminum wire / steel strips of required size in requisite number as per clause 24 of special technical parameters shall be laid closely in the spiral formation to protect the circumference of the cable fully and to provide adequate cores section area for flow of maximum fault current within limits of specified temperature rise and duration of fault. Direction of the lay of the

armour shall be opposite to that of the cable cores in case of single core cable armour shall be of non-metallic material.

4.12 OUTER SHEATH:

A reliable surving shall be necessary for maintaining conductivity of the armour particularly under corrosive condition in the form of jacket. Cable shall be therefore finished with extruded PVC over sheath of thickness as per clause 25 of special technical parameters.

The quality of PVC over sheath (jacket) shall be ensured for service reliability against moisture intrusion and shall confirm to type ST-2 of IS : 5831.

The colour of the outer sheath shall be follows:

For 11 KV cable : Blue

The sheaths shall be protected against white ants, vermin and termites by suitable, durable and reliable measures.

The suppliers shall suggest suitable materials for use, in the event of damage to the over sheath to prevent the passage of moisture along the cable.

4.13 CABLE IDENTIFICATION:

The following shall be embossed on the outer sheath for the identification.

a) Manufacturer's Name or Trade Mark.
b) Voltage Grade.
c) Nominal section and material of conductors and number of cores.
d) Year of manufacture.
e) Inscription of length of cables at 1.0 mtr interval.
f) Name of purchaser LAEDCL;
g) Marking "Power" shall be embossed throughout the length of the cable at 10 mtr spacing.
h) Type of insulation i.e. XLPE

4.13.1 CEILING OF CABLE ENDS:

The cable ends of the cable in the wooden drum for delivery shall be sealed with heat shrinkable caps.

7.0 WOODEN DRUMS:

The cable shall be packed in non-returnable wooden drums.

The following information shall be marked on each drum.

a) Drum identification number.
b) Manufacturer's name, Trade name / Trade mark, if any.
c) Nominal sectional area of the conductor of the cable.
d) Number of cores
e) Type of cable and voltage grade with cable code
f) Length of cable in cable drum
g) Direction of rotation of drum (by means of an arrow)
h) Appox. Weight: tare: gross:
i) Year and country of manufacture
j) Purchase order number
k) Date of delivery
l) Name of the purchaser.

Drum shall be proofed against attack by white ant or termite conforming to IS: 10418. The Drums may also be marked with ISI certificate mark, as applicable.

Safe pulling force : 30 N/mm^2 (for conductor)

8.0 Tests to be performed as per IS:7098 (part II)
Tenderer shall have to submit type test report (tested at CPRI Bangalore/Bhupal) along with the Bid. Bidder will be disqualified for non-submission of type test reports.

8.1 Type test all the test mentioned below are to be made as per details given in IS:10810

a) Test on conductor
   i. Tensile test (For aluminum)
   ii. Wrapping test for aluminum
   iii. Resistance test.
b) Test for armuoring wire strips.
c) Test for thickness of insulation and sheath.
d) Physical test for insulation.
   i. Tensile strength and elongation at break
   ii. Ageing in air oven.
   iii. Hot test
   iv. Shrinkage test.
   v. Water absorption (Gravimetric)
e) Physical tests for outer sheath
   i. Tensile strength and elongation at break
   ii. Ageing in air oven.
   iii. Shrinkage test.
   iv. Hot deformation
   v. Heat shock
   vi. Loss of mass in air oven
   vii. Thermal stability
   viii. Thermal Stability

f) Partial discharge test
g) Bending test
h) Dielectric power factor test
   i. As a function voltage
   ii. As a function of temperature
i) Insulation resistance (volume resistivity) test
j) Heating cycle test
k) Impulse with stand test
l) High voltage test
m) Flammability test

8.2 The following test on screen cable shall be performed successfully on the same test sample of completed cable, not less than 10 m. in length between the test accessories.
   a) PD test
   b) Bending test followed by PD test
   c) Di-electric power factor as function of voltage
   d) Di-electric power factor as a function of temperature
   e) Heating cycle test followed by Di-electric power factor as a function of voltage and PD test.
   f) Impulse with stand test and
   g) High voltage test as per para 30 of special technical parameters

   If a sample fails in test (g) one more sample shall be taken for this test, preceded by test (b) and (e)

8.3 **Acceptance test** : the following shall constitute acceptance test:
   a) Tensile test (For aluminum)
   b) Wrapping test for aluminum
   c) Conductor resistance test
   d) Test for thickness of insulation and sheath

e) Hot set test for insulation
f) Tensile strength and elongation at break test for insulation and outer sheath
g) PD test (Screen enables) only on full drum length
h) High voltage test, and
i) Insulation resistance (volume resistivity) test
J) Spark test on extruded un-insulated outer PVC sheath as per provision clause no 3.2 IEC standard (Publication no.229 of 1982)

8.4 **Routine test**:

The routine test shall be carried out on all cables manufacturer in accordance with this specification. The following routine test shall be made on cable length as specified in ISS.

a) Conductor resistance test
b) Partial discharge test on full drum length
c) High voltage test as per clause 29 of special technical parameters

8.5 Test witness

a) All tests shall be performed in presence of purchaser representatives if so desired by the purchaser.
b) The contractor shall give at least 15 days advance notice for witnessing such tests.

9.0 Test Certificate

9.1 Certified copies of all routine test carried out at work shall be furnished in 6 copies for approval of the Purchaser.

9.2 The cable shall be dispatched from works only after receipt of Purchaser's written approval of shop test report.

9.3 Type test certificates of the cable offered shall be furnished. Otherwise the cable shall have to be type tested on similar rating as per clause 10 free of any charges to prove the design.

10.0 Descriptive literatures test results etc.

The following details for the cable shall be submitted with bid

a) Manufacturers catalogue giving cable construction details and characteristics
b) Manufacturing process in details for cables highlighting the steps of control
   i. Contamination
   ii. Formation of water trees
   iii. Effects of by products of cross linking
   iv. Stress control etc.
c) Cross section drawing of the cable
d) Cable current ratings for different types of installation inclusive of derating factors due to ambient temperature, grouping etc.
e) Over-load characteristics of the cable without endangering the normal life and electrical quality of the insulation.
f) Complete technical date of the cables.
g) Type test certificate from government testing units/government authorized testing units.

with the quality assurance plan submitted by the firm, the offer shall be liable for rejection.

11.0 Guarantee:

The guarantee period shall either be 60 (Sixty) month from the date of commissioning or 66 (Sixty six) month from the date of material received at site. The tenderer shall have to replace the damage cable (electrical damage/physical deformation) within 30 days from reporting.

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)	Diameter	

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 mounted on the support structure at a suitable height so that the reading 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
	Residual Voltage Test a) Steep current 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
	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)
	Galvanizing 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
2.	Residual Voltage Test a) Steep current impulse residual voltage test b) Lightning impulse residual voltage test
3.	Long duration current impulse withstand test
4.	Switching surge operating duty test
5.	Power frequency voltage Vs. Time characteristics
	Accelerated Ageing test

7.	Pressure relief test a) High Current b) Low Current
8.	Artificial pollution test (for porcelain housing)
9.	Seismic Test
10.	Partial Discharge test
11.	Bending test
12.	a) Temperature cycle test (for porcelain housing) b) Porosity test (for porcelain housing)
13.	Galvanising test on metal parts
14.	Seal Leakage test (for porcelain housing)
15.	Seal leak test and operation tests (for surge monitor)
16.	Weather ageing test (for polymer housing)

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 classification	100 10 kA

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.

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)	Creep age 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 MVA 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 hardware's, 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 OF BATTERY BANK AND CHARGER

1.0 SCOPE:

This Section of the Specification covers the design, manufacture, and testing at manufacturer's work, of stationary type sealed, Valve Regulated Lead Acid Battery Bank, Battery Charger, DC Distribution Boards and LTAC Panels complete with all required accessories for various Sub-stations.

2.0 BATTERY BANK:

2.1 TECHNICAL PARTICULARS OF BATTERY BANK:

1.	Battery Rating	110V -150 Ah to 1.75 ECV at C10 at 27º C
2.	Type of battery	Maintenance free valve regulated lead acid (MF-VRLA) battery
3.	Battery specification	Batteries conforms to IS 15549:2005 Also conforms to International Standards (I) IEEE 1188 and 1189 (II) BS6290 Part 4/ IEC 896
4.	Manufacturers cell designation	F 100 P
5.	No of Cells	55 No. (for 110V)
6.	Cycle life of Battery @ 27º C	2000 cycles for 50 % depth of discharge or 1200 cycles for 80 % depth of discharge
7.	All efficiency	Above 90%
8.	WH Efficiency	Above 80 %
9.	Self discharge/ Week	< 1% of rated capacity
10.	Max, allowable ambient temp at which cell can safely operate	55º C continuously and 70º C short time
11.	Overall dimension of each cell	(107.8 x 198.5 x 477)mm approx.
12.	Overall weight of each cell	27 kg approx.
13.	Recommended Max period of storage	6 months from the date of manufacturing and the batteries

		shall be stored in covered area at 27º C
14.	Material of container	Polypropylene co-polymer
15.	Type of separator	Highly absorbent micro porous spun glass matrix (AGM)
16.	Type of +ve & -ve plates	Flat pasted
17.	Material of rack	Mild steel coated with acid resistance paint
18.	Method of connection between cells	Bolted
19.	Recommended float charge	Batteries shall be charged in constant potential mode with current limit Voltage: 2.23-2.25 Volts per cell Current: Recommended- charging current is 45 amps
20.	Recommended boost charge	Voltage: 2.3 Volts per cell Current: Recommended- charging current is 45 to 90 amps
21.	Time required for boost charge from fully discharged condition at 27º C	9 Hrs for 90 % state of charge (or) 24 hrs for 100 % state of charge
22.	Voltage ripple allowable	< 2% of the RMS value
23.	Type of connectors	Lead coated heavy duty copper strips

2.1.1 PLATES:

Positive plates shall be made of flat pasted type using lead-cadmium antimony alloy for durability, high corrosion resistant, maintenance free, long life both in cyclic as well as in ,float applications.

Negative plates shall be heavy duty, durable flat plate using lead calcium alloy pasted box grid. Negative plates shall be designed to match the life of positive plates and combination of negative and positive plates shall ensure long life, durability and trouble free operation of battery.

PLC operated equipment shall be deployed for preparation of paste to ensure consistency in paste quality. Conventional / manual type of paste preparation is not allowed.

2.1.2 CONTAINER AND LID:

The containers and lids shall be made of a special grade polypropylene copolymer plastic material. They shall be sufficiently robust and not liable lo deformation under internal operating pressures and within the temperature range naturally encountered, leak proof, non-absorbent and resistant to the acid with low water vapour permeability.

2.1.3 VENT PLUGS:

Each cell shall be equipped with one-way safety valve with opening pressure of 5±1 psi and closing pressure 4±1 psi. The vent plug shall be made with suitable grade of fire retardant plastic material. Each

valve opening shall be covered with flame barrier capable in preventing the ingress of flame into the cell interior when the valve opens and hydrogen / oxygen gas mixture is released.

2.1.4 SEPARATORS:

Separator shall be made of spun glass, micro porous matrix and shall be resistant to Sulphuric Acid. It shall be capable of keeping the entire electrolyte and shall be electrically insulated. Sufficient separator overlap and PVC shield protection to top and bottom edges of the plates is to be provided to prevent short circuit formation between the edges of adjacent plates.

2.1.5 CONNECTORS:

The connectors shall be lead coated copper of suitable size to join the cells. The connectors shall be suitably designed and coated to withstand corrosion due to sulphuric acid. The coating shall be adequate and tenacious. All the copper inter cell connectors shall be provided with heal shrinkable sleeves except at the connecting points.

2.1.6 ELECTROLYTE:

The electrolyte shall be prepared from the battery grade Sulphuric Acid confirming to ISS: 266. The batteries shall be supplied in factory filled and charged condition.

2.1.7 WATER :

Water required for preparation of electrolyte shall conform to IS: I069.

2.1.8 PLATE CONNECTION:

Lugs of plates of like polarity shall be connected by lead burning to a horizontal strap having an upstanding terminal post adopted for connection to external circuit. Strap and post shall be caste with lead alloy. The positive and negative terminal posts shall be clearly marked for unmistakable identification.

2.1.9 BOLTS AND NUTS:

Nuts and Bolts for connecting the cells shall be of superior grade passivated Stainless steel.

2.1.10 TERMINALS:

Terminals shall be of integral lead terminal with solid copper core with M6 threading for fastening. The junction between terminal posts and cover and between the cover and container shall be hermetically sealed.

2.1.11 BATTERY RACKS:

Batteries shall be installed on MS racks to be supplied by the Contractor to fit in the battery room. Racks/Trays shall be powder coated with anti corrosive paint. Rack shall accommodate 55 cells plus 2 spares. Racks/Tray shall be suitably treated before painting for protection against fungus growth and other harmful effects due to tropical environment.

The color of the supporting racks shall conform to RAL 7032 shade.

2.2 BATTERY CHARGING EQUIPMENT:

2.2.1 GENERAL DESCRIPTION:

Battery charger of 33/11kV substation shall have two complete different independent trickle (float) and boost charger i.e. Dual Trickle cum Boost charger (FCBC) and shall be SCADA compatible. Dual charger means one charger shall always be in stand by mood. Dual charger shall be fed through either

common source or separate 3-phase AC source and thus separate control supply & circuit shall be available for two Float cum-Boost and Float-cum-Boost charger.

Dual chargers shall be designed to supply both Load and Battery Charging current. During normal operation FCBC-1 is in ON condition and FCBC-2 is made off. Provision to select Auto (auto changeover from float to boost and vice versa), manual Float or Boost mode of operation shall have available for each charger. In case of manual connection of one FCBC to load and another to battery, the FCBC connected to load shall not go to boost mode. Dual float cum boost charger shall be designed in such a way that if FCBC-1 fails, FCBC-2 comes in line automatically and takes care of both load as well as battery charging currents.

The battery charging equipment shall be capable of giving two rate of charging currents namely Boost Charge and Trickle Charge. The charging equipments capable of giving two rate of charging currents shall consist of two separate sections: Boost Charger Section & Trickle Charger Section.

The Trickle Charger Section along with all necessary equipments is required for the purpose of float charging one battery bank of 55 cells of capacity 150 Ah at 10 hours discharge rate at the rate of 2.0 volts to 2.3 volts per cell and for meeting a constant D.C. load of 10 Amperes at 110 Volts D.C. simultaneously.

The Boost Charger Section along with all necessary equipments is required to charge a battery bank of 55 cells of capacity 150 Ah at 10 hours discharge rate at the rate of 1.85 volts to 2.55 volts per cell and for meeting a constant D.C. load of 10 Amperes simultaneously.

2.2.2 TYPE AND RATING:

i) TYPE

The charger shall be static type, using Silicon Rectifiers. The rectifiers shall be arranged in three phase bridge circuit for full wave rectification. The charger unit shall be suitable for operation on 415 volts three phase, 4 wire, 50 Hz A.C. Supply.

The Boost and Trickle Charger section shall have an arrangement for automatic and manual D.C. voltage regulating system with an Auto / Manual change over switch.

ii) RATING

The entire Dual charger circuitry shall have two separate sections eg. Boast charger and Trickle charger sections and shall of following ratings:

2.2.2.1 Float Charger:

(a) D.C. Output Voltage: (i) The D.C. output voltage of the Float charger shall be110 volts (nominal). (ii) The D.C. output voltage of the Float charger shall be adjustable between110 volts to 126.5 volts (for 110 volts).

(b) D.C. Output Current: (i) The Trickle charger shall be capable of supplying a continuous D.C. load of 10 amperes and float a battery bank of 150 Ah at 10 hours discharge rate simultaneously at normal voltage.

2.2.2.1 Boost charger:

(a) The d.c. output voltage of the Boost charger section shall be adjustable between 101 volts to 140 volts for 110 volts battery.

(b) D.C. Output Current: The Quick charger shall be capable of charging a battery bank of 150 Ah capacity at 10 hours discharge rate and to meet a continuous D.C. load of 5 amperes simultaneously. Output current of the Boost charger shall not be less than about 20 Amperes.

2.2.3 OPERATION AND CONTROL REQUIREMENTS:

1. Each battery bank is connected with two Float-Cum-Boost Chargers (FCBC). First float cum boost charger will be normally ON in float mode, supplying the D.C. load and the other FCBC trickle charging the battery and shall

   (a) Provide occasional equalizing charge

   (b) Boost charge the battery up to 2.55 Volts per cell as required. Each FCBC can take over all the functions of the other FCBC in case of the failure of the later. The float-cum-boost charger will also have provision for float, equalizing, and boost charging the battery through manual selection.
2. The float charger shall withstand momentary supply failure due to changeover on AC supply feeding bus and continue to operate on float mode satisfactorily on restoration of AC supply to charger.
3. The DC system shall be ungrounded and shall float with respect to the ground potential when healthy. An earth fault relay of approved type and make shall be provided for detection and annunciation of earth fault.
4 After the batteries are boost charged and operation is changed to float mode, the voltage impressed on the loads shall not exceed float charge voltage.
5. The charger shall be designed to operate at an ambient air temperature of 50°C. It will be located indoor but in a hot, humid and tropical atmosphere.
6. The voltage at load terminal will not exceed the limits of +10% and -10% of nominal system voltage for DC system.
7. In case of failure of AC, battery will meet the DC load requirement. After restoration of power, one FCBC will continue to supply the loads and the second FCBC will trickle charge the battery. Under discharge condition, one battery will be put to boost charge at a time.
8. Provision of Cell Tap assures that there is no need to isolate battery from loads while it is in boost mode. The incoming A.C. supply for Quick and Trickle charger shall be controlled by rotary switches. In addition to the rotary switches supplies to the both chargers shall be controlled by two push button operated contractors having overload protection. 'RED' & 'GREEN' indicating lamps shall be provided to indicate 'ON' & 'OFF' conditions respectively of the Quick and Float charges in addition to the A.C. 'ON' indication.

   During normal operation of the Trickle charger shall supply the normal direct current requirements of the substation and the station battery shall be floating on D.C. system. In the event of failure of A.C. supply or failure of the charger itself the battery shall come automatically across the load without any interruption.

   It is intended to supply the D.C. load of the equipment normally by the float charger during boost charging of the bank. Thus, when the Boost charger is switched 'ON' the Boost charger and the battery bank shall be isolated from the float charger and the load automatically. If during boost charging operation, the A.C. supply fails, the battery shall come automatically across the load without any interruption. During the infinitely small time required for initiation of the contractor a reduced number of cells shall be available across the load, through the blocking diode.

   Provision shall also be made so that in the event of failure of Float Charger, the Boost charger shall supply the load as well as charging a battery bank. Arrangement shall be made to limit the voltages across the load to around 110 volts, even if the boost charger is operating at maximum charging voltage. This aspect shall be clearly brought out in the tender by the bidder. In this operation also, the battery bank shall come across the load automatically and without any interruption in the event of A.C. mains failure.

2.2.4 VOLTAGE REGULATING SYSTEM:

The Float and Boost Charger sections shall have suitable arrangement for regulation of D.C. output voltage by the following methods.

(a) Automatic Voltage Regulation.

(b) Manual Voltage Regulation.

(a) Automatic Voltage Regulation:

The Automatic Voltage Regulation shall hold the voltage flat from zero to full load within ±1% of pre-set value of the charger with a fluctuation of ±10% in voltage and ±5% in frequency in the A.C. input voltage. The setting device of the automatic voltage regulator shall be so designed that the D.C. output voltage can be set anywhere between (i) 100 volts to 126.5 volts for Float Charger and (ii) 100 volts to 140 volts for Boost Charger. The automatic voltage regulator shall be static type and its characteristics shall be supplied with the tender.

(b) Manual Voltage Regulator:

The Manual Voltage Regulator for Trickle charger shall have suitable equipments and means to control the D.C. output voltage with the ranges mentioned earlier. The voltage control shall be smooth and continuous. The charger shall have a change over switch for selecting 'Auto' or 'Manual' mode of regulation to regulate the D.C. voltage. The tenderer shall furnish all the details of the manual voltage regulator in the tender.

Both the trickle and boost chargers shall be provided with alarm and indication for the following:

- Mains on
- Charger failed.
- Rectifier element fuse blown.
- Charger output fuse blown.
- AC input failed

In addition to the above arrangement for controlling, regulating and operation of the charger, the bidder may suggest and quote suitable alternative arrangement for the same. The right of acceptance of such an arrangement shall however, lie with the Employer.

2.2.5 INSTRUMENTS, EQUIPMENT ETC.:

i) Rectifier Transformer:

The rectifier transformers shall be designed to operate at a frequency of 50 Hz and at the r.m.s. voltage between the lines on the line side of transformers of 415+10% volts. The rating of the rectifier transformer shall correspond to the rating of the associated rectifier assembly. The transformer shall preferably be air cooled dry / synthetic oil filled type and shall conform to the latest issues of IS: 2026 and IS: 4540.

ii) Rectifier Elements:

Rectifier elements shall be Silicon and shall be arranged in three bridge circuit. The rectifier elements shall be protected by HRC fuse with fuse blow out indication. The rectifier stacks shall be supplied with their own heat dissipating arrangement for natural air cooling.

iii) Measuring Instruments:

The instruments shall be flush type and shall have dust proof and moisture resistant enclosed cases, finished in black and suitable for tropical use. Elements shall be shock resistant and shielded from external magnetic fields. The instruments and meters shall have easy accessible means for calibration testing and adjustment and shall conform to relevant I.S.S.

iv) Air Break Switches and Fuses:

The series combination air break rotary switches and HRC fuses shall conform to provisions of the latest issue of IS-4064, IS-4047 and IS-2208. the air break switches and fuses housed in the charger panel shall be so arranged that when they are opened, the terminals are readily accessible. Switches shall be of rotary operated type preferably with silver to silver contacts of adequate making, carrying and breaking current ratings and shall open and close with snap action to minimise arcing. The 'ON' and 'OFF' positions of the switches shall be definite and shall be clearly indicated. All fuses shall be of HRC type conforming to the latest issue of I.S. 2208.

v) The charger units shall be provided with but not limited to the following instruments and equipment:

a) 3-pole a.c. mains ON-OFF switches and HRC fuses of suitable capacity.

b) 2 pole air break switches with HRC fuses of suitable capacity output side of chargers.

c) Air break magnetic contactors of suitable ratings complete with push button and thermal overload devices and red and green indicating lamps for A.C. input ON/OFF to the chargers.

d) Fuse blown out indication for D.C. output fuses.

e) HRC fuses for protection of rectifier elements with fuse blow out indication.

f) 0-500 volts range, A.C. voltmeters to measure A.C. input voltage to the chargers. Accuracy class 1.0 as per I.S. 1248.

g) Moving coil, flush mounting type voltmeters of suitable ranges to measure trickle, boost and battery voltages. Accuracy class: 1.0 as per I.S.-1248.

h) Moving coil, flush mounting type ammeters of suitable scales to read the output currents of boost and trickle chargers and load current. Accuracy class : 1.0 as per I.S.-1248.

i) Single pole D.C. contactors of suitable ratings.

j) Blocking diode of adequate capacity.

k) Cubicle illuminating lamps with door operated switches suitable for 240 volts ac.

l) All other equipments and accessories for indication and alarm annunciation as mentioned earlier.

m) All other equipments not specifically mentioned but required for proper and satisfactory operation of the charger shall be provided.

n) The charger assembly shall be complete with input / output terminals, cable glands, internal wiring, earthing terminals, rating plates, etc.

2.2.6 CONSTRUCTIONAL FEATURES:

The whole battery charging equipment shall be housed in an indoor, floor mounting type; sheet metal clad, cubicle type enclosures which shall also be served as charger panels. The assembly shall be complete in all respect and shall contain all the components described in different clauses and which are essential for the proper operation and control of the equipment. The enclosures shall be totally enclosed dust tight and vermin proof.

All doors and covers shall be filled with rubber gaskets. The panels shall have double leaf hinged doors at the back and shall be provided with locks and duplicated keys. The equipment in the panels shall be so located as not to cause congestion and accessibility to the equipment located herein shall be easy and convenient.

All incoming and outgoing cables shall enter from bottom and suitable cable terminal boards with cable lugs shall be provided in side of each panel for incoming and outgoing cables. Each terminal of the terminal boards shall be serially numbered to facilitate connections. At least 20% extra terminals shall be provided in each terminal board. Suitable compression type cable glands with base plates shall also be provided. The terminal boards shall be easily accessible for inspection and checking. The panels shall

have cable supports and metallic clips for supporting power and control cables for internal wiring of the panels.

2.2.7 TESTS:

The battery charger and all the components of the charger shall be routine tested accordingly to their relevant standard. This shall include the following:

a) Operational check for boost and float charger.

b) Input / Output test of the chargers.

c) Performance test of the charger.

d) Temperature rise test of the rectifier transformer.

e) Power frequency H.V. test / Insulation tests.

2.3 DC DISTRIBUTION BOARD:

2.3.1 General Features:

The D.C. distribution boards shall be indoor, floor mounting of self supporting, sheet metal clad, and cubicle type. The panels shall be totally enclosed, dust tight and vermin proof and shall be made of 2.0mm cold rolled sheet steel. The boards shall be provided with double leaf hinged doors at the back. All doors and covers shall be fitted with rubber gaskets. The doors shall be provided with locks and duplicated covers.

2.3.2 Busbars :

The busbars shall be of electrolytic copper of ample cross-section. The busbars shall be insulated from the structure by means of durable, non-hydroscopic, non-combustible and non tracking materials.

2.3.3 Requirement in detail:

The 110 Volts D.C. distribution boards shall be provided with the following:

A. One mains failure alarm relay.

B. One earth fault alarm relay (both for +ve and –ve earth fault).

C. One 110 Volts D.C. bell to be operated by the mains failure alarm relay.

D. One 110 Volts D.C. buzzer to be operated by the earth failure alarm relay.

E. One double pole air-break circuit breaker of 200 amp capacity with thermal overload tripping arrangement to act as incoming breaker of the load bus.

F.One0-150 volts D.C. moving coil voltmeter to measure the bus-bar voltage. The display is to be in digital.

G. One pilot lamp to indicate D.C. on conditions.

H.250 volts, double pole double throw make before break switch with H.R.C. fuses of following ratings for outgoing feeders.

a) 100 Amp, for incoming feeder

b) 40 Amp, for outgoing feeders

I. One terminal Board/block for all feeder outlets including cable glands.

2.4 L.T. AC PANEL:

2.4.1 General Arrangement:

The 415 volts L.T.A.C. panels shall be indoor floor mountings sheet metal clad type comprising of combination switch fuse units and busbar chambers and equipped with circuits and equipments as specified. The different circuits shall be mounted above and below the busbar chamber to form a suitable arrangement, except that the incomings will be located at the front and mounted below the bus bar chamber. All equipments shall be suitable for the reception of the cables rising from the ground level. The switchboards shall be so designed as to be readily extensible.

2.4.2 Busbars :

The phase and neutral busbars shall be of high conductivity Aluminium of adequate uniform cross section. The busbars shall be insulated from the structure by means of durable non-hygroscopic, non-combustible and non-tracking materials. Busbar joints shall be of bolted type.

2.4.3 Requirement in detail :

The 415 Volts, L.T. AC switchgears shall have following circuits and equipment :

a) INCOMING: One number fitted with following:

i. One 200 Amp, four pole MCCB and cable glands suitable for 4 core P.V.C. cable labeled as 'INCOMING'.

ii. One Voltmeter, 0-500 Volts.

iii. One Ammeter, 0-500 Amps.

iv. One K.W.H. Digital Energy meter with connected C.T.R 200/5A.

b) OUTGOING: 1 no. comprising of:

One 32 Amps T.P.N. Switch fuse unit fitted with 32 Amps H.R.C. fuses and complete with direct connected round projecting pattern ammeter, scaled 0-50 Amps and cable glands suitable for 4 core P.V.C. cable and labeled as 'Transformer Heater' and 'Circuit Breaker Heater'.

c) OUTGOING: 2 No., each comprising of :

One 100 Amps, T.P.N. switch fuse unit, fitted with 100 Amp H.R.C. fuses and cable glands suitable for 4 core, P.V.C. cables and labeled as 'FILTRATION SET'.

d) OUTGOING: 3 No., each comprising of :

One 30 Amps D.P. switch fuse unit fitted with 15 Amp H.R.C. and cable glands suitable for 2 core P.V.C. cable labeled as :

No. 6: 'Indoor lights and Indicating Lamps'

No. 7: 'Emergency Lights'

No. 8: 'Spare'.

e) OUTGOING: 3 No., each comprising of :

One 60 Amps T.P.N. switch fuse units fitted with 30 Amp H.R.C. fuses and cable glands suitable for 4 core P.V.C. cables and labeled as :

No. 9: 'Outdoor Light'

No. 10: 'Battery Charger'

No. 11: Spare

No. 12: 'Spare'

TECHNICAL SPECIFICATION FOR TUBULAR STEEL POLES FOR OVERHEAD LINES

1 SCOPE:

This specification covers the general requirements towards design, manufacture, testing at manufacturers works, supply and delivery for tubular steel poles of circular cross section (swaged type) for overhead lines.

2 STANDARD:

The tubular steel poles shall conform to the latest edition of Indian Standard specification IS: 2713 (Part – I, III): 1980 or any other authoritative standards (as amended up-to- date) except where specified otherwise in this specification.

3 Topography and Climatic Condition:

The materials offered, shall be suitable for operation in tropical climate and will be subjected to the sun and inclement weather and shall be able to withstand wide range of temperature variation. For the purpose of design, average atmospheric temperature may be considered to be 50ºC with humidity nearing saturation.

4 Materials:

4.1 The materials used in construction of tubular steel poles shall be of the tested quality of steels of minimum tensile strength 410 MPa.

4.2 The materials, when analyzed in accordance with IS: 228 (Part-III: 1972) and IS : 228 (Part-IX) shall not show sulpher and phosphorous contents of more than 0.060 percent each.

5 Types, Size and construction:

5.1 Tubular Steel Poles shall be swaged type. GI climbing rungs each 700 mm long fabricated out of ISA 60x60x6 mm angles shall be fixed to the pole above 5 mtr .Height at an interval of 450 mm with 10 mm dia GI u BOLT, spring washers & nuts.

5.2 Swaged poles shall be made of seamless or welded tubes of suitable lengths swaged and jointed together. No circumferential joints shall be permitted in the individual tube lengths of the poles. If welded tubes are used they shall have one longitudinal weld seam only: and the longitudinal welds shall be staggered at each swaged joint.

5.3 Swaging may be done by any mechanical process. The upper edge of each joint shall be chamfered if at an angle of about 45º. The upper edge need not be chamfered if a circumferential weld is to be deposited in accordance with clause No. 5.3 2 of IS: 2713 (Part-I):1980.

5.4 The length of joints on swaged poles shall be in accordance with clause No. 5.4 of IS: 2713 (Par-I): 1980.

5.5. Poles shall be well-finished, clean and free from harmful surface defects. Ends of the poles shall be cut square. Poles shall be straight, smooth and cylindrical. The weld joints, if any, shall be of good quality, free from scale, surface defects, cracks, etc.

5.6. Tolerances for outside diameter, thickness, length, weight and straightness shall be in accordance with IS: 2713 (Part-I): 1980.

5.7. The poles shall be **GALVENISED** and coated with black bituminous paint conforming to IS : 158-1968 throughout, internally and externally, up to the level which goes inside the earth.

6 Earthing Arrangements:

For earthing arrangement a through hole of 14mm diameter shall be provided in each pole at a height of 300mm above the planting depth.

7 Tests and Test Certificates:

7.1 The following tests shall be conducted on finished poles :

A. Tensile test and chemical analysis for sulpher and phosphorous,

B. Deflocation test,

C. Permanent set test, and

D. Drop test.

7.2 In addition to above verification of dimensions as per IS: 2713 (Part-III): 1980 shall be carried out during acceptance lots.

7.3 Number of poles selected for conducting different tests shall be in accordance to clause No. 10.1.1 and No. 10.1.12: of IS: 2713 (Part-I) 1980.

7.4 Tests shall be carried out before supply of each consignment at the manufacturers woks and test certificates shall be submitted to the purchaser for approval prior to delivery.

7.5 Re-tests, if any, shall be made in accordance with IS: 2713 (Part-I) 1980.

7.6 Purchaser reserves the right to inspect during manufacturing and depute his representative to inspect/test at the works.

7.7 If any extra cost is required for carrying out the above specified tests, the same shall be borne by the manufacturer.

8 Marking:

8.1 The poles shall be marked with designation, manufacturer's identification, year of manufacture and name of the purchaser: APDCL (IPDS)

8.2 The poles may also be marked with the ISI certification mark.

9 Guaranteed technical particulars:

9.1 The manufacturer shall furnish all necessary guaranteed technical particulars in the prescribed Performa enclosed hereinafter.

10 Performance:-

10.1 The manufacturer shall furnish a list of the major supplies effected during the last 3 (three) years indicating the volume of supply and actual delivery dates.

10.2 Manufacturer may not be considered if the past manufacturing experience is found to be less that 3 (three) years.

11 Deviation:-

Any deviation in technical specification shall be clearly indicated with sufficient reasons thereof. Purchaser shall however reserve the right to accept and/or reject the same without assigning any reasons what-so-ever.

ANNEXURE –'A'

SPECIFIC TECHNICAL REQUIREMENTS FORTUBULAR STEEL POLES : SWAGED TYPE

	8.5 meters long	**11 meters long**	**14.5 meters long**	**12 meters long**
1) Standard	IS: 2713 (Pat-I and III): 1980 as amended upto date			
2) Type of Pole	Swaged Type			
3) Designation	410 SP 22	410 SP 52	410 SP 76	410 SP 60
4) Overall Length	8.5 meters	11 meters	14.5 meters	12 meters
5) Planting depth	1.5 meters	1.8 meters	2.0 meters	2.0 meters
6) Height above ground	7.0 meters	9.2 meters	12.5 meters	10.0 meters
7) Effective length of Each section.				
a) Bottom	5.0 meters	5.6 meters	6.50 meters	5.80 meters
b) Middle	1.75 meters	2.7 meters	4.00 meters	3.10 meters
c) Top	1.75 meters	2.7 meters	4.00 meters	3.10 meters
8) Outside diameter and Thickness of each Section.				
a) Bottom	165.1x 4.50 mm	165.1x4.50 mm	219.1x5.90 mm	165.1x5.40mm
b) Middle	139.7x4.50 mm	139.7x4.50 mm	193.7x4.85 mm	139.7x4.50 mm
c) Top	114.3x3.65 mm	114.3x3.65 mm	165.1x4.50 mm	114.3x3.65 mm
9) Joint Length (in cm.):				
a) Bottom (J2)	35 cm.	35 cm.	45 cm.	35 cm.
b) Top (J1)	30 cm.	30 cm.	40 cm.	30 cm.
10) Approximate weight	141 Kg.	175 Kg.	380 Kg.	208 Kg.

of Pole				
11)Point of application of load below/top (mtr.)	0.3 mtr.	0.6 mtr.	0.6 mtr	0.6 mtr
12) Breaking load (inKgf)			724	469
13) Working load with factor of Safety : 2.5 (in Kgf)	291	227	379	188
14) Crippling load (inKgf)	-	-	514	333
15) Load for permanent set Not exceeding 13mm (in Kgf)	-	-	352	228
16) Load for Temporary Deflection of 157.5 mm (in Kgf)	176	74	81	61
17) Tolerance	As per IS : 2713 (Part-I & Part-III): 1980			
18) Finish	-do-			
19) Manufacturing clause	-do-			

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

SECTION - II

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 stenciled 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 stenciled 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.

S	**Type**	**Nominal**	**Highest**	**Visible discharge**	**Wet power**	**Impulse**	**Minimum Creepage distance (mm)**	**Min.**	**Pin ball shankd**

l. No.	of composite insulator	system voltage KV (rms)	system voltage KV (rms)	ge test voltage KV (rms	frequency withstand voltage KV (rms	withstand voltage KV (rms	Normal & moderately polluted (20mm/ KV)	Heavily polluted (25mm/ KV)	Failing load KN	iameter mm
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. C**orona 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.

SPECIAL TECHNICAL SPECIFICATIONS FOR NEW SUBSTATION CIVIL WORKS

1.0 GENERAL

The intent of specification covers the following:

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

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

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

The work shall be carried out according to the design/drawings to be developed by the Contractor and approved by the owner based on Tender Drawings Supplied to the Contractor. by the Owner.

For all buildings, structures, foundations, etc., necessary layout and details shall be developed by the Contractor keeping in view the functional requirement of the substation facilities and providing enough space and access for operation, use and maintenance based on the input provided by the Owner. Certain minimum requirements are indicated in this specification for guidance purposes only. However, the Contractor shall quote according to the complete requirements.

2.0 PROFILE SETTING AND LEVELLING:-

a) Profile setting and levelling for the site has to be carried out by the Contractor for finding the amount of earth cutting and filling that will be required for setting the Final Ground Level, Tie Beam Level and to find the amount of excavation to be done for required foundation depth.

4.0 SITE PREPARATION

The Contractor shall be responsible for proper leveling of switchyard site as per layout and levels of switchyard finalized during detailed engineering stage. The Contractor at his own cost shall make the layout and levels of all structure, etc., from the general grids of the plot and benchmarks set by the Contractor and approved by the Owner. The Contractor shall give all help in instruments, materials and personal to the Owner for checking the detailed layout and shall be solely responsible for the correctness of the layout and levels. Site leveling shall be in the scope of the contractor. Bidder may decide the level of the sites. However, the level shall be such that it is 300 mm higher than the highest flood level (HFL) of the site.

5.0 SCOPE OF WORKS

This clause covers the design and execution of the work for site preparation, such as clearing of the site, the supply and compaction of fill material, slope protection by stone pitching/retaining walls depending on the site location/ condition, excavation and compaction of backfill for foundation, road construction, drainage, trenches and final topping by stone (broken hard stone).

5.1 General

1) The Contractor shall develop the site area to meet the requirement of the intended purpose. The site preparation shall conform to the requirements of relevant sections of this specification or as per stipulations of standard specifications. Necessary protection of slope of switchyard area and approach road shall also be carried out by contractor.
2) If fill material is required, the fill material shall be suitable for the above requirement. The fill shall be such a material and the site so designed as to prevent the erosion by wind and water of

material from its final compacted position or the in-site position of undisturbed soil.

3) When embankments are to be constructed on slopes of 15% or greater, benches or steps with horizontal and vertical faces shall be cut in the original slope prior to placement of embankment material. Vertical faces shall measure not more than 1 m in height.
4) Embankments adjacent to abutments, culverts, retaining walls and similar structures shall be constructed by compacting the material in successive uniform horizontal layers not exceeding 15 cm in thickness. (Of loose material before compaction). Each layer shall be compacted as required by means of mechanical tampers approved by the Owner. Rocks larger than 10 cm in any direction shall not be placed in embankment adjacent to structures.
5) Earth embankments of roadways and site areas adjacent to buildings shall be placed in successive uniform horizontal layers not exceeding 20 cm in thickness in loose stage measurement and compacted to the full width specified. The upper surface of the .embankment shall be shaped so as to provide complete drainage of surface water at all times.
6) The pitching shall be designed and provided for slope protection as per approved drawings. The stone used shall be sound, hard, durable and fairly regular in shape. Stones subjected to marked deterioration by water or weather shall not be used. Suitable measures shall be provided to prevent erosion by seepage of water. Largest stone procurable shall be used as approved by owner for the work. Random rubble masonry (1:6) retaining walls shall be provided wherever required as per site condition.

5.2 **Compaction**

3. The density to which fill materials shall be compacted shall be as per relevant IS and as per direction of Owner. All compacted sand filling shall be confined as far as practicable. Backfilled earth shall be compacted to minimum 95% of the Standard Proctor's density at OMC. The sub-grade for the roads and embankment filling shall be compacted to 70% relative density (minimum).
4. At all times unfinished construction shall have adequate drainage. Upon completion of the road's surface course, adjacent shallers shall be given a final shaping, true alignment and grade.
5. Each layer of earth embankment when compacted shall be as close to optimum moisture content as practicable. Embankment material, which does not contain sufficient moisture to obtain proper compaction, shall be wetted. If the material contains any excess moisture then it shall be allowed to dry before rolling. The rolling shall begin at the edges overlapping half the width of the roller each time and progress to the center of the road or towards the building as applicable. Rolling will also be required on rock fills. No compaction shall be carried out in rainy weather.

5.3 **Requirement for fill material under foundation**

The thickness of fill material under the foundations shall be such that the maximum pressure from the footing, transferred through the fill material and distributed onto the original undisturbed soil will not exceed the allowable soil bearing pressure of the original undisturbed soil. For expansive soils the fill materials and other protections, etc., to be used under the foundation is to be got approved by the Owner.

6.0 ANTI-WEED TREATMENT AND STONE SPREADING

6.1 **Scope of Works**

The Contractor shall furnish all labour, equipment and materials required for complete performance of the work in accordance with the drawings specification and direction of the Owner.

Stone spreading shall be done in the areas of the switchyard wherever equipments and or structures are to be provided under present scope of work. The stone spreading in future areas shall also be provided in case potential without stone layer is not well within safer limits.

7.0 GENERAL REQUIREMENT

7.1 The material required for site surfacing/stone filling shall be free from all types of organic materials and shall be of standard quality, and as approved by the Owner.

The material to be used for stone filling/site surfacing shall be uncrushed/ crushed/broken

stone of 20 mm nominal size (upgraded single size) conforming to Table 2 of IS:383-1970. Hardness, Flakiness shall be as required for wearing courses are given below:

a) Sieve Analysis Limits (Gradation)
(IS: 383 - Table 2)

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

b) Hardness
Abrasion value (IS: 2386 Part-IV) - not more than 40%
Impact value (IS: 2386 Part-IV) - not more than 30% and frequency shall be one test per 500 cum with a minimum of one test per source,

c) Flakiness Index
One test shall be conducted per 500 cum of aggregate as per IS: 2386 Part-I and maximum value is 25%,

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

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

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

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

7.6 Before taking up stone filling, anti-weed treatment shall be applied in the switchyard area wherever gravel filling is to be done, and the area shall be thoroughly de-weeded including removal of roots. The recommendation of local agriculture or horticulture department shall be sought wherever feasible while choosing the type of chemical to be used. Nevertheless the effectiveness of the chemical shall be demonstrated by the Contractor in a test area of 10M x 10M (approx.) and monitored over a period of two to three weeks by the Engineer-in-Charge. The final approval shall be given by Engineer-in-Charge and final approval given based on the results.

7.7 The anti-weed chemical shall be procured from reputed manufacturers.
The dosage and application of chemical shall be strictly followed as per manufacturer's recommendation. The contractor shall be required to maintain the area free of weeds for a period of 1 year from the date of application of 1st dose of anti-weed chemicals.

8.0 SITE DRAINAGE

1. Adequate site drainage system shall be provided by the Contractor. The Contractor shall obtain rainfall data and design the storm water drainage system, (culverts, ditches, drains, etc.) to accommodate run off due to the most intense rainfall that is likely to occur over the catchment area in one hour period on an average of once in tem years. The surface of the site shall be sloped to prevent the ponding of water.

2. The maximum velocity for pipe drains and open drains shall be limited to 2.4m/sec and 1.8m/sec respectively. However, minimum non-slitting velocity of 0.6 m/sec shall be ensured. Longitudinal bed slope not milder than 1 in 1000 shall be provided.
3. For design of RCC pipes for drains and culverts, 18:456 and 18:783 shall be followed.
4. The Contractor shall ensure that water drains are away from the site area and shall prevent damage to adjacent property by this water. Adequate protection shall be given to site surfaces, roads, ditches, culverts, etc., to prevent erosion of material by water.
5. The drainage system shall be adequate without the use of cable/pipe trenches. (Pipe drains shall be provided in areas of switchyard where movement of crane will be necessary in operating phase of the substation).
6. Open surface drains shall be provided with the Cement Concrete 1:2:4 of minimum thickness of 100 mm or more as per design condition.
7. Pipe drains shall be connected through manholes at an interval of max. 30m. Effluents shall be suitably treated by the Contractor to meet all the prevalent statutory requirements and local pollution control norms and treated effluents shall be conveyed to the storm water drainage system at a suitable location for its final disposal.
8. Invert of the drainage system shall be decided in such a way that the water can easily be discharged above the High Flood Level (HFL) outside substation boundary at suitable location upto a maximum 50M beyond boundary wall of substation or actual whichever occurs earlier and approved by Owner. Pumps for drainage of water (it required) shall be provided by Contractor.
9. All internal site drainage system, including the final connection/disposal to owner acceptance points shall be pat of Supplier's scope including all required civil work, mechanical and electrical systems. The Contractor shall connect his drain(s) at one or more points to outfall points as feasible at site.
10. The drainage scheme and associated drawings shall be got approved.

9.0 ROADS AND CULVERTS

1. The main approach road including modification of existing road to meet the site conditions, roads for access to equipment and building within substation are in the scope of bidder. Layout of the roads shall be based on General detail and Arrangement drawing for the substation.
2. All substation roads be constructed so as to permit transportation of all heavy equipment. The roads shall have min.3.75 black topping. Moorum shaller shall be provided on either side of the road. The width of the shaller shall be as per approved drawing depending upon the site conditions.
3. Road construction shall be as per IRC standards.
4. Adequate provision shall be made for road drainage. Protection of cut and embankment slopes of roads as per slope stability requirement shall be made.
5. All the culverts and its allied structure (required for road/rail, drain trench crossings, etc.) shall be designed for Class-AA loading as per IRC standards code and shall be checked for loading.
6. All roads shall be designed for Class-'E' of traffic as per IRC-37 Guidelines for the design of flexible pavements.

10.0 TRANSFORMER FOUNDATION

The Contractor shall provide a road system integrated with the transformer foundation to enable installation and the replacement of any failed unit by the spare unit located at the site. This system shall enable the removal of any failed unit from its foundation to the nearest road. If trench/drain crossings are required the suitable R.C.C. culverts shall be provided in accordance with I.R.C. Code & relevant IS.

The transformer foundation shall be of pile foundation with 6 nos. of cast in-situ pile with a depth of 14 m of 450 mm dia from the FGL.

11.0 FIRE PROTECTION WALLS

11.1 General

Fire protection walls shall be provided in accordance with Tariff Advisory Committee (TAC) recommendations.

11.2 Application Criteria

A firewall shall be erected between the transformers to protect each one from the effects of fire on another as per TAC guidelines.
Also, if the free distance between the transformer and auxiliary services transformer is less.

11.3 Fire resistance

The firewall shall have a minimum fire resistance of 3 hours. The partitions, which are made to reduce the noise level, shall have the same fire resistance where the partitions are also used as firewalls. The walls of the building, which are used as firewalls, shall also have a minimum fire resistance of 3 hours.
The firewall shall be designed in order to protect against the effect of radiant heat and flying debris from an adjacent fire.

11.4 Mechanical resistance

The firewall shall have the mechanical resistance to withstand local atmospheric conditions. If this wall shall serve as a support for equipment such as insulators, etc., its mechanical rigidity must be increased. Connecting the walls by steel or other structures, which may produce a reversing torque if overheated, shall be avoided.

11.5 Dimensions

The firewall shall extend at least 2 m on each side of the transformer and at least 1 m above the conservator tank or safety vent.
These dimensions might be reduced in special cases, and if T AC permits so, where there is lack of space. A minimum of 2 meter clearance shall be provided between the equipment's e.g., transformer and fire walls.
The building walls, which act as firewalls, shall extend at least 1 m above the roof in order to protect it.

11.6 Materials

The firewall may be made of reinforced concrete (M-20 grade), as per the system requirements. Materials used must conform to the standards of the National Fire Prevention Association and T AC norms.

12.0 CABLE AND PIPE TRENCHES

1. The cable trenches and precast removable RCC cover (with lifting arrangement)
2. The cable trench wall shall be designed for the following loads.
   i) Dead load of 155 Kg/m length of cable support + 75 Kg on one tier at the end.
   ii) Triangular earth pressure + uniform surcharge pressure of 2 T/m^2.
3. Cable trench covers shall be designed for self-weight of top slab + UDL of 2000 Kg/ m^2 + concentrated load of 200 Kg at centre of span on each panel.
4. Cable trench crossing the road/rails shall be designed for class AA. Loading of IRC/relevant IS Code and shall be checked for transformer loading.
5. Trenches shall be drained. Necessary sumps be constructed and sump pumps if necessary shall be supplied. Cable trenches shall not be used as storm water drains.
6. The top of trenches shall be kept at least 100 mm above the finished ground level. The top of cable trench shall be such that the surface rainwater does not enter the trench.
7. All metal parts inside the trench shall be connected to the earthing system.
8. Cables from trench to equipments shall run in hard conduit pipes.
9. Trench wall shall not foul with the foundation. Suitable clear gap shall be provided.
10. The trench bed shall have a slope of 1/500 along the run and 1/250 perpendicular to the run.
11. All the construction joints of cable trenches i.e., between base slab to base slab and the junction of vertical wall to base slab as well as from vertical wall to wall and all the expansion joints shall be provided with approved quality PVC water stops of approx. 230 x 5 mm size for those sections where the ground water table is expected to rise above the junction of base slab and vertical wall of cable trenches.
12. Cable trenches shall be blocked at the ends if required with brick masonry in cement sand mortar 1:6 and plaster with 12 mm thick 1:6 cement sand mortar.

13. Cable trenches shall be provided with suitable hangers to support the running cables.

13.0 FOUNDATION / RCC CONSTRUCTION

13.1 General

1. Work covered under this Clause of the Specification comprises the design and construction of foundations and other RCC constructions for switchyard structures, equipment supports, trenches, drains, jacking pad, control cubicles, bus supports, transformer, marshalling kiosks, auxiliary equipments and systems, buildings, tanks, boundary wall or for any other equipment or service and any other foundation required to complete the work. This clause is as well applicable to the other ECC constructions.
2. Concrete shall conform to the requirements mentioned in IS: 456 and all the tests shall be conducted as per relevant Indian Standard Codes as mentioned in Standard field quality plan appended with the specification.
   A minimum grade of M20 concrete (1:5:3 mix) shall be used for all structural/load bearing members as per latest IS 456.
3. If the site is sloppy, the foundation height will be adjusted to maintain the exact level of the top of structures to compensate such slopes.
4. The switchyard foundation's plinths and building plinths shall be minimum 300 mm and 500 mm above finished ground level respectively.
5. Minimum 75 mm thick lean concrete (1:4:8) shall be provided below all underground structures, foundations, trenches, etc., to provide a base for construction.
6. Concrete made with Portland slag cement shall be carefully cured and special importance shall be given during the placing of concrete and removal of shuttering.
7. The design and detailing of foundations shall be done based on the approved soil data and sub-soil conditions as well as for all possible critical loads and the combinations thereof. The Spread footings foundation or pile foundation as may be required based on soil/sub-soil conditions and superimposed loads shall be provided.
8. If pile foundations are adopted, the same shall be case-in-situ driven/bored or precast or under-reamed type as per relevant parts of IS Code 2911. Only RCC piles shall be provided. Suitability of the adopted pile foundations shall be justified by way of full design calculations. Detailed design calculations shall be submitted by the bidder showing complete details of piles/pile groups proposed to be used. Necessary initial load test shall also be carried out by the 'bidder at their cost to establish the piles design capacity. Only after the design capacity of piles has been established, the Contractor shall take up the job of piling. Routine tests for the piles shall also be conducted. All the work (design & testing) shall be planned in such a way that these shall not cause any delay in project completion.

13.2 Design

All foundation shall be of reinforced cement concrete. The design and construction of RCC structures shall be carried out as per IS: 456 and minimum grade of concrete shall be M-20. Higher grade of concrete than specified above may be used at the discretion of Contractor without any additional financial implication to the Owner.

Limit state method of design shall be adopted unless specified otherwise in the specification.

For detailing of reinforcement IS: 2502 and SP: 34 shall be followed. Cold twisted deformed bars (Fe=415 N/mm2) conforming to IS: 1786 shall be used as reinforcement. However, in specific areas, mild steel (Grade-I) conforming to IS: 432 can also be used. Two layers of reinforcement (on inner and outer face) shall be provided for wall and slab sections having thickness of 150 mm and above. Clear cover to reinforcement towards the earth face shall be minimum 40 mm.

RCC water retaining structures like storage tanks, etc., shall be designed as uncracked section in accordance with IS: 3370 (Part I to IV) by working stress method. However, water channels shall be designed as cracked section with limited steel stresses as per IS: 3370 (Part I to IV) by working stress method.

The procedure used for the design of the foundations shall be the most critical loading combination of the steel structure and or equipment and or superstructure and other conditions, which produces the maximum stresses in the foundation or the foundation component and as per the relevant IS

Codes of foundation design. Detailed design calculations shall be submitted by the bidder showing complete details of piles/pile groups proposed to be used.
Design shall consider any sub-soil water pressure that may be encountered following relevant standard strictly.
Necessary protection to the foundation work, if required shall be provided to take care of any special requirements for aggressive alkaline soil, black cotton soil or any other type of soil which is detrimental/harmful to the concrete foundations.
RCC columns shall be provided with rigid connection at the base.
All sub-structures shall be checked for sliding and overturning stability during both construction and operating conditions for various combinations of loads. Factors of safety for these cases shall be taken as mentioned in relevant IS Codes or as stipulated elsewhere in the Specifications. For checking against overturning, weight of soil vertically above footing shall be taken and inverted frustum of pyramid of earth on the foundation shall not be considered.
Earth pressure for all underground structures shall be calculated using coefficient of earth pressure at rest, co-efficient of active or passive earth pressure (whichever is applicable). However, for the design of substructures of any underground enclosures, earth pressure at rest shall be considered.
ln addition to earth pressure and ground water pressure etc., a surcharge load of 2T/Sq.m shall also be considered for the design of all underground structures including channels, sumps, tanks, trenches, sub-structure of any underground hollow enclosure, etc., for the vehicular traffic in the vicinity of the structure.
Following conditions shall be considered for the design of water tank in pumps house, channels, sumps, trenches and other underground structures:

a) Full water pressure from inside and no earth pressure and ground water pressure and surcharge pressure from outside (application only to structures, which are liable to be filled up with water or any other liquid).
b) Full earth pressure, surcharge pressure and ground water pressure from outside and no water pressure from inside.
c) Design shall also be checked against buoyancy due to the ground water during construction and maintenance stages. Minimum factor of safety of 1.5 against buoyancy shall be ensured ignoring the superimposed loadings.

The foundations shall be proportioned so that the estimated total and differential movements of the foundations are not greater than the movements that the structure or equipment is designed to accommodate.
The foundations of transformer and circuit breaker shall be of block type foundation. Minimum reinforcement shall be governed by IS: 2974 and IS: 456.
For transformer pad, cast in situ pile foundation should be used with minimum six numbers of pile of diameter 450 mm up to a depth of 14 mts. from the FGL.
The tower and equipment foundations shall be checked for a factor of safety of 2.2 for normal condition and 1.65 for short circuit condition against sliding, overturning and pullout. The same factors shall be used as partial safety factor overloads in limit site design also.
For the lattice towers, minimum one nos. of pile of 300 mm diameter up to a depth of 12 mts. from the FGL should be used.

13.3 **Admixtures & Additives**

Only approved admixtures shall be used in the concrete for the Works. When more than one admixture is to be used, each admixture shall be batched in its own, batch and added to the mixing water separately before discharging into the mixer. Admixtures shall be delivered in suitably labeled containers to enable identification.
Admixtures in concrete shall conform to IS: 9103. The water proofing cement additives shall conform to IS: 2645. Owner shall approve concrete Admixtures/Additives.
The Contractor may propose and the Owner may approve the use of a water-reducing set-retarding admixture in some of the concrete. The use of such an admixture will not be approved to overcome problems associated with inadequate concrete plant capacity or improperly planned placing operations and shall only be approved as an aid to overcoming unusual circumstances and placing conditions.
The water reducing set-retarding admixture shall be an approved brand of Ligno-sulphonate type

admixture.

The water proofing cement additives shall be used as required/advised by the owner.

14.0 GATES AND BOUNDARY WALL

The Gate frame shall be made of medium duty MS pipe conforming to relevant IS with welded joints.

The gates shall be fabricated with welded joints to achieve rigid connections. The gate frames shall be painted with one coat of approved steel primmer and two coats of synthetic enamel paint.

Gates shall be fitted with approved quality iron hinges, latch and latch catch. Latch and latch catch shall be suitable for attachment and operation of pad lock from either side of gates. Hinges shall permit gates to swing through 180 degree back against fence.

Gates shall be fitted with galvanized chain hook or gate hold back to hold gates open. Double gates shall be fitted with centre rest and drop bolt to secure gates in closed position.

Gates shall be installed in locations shown on drawings. Next to the main gate, a wicked gate (1.25 m wide, single leaf) shall also be provided.

Bottom of gates shall be set approximately 40 mm above ground surface and necessary guiding mechanism shall be fitted.

The Contractor shall design and& construct boundary wall around substation area as per requirements. The boundary wall shall be of height 1.80 M and shall be made of RCC frame construction with RCC column and plinth beam arrangement and panels filled with one brick thick wall in cement sand mortar 1 :6. The boundary wall shall be plastered on both external and internal faces with cement and sand plaster 1:6 of thickness15 mm and 12 mm respectively. An additional barbed Y -shaped arm of M8 angle 50x50x60 with 3-rows (6 nos) barbed wire A-4 18:278.

Expansion joints shall be provided as per codal requirements. M8 grating shall be provided at required locations for drainage purposes. The boundary wall shall be painted with minimum two coats of color wash over a base coat of white wash with line. The front portion of boundary wall shall however be with a RC jail and 12 mm square MS bar top above brick work and pebble dash plaster finish with colour pigment. The steel work shall be given two coats of synthetic enamel paint of approved make over one coat of primer. A tentative drawing is enclosed for guidance purpose.

15.0 BUILDINGS - GENERAL REQUIREMENTS

15.1 General

The scope include the design, engineering and construction including anti-termite treatment, plinth protection, DPC of Building including sanitary, water supply, electrification, false ceiling etc., of control room building, and DG set building. The buildings shall be of RCC framed structure of concrete of M20 grade (Min.). Cast in situ pile foundation should be adopted with pile dia. of 450 mm and up to a depth of 14 m from the FGL. **Minimum 3 nos. of pile per pile cap should be casted.**

15.2 Control Room Building

Minimum floor area requirements shall be **120 Sq. Meter** which may be increased at the time of detailed engineering to suit project requirements. The layout of the control room shall be finalized as per detailed engineering to suit project requirements.

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

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

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

15.2.1 Design

The buildings shall be designed:

i. To the requirements of the National Building Code of India, and the standards quoted therein.
ii. For the specified climatic and loading conditions
iii. To adequately suit the requirements of the equipment and apparatus contained in the buildings and in all respects to be compatible with the intended use and occupancy

iv. With a functional and economical space arrangement.
v. For a life expectancy of structure, systems and components not less than that of the equipment, which is contained in the building, provided regular maintenance is carried out
vi. Be aesthetically pleasing. Different buildings shall show a uniformity and consistency in architectural design.
vii. To allow for easy access to equipment and maintenance of the equipment.
viii. With, wherever required, fire retarding materials for walls, ceilings and doors, which would prevent supporting or spreading of fire.
ix. With materials preventing dust accumulation.
x. Suitable expansion joints shall be provided in the longitudinal direction wherever necessary with provision of twin columns.
xi. Individual members of the buildings frame shall be designed for the worst combination of forces such as bending moment, axial force, shear force, torsion, etc.
xii. Permissible stresses for different load combinations shall be taken as per relevant IS Codes.
xiii. All cable vaults shall be located above ground levels i.e., cable vaults shall not be provided as basements in the buildings.
xiv. The building lighting shall be designed in accordance with the requirements.
xv. One emergency exit shall be provided in control room building.

15.2.2 Design loads

Building structures shall be designed for the most critical combinations of dead loads, super-imposed loads, equipment loads, crane load, wind loads, seismic loads, and temperature loads.
Dead loads shall include the weight of structures complete with finishes, fixtures and partitions and shall be taken as per IS: 1911.
Super-imposed loads in different areas shall include live loads, minor equipment loads, cable trays, small pipe racks/hangers and erection, operation and maintenance loads. Equipment loads shall constitute, if applicable, all load of equipments to be supported on the building frame.
For crane loads an impact factor of 30% and lateral crane surge of 10% (lifted weight + trolley) shall be considered in the analysis of frame according to provisions of IS: 875.the horizontal surge shall be 5% of the static wheel load.
The wind loads shall be computed as per IS 875, Seismic Coefficient method shall be used for the seismic analysis as per IS 1893 with importance factor 1.5.
For temperature loading, the total temperature variation shall be considered as 2/3 of the average maximum annual variation in temperature. The average maximum annual variation in temperature for the purpose shall be taken as the difference between the mean of the daily minimum temperature during the coldest month of the year and mean of daily maximum temperature during the hottest month of the year. The structure shall be designed to withstand stresses due to 50% of the total temperature variation.
Wind and Seismic forces shall not be considered shall not be considered to act simultaneously.
Floors/slabs shall be designed to carry loads imposed by equipment, cables piping travel of maintenance trucks and equipment and other loads associated with building. Floors shall be designed for live loads as per relevant IS. Cable and piping loads shall also be considered additionally for floors where these loads are expected.
In addition, beams shall be designed for any incidental point loads to be applied at any point along the beams. The floor loads shall be subject to Owner's approval.
For consideration of loads on structures, IS: 875, the following minimum superimposed live loads shall, however, be considered for the design.

a) Roof	1.5 KN/M^2	For accessible roofs
	0.75 KN./M^2	For in- accessible roofs
b) RCC- Floor	i) 5 KN/M^2	For offices
	ii) 10 KN/M^2 (Minimum)	For equipment floors or actual requirement, if higher than 10 KN/M^2, based on equipment Component weight and layout plans
c) Toilet Room		2 KN/M^2
d) Chequered plate floor		4 KN/M^2

e) Walkways 3 KN/M^2

Any additional load coming in the structure shall be calculated as per IS: 875.

15.2.3 Submission

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

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

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

Fully, dimensioned concept plan including floor plans, cross-sections, longitudinal sections, elevations and perspective view of each building. These drawings shall be drawn at a scale not smaller than 1:50 and shall identify the major building components.

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

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

A detailed schedule of building finishes including colour schemes.

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

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

15.2.4 Finish Schedule

The finishing schedule is given in subsequent clauses.

15.2.5 Flooring

Flooring in various rooms of control room building shall be as for detailed schedules given in Table-1. High Voltage insulating mat conforming to IS 15652:2006 are to be provided in front of Indoor Switchgear Control panels inside the Control Room.

15.2.6 Walls

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

15.2.7 Plastering

All internal walls shall have minimum 15 mm thick 1:6 cement sand plaster. The ceiling shall have 6mm thick 1:4 cement sand plaster.

15.2.8 Finishing

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

INTERNAL FINISH SCHEDULE IS GIVEN TABLE - 1

SI No.	Location	Flooring & Skirting 150 mm High	Wall Internal	Ceiling	Doors, Windows Ventilators
1.	Control Room & Relay room	Homogeneous PVC /Vetrified tiles 2 mm thick over 25 mm thick 1 :2:4 under bed neat cement finished flooring	Plastic 7.3 mm thick ceramic tiles (DSR 11.41 A.2.1)	False Ceiling & Under deck insulation	Anodised aluminium Jindal or equivalent extruded sections as per IS 733 & 1285 Glazing Flat (DSR 97-11.64.2 drawn sheet & 11.4.1) glass (Min 5.5 mm thick) double glazing with 12 mm gap hermetically sealed. (DSR097, 24.1, 24.3, 24.4
2.	Sub-Station in-charge, officers, corridor, staff rooms	Vetrified **Terrazzo** tiles with white cement (DSR-97) (11.29 A.1)	Oil bound plastic paint washable distemper on smooth surface applied with POP putty	False ceiling & under deck insulation	Teak wood frame flush doors shutter (DSR 97 9.1.3 & 9.4 A.2.2) Windows, Ventilators Aluminium as at 1.
		(DSR-97) (11.48.1)	Smooth surface applied with POP putty.		For entrance with glazing
3.	Battery room	Acid Resistant Tiles 25 mm thick (DSR 9711.36 C 12)	DADO acid resistant title 2.1 M high Acid resistant paint above 2.1 M high acid resistant paint above 2.1 m upto ceiling (DSR 97.11.36 C 2.2) & 13.96.1)	Acid resistant paint (DSR 97 1372.1)	Steel door 45 mm thick double sheet 18 G steel suitably reinforced and filled with mineral wool. Hot rolled steel framed glazed window and ventilators.
4.	Cable vault double sheet (if required)	IPS flooring (DSR 97 11.4.3)	Oil bound distemper White wash (DSR 97 13.72.1)	**White Wash**	Steel door double sheet as above. Ventilators as at 5.
5.	Toilet	Non-solid/ vetrified **Terrazzo** tiles with White cement (DSR97,11.29a.1)	DADO glazed tile 2.1 M high for toilet for pantry above working platform upto 750 mm (DSR 97 11.36B)	**White wash** Weather coat	Teak wood frame flush door shutter with anodized Aluminium fixtures best quality (DSR 97 9.1.3 & 9.4 a 2) Windows, ventilators aluminium as at 1.
6.	Other areas not specified	Vetrified **Terrazzo** tiles with white cement	Plastic/O.B. distemper Dry distemper	White wash	

		(DSR 97 29 A.1)	(DSR 97.13.75)		

Note : DSR item references to be read with CPWD specifications are only for material and workmanship guidance of the Contractor.

15.2.9 Roof

Roof of the *CR.* Building shall consist of Cast-in-situ RCC slab treated with a water proofing system which shall be an integral cement based treatment conforming to CPWD specification (item NO.25.8 of DSR 1997) the water proofing treatment shall be of following operations.

a) Applying and grouting a slurry coat of neat cement using 2.75 kg/m2 of cement admixed with proprietary water proofing compounds conforming to IS:2645 over the RCC slab including cleaning the surface before treatment.
b) Laying cement concrete using broken bricks/bricks brick bats 25 mm to 100 mm size with 505 of cement mortar 1:5 (1 cement: 5 coarse sand) admixed with proprietary water proofing compound conforming to IS: 2645 over 20 mm thick layer of cement mortar of min 1:5 (Cement: 5 coarse sand) admixed with proprietary water proofing compound conforming to IS:2645 to required slope and treating similarly the adjoining walls upto 300 mm height including rounding of junctions of walls and slabs.
c) After two days of proper curing applying a second coat of cement slurry admixed with proprietary water proofing compound conforming to IS: 2645.
d) Finishing the surface with 20 mm thick joint less cement mortar of mix 1:4 (1 cement: 4 course sand) admixed with proprietary water proofing compound conforming to IS:2645 and finally finishing the surface with trowel with neat cement slurry and making of 300 x 300 mm square.
e) The whole terrace so finished shall be flooded with water for a minimum period of two weeks for curing and for final test. All above operations to be done in order and as directed and specified by the Engineering-in-charge.
With average thickness of 120 mm and minimum thickness at khurra at 65 mm.

15.2.10 Glazing

Minimum thickness of glazing shall be 5.5 mm as per IS: 2835 sun film shall be provided for all window/doors of AC rooms.

15.2.11 Doors and Windows

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

15.2.12 Plumbing & Sanitation

i) All plumbing and sanitation shall be executed to comply with the requirements of the appropriate bye-laws, rules and regulations of the Local Authority having jurisdiction over such matters. The Contractor shall arrange for all necessary formalities to be met in regard to inspection, testing, obtaining approval and giving notices etc.
ii) PVC syntax or equivalent make Roof water tank of adequate capacity depending on the number of users for 24 hours storage shall be provided. Minimum 2 Nos 500 litres capacity shall be provided.
iii) Galvanized MS pipe of medium class conforming to IS: 1239 shall be used for internal & external piping work for potable water supply.
iv) Sand CI pipes with lead joints conforming to IS: 1729 shall be used for sanitary works above ground level.
v) Each toilet shall have the following minimum fittings.
a) WC (Western type) 390 mm high with toilet paper roll holder and all fittings or
WC (Indian Type) Orissa Pattern (580 x 440 mill) with all fittings. (Both types of WCs shall be provided at alternate locations)
b) Urinal (430 x 260 x 350 mm size) with all fittings.
c) Wash basin (550 x 400 mm size) with all fittings.
d) Bathroom mirror (600 x 450 x 6 mm thick) hard board backing.

e) CP brass towel rail (600 x 20 mm) with CP brass brackets.
f) Soap holder and liquid soap dispenser.

vi) Water cooler for drinking water with adequate water storage facility shall be provided and located near control room instead of near toilet block.

vii) An Eye & ace fountain conforming to IS:1052 shall be provided for battery room

viii) 1 No. stainless steel kitchen sink with Drain board (510 x 1040 x 178 mm bowl depth) for pantry shall be provided.

ix) All fittings, fastener, grating shall be chromium plated.

x) All sanitary fixtures and fittings shall be of approved quality and type manufactured by well-known manufacturers. All items brought to site must bear identification marks of the type of the manufacturer.

xi) Soil, waste and drain pipes, for underground works shall be stone ware for areas not subject to traffic load. Heavy-duty cast iron pipes shall be used otherwise.

16.0 SECURITY FENCING

Security fencing shall be provided for 1.5 meter above the ground at the switchyard.
Security fencing shall be provided with barbed wire mesh of 5 rows connected with the PSCC poles at 2 meters interval.

17.0 MISCELLANEOUS GENERAL REQUIREMENTS

17.1 Dense concrete with controlled water cement ratio as per IS-code shall be used for all underground concrete structures such as pump-house, tanks, water retaining structures, cable and pipe trenches etc. for achieving water tightness.

17.2 All joints including construction and expansion joints for the water retaining structures shall be made water tight by using PVC ribbed water stops with central bulb. However, kicker type (externally placed) PVC water stops shall be used for the base slab and in other areas where it is required to facilitate concreting. The minimum thickness of PVC water stops shall be 5 mm and minimum width shall be 230 mm.

17.3 All steel sections and fabricated structures which are required to be transported on sea shall be provided with anti-corrosive paint to take care of sea worthiness.

17.4 All mild steel parts used in the water retaining structures shall be hot-double dip galvanized. The minimum coating of the zinc shall be 750 gm/sq. m for galvanized structures and shall comply with IS:2629 and IS:2633. Galvanizing shall be checked and tested in accordance with 18:2633.The galvanizing shall be followed by the application of an etching primer and dipping in black bitumen in accordance with B8:3416.

17.5 A screed concrete layer not less than 100 mm thick and of grade not weaker than M10 conforming to IS: 456-1978 shall be provided below all water retaining structures. A sliding layer of bitumen paper or craft paper shall be provided over the screed layer to destroy the bond between the screed and the base slab concrete of the water retaining structures.

17.6 Bricks having minimum 75 kg/cm^2 compressive strength can only be used for masonry work. Contractor shall ascertain himself at site regarding the availability of bricks of minimum 75 kg/cm^2 compressive strength before submitting his offer.

17.7 Doors and windows on external walls of the building (other than areas provided, with insulated metal claddings) shall be provided with RCC sun-shade over the openings with 3000 mm projection on either side of the openings. Projection of sunshade from the wall shall be minimum 450 mm over window openings and 750 mm over door openings.

17.8 All stairs shall have maximum riser height of 150 mm and a minimum tread width of 300 mm.

Minimum width of stairs shall be 1500 mm. Service ladder shall be provided for access to all roofs. RCC fire escape staircase shall be provided in control buildings.

17.9 Angles 50 x 50 x 6 mm (minimum) with lugs shall be provided for edge protection all round cut outs/openings in floor slab, edges of drains supporting grating covers, edges of RCC cable/pipe trenches supporting covers, edges of manholes supporting covers, supporting edges of manhole precast cover and any other place where breakage of corners of concrete is expected.

17.10 Anti-termite chemical treatment shall be given to column pits, wall trenches, foundations of buildings, filling below the floors etc. as per IS: 6313 and other relevant Indian Standards.

17.11 Hand-railing minimum 900 mm high shall be provided around all floor/roof openings, projections/balconies, walk ways, platforms, steel stairs etc. All handrails and ladder pipes shall be 32 mm nominal bore MS pipes (medium class) and shall be galvanized (medium-class as per IS:277). All rungs for ladder shall also be galvanized as per IS: 277 medium classes.
For RCC stairs, hand railing with 20 mm square MS bars, balustrades with suitable MS flats shall be provided with black PVC sheathing.

17.12 For all civil works covered under this specification, nominal mix by volume batching as per CPWD specification is intended. The relationship of grade of concrete and ratio of ingredients shall be as below:-

S.No.	Mix	Cement	Sand	Coarse Aggregate of 20 mm Down Grade as per IS 383
1.	M 10	1	3	6
2.	M 15	1	2	4
3.	M 20	1	1.5	3

The material specification, workmanship and acceptance criteria shall be as per relevant clauses of CPWD specification and approved standard Field Quality Plan.

17.13 The details given in tender drawings shall be considered along with details available in this section of the specification while deciding various components of the building.

17.14 Items/components of buildings not explicitly covered in the specification but required for completion of the project shall be deemed to be included in the scope.

18.0 INTERFACING

The proper coordination & execution of all interfacing civil works activities like fixing of conduits in roofs/walls/floors, fixing of foundation bolts, fixing of lighting fixtures, fixing of supports/embedment, provision of cutouts etc. shall be the sale responsibility of the Contractor. He shall plan all such activities in advance and execute in such a manner that interfacing activities do not become bottlenecks and dismantling, breakage etc. is reduced to minimum.

19.0 WATER SUPPLY

i) Contractor shall make its own arrangement for construction water.
ii) The contractor shall carry out all the plumbing/erection works required for supply of water in control room building.
iii) The details of tanks, pipes, fittings, fixtures etc for water supply are given elsewhere in the specification under respective sections.
iv) A scheme shall be prepared by the contractor indicating the layout and details of water supply which shall be got approved by the Owner before actual start of work including all other incidental items not shown or specified but as may be required for complete performance of the

works.

v) Bore wells with Min 100mm dia casing pipe & 1HP submersible pump to get a discharge of at least 1000 Litre/Hr. with zealete make iron removed filter to get iron free water. Water purifier with UV mechanism is to be provided and pumps for water supply are in the scope of contractor meeting the day-to-day requirement of the water supply.

20.0 SEWERAGE SYSTEM

i) Sewerage system shall be provided for control room building.
ii) The contractor shall construct septic tank and soak pit suitable for 20 users.
iii) The system shall be designed as per relevant IS Codes.

21.0 STATUTORY RULES

21.1 Contactor shall comply with all the applicable statutory rules pertaining to factories act (as applicable for the State). Fire Safety Rules of Tariff Advisory Committee. Water Act for pollution control etc.

21.2 Provisions for fire proof doors, no. of staircases, fire separation wall, plastering on structural members (in fire prone areas) etc. shall be made according to the recommendations of Tariff Advisory Committee.

21.3 Statutory clearance and norms of State Pollution Control Board shall be followed as per Water Act for effluent quality from plant.

21.4 Requirement of sulphate resistant cement (SRC) for sub-structural works shall be decided in accordance with the Indian Standards based on the findings of the detailed soil investigation to be carried by the bidder.

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

21.6 All water retaining structures designed as an un-cracked section shall also be tested for water tightness at full water level in accordance with clause No. 10 of IS:3370 (part-I)

21.7 Construction joints shall be as per IS:456

21.8 All underground concrete structures like basements, pumps houses, water retaining structures etc. shall have plasticizer cum water proofing cement additive conforming to IS:9103. in addition, limit on permeability as given in IS:2645 shall also be met with. The concrete surface of these structures in contact with earth shall also be provided with two coats of bituminous painting for water/damp proofing. In case of water leakage in the above structures, Injection Method shall be applied for requiring the leakage.