



**ORISSA POWER TRANSMISSION  
CORPORATION LIMITED  
REGD. OFFICE, JANAPATH,  
BHUBANESWAR –751022  
ORISSA.**

**Tender Notice No- TN - 4/2010-11**

**Tender Specification No- Sr. G.M (CPC)-  
Capacitor Bank- 4/2010-11**

**TENDER FOR SUPPLY,  
INSTALLATION, TESTING & AMC(10 YRS)  
OF CAPACITOR BANK IN 33 KV SIDE AT  
DIFFERENT GRID SUB-STATION OF  
OPTCL -**

**DATE OF OPENING - 7<sup>th</sup> December 2010-3:30PM**

**COST OF TENDER PAPER-Rs.10,000.00+4% VAT  
FOR EACH PACKAGE**



**ORISSA POWER TRANSMISSION CORPORATION  
LIMITED  
REGD. OFFICE, JANAPATH, BHUBANESWAR –751022  
ORISSA.**

**TENDER NOTICE NO -TN – 4 /2010-11**

For and on behalf of ORISSA POWER TRANSMISSION CORPORATION Limited, Sr. G.M. (C.P.C.) invites Tenders from reputed Electrical Contractors/manufacturer having adequate experience as prescribed in the tender specification and valid HT/EHT license from competent licensing authority for “Supply of all materials/equipments , its installations including all type of Civil works ,testing and commissioning and also for 10 years maintenance for Capacitor Banks of different MVAR(5,10,15 & 20) rating in OPTCL System” at different Grid sub-station in **four packages** ,on turn key basis . Tender papers shall be sold from **Date-6<sup>th</sup> November 2010 to Date-6<sup>th</sup> December 2010 and last date of receipt of Bid document on Dt.7<sup>th</sup> December 2010 upto 1:00 P.M.** Interested firms may visit OPTCL’s official website <http://www.OPTCL.co.in> for detail specifications . The FIRMS are requested to visit the proposed work locations prior to the bidding, for better understanding of the work.

SR. GENERAL MANAGER [C.P.C.]

<i>Sl. No</i>	<i>Tender Specification No.</i>	<i>Description of materials</i>	<i>Quantity</i>	<i>Earnest Money Deposit (In Rs.)</i>	<i>Cost of Tender Paper.</i>	<i>Last date of receipt &amp; opening of tender</i>
	<b>Sr. G.M.CPC-4/2010-11 -Capacitor Bank(33KV)</b>	<b><u>PACKAGE-I</u></b> 1) 10 MVAR Capacitor Bank including all associated equipments, installation, Testing & commissioning.(02 SETS) 2) 15 MVAR Capacitor Bank including all associated equipments, installation, Testing & commissioning.(02 SETS) 3) 20 MVAR Capacitor Bank including all associated equipments, installation, Testing & commissioning.(01 SET)	AS INDICATED BELOW.**	<b>3.0 Lakh</b>	<b>Rs.10,000 +4% VAT</b>	Last date of receipt Dt. 7 <sup>th</sup> December 2010 upto 1:00 P.M & Opening on Dt. 7 <sup>th</sup> December 2010 3:30 P.M.

**\*\*PACKAGE-I: NAME OF THE SUB-STATION:**

- 1. 220/132/33 KV S/S Balasore.(15 MVAR)**
- 2. 220/132/33 KV S/S Bhadrak(15 MVAR)**
- 3. 132/33 KV S/S Jajpur Town(20 MVAR)**
- 4. 132/33 KV S/S Palashpanga(10 MVAR)**
- 5. 132/33 KV S/S Jaleswar(10 mVAR)**

**(Total 70 MVAR)**

**SR. GENERAL MANAGER [C.P.C.]**

<i>Sl. No</i>	<i>Tender Specification No.</i>	<i>Description of materials</i>	<i>Quantity</i>	<i>Earnest Money Deposit (In Rs.)</i>	<i>Cost of Tender Paper.</i>	<i>Last date of receipt &amp; opening of tender</i>
	<b>Sr. G.M.CPC-4/2010-11 -Capacitor Bank(33KV)</b>	<b><u>PACKAGE-II</u></b> 1) 10 MVAR Capacitor Bank including all associated equipments, installation, Testing & commissioning.(03 SETS) 2) 20 MVAR Capacitor Bank including all associated equipments, installation, Testing & commissioning.(02 SETS)	AS INDICATED BELOW.**	<b>3.00 Lakh</b>	<b>Rs.10,000 +4% VAT</b>	Last date of receipt Dt. 7 <sup>th</sup> December 2010 upto 1:00 P.M & Opening on Dt. 7 <sup>th</sup> December 2010 3:30 P.M.

\*\*PACKAGE-II: NAME OF THE SUB-STATION:

1. 132/33 KV S/S Balugaon.(10 MVAR)
  2. 132/33 KV S/S Berhampur(10 MVAR)
  3. 132/33 KV S/S Khurdha(20 MVAR)
  4. 132/33 KV S/S Nimapara(10 MVAR)
  5. 132/33 KV S/S Puri (20 mVAR)
- (Total 70 MVAR)

SR. GENERAL MANAGER [C.P.C.]

<i>Sl. No</i>	<i>Tender Specification No.</i>	<i>Description of materials</i>	<i>Quantity</i>	<i>Earnest Money Deposit (In Rs.)</i>	<i>Cost of Tender Paper.</i>	<i>Last date of receipt &amp; opening of tender</i>
	<b>Sr. G.M.CPC-4/2010-11 -Capacitor Bank(33KV)</b>	<b><u>PACKAGE-III</u></b> 1) 10 MVAR Capacitor Bank including all associated equipments, installation, Testing & commissioning.(04 SETS) 2) 15 MVAR Capacitor Bank including all associated equipments, installation, Testing & commissioning.(01 STS)	AS INDICATED BELOW.**	<b>3.0 Lakh</b>	<b>Rs.10,000 +4% VAT</b>	Last date of receipt Dt. 7 <sup>th</sup> December 2010 upto 1:00 P.M & Opening on Dt. 7 <sup>th</sup> December 2010 3:30 P.M.

\*\*PACKAGE-III: NAME OF THE SUB-STATION:

1. 132/33 KV S/S Boinda.(10 MVAR)
2. 132/33 KV S/S Rairakhola(10 MVAR)
3. 132/33 KV S/S Sonapur(10 MVAR)
4. 132/33 KV S/S Sunabeda(15 MVAR)
5. 220/132/33 KV S/S Duburi(Old) (10 mVAR)

**(Total 55 MVAR)**

SR. GENERAL MANAGER [C.P.C.]

<i>Sl. No</i>	<i>Tender Specification No.</i>	<i>Description of materials</i>	<i>Quantity</i>	<i>Earnest Money Deposit (In Rs.)</i>	<i>Cost of Tender Paper.</i>	<i>Last date of receipt &amp; opening of tender</i>
	<b>Sr. G.M.CPC-4/2010-11 -Capacitor Bank(33KV)</b>	<b><u>PACKAGE-IV</u></b> 1) 10 MVAR Capacitor Bank including all associated equipments, installation, Testing & commissioning.(01 SET) 2) 15 MVAR Capacitor Bank including all associated equipments, installation, Testing & commissioning.(02 SETS) 3) 20 MVAR Capacitor Bank including all associated equipments, installation, Testing & commissioning.(02 SETS)	AS INDICATED BELOW.**	<b>3.20 Lakh</b>	<b>Rs.10,000 +4% VAT</b>	Last date of receipt Dt. 7 <sup>th</sup> December 2010 upto 1:00 P.M & Opening on Dt. 7 <sup>th</sup> December 2010 3:30 P.M.

\*\*PACKAGE-IV: NAME OF THE SUB-STATION:

1. 132/33 KV S/S Cuttack.(10 MVAR)
2. 132/33 KV S/S Jagatsinghpur(15 MVAR)
3. 132/33 KV S/S Kendrapara(20 MVAR)
4. 132/33 KV S/S Pattamundai(15 MVAR)
5. 220/132/33 KV S/S Ranasinghpur(20 MVAR)

**(Total 80 MVAR)**

SR. GENERAL MANAGER [C.P.C.]

The tender specification documents can be had from the office of the undersigned on payment of non-refundable cost of tender specification documents in the shape of cash from **10 A .M. to 3 P.M. during Date:6<sup>th</sup> November 2010 to Date:6<sup>th</sup> December 2010 (both days inclusive)** on any working day either in person or by remitting demand draft payable to Drawing & Disbursing Officer, ORISSA POWER TRANSMISSION CORPORATION Limited, Regd. Office: Janpath, Bhubaneswar-751 022. No other mode of payment is acceptable. No tender documents will be sold on any other day except as indicated.

The specification can also be down loaded from OPTCL's official web site and the same may be submitted along with the cost of tender document by way of demand draft/ pay order payable to D.D.O ,OPTCL Ltd. Janpath, Bhubaneswar at the time of submission of tender document. Incase any deviation is found in the tender document submitted by the Tenderers from the content mentioned in our web site and/ or non submission of cost of tender documents, the tender shall liable to be rejected at any stage of the contract. The Tenderers has to indemnify OPTCL for any loss accruing due to such alternation in the terms and conditions of the tender document & / or for such alternation, resulting in the cancellation of the contract.

The intending bidders, who want to get a copy of the tender specification document by post, are required to deposit an additional amount of Rs.1000/- over and above the cost of the tender specification, mentioned under heading "Cost of tender specification". Complete bid for the works will be **received upto 1 P.M of Date 7th December 2010. only and the same will be opened at 3:30 P.M. on the same day.** Date and time of opening of price bids in respect of two-part tenders shall be intimated to the techno-commercially responsive bidders only. In the event of any specified date for the sale, submission or opening of bids being declared a holiday for purchaser, the bids will be sold/ received/ opened upto the appointed times on the next working day. Only one representative of the bidder will be allowed to participate in the bid opening. OPTCL also reserves the right to accept or reject the tender without assigning any reasons thereof, if the situation so warrants. OPTCL shall not be responsible for any postal delay at any stage.

**QUALIFYING CRITERION FOR AWARD OF OPTCLTURNKEY FOR ENGINEERING,SUPPLY,ERECTION,TESTING & COMMISSIONING AND MAINTENANCE THEREAFTER AFTER THE GUARANTEE PERIOD FOR CAPACITOR BANK INSTALLATION OF DIFFERENT MVA RATING IN 33 KV SIDE OF THE GRID SUB-STATION IN OPTCL SYSTEM.**

**(A) GENERAL QUALIFYING CRITERION**

(1)The performance B.G. to be submitted by the Firms shall be capable of being encashed at any operating branch of the issuing bank at Bhubaneswar or encashment at the operating branch of the Bank at Bhubaneswar.

(2) In case bidders intend to bid for the project in joint venture with another firm, the parties together must be able to meet the required qualifying criteria. Maximum two nos of Partners(Lead+Other) are allowed as Joint venture partners and the detailed terms and conditions in this regard are contained in the bid documents.

**(B)MINIMUM TECHNICAL QUALIFYING CRITERION**

(i) The bidder should be HT/EHT electrical contractor having a valid license from the competent licensing authority on the date of opening of the tender.

(ii) The contractor must have executed , installation and its maintenance of minimum 10 Nos Capacitor Bank of minimum capacity of 5 MVAR and above and its associated equipment of 33 KV system in Turn Key Basis earlier& completed successfully .

Or,

The contractor must have executed installation and its maintenance of minimum 20 Nos Capacitor Bank of minimum capacity of 5 MVAR and above and its associated equipment of 33 KV system earlier& completed successfully

(iii) The above installation should be in successful operation for last two years.

Note: The above 3 criterion have to be supported by Performance certificate/ TOC issued by Central/State Govt. Utilities/Organisations/ PSUs

(iv) The contractor has to get project license from ELBO within one month of issue of LOI, at his own cost.

**Important: The bidder should be a reputed manufacturer of Capacitor bank in addition to the above Technical qualifying criteria. In case the bidder is not a manufacturer, than the bidder has to furnish a certificate from the capacitor manufacturer to support the bidder for the aforesaid works. The certificate has to be signed by the manufacture representative holding power of attorney. Manufacture can extend their support only to one bidder per package.**

**( C ) MINIMUM FINANCIAL QUALIFYING CRITERION**

TURN OVER-The Bidder should have an average annual turnover of at least Rs 200 Crores(Two hundred crores) in the last three financial years as per the audited accounts. Documentary evidence to be furnished along with techno-commercial documents.

**(D) SPECIAL TERMS AND CONDITIONS OF THE BID**

(i) Mobilization advance of 10 % value of the contract value (Both supply portion and erection portion) shall be paid against equivalent amount of BG from any nationalized/scheduled bank having Branch at Bhubaneswar. The mobilization advance shall be recovered proportionately from each running bills of the contractor by



OPTCL.10% simple interest shall be charged on the mobilisation advance paid to the firms.

(ii) The extra quantities, if any, to be executed by the firm, shall be billed as per the unit price quoted by the firm.

(iii) The unit price quoted by the firm shall be FIRM.

(iv) Where valid type test certificate of materials during last five years are available OPTCL shall not insist for further type test.

#### **(E)PAYMENT TERMS**

##### **(a) payment against Supply of equipment and materials shall be effected as follows-**

(i) 50 % of cost of the material shall be paid on receipt of the material at site against production of Lorry Receipt.

(ii)10% cost of material shall be paid after verification by the consignee.

(iii)30% cost of the material shall be paid after erection of the material at site.

(iv) Balance 10 % cost of material shall be paid after successful commissioning of the capacitor bank and handing over to OPTCL.

All the above payments will be made within 30 days of submission of invoice enclosing the required documents mentioned above.

##### **(b) Payment for Erection and commissioning work**

(i)90% cost of erection shall be paid on running bill within 30 days on production of the bill to the engineer in charge and verification there of after completion of erection work of the preceding month.

(ii)Balance 10 % cost of the erection shall be paid only after satisfactory commissioning of the project and handing over to OPTCL.

##### **c) FOR ANNUAL MAINTENANCE CONTRACT:-(scope & other Terms & Conditions):REFER SECTION – V**

( I ) **TERMS OF PAYMENT:** (For AMC Contract of Capacitor Bank Installation Scheme)

The terms of payments under this contract shall be governed as per the following:

1. Your unconditional acceptance of this order.
2. A performance Bank Guarantee as per the proforma enclosed for 10% of the total Maintenance Contract price(for 10 years) , which will remain valid for more than two months from the expiry of the contract period.
3. Payment will be made equally at the end of each half(every six months) period starting from the date of contract agreement as per the details below:

(a) Release of payment for the 1<sup>st</sup> instalment:- All the Capacitor Bank Installation schemes need to be Checked Properly under Preventive Maintenance (PM) to ascertain the performance to the satisfaction of OPTCL in each quarter. This inspection to be carried out in presence of OPTCL Engineer and your representative and a report on inspection & testing along with the status of the Capacitor Bank Installation Scheme

should be jointly signed and furnished to the verifying authority(Concerned A.G.M of O&M Division) for verification and onward transmission to C.G.M (O&M)/Nodal Officer. C.G.M (O&M)/Nodal Officer shall intimate/forward the documents along with the invoice to Sr.G.M( CPC) for release of the payment. You have to furnish the draft format for the inspection/testing& Status report of the Capacitor Bank Installation scheme,which shall be approved by the C.G.M (O&M),OPTCL, Bhubaneswar.

(b) Similarly the payment of 2<sup>nd</sup> installments (last Instalment of the each year)of each year are to be paid to you at the end of each year (12 months) , during which the inspection of Capacitor Bank Installation Scheme to keep the Bus Bar protection schemes in a healthy and functional condition, shall be carried out by the bidder, on production of documents as indicated above.

**(II) PENALTY:**

(A) In the event of failure on your part to comply with the provisions of the contract regarding attending to the **Break down** of the Capacitor Bank Installation scheme at various grid substations as indicated elsewhere, a penalty @0.5% of the total contract value for each day of delay, or part thereof, for such delay, subject to no upper ceiling, will be levied, without prejudice to any other remedies to which OPTCL may also be entitled, under the provisions of the contract/bid specifications.

(B) In the event of failure on your part to comply with the provisions of the contract regarding attending to the **Preventive maintenance(PM)** of the Capacitor Bank Installation scheme at various grid substations as indicated elsewhere, a penalty @30% of the total AMC value for the period shall be imposed for that quarter.

**(F) OTHER IMPORTANT TERMS AND CONDITIONS**

(i) OPTCL may invite a pre-bid discussion for which the contractors should contact the Sr. G.M., Central Procurement Cell, Head Qrs. Office, OPTCL, Bhubaneswar.

(ii) Work contract taxes shall be deducted from the firms bill as per the prevailing rates

(iii) The Firm shall not include Entry Tax and Service Taxes in their quoted price, which shall be reimbursed to them as per prevailing rate subject to production of documentary evidence.

(iv) For delay in completion of the project, Penalty shall be recovered from the contractor, at the rate of 0.5% per week of delay subject to maximum of 5% of the total sub-station wise contract price. Total price for that Capacitor bay.

(v) Incentive: 0.25% of the contract price as an incentive, per completed full month (no proportionate for the part thereof) shall be given, for the projects completed before the scheduled date of completion but limiting to over all 2.5%.

(vi) Bids of the Firms not complying the minimum qualification criterion, not furnishing bid security, furnishing incomplete data's /price bid, Not agreeing to to the bid validity date, not agreeing for the security and performance BG, not agreeing to

the payment clause, not agreeing to the completion time, not agreeing to defect liability and not agreeing to governing laws, shall be out rightly rejected.

**(vii) ENGAGEMENT OF SECURITY-** The Contractor shall have to engage his own security at his own cost till final handing over of the entire work to OPTCL

**(viii) PRICE CLAUSE- Price quoted shall be FIRM.**

**(ix) QUANTITY VARIATION-** Extra quantities executed if any by the firm shall be billed as per the unit quoted rate of the Firm and there shall be no limitation for the extra quantity to be executed.

**(x) WORK OFF LOADED FROM FIRMS**

Firms from whom, OPTCL have off loaded works due to non-performance, during last seven years, shall not be eligible to participate in any of the OPTCL turnkey tenders.

**(xi)** The participant Firms shall **submit an undertaking** along with the price bid to the effect that any items missing/not quoted in the price bid, shall be executed free of cost by them without any financial liability to OPTCL and that the said undertaking shall cover all the evaluation criterion as recommended above The condition of rejection of incomplete price bid appearing under the Outright rejection Criterion shall stand deleted.

**(xii)** Successful bidders may procure tower structures for S/S, preferably from the OPTCL empaneled Rate contractor holders for Supply of Structures.

The Bidder shall also furnish the price breakdown in the appropriate schedules of Bid Form to indicate the following:

- i) Ex-works price of the equipment/materials (including tools and tackles etc.)
- ii) Charges for inland transportation (including port handling) and insurance for delivery of the equipment/materials up to their final destinations.
- iii) Lump sum charges towards unloading, storage, insurance,
- iv) Price break up for spares in line with Clause 18.0 of this Section.
- v) Sales Tax/ Excise duty/Entry tax and any other levies legally payable on the transactions between the Owner and the Bidder.
- vi) Any other charges as per the requirement of Contract/Technical Specifications.
- vii) Unit erection, testing and commissioning charges as per the schedule.

**(Xiii)** The bidder should furnish the un-priced schedule (un-priced Bid) along with the techno-commercial bid (Part-I of the Bid). All the columns shall be filled by quoting “Quoted” only.

**XIV)** Evaluation will be done on package wise. The Bidder has to fillup Annexure-I,II,III and of price schedule for each sub-station. Annexure IV (consolidated price schedule) should be filled up for each package.

**XV)** Bidder's are to furnish the PERT chart in details along with the Techno-commercial bid. This shall be a part of the bid and shall be binding upon the bidder for strictly adherence to it for timely completion of the project. Non compliance to the same for timely completion of the project shall attract penalty as mentioned in the document.

(G) OPTCL shall conduct a Pre-Bid meeting with the participants of this tender preferably before opening of Techno-commercial Bid(Part-I). Exact date shall be uploaded in OPTCL web-site.

(H) Bidder to note that, there shall be two modes of transaction for supply of materials/equipment. One is direct mode, where in the Bidder is a manufacturer and the same directly to OPTCL. The other one is bought out mode, where in the bidder is not a manufacturer , and supplying the same to OPTCL by purchasing from others. In case of bought out items, the total price shall be inclusive of all taxes and duties. In case of the bidder is a manufacturer, the bidder shall quote the break up price for different taxes and duties.

**SR. GENERAL MANAGER  
CENTRAL PROCUREMENT CELL**

## CHECK LIST FOR THE BIDDING DOCUMENTS

( Bidders are requested to ensure that all the documents as check listed below are enclosed as per the  
Sl.No. & neatly pages marked.)

Ref: (i) Tender Notice No. .... /2010-2011  
(ii) Tender Specification No. ....

Sl. No.	Description.	Page Nos.	
		From	To
1	Page counting for the complete tender document submitted duly signed by the firm & JV partner (if any)		
2	Forwarding letter for submission of Bid		
3	Original Money Receipt for procurement of the Tender Documents		
4	Required ORIGINAL EMD BG with confirmation of the Bank (Invokable Clause & witness signatures must be taken care of )- [Annexure-I]		
5	Form of Power of Attorney for JV /Consortium [Annexure-III]		
6	Form of JV /Consortium Agreement [Annexure-IV]		
7	Form of Power of Attorney for signing of the tender		
8	Up to date Electrical License of the Firm		
9	Copies of the Audited financial Accounts for the last three financial years.		
10	Documents in support of Financial Qualifying Criteria		
11	Documents in support of Technical Qualifying Criteria		
12	General Information of the Bidder [Annexure-VIII]		
13	Declaration Form [Annexure-IX]		
14	Abstracts of Terms & Conditions [Annexure-X]		
15	Personnel Capabilities [Annexure-XI]		
16	Equipment Capability [Annexure-XII]		
17	Financial Capabilities [Annexure-XIII]		
18	Record of experience [Annexure-XIV]		
19	Departure from Technical & Financial Specification [Annexure-XV]		
20	Litigation History [Annexure-XVI]		
21	Copy of undertaking submitted with the Price Bid [Annexure-XVII]		
22	OFF-LOAD Statement ( with reasons) [Annexure-XVIII]		
23	Guaranteed Technical Particulars duly filled in, in complete shape. (Volume-IIA)		

Date:

(Signature).....

Place:

(Printed Name) .....

(Designation) .....

**(Common Seal)**

# **SECTION FOR AMC**

**COMPREHENSIVE AMC( FOR CAPACITOR  
BANK INSTALLATION SCHEME)**

**(Page 111-114).**

## **ANNEXURE – III : FOR GTP**

### **SECTION FOR PRICE BID:**

**SEPARATELY ENCLOSED**

#### **SECTION FOR TECHNICAL SPECIFICATION:-**

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**E3: ISOLATOR**

**E4: SURGE ARRESTOR**

**E5: CAPACITOR BANK & etc.**

**E6: CIVIL WORKS**

**E7: CONTROL & POWER CABLE**

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# **SECTION – INB**

## **INSTRUCTION TO BIDDERS**

### **A. INTRODUCTION**

#### 1.0 GENERAL INSTRUCTIONS

1.1 The ORISSA POWER TRANSMISSION CORPORATION Limited, hereinafter called 'OPTCL'/'OWNER' will receive bids in respect of equipment to be furnished and erected as set-forth in the accompanying Specifications. All bids shall be prepared and submitted in accordance with these instructions. The tender is invited in two-part basis i.e. (1) Techno-commercial bids consisting all the documents except price bid & (2) Price Bid. Both the bids duly sealed separately shall be kept inside the third sealed cover with superscribed Tender specification No. & Date of Opening.

#### 2.0 QUALIFYING REQUIREMENTS OF BIDDERS

a) As specified in the minimum qualifying Criterion

#### 2 COST OF BIDDING

2.1 The Bidder shall bear all costs and expenses associated with preparation and submission of its bid including pre and post-bid discussions, technical and other presentations etc., and the Owner will in no case be responsible or liable for those costs, regardless of the conduct or outcome of the bidding process.

### **B. THE BIDDING DOCUMENTS**

#### 3 CONTENTS OF BIDDING DOCUMENT

3.1 The goods and services required, bidding procedures and contract terms are prescribed in the Bidding Document.

In addition to the Invitation to Bids, the Bidding Document is a compilation of the following sections:

- a) Instructions to Bidders – Section INB (Vol.I)
- b) General Conditions of Contract – Section GCC (Vol.I)
- c) Erection Conditions of Contract – Section ECC (Vol.I)
- d) Bid Form and Price Schedules
- e) Technical Specifications
- f) Technical Data Sheets

#### 4 UNDERSTANDING OF BID DOCUMENTS

- 4.1 A prospective Bidder is expected to examine all instructions, forms, terms and specifications in the Bid documents and fully inform himself as to all the conditions and matters which may in any way affect the scope of work or the cost thereof. Failure to furnish all information required by the Bid documents or submission of a Bid not substantially responsive to the Bid document in every respect will be at the Bidder's risk and may result in the rejection of its bid.

#### 5 CLARIFICATIONS ON BID DOCUMENTS

- 5.1 If the prospective Bidder finds discrepancies or omissions, in specifications and document or is in doubt as to the true meaning of any part, he shall at once make a request, in writing, for an interpretation/clarification, to the Owner in triplicate. The Owner, then, will issue interpretation(s) and clarification(s) as he may think fit in writing. After receipt of such interpretation(s) and clarification(s), the Bidder may submit his bid but within the time and date as specified in the Invitation to Bid. All such interpretations and clarifications shall form a part of the Bidding Document and shall accompany the Bidder's Proposal. A prospective Bidder requiring any clarification on Bidding Document may notify the Owner in writing. The Owner will respond in writing to any request for such clarification of the Bidding Document which it receives not later than fifteen (15) days prior to the deadline for submission of bids prescribed by the Owner. Written copies of the Owner's response (including an explanation of the query but without identifying its source) will be sent to all prospective Bidders who have received the Bidding Document.
- 5.2 Verbal clarification and information given by the Owner or his employee(s) or his representative(s) shall not in any way be binding on the Owner.

#### 6 AMENDMENT TO BIDDING DOCUMENT

- 6.1 At any time prior to the deadline for submission of bids, the Owner may, for any reason, whether at its own initiative or in response to a clarification requested by a prospective Bidder, modify the Bidding Document by amendment(s).

- 6.2 The amendment will be notified in writing or by telex or cable to all prospective Bidders, which have received the Bidding Document at the address contained in the letter of request for issue of Bidding Document from the Bidders. Owner will bear no responsibility or liability arising out of non-receipt of the same in time or otherwise.
- 6.3 In order to afford prospective Bidders reasonable time in which to take the amendment into account in preparing their bids, the Owner may, at its discretion, extend the deadline for the submission of bids.
- 6.4 Such amendments, clarifications, etc. shall be binding on the Bidders and will be given due consideration by the Bidders while they submit their bids and invariably enclose such documents as a part of the bid.

## **C. PREPARATION OF BIDS**

### **7 LANGUAGE OF BID**

- 8.1 The bid prepared by the Bidder and all correspondences and documents relating to the bid, exchanged by the Bidder and the Owner shall be written in the English language, provided that any printed literature furnished by the Bidder may be written in another language so long as accompanied by an English translation of its pertinent passages. Failure to comply with this may disqualify a bid. For purposes of interpretation of the bid, the English translation shall govern.

### **8 LOCAL CONDITIONS**

- 9.1 It will be imperative on each Bidder to fully inform himself of all local conditions and factors which may have any effect on the execution of the Contract covered under these documents and specifications. The owner shall not entertain any request for clarifications from the Bidders, regarding such local conditions.
- 9.2 It must be understood and agreed that such factors have properly been investigated and considered while submitting the Proposals. No claim for financial adjustment to the Contract awarded under these specifications and documents will be entertained by the Owner. Neither any change in the time schedule of the Contract nor any financial adjustments arising thereof shall be

permitted by the Owner, which are based on the lack of such clear information or its effect on the cost of the Works to the Bidder.

## 10 DOCUMENTS COMPRISING THE BID

- 10.1 The Bidder shall complete the Bid Form inclusive of Price Schedules, Technical Data Requirements etc. furnished in the Bidding Documents, indicating for the goods to be supplied and services to be rendered, a brief description of goods and services, quantity and prices.
- 10.2 The Bidder shall also submit documentary evidence to establish that the Bidder meets the Qualification Requirements as detailed in Clause 2.0 above including the minimum qualification as stipulated and accompanying Special Conditions of Contract.
- 10.3 The Bid Guarantee shall be furnished in a separate cover in accordance with clause 24.0 of Section INB.

## 11. SCOPE OF THE PROPOSAL

- 11.1 The scope of the Proposal shall be on the basis of a single Bidder's responsibility, completely covering all the work and equipment specified under the accompanying Technical Specifications. It will include the following -
- a) detailed design of the equipment;
  - b) complete manufacture including shop testing;
  - c) providing Engineering drawing, data, operational manual, etc. for the Owner's approval;
  - d) packing and transportation from the manufacturer's works to the site;
  - e) receipt, storage, preservation and conservation of equipment at the site;
  - f) pre-assembly, if any, erection, testing and commissioning of all the equipment;
  - g) reliability tests and performance and guarantee tests on completion of commissioning; and
  - i) erection and commissioning procedure
  - j) erection and commissioning programme.
  - k) Details of steel and cement to be used by the firm.
- 11.2 Bids containing deviations from provisions relating to the following clauses will be considered as non-responsive:
- a) Price Basis and Payments & Price Adjustment: Clause 14 & 16, Section INB, Vol.I, Conditions of Contract.

- b) Bid Guarantee: Clause 24.0, Section INB, Vol.I, Conditions of Contract.
- c) Contract Performance Guarantee: Clause 43.0, Section INB, Vol.I, Conditions of Contract.
- d) Liquidated damages: Clause 14.0, Section GCC, Vol.I, Conditions of Contract.
- e) Guarantee: Clause 15.0, Section GCC, Vol.I, Conditions of Contract.
- f) Payment: Clause 34.0, Section GCC, Vol.I, Conditions of Contract.

However, the Bidders, wishing to propose deviations to any of the above provisions, must provide in the Commercial Deviations schedule of Bid Proposal Sheet in their bid, the cost of withdrawal of such deviations. If the deviation to any of these provisions is not priced, the bid will be rejected. The evaluated cost of the bid shall include, in addition to the costs described in INB Clause 37, the cost of withdrawal of the deviations from the above provisions to make the bid fully compliant with these provisions.

At the time of Award of Contract, if so desired by the Owner, the Bidder shall withdraw these deviations listed in Commercial Deviation Schedule of Bid Proposal Sheet in their Bid at the cost of withdrawal stated by him in the bid. In case the Bidder does not withdraw the deviations proposed by him, if any, at the cost of withdrawal stated by him in the bid, his bid will be rejected and his bid security forfeited.

The Owner's determination of a bid's responsiveness is to be based on the contents of the bid itself without recourse to extrinsic evidence.

- 11.3 Should agree to (i) complete the entire scope of work covered under each package,(ii) Furnish the Guaranteed Technical particulars,(iii) Furnish the users certificate in support of successful operation for last two years,(iv) Furnish the experience certificate in support of the works (similar type) executed for the last Five years.(v) Furnish the Type test report of the equipments, which should have been conducted for last Five years.
- 11.4 Bids not covering the above entire scope of Works may be treated as incomplete and hence rejected.

## **12. BID PRICE- The quoted price shall be FIRM for all Items**

12.1 The Bidder shall quote in the appropriate schedule of Bid Form annexed, the unit cost and total cost as per the schedule of quantity. the unit rates of the goods it proposes to supply under the Contract on a base price with Firm Price basis, unless otherwise specified in the Special Conditions of Contract.

12.2 The Bidder shall also furnish the price break down in the appropriate schedules of Bid Form to indicate the following:

- i) Ex-works price of the equipment/materials(including tools and tackles etc.)

- ii) Charges for inland transportation (including port handling) and insurance for delivery of the equipment/materials upto their final destinations.
- iii) Lump sum charges towards unloading, storage, insurance, erection, testing and commissioning.
- iv) Price break up for spares in line with Clause 18.0 of this Section.
- v) Sales Tax /VAT and any other levies legally payable on the transactions between the Owner and the Bidder.
  - vi) Any other charges as per the requirement of Technical Specifications.
  - vii) Unit erection and commissioning charges as per the schedule.

### 13. ALTERNATIVE PROPOSALS

- 13.1 Based on their experience, capabilities, patented research, and development works etc., the Bidder may, in addition to a base Proposal, offer alternate Proposal(s), for reasons of economy or better performance. But in all such cases, the base Proposal shall be strictly in line with the requirements as stipulated in the Bidding Documents and only such base Proposal shall be considered for the purposes of evaluation of the Proposals. Should the bid by the successful Bidder contain such alternate Proposal then the Owner at its discretion may accept the same at the time of award of Contract.

### 14. PRICE BASIS AND PAYMENTS

- 14.1 The Bidders shall quote in their proposals the **FIRM** price in per unit basis as per annexed schedule. Any excess quantity to be executed shall be billed as per the unit rate quoted by the firm. **The price shall remain firm for the entire period and the entire work until final handing over to the owner.**

- 14.2 Bidder shall indicate bid prices in Indian Rupees only.

### 15. TAXES AND DUTIES

- 15.1 All customs duties, excise duties, sales taxes, service taxes and other levies payable by the Bidders in respect of the transaction between the Bidders and their vendors/sub-suppliers while procuring any components, sub-assemblies, raw materials and equipment, erection cost shall be included in the bid price and no claim on this behalf will be entertained by the Owner.

However, entry tax as applicable for destination site/state on all items of supply including bought out finished items (as identified in the Contract), which shall

be dispatched directly from the sub-vendors' works to Owner's site (sale-in-transit) shall not be included in the bid price. The applicable entry tax in respect of the said items of supply would be reimbursed to the Contractor separately by the Owner subject to furnishing of documentary proof/evidence.

- 15.2 **VAT**, Sales tax, excise duties, local taxes and other levies should be clearly mentioned in the price schedule.

Whenever ex-works price is quoted exclusive of Excise Duty applicable on the transaction between the Owner and the Contractor, then the due credit under the MODVAT (modified Value Added Tax), scheme as per the relevant Government policies wherever applicable, shall be taken into account by the Bidder while quoting bid price.

- 15.3 In respect of transactions solely between the owner and the contractor (for dispatches made from the contractor's works under the Supply Contract), Sales Tax, Excise Duties, local taxes and other levies shall be paid/reimbursed by the owner at the applicable rate at the time of despatch, However, in case of advancement of supplies solely at the request of the owner, taxes and duties prevailing at the time of dispatch, shall be payable by the owner.

- 15.4 Concessional Sales Tax declaration forms, as admissible, would be issued to the contractor, on request, for all items, identified in the price schedule of the bid) to be supplied directly by the contractor as well as for the items to be supplied by the sub-suppliers as sale in transit.

- 15.5 Sales Tax on goods incorporated in the Works:

The Bidder shall include the Sales Tax on Works Contract, Turnover Tax or any other similar taxes under the Sales Tax Act, as applicable in their quoted bid price and OPTCL would not bear any liability on this account. OPTCL shall, however, deduct such taxes at source as per the rules and issue TDS Certificate to the Contractor.

- 15.6 For payment/reimbursement of Sales Tax, in respect of dispatches made directly from contractor's works, invoices raised by the contractor shall be accepted as documentary evidence. Similarly, pre-numbered invoices duly signed by authorized signatory will be considered as evidence for payment of Excise Duty.

- 15.7 As regards the Income Tax, surcharge on Income Tax and other corporate taxes the Bidder shall be responsible for such payment to the concerned authorities.



## 16. PRICE ADJUSTMENT

As mentioned earlier

## 17. TIME SCHEDULE

17.1 The basic consideration and the essence of the contract shall be strict adherence to the time schedule for performing the specified works i.e(1) **Twelve Months from the date of placement of the LOI .**

17.2 The owner's requirement of completion schedule for the works is twelve months

17.3 The completion schedule as stated in the Conditions of Contract shall be one of the major factors in consideration of the bids.

17.4 The owner reserves the right to request for a change in the work schedule during pre-award discussions with successful Bidder.

17.5 The successful Bidder will be required to prepare detailed PERTG network and finalise the same with the owner as per the requirement of Clause 12.0, Section GCC.

## 18. SPARE PARTS

## 19.0 CONTRACT QUALITY ASSURANCE

19.1 The Bidder shall include in his Proposal the Quality Assurance Programme containing the overall quality management and procedures which he proposes to follow in the performance of the works during various phases as detailed in relevant clause of the General Technical Conditions.

19.2 At the time of Award of Contract, the detailed Quality Assurance Programme to be followed for the execution of the contract will be mutually discussed and agreed to and such agreed programme shall form a part of the contract.

## 20.0 INSURANCE

The Bidder's insurance liabilities pertaining to the scope of works are detailed out in clauses titled 'Insurance' in General Terms and Conditions of Contract and in Erection Conditions of Contract of this specification. Bidder's attention is specifically invited to these clauses. Bid price shall include all the cost in pursuance of fulfilling all the insurance liabilities under the Contract.

## 21.0 MAINTENANCE TOOLS AND TACKLES

The proposal shall include all special tools and tackles required for the operation and maintenance of the equipment in each equipment package. The

Bidder shall indicate all the above items in the proposal sheets in the form of a schedule given 4therein and the description and the quantity of each item. The lump sum price to be quoted by the Bidder shall include prices of these tools and tackles. These tools and tackles shall be delivered at site along with the last consignment of equipment and in no case earlier than this, unless otherwise specified in the Special Conditions of Contract and/or Technical Specifications, Vol.II.

## 22.0 **ERECTION TOOLS & TACKLES**

The Bidder, under a separate schedule, in his proposal shall include a list of all special equipment, tools and tackles etc. which he proposes to bring to site for the purpose of erection, handling, testing and commissioning including performance and guarantee tests of the equipment. If any such equipment is listed anywhere else in the proposal and not specially mentioned in the above schedule, it shall be deemed to have been included in the Bidder's proposed scope of supply.

## 23.0 **BRAND NAMES**

23.1 The specific reference in these specifications and documents to any material/equipment by brand name, make or catalogue number shall be construed as establishing standards of quality and performance and not as limiting competition. However, Bidders may offer other similar material/equipment provided they meet the specified standard, design and performance requirements. The Bidder shall furnish adequate technical information about such alternative material/equipment to enable the owner to determine its acceptability. The owner shall be the sole judge on the acceptability or otherwise of such alternative material/equipment.

23.2 The Bidder shall note that standards for workmanship, material and equipment and reference to brand names or catalogue numbers designated by the owner in its Technical Specifications are intended to be descriptive only and not restrictive. The bidder may substitute alternative standards, branch name and/or catalogue numbers in its bid, provide tha5t it demonstrates to the owner's satisfaction that the substitutions are substantially equivalent or superior to those designed in the Technical Specifications.

**24.0 BID GUARANTEE (EMD BG)**

24.1 The Bidder shall furnish, as part of its bid, bid guarantee for an amount as specified in the tender. The bid guarantee shall be valid for a period of **eight (8) calendar months** from the date of opening of bids.

24.2 The bid security is required to protect the owner against the risk of Bidder's conduct, which would warrant the guarantee forfeiture, pursuant to Clause 24.7. The bid guarantee shall be made payable to the owner without any condition whatsoever.

24.3 The bid guarantee shall be denominated in Indian Rupees only and shall be in one of the following forms:

24.4 Any bid not secured in accordance with paras 24.1 and 24.3 above will be rejected by the owner as non-responsive.

24.5 Unsuccessful Bidder's bid guarantee will be discharged/returned as promptly as possible but not later than 60 days after the expiration of the period of bid validity prescribed by the owner.

24.6 The successful Bidder's bid guarantee will be discharged upon the Bidder's executing the contract and furnishing the Performance Guarantee pursuant to Clause 43.0

24.7 The bid guarantee may be forfeited:

- a) If a Bidder withdraws its bid during the period of bid validity specified by the Bidder on the Bid Form; or
- b) In case of a successful Bidder, if the Bidder fails:
  - i) to sign the contract; or
  - ii) to furnish the Performance Guarantee.

24.8 The bid guarantee shall be submitted along with the bid in separate sealed envelope in one original and two copies. Any bid not accompanied by the required bid security in accordance with provisions of this clause will be rejected by the owner and shall not be opened.

24.9 No interest shall be payable by the owner on the above bid security.

**25.0 PERIOD OF VALIDITY OF BIDS**

**25.1 Bids shall remain valid for 6(six ) calendar months after the date of bid opening** prescribed by the owner unless otherwise specified. A bid valid for a shorter period will be rejected by the owner as non-responsive.

25.2 In exceptional circumstances the owner may solicit the bidder’s consent to an extension of the period of validity. The request and the response thereto shall be made in writing (including FAX). The bid security provided under clause 24.0 shall also be extended by the same period as the extension in the validity of the bid. A bidder may refuse the request without forfeiting his bid security. A bidder granting the request will not be required or permitted to modify its bid.

**26. SUBMISSION OF BIDS**

**26.0 FORMAT OF BID**

26.1 The bidder shall prepare three copies of the bid, clearly marking each “Original Bid” and “Copy of bid”, as appropriate. In the event of any discrepancy between them, the original shall govern.

26.2 The original and all copies of the bid shall be typed or written in indelible ink and shall be signed by the Bidder or a person or persons duly authorized to bind the Bidder to the contract. The letter of authorization shall be indicated by written Power of Attorney accompanying the bid. All pages of the bid, except for un-amended printed literature, shall be initialed by the person or persons signing the bid.

26.3 The Bidder’s must submit the qualifying data in five copies, as required in this Instruction to Bidders in a separate envelope sealed and enclosed in the envelope submitting proposals, superscribed as under:

**QUALIFYING DATA FOR THE SUPPLY AND ERECTION OF**

---

(Name of the Package)

---

(Specification Number)

26.4 The bid shall contain no interlineations, erasures or overwriting except as necessary to correct errors made by the bidder, in which case such corrections shall be initialed by the person or persons signing the bid.

26.5 Price bid shall be sealed in a separate cover duly marked as Price Bid which shall only be opened, once the bidder is found to be techno commercially suitable.

26.6 The Bid Security to be separately submitted in the tender with sealed envelope marked as **BID SECURITY**.

**26.7 All the GTPs of equipment ,commercial requirements, commercial formats, all technical literatures and all the annexures for technical and commercial specification shall be duly filled up as per the most advanced technology available for equipment and to be submitted as the techno commercial bid in the tender**

#### 27.0 **SIGNATURE OF BIDS**

27.1 The bid must contain the name, residence and place of business of the person or persons making the bid and must be signed and sealed by the bidder with his usual signature. The names of all persons signing should also be typed or printed below the signature.

27.2 Bid by a partnership must be furnished with full names of all partners and be signed with the partnership name, followed by the signature(s) and designation(s) of the authorized partner(s) or other authorized representative(s).

27.3 Bids by Corporation/Company must be signed with the legal name of the Corporation/Company by the President, Managing Director or by the Secretary or other person or persons authorized to bid on behalf of such Corporation/Company in the matter.

27.4 A bid by a person who affixes to his signature the word 'President', 'Managing Director', 'Secretary', 'Agent' or other designation without disclosing his principal will be rejected.

27.5 Satisfactory evidence of authority of the person signing on behalf of the Bidder shall be furnished with the bid.

27.6 The Bidder's name stated on the proposal shall be the exact legal name of the firm.

27.7 Bids not conforming to the above requirements of signing may be disqualified.

#### 28.0 **SEALING AND MARKING OF BIDS**

28.1 The Bidders shall seal the original and each copy of the bid in an inner and an outer envelope, duly marking the envelopes “Original” and “Copy”.

28.2 The inner and outer envelopes shall:

(a) be addressed to the Owner at the following address:

**Senior General Manager, Central Procurement Cell, At/ PO- Bhoi  
Nagar, Bhubaneswar**

(b) bear the name of package, the specification number, and the words “**DO NOT OPEN BEFORE.....**”

28.3 The inner envelope shall indicate the name and address of the Bidder to enable the bid to be returned unopened in case it is declared “late” or “rejected”.

28.4 If the outer envelope is not sealed and marked as required by para 28.2 above, the owner will assume no responsibility for the bid’s misplacement or premature opening.

28.5 The Bid Guarantee must be submitted in a separate sealed envelope.

28.6 Bids must be received by the owner at the address specified under para 28.2, not later than the time and date mentioned in the Invitation to Bid.

28.7 The owner may, at its discretion, extend this deadline for the submission of bids by amending the Bidding Document, in which case all rights and obligations of the owner and bidders previously subject to the deadline will thereafter be subject to the deadline as extended.

## 29.0 **DEADLINE FOR SUBMISSION OF BIDS**

29.1 The Bidders have the option of sending the bid by registered post or submitting the bid in person. Bids submitted by telex/telegram will not be accepted. No request from any Bidder to the owner to collect the proposals from airlines, cargo agents etc. shall be entertained by the owner.

## 30.0 **LATE BIDS**

30.1 Any bid received by the owner after the time and date fixed or extended for submission of bids prescribed by the owner, will be rejected and/or returned unopened to the Bidder.

## **31.0 MODIFICATION AND WITHDRAWAL OF BIDS**

- 31.1 The Bidder may modify or withdraw its bid after the bid's submission provided that written notice of the modification or withdrawal is received by the owner prior to the deadline prescribed for submission of bids.
- 31.2 The Bidder's modification or withdrawal notice shall be prepared, sealed, marked and dispatched in accordance with the provisions of Clause 28.0.
- 31.3 No bid may be modified subsequent to the deadline for submission of bids.
- 31.4 No bid may be withdrawn in the interval between the deadline for submission of bids and the expiration of the period of bid validity specified by the Bidder on the Bid Form. Withdrawal/modification of a bid during this interval may result in the Bidder's forfeiture of its bid security.

## **32.0 INFORMATION REQUIRED WITH THE PROPOSAL**

- 32.1 The bids must clearly indicate the name of the manufacturer, the type of model of each principal item of equipment proposed to be furnished and erected. The bid should also contain drawings and descriptive materials indicating general dimensions, materials from which the parts are manufactured, principles of operation, the extent of pre-assembly involved, major construction equipment proposed to be deployed, method of erection and the proposed erection organizational structure.
- 32.2 The above information shall be provided by the Bidder in the form of separate sheets, drawings, catalogues, etc. in five copies.
- 32.3 Any bid not containing sufficient descriptive material to describe accurately the equipment proposed may be treated as incomplete and hence rejected. Such descriptive materials and drawings submitted by the Bidder will be retained by the owner. Any major departure from these drawings and descriptive material submitted will not be permitted during the execution of the contract without specific written permission of the owner.
- 32.4 Oral statements made by the Bidder at any time regarding quality, quantity or arrangement of the equipment or any other matter will not be considered.
- 32.5 Standard catalogue pages and other documents of the Bidder may be used in the bid to provide additional information and data as deemed necessary by the Bidder.

32.6 The Bidder, along with his proposal, shall submit a list of recommended erection equipment and materials which will be required for the purpose of erection of equipment and materials supplied under the contract.

32.7 In case the 'Proposal' information contradicts specification requirements, the specification requirements will govern, unless otherwise brought out clearly in the Technical/Commercial Deviations Schedule.

### **33. BID OPENING AND EVALUATION**

#### **33.0 OPENING OF BIDS BY OWNER**

33.1 The owner will open bids in the presence of Bidders' representatives (upto 2 persons) who choose to attend at the date and time for opening of bids in the Invitation to Bid or in case any extension has been given thereto, on the extended bid opening date and time notified to all the Bidders who have purchased the Bidding Document. The Bidders' representatives who are present shall sign in a register evidencing their attendance.

33.2 The Bidders' names, bid prices, modifications, bid withdrawals and the presence or absence of the requisite bid guarantee and such other details as the owner, at its discretion, may consider appropriate will be announced at the opening.

33.3 No electronic recording devices will be permitted during bid opening.

#### **34.0 CLARIFICATION OF BIDS**

34. To assist in the examination, evaluation and comparison of bids of owner may, at its discretion, ask the Bidder for a clarification of its bid. The request for clarification and the response shall be in writing and no change in the price or substance of the bid shall be sought, offered or permitted.

#### **35.0 PRELIMINARY EXAMINATION**

35.1 The owner will examine the bids to determine whether they are complete, whether any computational errors have been made, whether required sureties have been furnished, whether the documents have been properly signed, and whether the bids are generally in order.

#### **35.2 Arithmetical errors will be rectified on the following basis:**

If there is a discrepancy between the unit price and the total price that is obtained by multiplying the unit price and quantity, the unit price shall prevail



and total price shall be corrected. If there is a discrepancy between words and figures, the amount in words will prevail. If the Bidder does not accept the correction of the errors as above, his Bid will be rejected and the amount of Bid guarantee forfeited.

The Bidder should ensure that the prices furnished in various price schedules are consistent with each other. In case of any inconsistency in the prices furnished in the specified price schedules to be identified in Bid Form for this purpose, the owner shall be entitled to consider the highest price for the purpose of evaluation and for the purpose of award of the contract use the lowest of the prices in these schedules.

35.3 Prior to the detailed evaluation, the owner will determine the substantial responsiveness of each bid to the Bidding Document. For purpose of this clause, a substantially responsive bid is one which conforms to all the terms and conditions of the Bidding Document without material deviations. A material deviation is one which affects in any way the prices, quality, quantity or delivery period of the equipment or which limits in any way the responsibilities or liabilities of the Bidder of any right of the owner as required in these specifications and documents. The owner's determination of a bid's responsiveness shall be based on the contents of the bid itself without recourse to extrinsic evidence.

35.4A bid determined is not substantially responsive will be rejected by the owner and may not subsequently be made responsive by the Bidder by correction of the non-conformity.

35.5The owner may waive any minor informality or non-conformity or irregularity in a bid which does not constitute a material deviation, provided such waiver does not prejudice or affect the relative ranking of any Bidder.

### 36.0 **DEFINITIONS AND MEANINGS**

For the purpose of evaluation and comparison of bids, the following meanings and definitions will apply:-

- a) **'Bid Price'** shall mean the base price quoted by each Bidder in his proposal for the complete scope of works.
- b) **'Differential Price'** shall mean the summation of the equalizing elements of price for parameter differential or deficiencies in the equipment and services determined from the Bidder's Proposal.

- c) **‘Cost Compensation for Deviations’** shall mean the Rupee value of deviations from the Bidding Documents as determined from the Bidder’s Proposal.
- d) **‘Evaluated Bid Price’** shall be the summation of ‘Bid Price’, ‘Differential Price’ and ‘Cost Compensation for deviations’.

36.1 Calculation of Differential Price and Cost Compensation for Deviations.

36.1.1 The Differential Price to be added to the Bid Price of each bid during evaluation and comparison shall be derived as under:

Differential Price (DP) =  $n_1F_1 + n_2F_2 + \dots + n_nF_n$  where  $F_1, F_2, \dots, F_n$  are the various factors in Indian Rupees per unit of parameter differential or deficiency in the equipment and services offered as stipulated in these specifications;  $n_1, n_2, \dots, n_n$  are the respective parameter differential or deficiency in the corresponding units to be determined from the Bidder’s Proposal. The above factors and corresponding units of parameter differential are brought out in the technical Specifications and/or Special Conditions of Contract.

36.1.2 Deviations from the Bidding Documents in so far as practicable, will be converted to Rupee value (D) and added to the bid price to compensate for the deviation from the Bidding Document while evaluating the bids. In determining the Rupee value of the deviations the owner will use parameters consistent with those specified in the specifications and documents and/or other information as necessary and available to the owner.

37.0 **COMPARISON OF BIDS**

37.1 The bids shall be compared on the basis of total price taking into account the unit cost and the schedule of quantities.

37.2 For comparison purposes all the evaluated bid prices shall be in Indian Rupees as under:-

$$W = M + DP + D$$

Where

$$W = \text{Total Comparison Price}$$

- M = Bid price in Indian Rupees (Ex-works value of equipment + components of erection cost + mandatory spares, and other components, if any).
- DP = Differential price in Indian Rupees calculated according to para 36.1.1 above.
- D = Cost compensation for deviations calculated according to para 36.1.2 above.

37.3 All evaluated bid prices of all the Bidders shall be compared among themselves to determine the lowest evaluated bid and, as a result of this comparison, the lowest Bid will be selected for the award of the Contract.

### 38.0 **CONTACTING THE OWNER**

Bids shall be deemed to be under consideration immediately after they are opened and until such time official intimation of award/rejection is made by the owner to the Bidders. While the bids are under consideration, Bidders and/or their representatives or other interested parties are advised to refrain from contacting by any means, the owner and/or his employees/representatives on matters related to the bids under consideration. The owner, if necessary, will obtain clarifications on the bids by requesting for such information from any or all the Bidders, either in writing or through personal contacts as may be necessary. Bidders will not be permitted to change the substance of the bids after the bids have been opened.

### 39.0 **AWARD CRITERIA**

39.1 The owner will award the contract to the successful bidder whose bid has been determined to be substantially responsive and has been determined as the lowest evaluated bid, provided further that the Bidder is determined to be qualified to perform the contract satisfactorily. The owner shall be the sole judge in this regard.

39.2 In case of Supply Contract, the award shall be on the basis of FOR destination (site) basis.

39. Further, the owner reserves the right to award separate contracts to two or more parties in line with the terms and conditions specified in the accompanying Technical Specifications for both supply and erection.

## **40.0 PROCEDURE FOR EVALUATION OF THE PRICE BID.**

### **Evaluation of Price Bid**

The Bid Price quoted by bidder shall be arrived in the following manner.

#### **40.1 Arithmetical Correction:**

- (i) The price of all such items(s) against which bidder has not quoted rates/amount (viz. items left blank or against which-'is indicated) in the schedule will be deemed to have been included in other item(s) total quoted bid price.
- (ii) The Bidder should ensure that the unit prices furnished in various price schedules are consistent with each other. In case of any inconsistency in the prices furnished in the specified price schedules to be identified in Bid Form for this purpose, the OPTCL shall be entitled to consider the highest price for the purpose of evaluation and for the purpose of award of the Contract use the lowest of the prices in these schedules. The prices quoted by the Bidders shall be checked for arithmetic correction, if any, based on rate and amount filled by the Bidder in the respective price schedule. If some discrepancies are found between the rate/ amount given in words and figures, the total amount shall be corrected as per the following procedure, which shall be binding upon the Bidder.
  - (a) If there is a discrepancy between unit price and the total price that is obtained by multiplying the unit price and quantity, the unit price shall prevail and total price shall be corrected.
  - (b) If there is a discrepancy between words and figures, the amount in words will prevail. If a Bidder does not accept the above correction of errors as above, his bid will be rejected and the amount of Bid Guarantee shall be forfeited.

40.2 To arrive at the evaluated prices, loading / adjustment on total quoted prices for the entire scope of supplies/works (including mandatory spares but excluding optional/recommended spares, if any), wherever applicable, shall be done as per following:

- i) The prices quoted by the Bidders who have retained the deviations to the terms and conditions, if any, which are otherwise considered acceptable and can be quantified shall be loaded.
- ii) The prices quoted by the Bidders who have retained the deviations, if any, which are otherwise considered unacceptable by the Owner and

have quoted a “Cost of Withdrawal of Deviation”, shall be loaded by the amount quoted towards “Cost of Withdrawal of Deviation.

- 40.3 Optional items shall not be considered for the purpose of arriving at the total cost unless specifically mentioned. However, in case the rates quoted by the selected Bidder for optional items are considered high, the same shall be negotiated.
- 40.4 Prices received in soft copies shall be used for Tabulation / Price Bid Comparison. In the event of any discrepancy between prices in soft copy & hard copy, the prices given in hard copy shall govern.
- 40.5 The bidder submit all the details asked for with their bid in Part-I. However, Owner(OPTCL) may give opportunity to the bidders to submit missing details or clarifications within the stipulated time. In case these are not submitted within stipulated time, offer of the bidder will be evaluated based on available details. The same shall be considered, if found adequate or else shall be rejected.
- 40.6 Bids shall be evaluated and compared on the basis of lump sum price for the entire scope of work under the package. The lump sum price shall include.
- (i) FOR destination (site) price of equipment/ materials, including type test and mandatory spares (if any).
  - (ii) Charges for erection, which shall include unloading, handling, storage, insurance, erection, testing & commissioning of the complete sub-station, associated transmission line and associated system including civil works.

All evaluated bid prices of all the Bidders shall be compared among themselves to determine the lowest evaluated bid and, as a result of this comparison, the lowest Bid will be selected for the award of the Contract.

**40.7 Bid Evaluation Process to be Confidential**

Information related to the examination, clarification, evaluation and comparison of bids and recommendations for award of contract shall not be disclosed to Bidder or other person not officially concerned with such process. Any effort by Bidder to influence Owner’s(OPTCL) processing of bidding or award decisions may result in rejection of such Bidder’s Bid.

**41.0 OWNER’S RIGHT TO ACCEPT ANY BID AND TO REJECT ANY OR ALL BIDS.**

41.1 **The owner reserves the right to accept or reject any bid, and to annul the bidding process and reject all bids at any time prior to award of contract, without thereby incurring any liability to the affected Bidder or Bidders or any obligation to inform the affected Bidder or Bidders of the grounds for the owner's action.**

#### 42.0 **NOTIFICATION OF AWARD**

42.1 Prior to the expiration of the period of bid validity and extended validity period, if any, the owner will notify the successful Bidder in writing by registered letter or by cable or fax, to be confirmed in writing by registered letter, that its bid has been accepted.

42.1 The notification of award will constitute the formation of the Contract.

42.2 Upon the successful Bidder's furnishing of contract performance guarantee pursuant to clause 43.0 the owner will promptly notify each unsuccessful Bidder and will discharge its bid security, pursuant to clause 24.0.

#### 43.0 **SIGNING OF CONTRACT**

43.1 At the same time as the owner notifies the successful bidder that its bid has been accepted, the owner will send the bidder the detailed Letter of Award, incorporating all agreements between the parties.

43.2 Within 15 days of receipt of the detailed Letter of Award, the successful Bidder shall sign and date the same and return it to the owner.

43.3 The Bidder will prepare the Contract Agreement as per the proforma to be supplied by OPTCL while awarding the and the same will be signed within 20 (Twenty) days of Notification of Award.

#### 44.0 **CONTRACT PERFORMANCE GUARANTEE.**

44.1 As a Contract Performance Security, the successful Bidder, to whom the work is awarded, shall be required to furnish a Performance Guarantee from (a) a Public Sector Bank or b) a Scheduled Indian Bank having paid up capital (net of any accumulated losses) or Rs.100 crores or above (the latest annual report of the Bank should support compliance of capital adequacy ratio requirement) or (c) any foreign Bank or subsidiary of a foreign Bank with overall international corporate rating or rating of long term debt not less than A-(A minus) or equivalent by reputed rating agency, in the form attached as Annexure in favour of the owner. The guarantee amount shall be equal to ten percent (10%) of the Contract Price and it shall guarantee the faithful performance of the Contract in accordance with the terms and conditions specified in these documents and

specifications. The guarantee shall be valid upto 90 days after the end of Warranty Period and shall be furnished within 30 days of issuance of the LOI.

44.2 The Performance Guarantee shall cover additionally the following guarantees to the owner:

- a) The successful Bidder guarantees the successful and satisfactory operation of the equipment furnished and erected under the contract, as per the specifications and documents including the erection work.
- b) The successful Bidder further guarantees that the equipment provided/ and erection work done and installed by him shall be free from all defects in design, material and workmanship and shall upon written notice from the owner fully remedy free of expenses to the owner such defects as developed under the normal use of the said equipment within the period of guarantee specified in the relevant clause of the General Terms and Conditions in this Vol.I/Special Conditions of Contract.

44.3 The Contract Performance Guarantee is intended to secure the performance of the entire Contract. However, it is not to be construed as limiting the damages under clause entitled “Equipment and erection Performance Guarantee” in Technical Specifications, Vol.II and damages stipulated in other clauses in the Bid documents.

44.4 The Performance Guarantee will be returned to the Contractor without any interest at the end of guarantee period, unless otherwise specified in the Conditions of Contract.

**END OF SECTION – INB**

## **SECTION – GCC**

# **GENERAL TERMS AND CONDITIONS OF CONTRACT**



# GENERAL TERMS & CONDITIONS OF CONTRACT

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# SECTION – GCC

## GENERAL TERMS & CONDITIONS OF CONTRACT

### A. INTRODUCTION

#### 1.0 DEFINITION OF TERMS

- 1.1 The ‘Contract’ means the agreement entered into between the owner and the Contractor as per the Contract Agreement signed by the parties, including all attachments and appendices thereto and all documents incorporated by reference therein.
- 1.2 ‘Owner’ shall mean the ORISSA POWER TRANSMISSION CORPORATION Ltd Bhubaneswar and shall include its legal representatives, successors and assigns.
- 1.3 ‘Contractor’ or ‘Manufacturer’ shall mean the Bidder whose bid will be accepted by the owner for the award of the works and shall include such successful Bidder’s legal representatives, successors and permitted assigns.
- 1.4 ‘Sub-Contractor’ shall mean the person named in the Contract for any part of the works or any person to whom any part of the contract has been sublet by the Contractor with the consent in writing of the Engineer and will include the legal representatives, successors and permitted assigns of such person
- 1.5 ‘Engineer’ shall mean the officer appointed in writing by the owner to act as Engineer from time to time for the purpose of the Contract **.For this tenders Chief General Manager (EHT O&M) OPTCL or their authorized representatives are the Engineer in Charge.**
- 1.6 ‘Consulting Engineer’/’Consultant’ shall mean any firm or person duly appointed as such from time to time by the owner.
- 1.7 The terms ‘Equipment’, ‘Stores’ and ‘Materials’ shall mean and include equipment, stores and materials to be provided by the Contractor under the Contract.

- 1.8 'Works' shall mean and include the furnishing of equipment, labour and services, as per the Specifications and complete erection, testing and putting into satisfactory operation including all transportation, handling, unloading and storage at the Site as defined in the contract.
- 1.9 'Specifications' shall mean the Specifications and Bidding Document forming a part of the Contract and such other schedules and drawings as may be mutually agreed upon.
- 1.10 'Site' shall mean and include the land and other places on, into or through which the works and the related facilities are to be erected or installed and any adjacent land, paths, street or reservoir which may be allocated or used by the owner or contractor in the performance of the contract.
- 1.11 The term 'Contract Price' shall mean the lump sum price quoted by the contractor in his bid with additions and/or deletions as may be agreed and incorporated in the Letter of Award, for the entire scope of works.
- 1.12 The term 'Equipment Portion' of the contract price shall mean the ex-works value of the equipment.
- 1.13 The term 'Erection Portion' of the contract price shall mean the value of field activities of the works including erection, testing and putting into satisfactory operation including successful completion of performance and guarantee tests to be performed at Site by the Contractor including cost of insurances.
- 1.14 'Manufacturer's Works' or 'Contractor's Works', shall mean the place of work used by the manufacturer, the Contractor, their collaborators/associates or Sub-Contractors for the performance of the Contract.
- 1.15 'Inspector' shall mean the owner or any person nominated by the owner from time to time, to inspect the equipment; stores or works under the contract and/or the duly authorized representative of the owner.
- 1.16 'Notice of Award of Contract'/'Letter of Award'/'Telex of Award' shall mean the official notice issued by the owner notifying the contractor that his bid has been accepted.
- 1.17 'Date of Contract' shall mean the date on which Notice of Award of Contract/Letter of Award has been issued.
- 1.18 'Month' shall mean the calendar month. 'Day' or 'Days' unless herein otherwise expressly defined shall mean calendar day or days of 24 hours each.

A 'Week' shall mean continuous period of seven(7) days.

- 1.19 'Writing' shall include any manuscript, type written or printed statement, under or over signature and/or seal as the case may be.
- 1.20 When the words 'Approved', 'Subject to Approval', 'Satisfactory', 'Equal to', 'Proper', 'Requested', 'As Directed', 'Where Directed', 'When Directed', 'Determined by', 'Accepted', 'Permitted', or words and phrases of like importance are used the approval, judgement, direction etc. is understood to be a function of the Owner/Engineer.
- 1.21 test on completion shall mean such tests as prescribed in the Contract to be performed by the Contractor before the work is taken over by the owner.
- 1.22 'Start up' shall mean that time period required to bring the equipment covered under the Contract from an inactive condition, when construction is essentially complete, to the state ready for trial operation. The start up period shall include preliminary inspection and check out of equipment and supporting sub-system, initial operation of the complete equipment covered under the Contract to obtain necessary pre-trial operation data, perform calibration and corrective action, shut down, inspection and adjustment prior to the trial operation period.
- 1.23 'Initial Operation' shall mean the first integral operation of the complete equipment covered under the Contract with the sub-system and supporting equipment in service or available for service.
- 1.24 'Trial Operation', 'Reliability Test', 'Trial Run', 'Completion Test', shall mean the extended period of time after the start up period. During this trial operation period the unit shall be operated over the full load range. The length of trial operation shall be as determined by the Engineer, unless otherwise specified elsewhere in the Contract.
- 1.25 'Performance and Guarantee Tests' shall mean all operational checks and tests required to determine and demonstrate capacity, efficiency, and operating characteristics as specified in the Contract Documents.
- 1.26 The term 'Final Acceptance'/'Taking Over' shall mean the Owner's written acceptance of the works performed under the contract, after successful commissioning/completion of performance and guarantee tests, as specified in the accompanying Technical Specifications or otherwise agreed in the contract.
- 1.27 'Commercial Operation' shall mean the condition of operation in which the complete equipment covered under the Contract is officially declared by the owner to be available for continuous operation at different loads upto and including rated capacity. Such declaration by the owner, however, shall not relieve or prejudice the Contractor of any of his obligations under the Contract.

- 1.28 'Guarantee Period'/'Maintenance Period' shall mean the period during which the Contractor shall remain liable for repair or replacement of any defective part of the works performed under the Contract.
- 1.29 'Latent Defects' shall mean such defects caused by faulty designs, materials or workmanship which cannot be detected during inspection, testing etc. based on the technology available for carrying out such tests.
- 1.30 'Drawing', 'Plans' shall mean all:
- a) Drawings furnished by the owner/consultant as a basis of Bid/Proposals.
  - b) Supplementary drawings furnished by the owner/consultant to clarify and to define in greater detail the intent of the contract.
  - c) Drawings submitted by the contractor with his bid provided such drawings are acceptable to the owner/consultant.
  - d) Drawings furnished by the owner/consultant to the contractor during the progress of the work; and
  - e) Engineering data and drawings submitted by the contractor during the progress of the work provided such drawings are acceptable to the Engineer/Owner.
- 1.31 'Codes' shall mean the following including the latest amendments and/or replacements, if any:
- a) Indian Electricity Act, 1905 and Rules and Regulations made thereunder.
  - b) Indian Factory Act, 1948 and Rules and Regulations made thereunder.
  - c) Indian Explosives Act, 1884 and Rules and Regulations made thereunder.
  - d) Indian Petroleum Act, 1934 and Rules and Regulations made thereunder.
  - e) ASME Test Codes.
  - f) AIEE Test Codes
  - g) American Society of Materials Testing Codes.
  - h) Standards of the Indian Standards Institution.

- i) Other Internationally approved standards and/or rules and regulations touching the subject matter of the contract.
- 1.32 Words imparting the singular only shall also include the plural and vice-versa where the context so requires.
- 1.33 Words imparting 'Person' shall include firms, companies, corporations and associations or bodies of individuals, whether incorporated or not.
- 1.34 Terms and expressions not herein defined shall have the same meaning as are assigned to them in the Indian Sale of Goods Act (1930), failing that in the Indian Contract Act (1872) and failing that in the General Clauses Act (1897) including amendments thereof, if any.

The various Acts and Regulations are normally available for sale from the following addresses:

- i) Deputy Controller  
Publication Department  
Government of INDIA  
Civil Lines,  
DELHI-110 006.
- ii) Deptt. of Publication  
Government of INDIA  
Kitab Mahal  
Unit No.21, Emporia Building,  
Baba Kharak Singh Marg,  
NEW DELHI-110 001.

OR

With leading authorized Government of INDIA Book – Sellers.

- 1.35 In addition to the above the following definitions shall also apply.
- a) 'All equipment and materials' to be supplied shall also mean 'Goods'.
  - b) 'Constructed' shall also mean 'erected and installed'.
  - c) 'Contract Performance Guarantee' shall also mean 'Contract Performance Security'.



## 2.0 APPLICATION

These General Conditions shall apply to the extent that they are not superseded by provisions in other parts of the Contract.

## 3.0 STANDARDS

The goods supplied under this Contract shall conform to the standards mentioned in the Technical Specifications, and, when no applicable standard is mentioned, to the authoritative standard appropriate to the goods and such standards shall be the latest issued by the concerned institution.

## 4.0 LANGUAGE AND MEASURES

All documents pertaining to the contract including specifications, schedules, notices, correspondences, operating and maintenance instructions, drawings or any other writing shall be written in English language. The Metric System of measurement shall be used exclusively in the contract.

## 5.0 CONTRACT DOCUMENTS

5.1 The term Contract Documents shall mean and include the following which shall be deemed to form an integral part of the Contract:

- a) Invitation to Bid including letter forwarding the Bidding Documents, Instructions to Bidders, General Terms and Conditions of Contract and all other documents included and the Special Conditions of Contract.
- b) Specifications of the equipment to be furnished and erected under the contract as brought out in the accompanying Technical Specifications.
- c) Contractor's Bid Proposal and the documents attached there to including the letters of clarifications thereto between the Contractor and the Owner/Consultant prior to the Award of Contract except to the extent of repugnancy.
- d) All the materials, literature, data and information of any sort given by the Contractor along with his bid, subject to the approval of the owner/consultant.
- e) Letter of Award and any agreed variations of the conditions of the documents and special terms and conditions of contract, if any.

5.2 In the event of any conflict between the above-mentioned documents the matter shall be referred to the Engineer whose decision shall be considered as final and binding upon the parties.

## 6.0 **USE OF CONTRACT DOCUMENTS AND INFORMATION**

6.1 The contractor shall not, without the owner's prior written consent, disclose the contract, or any provision thereof, or any specification, plan, drawing, pattern, sample or information furnished by or on behalf of the owner in connection therewith, to any person other than a person employed by the contractor in the performance of the contract. Disclosure to any such employed person shall be made in confidence and shall extend only so far as may be necessary for the purpose of such performance.

6.2 The contractor shall not, without the owner's prior written consent, make use of any document or information enumerated in various contract documents except for the purpose of performing the contract.

6.3 The contractor shall not communicate or use in advertising, publicity, sales releases or in any other medium, photographs or other reproduction of the works under this contract, or descriptions of the site, dimensions, quantity, quality or other information, concerning the works unless prior written permission has been obtained from the owner.

6.4 Any document, other than the contract itself, enumerated in various contract documents shall remain the property of the owner and shall be returned (in all copies) to the owner on completion of the contractor's performance under the contract if so required by the owner.

## 7.0 **CONSTRUCTION OF THE CONTRACT**

7.1 Notwithstanding anything stated elsewhere in the bid documents, the contract to be entered into will be treated as a divisible supply and erection contract.

Award shall be placed on the successful bidder as follows:

- i) First Contract: For Ex-works supply of all equipment and materials.
- ii) Second Contract: For providing all other services like inland transportation, insurance for delivery at site, unloading, storage, handling at site, installation, testing and commissioning including performance testing in respect of all the equipment supplied under the "First Contract" and any other services specified in the Bid Documents.

- iii) Both these contracts will contain interlinking cross-fall breach clause specifying that breach of one contract will constitute breach of the other contract.
- 7.2 In case of divisible supply and erection contract, or where the owner hands over his equipment to the contractor for executing, then the contractor shall at the time of taking delivery of the equipment/dispatch documents be required to execute an Indemnity Bond in favour of the owner in the form acceptable to OPTCL for keeping the equipment in safe custody and to utilize the same exclusively for the purpose of the said contract. Samples of proformae for the Indemnity Bond are enclosed as Annexure-VII & VIII to this Vol.I.
- 7.3 The contract shall in all respects be construed and governed according to Indian Laws.
- 7.4 It is clearly understood that the total consideration for the contract(s) has been broken up into various components only for the convenience of payment of advance under the contract(s) and for the measurement of deviations or modifications under the contract(s).
- 8.0 **JURISDICTION OF CONTRACT**
- 8.1 The laws applicable to the contract shall be the laws in force in ORISSA. The courts of Cuttack/ Bhubaneswar shall have exclusive jurisdiction in all matters arising under this contract.
- 9.0 **MANNER OF EXECUTION OF CONTRACT**
- 9.1 The owner, after the issue of the Letter of Award to the Contractor, will send one copy of the final agreement to the Contractor for his scrutiny and approval.
- 9.2 The Agreement, unless otherwise agreed to, shall be signed within 60 days of the acceptance of the Letter of Award, at the office of the owner at Bhubaneswar, on a date and time to be mutually agreed. The contractor shall provide for signing of the contract, performance guarantee in six copies, appropriate power of attorney and other requisite materials. In case the contract is to be signed beyond the stipulated time, the bid guarantee submitted with the proposal will have to be extended accordingly.
- 9.3 The Agreement will be signed in six originals and the contractor shall be provided with one signed original and the rest will be retained by the owner.

9.4 The contractor shall provide free of cost to the owner all the Engineering data, drawings, and descriptive materials submitted with the bid, in at least six(6) copies to form a part of the contract immediately after issue of Letter of Award.

9.5 Subsequent to signing of the contract, the contractor at his own cost shall provide the owner with at least thirty(30) true copies of agreement within thirty(30) days after the signing of the contract.

#### **10.0 ENFORCEMENT OF TERMS**

10.1 The failure of either party to enforce at any time any of the provisions of this contract or any rights in respect thereto or to exercise any option therein provided, shall in no way be construed to be a waiver of such provisions, rights or options or in any way to affect the validity of the contract. The exercise by either party of any of its rights herein shall not preclude or prejudice either party from exercising the same or any other right it may have under the contract.

#### **11.0 COMPLETION OF CONTRACT**

11.1 Unless otherwise terminated under the provisions of any other relevant clause, this contract shall be deemed to have been completed on the expiry of the guarantee period as provided for under the clause entitled 'Guarantee' in this section.

#### **12.0 TIME – TIME IS THE ESSENCE OF CONTRACT**

12.1 The time and the date of completion of the contract as stipulated in the contract by the owner without or with modifications, if any, and so incorporated in the Letter of Award, shall be deemed to be the essence of the contract. The contractor shall so organize his resources and perform his work as to complete it not later than the date agreed to.

12.2 The contractor shall submit a detailed PERT network/bar chart within the time frame agreed consisting of adequate number of activities covering various key phases of the work such as design, procurement, manufacturing, shipment and field erection activities within fifteen (15) days of the date of Notification of Award. This network shall also indicate the interface facilities to be provided by the owner and the dates by which such facilities are needed. The contractor shall discuss the network so submitted with the owner and the agreed network shall form part of the contract documents. As provided in the clause of Terms of Payment in this Section, finalisation of the network/bar charts will be pre-condition to release of any initial advance to the contractor. During the performance of the contract, if in the opinion

of the Engineer, proper progress is not maintained, suitable changes shall be made in the contractor's operations to ensure proper progress without any cost implication to the owner. The interface facilities to be provided by the owner in accordance with the agreed network shall also be review while reviewing the progress of the contractor.

12.3 Based on the above agreed network/bar chart fortnightly reports shall be submitted by the contractor as directed by the Engineer.

12.4 Subsequent to the finalisation of the network, the contractor shall make available to the Engineer a detailed manufacturing programme in line with the agreed contract network. Such manufacturing programme shall be reviewed, updated and submitted to the Engineer once every two months thereafter.

12.5 The above bar charts/manufacturing programme shall be compatible with the owner's computer environment and furnished to the owner on such media as may be desired by the owner.

### 13.0 **EFFECTIVENESS OF CONTRACT**

The contract shall be considered as having come into force from the date of the notification of award unless otherwise provided in the notification of award.

### 14.0 **PENALTY**

#### 14.1 **For Equipment Supply/Erection Portion**

14.1.1 If the contractor fails to successfully complete the commissioning within the time fixed under the contract, the contractor shall pay to the owner as penalty a sum specified for each specified period of delay. The details of such Penalty are brought out in the accompanying Special Conditions of Contract.

14.1.2 Equipment and materials will be deemed to have been delivered only when all its components, parts are also delivered. If certain components are not delivered in time the equipment and materials will be considered as delayed until such time the missing parts are also delivered.

14.1.3 The total amount of penalty for delay under the contract will be subject to a maximum of 5% of the contract price.

#### 14.2 **For Spares**

14.2.1 Unless otherwise specified in the Special Conditions of Contract, the Penalty for delay in supply of spares, beyond the dates stipulated under Clause

36.2, Section GCC shall be ½% (half per cent) of the price of undelivered spares, per week or part thereof.

14.2.2 The total amount of Penalty for delay under the contract will be subject to a maximum of ten per cent (10%) of the value of spares ordered unless otherwise specifically mentioned in special Conditions of Contract.

14.3 Penalty for not meeting performance guarantee during the performance and guarantee tests shall be assessed and recovered from the contractor as detailed in Technical Specifications/Special Conditions of Contract. Such Penalty shall be without any limitation whatsoever and shall be in addition to Penalty, if any, payable under any other clause of Conditions of Contract.

## 15.0 **GUARANTEE**

15.1 The contractor shall warrant that the equipment will be new, unused and in accordance with the contract documents and free from defects in material and workmanship for a period of twelve(12) calendar months commencing immediately upon the satisfactory commissioning. The contractor's liability shall be limited to the replacement of any defective parts in the equipment of his own manufacture or those of his Sub-Contractors under normal use and arising solely from faulty design, materials and/or workmanship provided always that such defective parts are repairable at the site and are not in meantime essential in the commercial use of the equipment. Such replaced/defective parts shall be returned to the contractor unless otherwise arranged. No repairs or replacement shall normally be carried out by the Engineer when the equipment is under the supervision of the contractor's supervisory Engineer.

15.2 In the event of any emergency where in the judgement of the Engineer, delay would cause serious loss or damages, repairs or adjustment may be made by the Engineer or a third party chosen by the Engineer without advance notice to the contractor and the cost of such work shall be paid by the contractor. In the event such action is taken by the Engineer, the contractor will be notified promptly and he shall assist wherever possible in making necessary corrections. This shall not relieve the contractor of his liabilities under the terms and conditions of the contract.

15.3 If it becomes necessary for the contractor to replace or renew any defective portions of the works the provision of this clause shall apply to portion of the works so replaced or renewed until the expiry of twelve(12) months from the date of such replacement or renewal. If any defects are not remedied within a reasonable time, the Engineer may proceed to do the work at the contractor's risk and cost but

without prejudice to any other rights which the owner may have against the contractor in respect of such defects.

- 15.4 The repaired or new parts will be furnished and erected free of cost by the contractor. If any repair is carried out on his behalf at the site, the contractor shall bear the cost of such repairs.
- 15.5 The cost of any special or general overhaul rendered necessary during the maintenance period due to defects in the equipment or defective work carried out by the contractor, the same shall be borne by the contractor.
- 15.6 The acceptance of the equipment by the Engineer shall in no way relieve the contractor of his obligations under this clause.
- 15.7 In the case of those defective parts, which are not repairable at site but are essential for the commercial operation of the equipment, the contractor and the Engineer shall mutually agree to a programme of replacement or renewal, which will minimize interruption to the maximum extent in the operation of the equipment.
- 15.8 At the end of the guarantee period, the contractor's liability ceases except for latent defects. For latent defects, the contractor's liability as mentioned in Clause Nos. 15.1 through 15.7 above, shall remain till the end of 5 years from the date of completion of guarantee period.

In respect of goods supplied by Sub-Contractors to the Contractor where a longer guarantee (more than 12 months) is provided by such Sub-Contractor, the owner shall be entitled to the benefits of such longer guarantee.

- 15.9 The provisions contained in this clause will not be applicable.
- a) If the owner has not used the equipment according to generally approved industrial practice and in accordance with the conditions of operations specified and in accordance with operating manuals, if any.
- b) In cases of normal wear and tear of the parts to be specifically mentioned by the contractor in the offer.
- 15.10 The Contractor shall not stand guaranteed for the materials supplied by OPTCL but shall stand guarantor for the execution of the materials

#### 16.0 **TAXES, PERMITS & LICENCES**

The contractor shall be liable and pay all non-Indian taxes, duties, levies lawfully assessed against the owner or the contractor in pursuance of the

contract. In addition the contractor shall be responsible for payment of all Indian duties, levies and taxes lawfully assessed against the contractor for his personal income and property only. This clause shall be read in conjunction with Clause 15.0 of Section INB of this Vol.I.

#### **17.0 REPLACEMENT OF DEFECTIVE PARTS AND MATERIALS**

17.1 If during the performance of the contract, the Engineer shall decide and inform in writing to the contractor that the contractor has manufactured any equipment, material or part of equipment unsound and imperfect or has furnished any equipment inferior to the quality specified, the contractor on receiving details of such defects or deficiencies shall at his own expense within seven (7) days of his receiving the notice, or otherwise, within such time as may be reasonably necessary for making it good, proceed to alter, reconstruct or remove such works and furnish fresh equipment/materials upto the standards of the specifications. In case, the contractor fails to do so, the Engineer may on giving the contractor seven (7) days notice in writing of his intentions to do so, proceed to remove the portion of the works so complained of and at the cost of the contractor perform all such works or furnish all such equipment/material provided that nothing in this clause shall be deemed to deprive the owner of or affect any rights under the contract which the owner may otherwise have in respect of such defects and deficiencies.

17.2 The contractor's full and extreme liability under this clause shall be satisfied by the payment to the owner of extra cost, of such replacement procured including erection as provided for in the contract, such extra cost being the ascertained difference between the price paid by the owner for such replacements and the contract price by portion for such defective equipment/materials/works and repayments of any sum paid by the owner to the contractor in respect of such defective equipment/material. Should the owner not so replace the defective equipment/materials the contractor's extreme liability under this clause shall be limited to repayment of all sums paid by the owner under the contract for such defective equipment/materials.

#### **18.0 PATENT RIGHTS AND ROYALTIES**

Royalties and fees for patents covering materials, articles, apparatus, devices, equipment or processes used in the works shall be deemed to have been included in the Contract Price. The contractor shall satisfy all demands that may be made at any time for such royalties or fees and he alone shall be liable for any damages or claims for patent infringements and shall keep the owner indemnified in that regard. The contractor shall, alleged infringement of any patents involved in the works, and, in case of an award of damages, the contractor shall pay for such award. In the event of any suit or other



proceedings instituted against the owner, the same shall be defended at the cost and expense of the contractor who shall also satisfy/comply with any decree, order or award made against the owner. But it shall be understood that no such machine, plant, work, material or thing has been used by the owner for any purpose or any manner other than that for which they have been furnished and installed by the contractor and specified under these specifications. Final payment to the contractor by the owner will not be equipment, or any part thereof furnished by the contractor, is in such suit or proceedings held to constitute infringement, and its use is enjoined, the contractor shall at his option and at his own expense, either procure for the owner, the right to continue the use of said apparatus, equipment or part thereof, replace it with non-infringing apparatus or equipment or modify it, so it becomes non-infringing.

#### **19.0 DEFENCE OF SUITS**

If any action in court is brought against the owner or Engineer or an officer or agent of the owner, for the failure, omission or neglect on the part of the contractor to perform any acts, matters, covenants or things under the contract, or for damage or injury caused by the alleged omission or negligence on the part of the contractor, his agents, representatives or his Sub-Contractors, or in connection with any claim based on lawful demands of sub-contractors, workmen, suppliers or employees, the contractor shall in all such cases indemnify and keep the owner, and the Engineer and/or his representative, harmless from all losses, damages, expenses or decrees arising of such action.

#### **20.0 LIMITATION OF LIABILITIES**

The final payment by the owner in pursuance of the contract shall mean the release of the contractor from all his liabilities under the contract. Such final payment shall be made only at the end of the Guarantee/Warranty period, and till such time as the contractual liabilities and responsibilities of the contractor, shall prevail. All other payments made under the contract shall be treated as on-account payments.

#### **21.0 ENGINEER'S DECISION**

21.1 In respect of all matters which are left to the decision of the Engineer including the granting or with-holding of the certificates, the Engineer shall, if required to do so by the contractor, give in writing a decision thereon.

21.2 If, in the opinion of the contractor, a decision made by the Engineer is not in accordance with the meaning and intent of the contract, the contractor may file with the Engineer, within fifteen (15) days after receipt of the decision, a

written objection to the decision. Failure to file an objection within the allotted time will be considered as an acceptance of the Engineer's decision and the decision shall become final and binding.

- 21.3 The Engineers' decision and the filing of the written objection thereto shall be a condition precedent to the right to request arbitration. It is the intent of the Agreement that there shall be no delay in the execution of the works and the decision of the Engineer as rendered shall be promptly observed.

## **22 POWER TO VARY OR OMIT WORK**

- 22.1 No alterations, amendments, omissions, suspensions or variations of the works (hereafter referred to as 'variation') under the contract as detailed in the Contract Documents, shall be made by the contractor except as directed in writing by the Engineer, but the Engineer shall have full powers subject to the provisions hereafter contained, from time to time during the execution of the contract, by notice in writing to instruct the contractor to make such variation without prejudice to the contract. The contractor shall carry out such variation and be bound by the same conditions as far as applicable as though the said variations occurred in the Contract Documents. If any suggested variations would, in the opinion of the contractor, if carried out, prevent him from fulfilling any of his obligations or guarantees under the contract, he shall notify the Engineer thereof in writing and the Engineer shall decide forthwith whether or not, the same shall be carried out and if the Engineer confirms his instructions, the contractor's obligations and guarantees shall be modified to such an extent as may be mutually agreed. Any agreed difference in cost occasioned by any such variation shall be added to or deducted from the contract price as the case may be.
- 22.2 In the event of Engineer requiring any variation, a reasonable and proper notice shall be given to the contractor to enable him to work his arrangement accordingly, and in cases where goods or materials are already prepared or any design, drawings or pattern made or work done requires to be altered, a reasonable and agreed sum in respect thereof shall be paid to the contractor.
- 22.3 In any case in which the contractor has received instructions from the Engineer as to the requirement of carrying out the alterations or additional or substituted work which either then or later on, will in the opinion of the contractor, involve a claim for additional payment, the contractor shall immediately and in no case later than thirty(30) days, after receipt of the instructions aforesaid and before carrying out the instructions, advise the Engineer to that effect. But the Engineer shall not become liable for payment of any charges in respect of any

such variations, unless the instructions for the performance of the same shall be confirmed in writing by the Engineer.

- 22.4 If any variation in the works results in reduction of contract price, the parties shall agree, in writing, so to the extent of any change in the price, before the contractor proceeds with the change.
- 22.5 In all the above cases, in the event of a disagreement as to the reasonableness of the said sum, the decision of the Engineer shall prevail.

**22.6** Notwithstanding anything stated above in this clause, the Engineer shall have the full power to instruct the contractor, in writing, during the execution of the contract to vary the quantities of the items or groups of items in accordance with the provisions of clause entitled 'Change of Quantity' in section GCC of this Vol.I. The contractor shall carry out such variations and be bound by the same conditions as though the said variations occurred in the Contract Documents. However, the contract price shall be adjusted at the rates and the prices provided for the original quantities in the Contract.

### **23. ASSIGNMENT AND SUB-LETTING OF CONTRACT**

- 23.1 The contractor may, after informing the Engineer and getting his written approval, assign or sub-let the contract or any part thereof other than for raw material, for minor details or for any part of the plant for which makes are identified in the contract. Suppliers of the equipment not identified in the contract or any change in the identified suppliers shall be subjected to approval by the Engineer. The experience list of equipment vendors under consideration by the contractor for this contract shall be furnished to the Engineer for approval prior to procurement of all such items/equipment. Such assignment/sub-letting shall not relieve the contractor of any obligation, duty or responsibility under the contract. Any assignment as above, without prior written approval of Engineer, shall be void.
- 23.2 For components/equipment procured by the contractor for the purposes of the contract, after obtaining the written approval of the owner, the contractor's purchase specifications and enquiries shall call for quality plan to be submitted by the suppliers along with their proposals. The quality plans called for from the vendors shall set out, during the various stages of manufacture and installation, the quality practices and procedures followed by the vendors' quality control organization, the relevant reference document/standard used, acceptance level, inspection documentation raised, etc. Such quality plans of the successful vendors shall be discussed and finalized in consultation with the Engineer and shall form a part of the Purchase Order/Contract between the Contractor and the

Vendor. Within three weeks of the release of the Purchase Orders/Contracts for such bought out items/components a copy of the same without price details but together with detailed purchase specifications, quality plans and delivery conditions shall be furnished to the Engineer by the Contractor.

## **24. CHANGE OF QUALITY**

- 24.1 During the execution of the contract, the owner reserves the right to increase or decrease the quantities of items under the contract but without any change in unit price or other terms and conditions. Such variations unless otherwise specified in the accompanying Special Conditions of Contract and/or technical Specifications, shall not be subjected to any limitation for the individual items but the total variations in all such items under the contract shall be limited to a percentage of the contract price as specified in the Special Conditions of Contract.
- 24.2 The contract price shall accordingly be adjusted based on the unit rates available in the contract for the change in quantities as above. The base unit rates, as identified in the contract shall however remain constant during the currency of the contract, except as provided for in Clause 33.0 below. In case the unit rates are not available for the change in quantity, the same shall be subjected to mutual agreement.

## **25. PACKING, FORWARDING AND SHIPMENT**

- 25.1 The contractor, wherever applicable, shall after proper painting, pack and crate all equipment in such a manner as to protect them from deterioration and damage during rail and road transportation to the site and storage at the site till the time of erection. The contractor shall be held responsible for all damages due to improper packing.
- 25.2 The contractor shall notify the owner of the date of each shipment from his works, and the expected date of arrival at the site for the information of the owner.
- 25.3 The contractor shall also give all shipping information concerning the weight, size and content of each packing including any other information the owner may require.
- 25.4 The following documents shall be sent by registered post to the owner within three days from the date of shipment, to enable the owner to make progressive payments to the contractor:

Application for payment in the standard format of the owner ( 3 copies)

In voice (6 copies)  
Packing list (6 copies)  
Pre-despatch clearance certificate, if any ( 3 copies)  
Test Certificate, wherever applicable ( 3 copies)  
Insurance certificate (3 copies)

- 25.5 The contractor shall prepare detailed packing list of all packages and containers, bundles and loose materials forming each and every consignment dispatched to site.

**The contractor shall further be responsible for making all necessary arrangements for loading, unloading, storing(in OPTCL store) and other handling right from his works upto the site and also till the equipment is erected, tested and commissioned. He shall be solely responsible for proper storage and safe custody with security arrangement of all equipment till final commissioning and handing over to OPTCL. The Firm has to arrange all ROW and security at their own cost till handover to OPTCL.**

## **26. COOPERATION WITH OTHER CONTRACTORS**

The contractor shall agree to cooperate with the owner's other contractors Engineers and freely exchange with them such technical information as is necessary to obtain the most efficient and economical design and to avoid unnecessary duplication of efforts. The Engineer shall be provided with three copies of all-correspondence addressed by the contractor to other contractors and Engineers of the owner in respect of such exchange of technical information.

## **27. NO WAIVER OF RIGHTS**

Neither the inspection by the owner or the Engineer or any of their officials, employees, or agents nor any order by the owner or the Engineer for payment of money or any payment for or acceptance of, the whole or any part of the works by the owner or the Engineer, nor any extension of time, nor any possession taken by the Engineer shall operate as a waiver of any provision of the contract, or of any power herein reserved to the owner or any right to damages herein provided nor shall any waiver of any breach in the contract be held to be a waiver of any other or subsequent breach.

## **28. CERTIFICATE NOT TO AFFECT RIGHT OF OWNER AND LIABILITY OF THE CONTRACTOR**

No interim payment certificate of the Engineer, nor any sum paid on account by the owner, nor any extension of time for execution of the works granted by the

Engineer shall affect or prejudice the rights of the owner against the contractor or relieve the contractor of his obligation for the due performance of the contract, or be interpreted as approval of the works done or of the equipment furnished and no certificate shall create liability for the owner to pay for alterations, amendments, variations or additional works not ordered, in writing, by the Engineer or discharge the liability of the contractor for the payment of damages whether due, ascertained, or certified or not or any sum against the payment of which he is bound to indemnify the owner, nor shall any such certificate nor the acceptance by him of any sum paid on account or otherwise affect or prejudice the rights of the owner against the contractor.

## **29. PROGRESS REPORTS AND PHOTOGRAPHS**

During the various stages of the work in pursuance of the contract, the contractor shall at his own cost submit periodic progress reports as may be reasonably required by the Engineer with such materials as, charts, net-works, photographs, test certificates, etc. Such progress reports shall be in the form and size as may be required by the Engineer and shall be submitted in at least three (3) copies.

## **30. TAKING OVER**

Upon successful completion of all the tests to be performed at site on equipment furnished and erected by the contractor, the Engineer shall issue to the contractor a Taking Over Certificate as proof of the final acceptance of the equipment. Such certificate shall not unreasonably be withheld nor will the Engineer delay the issuance thereof on account of minor omissions or defects, which do not affect the commercial operation and/or cause any serious risk to the equipment. Such certificate shall not relieve the contractor of any of his obligations which otherwise survive, by the terms and conditions of the contract after issue of such certificate.

## **31. CONTRACT SECURITY AND PAYMENTS**

### **32. CONTRACT PERFORMANCE GUARANTEE**

The contractor shall furnish Contract Performance Guarantee(s) for the proper fulfillment of the contract in the prescribed form within thirty(30) days of "Notice of Award of Contract". The performance guarantee(s) shall be as per terms prescribed in Section INB, Conditions of Contract Vol.I and/or Special Conditions of Contract.

33.0 CONTRACT PRICE ADJUSTMENT-To be done as per the standard practice of OPTCL.

#### 34.0 PAYMENT

34.1 The payment to the contractor for the performance of the works under the contract will be made by the owner as per the guidelines and **as specified in the Special terms and conditions**. All payments made during the contract shall be on account payments only. The final payment will be made on completion of all works and on fulfillment by the contractor of all his liabilities under the contract.

34.2 Currency of Payment

All payments under the contract shall be in Indian Rupees only.

34.3 Due Dates for Payments

The initial advance amount shall be payable after fulfillment of all the conditions laid down in the special Conditions of Contract, and receipt of the contractor's invoice along with all necessary supporting documents for such advance payment. The price component of the initial advance amount will become due for payment within thirty (30) days of receipt of the contractor's invoice. Owner will make progressive payment as and when the payment is due as per the terms of payment set forth in the accompanying Special Conditions of Contract. Progressive payments other than those under the letter of credit will become due and payable by the owner within thirty (30) days of the date of receipt of contractor's bill/invoice/debit note by the owner provided the documents submitted are complete in all respects.

34.4 Payment Schedule

The contractor shall prepare and submit to the Engineer for approval, a break up of the contract price. This contract price break up shall be interlinked with the agreed detailed PERT network of the contractor setting forth his starting and completion dates for the various key phases of works prepared as per conditions in clause 12.0 of this Section GCC of Vol.I. Any payment under the contract shall be made only after the contractor's price break up is approved by the Engineer. The aggregate sum of the contractor's price break up shall be equal to the lump sum contract price. A price break up over valuing those items of supply which will be shipped first will not be accepted.

### 34.5 Application for Payment

34.5.1 The Contractor shall submit application for the payment in the prescribed proforma of the owner.

34.5.2 Each such application shall state the amount claimed and shall set forth in detail, in the order of the Payment schedule, particulars of the works including the works executed at site and of the equipment shipped/brought on to the site pursuant to the contract upto the date mentioned in the application and for the period covered since the last preceding certificate, if any.

34.5.3 Every interim payment certificate shall certify the contract value of the works executed upto the date mentioned in the application for the payment certificate, provided that no sum shall be included in any interim payment certificate in respect of the works that, according to the decision of the engineer, does not comply with the contract or has been performed, at the date of certificate prematurely.

### 34.6 Mode of Payment

34.6.1 Payment due on dispatch of equipment shall be made by the owner through owner's Bank or directly to the contractor as per the payment schedule.

34.6.2 The payment of the advance, test charges, if any, price adjustment, any other supply payment, taxes and duties (whenever admissible) inland transportation (including port handling), insurance and the erection portion of the works shall be made direct to the contractor by the owner.

### 34.7 Terms of Payment

The terms of payments for various activities under the contract are as under.

#### 34.7.1 Ex-works Price and Erection

The terms of payments for ex-works price components of the equipment and erection are detailed in Special Conditions of Contract, for each equipment package. Mobilisation advance on both supply and erection cost shall be paid as per special terms and conditions .

- i) For ex-works price component of equipment
- a) Acknowledgement of Letter of Award.



b) Submission of an unconditional Bank Guarantee from (a) a Public Sector Bank or (b) a scheduled Indian Bank having paid up capital (net of any accumulated losses) of Rs.100 crores or above (the latest annual report of the Bank should support compliance of capital adequacy ratio requirement) or (c) any foreign Bank or subsidiary of a foreign Bank with overall international corporate rating or rating of long term debt not less than A-(A minus) or equivalent by reputed rating agency, covering the advance amount which shall be initially kept valid till 90 days after the schedule date for successful completion of commissioning. The proforma of Bank Guarantee for advance is enclosed as Annexure-VI of Vol.I. The value of the Bank Guarantee for advance shall be allowed to be reduced every six months after the first running account bill/stage payment under the contract if the validity of the bank guarantee is more than one year. The cumulative amount of reduction at any point of time shall not exceed 75% of the advance corresponding the cumulative value of supplies work completed as per a certificate to be issued by the Engineer-in-charge. It should be clearly understood that the reduction in the value of the advance Bank guarantee or other security as above shall not in any way dilute the contractor's responsibilities and liabilities under the contract including in respect of supplies/work for which the reduction in the value of the bank guarantee is allowed.

c) Submission of an unconditional bank guarantee towards contract performance guarantee valid upto ninety(90) days after the end of the warranty period, in accordance with clause 43.0 of Section INB of this Vol.I.

d) Submission of a detailed PERT network/bar chart based on the work schedule stipulated in the Letter of Award and its approval by the owner.

#### 34.7.2 Inland Transportation and Insurance

Inland transportation (including port handling) and inland insurance charges shall be paid to the contractor on prorata to the value of the equipment received at site and on production of the invoices by the contractor. However, wherever equipment wise inland transportation charges have been called for in the 'Bid Proposal Sheets' and have been furnished by the contractor, the payment of inland transportation charges shall be made after receipt of equipment at site based on the charges thus identified by the contractor in his Proposal and incorporated in the contract. The aggregate of all such prorata payments shall however not exceed the total amount quoted by the Bidder in his bid and incorporated in the contract.

#### 35.0 DEDUCTIONS FROM CONTRACT PRICE

All costs, damages or expenses which the owner may have paid, for which under the contract contractor is liable, will be claimed by the owner. All such claims shall be billed by the owner to the contractor regularly as and when they fall due. Such bills

shall be supported by appropriate and certified vouchers or explanations, to enable the contractor to properly identify such claims. Such claims shall be paid by the contractor within thirty(30) days of the receipt of the corresponding bills and if not paid by the contractor within the said period, the owner may then deduct the amount, from any monies due or becoming due by him to the contractor under the contract or may be recovered by actions of Law or otherwise.

## **D. SPARES**

### **36.0 SPARES**

36.1 All the spares for the equipment under the contract will, strictly, conform to the specification and documents and will be identical to the corresponding main equipment/components supplied under the contract and shall be fully interchangeable.

36.2 All the mandatory spares covered under the contract shall be produced along with the main equipment as a continuous operation and the delivery of the spares will be affected along with the main equipment in a phased manner and the delivery would be completed by the respective dates for the various categories of equipment as per the agreed network. In case of recommended spares the above will be applicable provided the order for the recommended spares has been placed with the contractor prior to commencement of manufacture of the main equipment.

36.3 The quality plan and the inspection requirement finalized for the main equipment will also be applicable for the corresponding spares.

36.4 The contractor will provide the owner with the manufacturing drawings, catalogues, assembly drawings and any other document required by the owner so as to enable the owner to identify the recommended spares. Such details will be furnished to the owner as soon as they are prepared but in any case not later than six months prior to commencement of manufacture of the corresponding main equipment.

36.5 The contractor will provide the owner with all the addresses and particulars of his sub-suppliers while placing the order on vendors for items/components/equipment covered under the contract and will further ensure with his vendors that the owner, if so desires, will have the right to place order(s) for spares directly on them on mutually agreed terms based on offers of such vendors.

36.6 Warranty for spares

The contractor shall warrant that all spares supplied will be new and in accordance with contract documents and will be free from defects in design, materials and workmanship and shall further guarantee as under:

#### 36.6.1

a) For any item of spares ordered or to be ordered by the owner for 3 years operational requirement of the plant which are manufactured as a continuous operation together with the corresponding main equipment/component, the warranty will be 12 months from the scheduled date of commercial operation of the last unit of main equipment under the contract. In case of any failure in the original component/equipment due to faulty designs, materials and workmanship, the corresponding spare parts, if any, supplied will be replaced without any extra cost to the owner unless a joint examination and analysis by the owner and the contractor of such spare parts prove that the defect found in the original part that failed, can safely be assumed not to be present in spare parts. Such replaced spare parts will have the same warranty as applicable to the replacement made for the defective original part/component provided that such replacement for the original equipment and the spare replaced are again manufactured together. The discarded spare parts will become the property of the contractor as soon as they have been replaced by the contractor.

b) For the item of spares ordered/to be ordered by the owner for 3 years operational requirement of the equipment, which with the written approval of the owner, are not manufactured as a continuous operation together with the manufacture of the corresponding main equipment/component, will be warranted for 6000 hrs. of trouble free operation if used within a period of 18 months (reckoned from the date of delivery at site). However, if such spare parts are put to use after 18 months of the delivery at site then the guarantee of such spares will stand valid till the expiry of 36 months from the scheduled date of the completion of commissioning of the last unit of equipment or 6000 hrs. of trouble free operation after such spares are put in service, whichever is earlier.

c) For long term requirement.

For items of spares that may be ordered by the owner to cover requirements beyond 3 years of initial operation of the plant, the warranty will be till the expiry of 6000 hrs. of trouble free operation if used within a period of 18 months from the date of delivery at site. For items of spares that may be used after 18 months from the date of delivery at site, the warranty period will be 12 months from the date they are put to use or 6000 hrs. of trouble free operation, whichever is earlier.

- 36.6.2 The warranty of spares that are not used within 18 months from the respective dates of the delivery at site covered in Para (b) & (c) above will, however, be subject to the condition that all such spares have been stored/maintained/preserved in accordance with contractor's standard recommended practice, if any, and the same have been furnished to the owner.
- 36.7 To enable the owner to finalise the requirement of recommended spares which are ordered subsequent to placement of order for main equipment in addition to necessary technical details catalogue and such other information brought out here-in-above, the contractor will also provide a justification in support of reasonableness of the quoted prices of spares which will, inter-alia, include documentary evidence that the price quoted by the contractor to the owner are not higher than those charged by them from other customers in the same period.
- 36.8 In addition to the spares recommended by the contractor, if the owner further identifies certain particular items of spares, the contractor will submit the prices and delivery quotations for such spares within 30 days of receipt of such request with validity period for 6 months for consideration by the owner and placement of order for additional spares if owner so desires.
- 36.9 The contractor shall guarantee the long term availability of spares to the owner for the full life of the equipment covered under the contract. The contractor shall guarantee that before going out of production of spare parts of the equipment, he shall give the owner at least twelve (12) months advance notice so that the latter may order his bulk requirement of spares, if he so desires. The same provision will also be applicable to Sub-Contractor of any spares by the contractor or his Sub-Contractors. Further, in case of discontinuance of manufacture of any spares by the contractor or his Sub-Contractors, the contractor will provide the owner, two years in advance, full manufacturing drawings, material specifications and technical information required by the owner for the purpose of manufacture of such items.
- 36.10 Further in case of discontinuance of supply of spares by the contractor or his Sub-Contractors, the Contractor will provide the Owner with full information for replacement of such spares with other equivalent makes, if so required by the Owner.
- 36.11 The prices of all future requirements of items of spares beyond 3 years operational requirement will be derived from the corresponding ex-works price at which the order for such spares have been placed by owner as part of mandatory spares or recommended spares. Ex-works order price of future spares shall be computed in accordance with the price adjustment provisions covered under the main contract excepting that the base indices will be counted

from the scheduled date of successful completion of trial operation of the last equipment under the main project and there will be no ceiling on the amount of variation in the prices. The above option for procuring future long term requirement of spares by the owner shall remain valid for a period of 5 years from successful completion of commissioning of last unit of equipment.

- 36.12 The contractor will indicate in advance the delivery period of the items of spares, which the owner may procure in accordance with above sub-clause. In case of emergency requirements of spares, the contractor would make every effort to expedite the manufacture and delivery of such spares on the basis of mutually agreed time schedule.
- 36.13 In case the contractor fails to supply the mandatory, recommended or long term spares in accordance with the terms stipulated above, the owner shall be entitled to purchase the same from alternate sources at the risk and the cost of the contractor and recover from the contractor, the excess amount paid by the owner over the rates worked out on the above basis. In the event of such risk purchase by the owner, the purchases will be as per the works and procurement policy of the owner prevalent at the time of such purchases and the owner at his option may include a representative of the contractor in finalizing the purchases.
- 36.14 It is expressly understood that the final settlement between the parties in terms of the relevant clauses of the Bidding Documents shall not relieve the contractor of any of his obligations under the provision of long term availability of spares unless otherwise discharged in writing by the owner.

## **E. RISK DISTRIBUTION**

### **37.0 TRANSFER OF TITLE**

- 37.1 Transfer of title in respect of equipment and materials supplied by the contractor to OPTCL pursuant to the terms of the contract shall pass on to OPTCL with negotiation of dispatch documents.
- 37.2 This Transfer of Title shall not be construed to mean the acceptance and the consequent “Taking Over” of equipment and materials. The contractor shall continue to be responsible for the quality and performance of such equipment and materials and for their compliance with the specifications until “Taking Over” and the fulfillment of guarantee provisions of this contract.
- 37.3 This Transfer of Title shall not relieve the contractor from the responsibility for all risks of loss or damage to the equipment and materials as specified under the clause entitled “Insurance” of this Section.

## **38.0 INSURANCE**

- 38.1 The contractor at his cost shall arrange, secure and maintain all insurance as may be pertinent to the works and obligatory in terms of law to protect his interest and interests of the owner against all perils detailed herein. The form and the limit of such insurance as defined herein together with the under-writer in each case shall be acceptable to the owner. However, irrespective of such acceptance, the responsibility to maintain adequate insurance coverage at all time during the period of contract shall be of contractor alone. The contractor's failure in this regard shall not relieve him of any of his contractual responsibilities and obligations. The insurance covers to be taken by the contractor shall be in the joint name of the owner and the contractor. The contractor shall, however, be authorized to deal directly with Insurance Company or Companies and shall be responsible in regard to maintenance of all insurance covers. Further the insurance should be in freely convertible currency.
- 38.2 Any loss or damage to the equipment during handling, transportation, storage, erection, putting into satisfactory operation and all activities to be performed till the successful completion of commissioning of the equipment shall be to the account of the contractor. The contractor shall be responsible for preference of all claims and make good the damages or loss by way of repairs and/or replacement of the equipment, damaged or lost. The transfer of title shall not in any way relieve the contractor of the above responsibilities during the period of contract. The contractor shall provide the owner with copy of all insurance policies and documents taken out by him in pursuance of the contract. Such copies of documents shall be submitted to the owner immediately after such insurance coverage. The contractor shall also inform the owner in writing at least sixty(60) days in advance regarding the expiry/cancellation and/or change in any of such documents and ensure revalidation, renewal etc. as may be necessary well in time.
- 38.3 The perils required to be covered under the insurance shall include, but not be limited to fire and allied risks, miscellaneous accidents (erection risks) workman compensation risks, loss or damage in transit, theft, pilferage, riot and strikes and malicious damages, civil commotion, weather conditions, accidents of all kinds etc. The scope of such insurance shall be adequate to cover the replacement/ reinstatement cost of the equipment for all risks upto and including delivery of goods and other costs till the equipment is delivered at site. The insurance policies to be taken should be on replacement value basis and/or incorporating escalation clause. Notwithstanding the extent of insurance cover and the amount of claim available from the underwriters, the contractor

shall be liable to make good the full replacement/rectification value of all equipment/materials and to ensure their availability as per project requirements.

38.4 All costs on account of insurance liabilities covered under the contract will be on contractor's account and will be included in contract price. However, the owner may from time to time, during the pendency of the contract, ask the contractor in writing to limit the insurance coverage, risks and in such a case, the parties to the contract will agree for a mutual settlement, for reduction in contract price to the extent of reduced premia amount. The contractor, while arranging the insurance shall ensure to obtain all discounts on premia which may be available for higher volume or for reason of financing arrangement of the project.

38.5 The clause entitled 'insurance' under the section ECC of this Vol.I, covers the additional insurance requirements for the portion of the works to be performed at the site.

### **39.0 LIABILITY FOR ACCIDENTS AND DAMAGES**

Under the contract, the contractor shall be responsible for loss or damage to the plant until the successful completion of commissioning as defined else where in the Bid Document.

### **40.0 DELAYS BY OWNER OR HIS AUTHORISED AGENTS**

40.1 In case the contractor's performance is delayed due to any act of omission on the part of the owner or his authorized agents, then the contractor shall be given due extension of time for the completion of the works, to the extent such omission on the part of the owner has caused delay in the contractor's performance of the contract.

Regarding reasonableness or otherwise of the extension of time, the decision of the Engineer shall be final.

40.2 In addition, the contractor shall be entitled to claim demonstrable and reasonable compensation if such delays have resulted in any increase in cost. The owner shall examine the justification for such a request for claim and if satisfied, the extent of compensation shall be mutually agreed depending upon the circumstances at the time of such an occurrence.

### **41.0 DEMURRAGE, WHARFAGE ETC.**

All demurrage, wharf age and other expenses incurred due to delayed clearance of the material or any other reason shall be to the account of the contractor.

## **42.0 FORCE MAJEURE**

42.1 Force majeure is herein defined as any cause which is beyond the control of the contractor or the owner as the case may be, which they could not foresee or with a reasonable amount of diligence could not have foreseen and which substantially affects the performance of the contract, such as:

- a) Natural phenomena, including but not limited to floods, droughts, earthquakes and epidemics;
- b) Acts of any Government, domestic or foreign, including but not limited to war, declared or undeclared, priorities, guarantees, embargoes.

Provided either party shall within fifteen(15) days from the occurrence of such a cause notify the other in writing of such causes.

42.2 The contractor or the owner shall not be liable for delays in performing his obligations resulting from any force majeure cause as referred to and/or defined above.

The date of completion will, subject to hereinafter provided, be extended by a reasonable time even though such cause may occur after contractor's performance of obligation has been delayed due to other causes.

## **43.0 SUSPENSION OF WORK**

43.1 The owner reserves the right to suspend and reinstate execution of the whole or any part of the works without invalidating the provisions of the contract. Orders for suspension or reinstatement of the works will be issued by the Engineer to the contractor in writing. The time for completion of the works will be extended for a period equal to duration of the suspension.

43.2 Any necessary and demonstrable cost incurred by the contractor as a result of such suspension of the works will be paid by the owner, provided such costs are substantiated to the satisfaction of the Engineer. The owner shall not be responsible for any liabilities if suspension or delay is due to some default on the part of the contractor or his sub-contractor.

## **44.0 CONTRACTOR'S DEFAULT**

44.1 If the contractor shall neglect to execute the works with due diligence and expedition or shall refuse or neglect to comply with any reasonable order given to him, in writing 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. Should 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 contractors 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 works or of completing the works as the case may be. If the cost of completing of works or executing 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.

44.2 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 14.0 of this Section.

44.3 Such action by the owner as aforesaid the termination of the contract under this clause shall not 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.

#### **45.0 TERMINATION OF CONTRACT ON OWNER'S INITIATIVE**

45.1 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.

45.2 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

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.

- 45.3 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 the 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 incompleted part without being in any way liable to payment of any compensation to the estate of deceased contractor and/or to the 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 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 partners of the estate of the deceased contractor and/or the surviving partners of the contractor's firm liable to damages for not completing the contract.

#### **46.0 FRUSTRATION OF CONTRACT**

- 46.1 In the event of frustration of the contract because of supervening impossibility in terms of section 56 of the Indian Contract Act, parties shall be absolved of their responsibility to perform the balance portion of the contract, subject to provisions contained in sub-clause 46.3 below.

- 46.2 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.

- 46.3 In the event referred to in sub-clauses 46.1 and 46.2 above the parties shall mutually discuss to arrive at reasonable settlement 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.

#### **47.0 GRAFTS AND COMMISSIONS ETC.**

Any graft, commission, gift or advantage given, promised or offered by or on behalf of the contractor or his partner(s), agent(s), officer(s), director(s), employee(s) or servant(s) or any one on his or their behalf in relation to the obtaining or to the execution of this or any other contract with the owner, shall in addition to any criminal liability which it may incur, subject the contractor to the cancellation of this and all other contracts and also to payment of any loss or damage to the owner resulting from any cancellation. The owner shall then be entitled to deduct the amount so payable from any monies otherwise due to contractor under the contract.

### **Φ. RESOLUTION OF DISPUTES**

#### **48.0 SETTLEMENT OF DISPUTES**

- 48.1 Any dispute(s) or difference(s) arising out of or in connection with the contract shall, to the extent possible, be settled amicably between the parties.
- 48.2 If any dispute or difference of any kind, whatsoever, shall arise between the owner and the contractor arising out of the contract for the performance of the works whether during the progress of the works or after its completion or whether before or after the termination, abandonment or breach of the contract, it shall, in the first place, be referred to and settled by the Engineer, who, within a period of thirty(30) days after being requested by either party to do so, shall give written notice of his decision to the owner and the contractor.
- 48.3 Save as hereinafter provided, such decision in respect of every matters so referred shall be final and binding upon the parties until the completion of the works and shall forthwith be given effect to by the contractor who shall proceed with the works with all due diligence, whether he or the owner requires arbitration as hereinafter provided or not.
- 48.4 If after the Engineer has given written notice of his decision to the parties, no claim to arbitration has been communicated to him by either party within thirty(30) days from the receipt of such notice, the said decision shall become final and binding on the parties.
- 48.5 In the event of the Engineer failing to notify his decision as aforesaid within thirty(30) days after being requested as aforesaid, or in the event of either the owner or the contractor being dissatisfied with any such decision, or within thirty(30) days after the expiry of the first mentioned period of thirty days, as the case may be, either party may require that the matters in dispute be referred to arbitration as hereinafter provided.

## **49.0 ARBITRATION**

49.1 All disputes or differences in respect of which the decision, if any, of the Engineer has not become final or binding as aforesaid shall be settled by arbitration in the manner hereinafter provided.

49.1.1 The arbitration shall be conducted by three arbitrators, one each to be nominated by the contractor and the owner and the third to be appointed as an umpire by both the arbitrators in accordance with the Indian Arbitration Act. If either of the parties fails to appoint its arbitrator within sixty (60) days after receipt of a notice from the other party invoking the Arbitration clause, the arbitrator appointed by the party invoking the arbitration clause shall become the sole arbitrator to conduct the arbitration.

49.1.2 The arbitration shall be conducted in accordance with the provisions of the Indian Arbitration Act, 1940 or any statutory modification thereof. The venue of arbitration shall be Bhubaneswar of ORISSA state.

49.2 The decision of the majority of the arbitrators shall be final and binding upon the parties. The arbitrators may, from time to time with the consent of all the parties enlarge the time for making the award. In the event of any of the aforesaid arbitrators dying, neglecting, resigning or being unable to act for any reason, it will be lawful for the party concerned to nominate another arbitrator in place of the outgoing arbitrator.

49.3 The arbitrator shall have full powers to review and/or revise any decision, opinion, direction, certification or valuation of the Engineer in accordance with the contract, and neither party shall be limited in the proceedings before such arbitrators to the evidence or arguments put before the Engineer for the purpose of obtaining the said decision.

49.4 No decision given by the Engineer in accordance with the foregoing provisions shall disqualify him as being called as a witness or giving evidence before the arbitrators on any matter whatsoever relevant to the dispute or difference referred to the arbitrators as aforesaid.

49.5 During settlement of disputes and arbitration proceedings, both parties shall be obliged to carry out their respective obligations under the contract.

## **50.0 RECONCILIATION OF ACCOUNTS**

The contractor shall prepare and submit every six months, a statement covering payments claimed and the payments received vis-à-vis the works executed, for reconciliation of accounts with the owner. The contractor shall also prepare and

submit a detailed account of Owner Issue materials received and utilized by him for reconciliation purpose in a format to be discussed and finalized with the owner before the award of contract.

51- All other disputes shall come under **HIGH COURT OF ORISSA.**

**END OF SECTION – GCC**

**SCHEDULE OF FORMATS TO BE UTILISED BY THE  
FIRMS AND TO BE SUMMITTED WITH THE BID WHERE  
REQUIRED**

**1) ANNEXURE –I: PROFORMA FOR BANK GUARANTEE FORM FOR EARNEST MONEY DEPOSIT.**

**2) ANNEXURE –II: PROFORMA FOR COMPOSITE BANK GUARANTEE FOR SECURITY DEPOSIT , PAYMENT AND PERFORMANCE.**

**3) ANNEXURE-III:FORM OF POWER OF ATTORNEY FOR JOINT VENTURE / CONSORTIUM.**

**4) ANNEXURE-IV:FORM OF JOINT VENTURE / CONSORTIUM AGREEMENT.**

# ANNEXURE –I

## PROFORMA FOR BANK GUARANTEE FORM FOR EARNEST MONEY DEPOSIT

Ref \_\_\_\_\_ Date \_\_\_\_\_ Bank Guarantee

No:

To

The SR.General Manager,CPC,  
OPTCL, Bhubaneswar.

1 In accordance with invitation to Bid No. \_\_\_\_\_ Dated \_\_\_\_\_ of ORISSA  
POWER TRANSMISSION CORPORATION LTD. [OPTCL][herein after referred to  
as the OPTCL for the purchase of

\_\_\_\_\_ Messers \_\_\_\_\_

Address \_\_\_\_\_

\_\_\_\_\_ wish/wis  
hed to participate in the said tender and as a Bank Guarantee for the sum of  
Rs. \_\_\_\_\_ [Rupees \_\_\_\_\_]

Valid for a period of 240 days [Two hundred forty days] is required to be submitted by  
the \_\_\_\_\_ Tenderer. We \_\_\_\_\_ the

\_\_\_\_\_ [Indicate the Name of the  
Bank]

[Hereinafter referred to as 'the Bank'] at the request of M/S

\_\_\_\_\_ [Herein after referred to as supplier (s)] do hereby unequivocally and unconditionally  
guarantee and undertake to pay during the above said period, on written request by the  
Sr. General Manager [Procurement] ORISSA POWER TRANSMISSION  
CORPORATION LTD. \_\_\_\_\_

\_\_\_\_\_ [Indicate designation of the  
purchaser]

an amount not exceeding Rs. \_\_\_\_\_ to the OPTCL, without any  
reservation. The guarantee would remain valid up to 4.00 PM of

\_\_\_\_\_ [date] and if any further extension to this is required, the same will be extended on  
receiving instructions from the \_\_\_\_\_ on  
whose

behalf this guarantee has been issued.

2. We the \_\_\_\_\_ do hereby, further undertake

[Indicate the name of the bank]

to pay the amounts due and payable under this guarantee without any demur, merely on  
a demand from the OPTCL stating that the amount claimed is due by way of loss or

damage caused to or would be caused to or suffered by the OPTCL by reason of any breach by the said supplier [s] of any of the terms or conditions or failure to perform the said Bid . Any such demand made on the Bank shall be conclusive as regards the amount due and payable by the Bank under this guarantee. However, our liability under this guarantee shall be restricted to an amount not exceeding Rs. \_\_\_\_\_

3. We undertake to pay the OPTCL any money so demanded notwithstanding any dispute or disputes so raised by the contractor [s] in any suit or proceeding instituted/pending before any Court or Tribunal relating thereto, our liability under this present being absolute and unequivocal. The payment so made by us under this bond shall be a valid discharge of our liability for payment there under and the supplier(s) shall have no claim against us for making such payment.

4. We, the \_\_\_\_\_ further agree that the guarantee

[Indicate the Name of the Bank]

herein contained shall remain in full force and effect during the aforesaid period of 240 days [two hundred forty days] and it shall continue to be so enforceable till all the dues of the OPTCL under or by virtue of the said Bid have been fully paid and its claims satisfied or discharged or till Managing Director, ORISSA POWER TRANSMISSION CORPORATION LTD. certifies that the terms and conditions of the said Bid have been fully and properly carried out by the said Supplier [s] and accordingly discharges this guarantee. Unless a demand or claim under this guarantee is made on us in writing on or before the \_\_\_\_\_

we shall be discharged from all liability under this guarantee thereafter.

5. We, the \_\_\_\_\_ further agree with the OPTCL that

[Indicate the name of the Bank]

the OPTCL shall have the fullest liberty without our consent and without affecting in any manner our obligations hereunder to vary any of the terms and conditions of the said Bid or to extend time of performance by the said Supplier [s] from time to time or to postpone for any time or from time to time any of the powers exercisable by the OPTCL against the said supplier [s] and to forbear or enforce any of the terms and conditions relating to the said bid and we shall not be relieved from our liability by reason of any such variation, postponement or extension being granted to the said Supplier [s] or for any forbearance act or omission on the part of the OPTCL or any indulgence by the OPTCL to the said Supplier[s] or by any such matter or thing whatsoever which under the law relating to sureties would, but for this provision, have effect of so relieving us.

6. This guarantee will not be discharged due to the change in the name, style and constitution of the Bank or the supplier [s].

7. We, \_\_\_\_\_ lastly undertake not revoke this

[Indicate the name of the Bank]



Guarantee during its currency except with the previous consent of the OPTCL in writing.

8. We the \_\_\_\_\_ Bank further agree that this guarantee shall also be invocable at our place of business at Bhubaneswar in the state of Orissa.

Dated \_\_\_\_\_ Day of \_\_\_\_\_

For \_\_\_\_\_

Witness(Signature, names & address)

[Indicate the name of Bank]

1.

2

## **ANNEXURE –II**

### **PROFORMA FOR COMPOSITE BANK GUARANTEE FOR SECURITY DEPOSIT , PAYMENT AND PERFORMANCE**

1. This Guarantee Bond is executed this \_\_\_\_\_ day of \_\_\_\_\_ 20\_\_\_\_ by us the \_\_\_\_\_ Bank at \_\_\_\_\_

P.O. \_\_\_\_\_ P.S. \_\_\_\_\_  
District \_\_\_\_\_ State \_\_\_\_\_

WHEREAS the ORISSA POWER TRANSMISSION CORPORATION LTD., a body corporate constituted under the Electricity Act, 2003 [hereinafter called “the OPTCL” which shall include its successors and assigns has placed orders No. \_\_\_\_\_ Date \_\_\_\_\_ [hereinafter called “The Agreement”] on M/s. \_\_\_\_\_

[hereinafter called “The Supplier”] which shall include its successors & assigns for supply of materials.

AND WHERE AS the supplier has agreed to supply materials to the OPTCL in terms of the said agreement AND

WHEREAS the OPTCL has agreed [1] to exempt the supplier from making payment of Security [2] to release 100% payment of the cost of materials as per the said agreement and [3] to exempt from performance guarantee on furnishing by the Supplier to the OPTCL, a Composite bank Guarantee of the value of 10 % [ten percent] of the contract price of the said agreement.

NOW THEREFORE, in consideration of the OPTCL having agreed [1] to exempt the Supplier from making payment of Security [2] releasing 100% payment to the Supplier and [3] to exempt from furnishing performance guarantee in terms of the said agreement as aforesaid, we, the \_\_\_\_\_ [Bank] [hereinafter referred to as ‘the Bank’] do hereby undertake to pay to the OPTCL an amount \_\_\_\_\_ not exceeding Rs. \_\_\_\_\_ [Rupees \_\_\_\_\_] against any loss or damage caused to or suffered by or would be caused to or suffered by the OPTCL by reason of any breach by the said Supplier [s] of any of the terms or conditions contained, in the said agreement.

2. We the ( \_\_\_\_\_ Bank) do hereby undertake to pay the amounts due and payable under this guarantee without any demur, merely on demand from the OPTCL stating that the amount claimed is due by way of loss or damage caused to or suffered by the OPTCL by reason of any breach by the said Supplier [s] of any of the terms or conditions, contained in the said agreement or by reason of the supplier’s failure to perform the said agreement. Any such demand made on the bank shall be conclusive as regards the amount due and payable by the Bank

under this guarantee. However, our liability under this guarantee shall be restricted to an amount not exceeding Rs. \_\_\_\_\_  
[Rupees \_\_\_\_\_]

3. We the \_\_\_\_\_ Bank} also undertake to pay to the OPTCL any money so demanded notwithstanding any dispute or disputes raised by the supplier [s] in any suit or proceeding instituted/pending before any Court or Tribunal relating thereto our liability under this present being absolute and unequivocal.

The payment so made by us under this bond shall be a valid discharge of our liability for payment there under and the Supplier [s] shall have no claim against us for making such payment.

4 We, ( \_\_\_\_\_ Bank) further agree that the guarantee herein contained shall remain in full force and effect during the period that would be taken for the performance of the said agreement and that it shall continue to do so enforceable till all the dues of the OPTCL under or by virtue of the said agreement have been fully paid and its claims satisfied or discharged or till Managing Director, ORISSA POWER TRANSMISSION CORPORATION LTD. certifies that the terms and conditions of the said agreement have been fully and properly carried out by the said Supplier [s] and accordingly discharges this Guarantee.

Unless a demand or claim under this guarantee is made on us in writing on or before the [Date \_\_\_\_\_], we shall be discharged from all liability under this guarantee thereafter.

5. We,( \_\_\_\_\_ Bank) further agree that the OPTCL shall have the fullest liberty without our consent and without affecting in any manner our obligations hereunder to vary any of the terms and conditions of the said agreement or to extend time of performance by the said Supplier [s] and we shall not be relieved from our liability by reason of any such variations or extension being granted to the said supplier [s] or for any forbearance, act or omission on the part of the OPTCL or any indulgence by the OPTCL to the said Supplier [s] or by any such matter or thing whatsoever which under the law relating to sureties would but these provisions have effect of so relieving us.

6. This guarantee will not be discharged due to the change in the name , style and constitution of the Bank and supplier [s].

7. We,[ \_\_\_\_\_ Bank] lastly undertake not to revoke this guarantee during its currency except with the previous consent of the OPTCL in writing.

8. We the \_\_\_\_\_ Bank further agree that this guarantee shall also be invokable at our place of business at Bhubaneswar in the state of Orissa.

Date at \_\_\_\_\_ the, \_\_\_\_\_ day of  
Two thousand \_\_\_\_\_

For \_\_\_\_\_  
[Indicate the name of the bank]

Witness (Name, Signature & Address)

1.

2.

## **ANNEXURE-III**

### FORM OF POWER OF ATTORNEY FOR JOINT VENTURE / CONSORTIUM

(On Non –Judicial Stamp Paper of rs100.00 value  
to be Purchased in the Name of Joint venture/ consortium)

KNOW ALL MEN BY THESE RESENTS THAT WE, the Partners whose details are given hereunder.....have formed a joint venture/consortium under the laws of .....and having our Registered Office (s)/Head Office (s) at .....(hereinafter called the ‘Joint venture/ consortium’ which expression shall unless repugnant to the context or meaning thereof, include its successors, administrators and assign(s) acting through M/s.....being the Partner in-charge do hereby constitute, nominate and appoint M/s.....a company incorporated under the laws of .....and having its Registered/Head Office at .....as our duly constituted lawful Attorney (hereinafter called “Attorney” or “Authorised Representative” or “Partner in Charge”) to exercise all or any of the powers for and on behalf of the joint venture/consortium in regard to specification No.....for construction of .....Package of ORISSA POWER TRANSMISSION CORPORATION LIMITED ( 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/consortium”.
- (ii) To-negotiate with 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/consortium”.
- (iii)To do any other act or submit any document related to the above.
- (iv)To receive, accept and execute the contract for and on behalf of the “Joint venture/consortium”.

It is clearly understood that the Partner in –charge (Load Partner) shall ensure performance of the contracts (s) and if one or more Partner fail to perform their respective portion of the contracts (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 of liability period in terms of the contract.

The joint venture/ consortium hereby agrees and undertakes to ratify and confirm all the whatsoever the said Attorney/ Authorised 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/ consortium by virtue of this Power of Attorney and the same shall bind the Joint venture/ consortium as if done by itself.

IN WITNESS THEREOF the Partners Constituting the Joint venture/ consortium 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 venture/ consortiums

.....  
.....  
.....

The Common Seal of the above Partners of the Joint venture/ consortium:

The Common Seal has been affixed there unto in the presence of:

**WITNESS**

1. Signature .....
- Name .....
- Designation.....
- Occupation.....
  
2. Signature .....
- Name .....
- Designation.....
- Occupation.....

# ANNEXURE-IV

## FORM OF JOINT VENTURE / CONSORTIUM AGREEMENT

(ON NON-JUDICIAL STAMP PAPER OF APPROPRIATE VALUE TO BE PURCHASED IN THE NAME OF JOINT VENTURE/ CONSORTIUM)

PERFORMA OF JOINT VENTURE/ CONSORTIUM AGREEMENT BETWEEN .....AND .....FOR BID SPECIFICATION NO.....OF CESU.

THIS Joint venture / consortium Agreement executed on this .....day of .....Two thousand and .....between M/s.....a company incorporated under the laws of ..... and having its Registered Office at..... (hereinafter 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 (hereinafter called the “Load Partner” which expression shall include its successors, executors and permitted assigns) for the purpose of making a bid and entering into a contract (in case of award) against the Specification No.: ..... for Construction of .....of OPTCL, agovt of orissa Undertaking, having its. Registered Office at OPTCL Office, Jnpath, Bhubaneswar (hereinafter 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-

AND WHEREAS Annexure – A (Qualification Requirement of the Bidder), Section-----, forming art of the biding documents, stipulates that a Joint venture/ consortium of two or more qualified firms as partners, meeting the requirement of minimum qualification for the bid as applicable may bid, provided the Joint venture/ consortium fulfills all other requirements of minimum qualification 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/ consortium, who will be jointly and severally liable to perform the Contract and all obligations hereunder.

The above clause further states that the Joint venture/ consortium 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/ consortium agreement between all the Partners

under these presents and the bid in accordance with the requirements of Annexure-A (Qualification Requirement of the Bidders), Section -SSC has been signed by all the partners.

NOW THIS INDENTURE WITNESSETH AS UNDER:

In consideration of the above premises and agreement all the Partners to this Joint venture/ consortium do hereby now agree as follows:

1. In consideration of the award of the Contract by the Owner to the Joint venture/ consortium partners, we, the Partners to the Joint venture/ consortium 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) 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, the 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 Partner(s).
4. The financial liability of the Partners of this Joint venture/ consortium agreement to the Owner, with respect to any of the claims arising out of the performance of non-performance of the obligation set forth in the said Joint venture/ consortium 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/ consortium agreement.
5. It is expressly understood and agreed between the Partners to this Joint venture/ consortium agreement that the responsibilities and obligation of each of the Partners shall be as delineated in Appendix-I (\*To be incorporated suitably by



the Partners that the above sharing of responsibilities of the Partners under this Contract.

6. This Joint venture/ consortium agreement shall be construed and interpreted in accordance with the laws of India and the courts of Bhubaneswar/Cuttack shall have the exclusive jurisdiction in all matters arising thereunder.
7. In case of an award of Contract, We the Partners to the Joint venture/ consortium 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/ consortium agreement shall be irrevocable and shall form an integral part of the Contract, and shall continue to be enforceable till the Owner discharge 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/ consortium 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.

<p>1. Common Seal.....of has been affixed in my/our pursuant to the Board of Director's dated.....</p> <p>Signature..... Name..... Designation.....</p>	<p>For Lead Partner</p> <p>(Signature of authorised resolution representative )</p> <p>Name..... Designation..... Common Seal of the company .....</p>
---	--

<p>2. Common Seal of .....For the Partners has been affixed in my/our presence Pursuant to the Board of Director's resolution dated</p> <p>Signature..... Name..... Designation.....</p>	<p>(Signature of authorised representative)</p> <p>Name..... Designation..... Common Seal of the company .....</p>
--	--

WITNESSES:

<p>1. .... (Signature)</p>	<p>Name..... ..... (official address)</p>
<p>2. ....</p>	

(Signature)

(Official address)

.....

**ANNEXURE-V**  
**PERFORMANCE SECURITY FORM**  
**Bank Guarantee- Unconditional**

.....

(Name of the Contract)

Date.....

To

Loan No.....

Contract No.....

(Name and address of the Employer)

Dear Ladies and/or Gentlemen,

We refer to the Contract (“the Contract”) signed on .....between you and ..... (“the Contractor”) concerning design, execution and completion of (Brief description of the Facilities).

By this letter we, the undersigned.....(Name of the Bank), a bank organized under the laws of .....and having its registered/principal office at ..... do hereby jointly and severally with the Contractor irrevocably guarantee payment to you up to the sum of ..... equivalent to ten percent (10%) of the Contract Price until twelve (12) months after the last date of Operational Acceptance.

Were, it is agreed between you and the Contractor that the Facilities are to be accepted in parts, and thus where there are separate Operational Acceptance Certificates for each part, this Letter of Guarantee shall be apportioned to the value of such part and shall reduce on expiry of twelve (12) months after the date of Operational Acceptance of the part. However, such reduction shall be effected once in one calendar year and the aggregate of such reduction shall be up to a limit of fifty percent (50%) of the value of Performance Security which shall remain valid until twelve (12) months after the last date of Operational Acceptance.

We undertake to make payment under this Letter of Guarantee upon receipt by us of your first written demand signed by your duly authorized officer declaring the Contractor to be in default under the Contract and without cavil or argument any sum or sums within the above named limits, without your need to prove or show grounds or reasons for your demand and without the right of the Contractor to dispute or question such demand.

Our liability under this Letter of Guarantee shall be to pay to you whichever is the lesser of the sum so requested or the amount then guaranteed hereunder in respect of any demand duly made hereunder prior to expiry of this Letter of Guarantee (date) without being entitled to inquire whether or not this payment is lawfully demanded.

This letter of Guarantee shall be valid from the date of issue until twelve (12) months after the last date of Operational Acceptance of the Facilities, i.e. up to and inclusive of .....(Year, month and date) whichever comes first.

Except for the documents herein specified, no other documents or other action shall be required notwithstanding any applicable law or regulation.

If the Defect Liability Period is extended with respect to any part of the Facilities in accordance with the Contract, the validity of this Letter of Guarantee shall be extended with respect to ten percent (10%) of the Contract Price of that part until expiry of such extended Defect Liability Period.

Our liability under this Letter of Guarantee shall become null and void immediately upon its expiry, whether it is returned or not, and no claim may be made hereunder after such expiry or after the aggregate of the sums paid by us to you shall equal the sums guaranteed hereunder , whichever is earlier.

All notices to be given hereunder shall be given by registered (airmail) post to the addressee at the address herein set out or as otherwise advise by and between the parties hereto.

We hereby agree that any part of the Contract may be amended, renewed, extended, modified, compromised, released or discharged by mutual agreement between you and the Contractor, and this security may be exchanged or surrendered without in any way impairing or affecting our liabilities hereunder without notice to us and without the necessity for any additional endorsement, consent or guarantee by us, provided, however, that the sum guaranteed shall not be increased or decreased.

No action, event or condition which by any applicable law should operate to discharge us from liability hereunder shall have any effect and we hereby waive any right we may have to apply such law so that in all respects our liability shall be irrevocable and, except as stated herein, unconditional in all respect.

Yours truly,

Name of the Bank

Authorized signature

Signature of witness\_\_\_\_\_

Name\_\_\_\_\_

Address\_\_\_\_\_

Note:

1. The non-judicial stamp papers of appropriate value shall be purchased in the name of the Bank who issues the “Bank Guarantee”.
2. Performance security is to be provided by the successful bidder in the form of a bank guarantee, which should be issued either:
  - (a) by a reputed bank located in the country of the Employer and acceptable to the Employer or
  - (b) by a foreign bank confirmed by either its correspondent bank located in the country of the Employer which should be reputed and acceptable to the Employer, or a Public Sector Bank in the country of the Employer.

# ANNEXURE-VI

## BANK GUARANTEE FOR ADVANCE PAYMENT

.....  
(Name of the Contract)

To

Date.....

Loan No.....

Contract No.....

(Name and address of the Employer)

Dear Ladies and/or Gentlemen,

We refer to the Contract (“the Contract”) signed on .....between you and .....(“the Contractor”) concerning design, execution and completion of (Brief description of the Facilities).

Whereas in accordance with the terms of the said Contract, the Employer has agreed to pay or cause to be paid to the Contractor an Advance payment in the amount of

\_\_\_\_\_

\_ (amount of foreign currency in words)

\_\_\_\_\_ (\_\_\_\_\_)

(Amount in Figures)

and

\_\_\_\_\_

(Amount of local currency in words)

\_\_\_\_\_ (\_\_\_\_\_)

\_)

(Amount in figures)

By this letter we, the undersigned.....(Name of the Bank), a bank organized under the laws of .....and having its registered/principal office at .....do hereby jointly and severally with the Contractor irrevocably argument in the event

that the contractor fails to commence or fulfill its obligations under the terms of the said advance payment to the Employer.

Provided always that the Bank's obligation shall be limited to an amount equal to the outstanding balance of the advance payment, taking into account such amounts that have been repaid by the contractor from time to time in accordance with the terms of payment of the said contract as evidenced by appropriate payment certificates.

This guarantee shall remain in full force from the date of upon which the said advance payment is received by the contractor until the date upon which the contractor has fully repaid the amount so advanced to the employer in accordance with the terms of the contract. At the time at which the outstanding amount is NIL, this Guarantee shall become null and void, whether the original is returned to us or not.

Any claims to be made under this Guarantee must be received by the Bank during its period of validity i.e. on or before \_\_\_\_\_\*(year, month, date).

We the bank further undertake that the BG shall be encashable at our operating Bank branch at Bhubaneswar

Yours truly,

Name of the Bank

Authorized signature

Signature of witness\_\_\_\_\_

Name\_\_\_\_\_

Address\_\_\_\_\_

- The date shall be three (3) months after the date of operational acceptance by the Employer.

Note:

1. The non-judicial stamp papers of appropriate value shall be purchased in the name of the Bank who issues the "Bank Guarantee".
2. Performance security is to be provided by the successful bidder in the form of a bank guarantee, which should be issued either:
  - (a) by a reputed bank located in the country of the Employer and acceptable to the Employer or
  - (b) by a foreign bank confirmed by either its correspondent bank located in the country of the Employer which should be reputed and acceptable to the Employer, or a Public Sector Bank in the country of the Employer.

# ANNEXURE-VII

## FORM OF COMPLETION CERTIFICATE

.....  
(Name of the Contract)

To

Date.....

Loan No.....

Contract No.....

(Name and address of the Employer)

Dear Ladies and/or Gentlemen,

Pursuant to GCC 24 (Completion of the Facilities) of the General Conditions of the Contract entered into between yourselves and the Employer dated .....relating to the .....(brief description of the Facilities), we hereby notify you that the following part (s) of the Facilities was (were) complete on the date specified below, and that, in accordance with the terms of the Contract, the Employer hereby takes over the said part (s) of the Facilities, together with the responsibility for care and custody and the risk of loss thereof on the date mentioned below

1 .Description of the Facilities or part or part thereof

.....

2. Date of Completion:

.....

However, you are required to complete the outstanding items listed in the attachment hereto as soon as practicable.

This letter does not relieve you of your obligation to complete the execution of the Facilities in accordance with the Contract nor your obligations during the Defects Liability Period.

Very truly yours,

Title

(Project Manager)

# ANNEXURE-VIII

## FORM OF OPERATIONAL ACCEPTANCE CERTIFICATE

(Name of the Contract) \_\_\_\_\_

To

Date.....

Loan

No.....

Contract No.....

(Name and address of the Employer)

Dear Ladies and/or Gentlemen,

Pursuant to GCC 25.3 (Operational Acceptance) of the General Conditions of the Contract entered into between yourselves and the Employer dated .....relating to the .....(brief description of the Facilities), we hereby notify you that the following part (s) of the Facilities was (were) complete on the date specified below, and that, in accordance with the terms of the Contract, the Employer hereby takes over the said part (s) of the Facilities, together with the responsibility for care and custody and the risk of loss thereof on the date mentioned below

1. Description of the Facilities.....
2. Date of Operational Acceptance:.....

This letter does not relieve you of your obligation to complete the execution of the Facilities in accordance with the Contract nor your obligations during the Defects Liability Period. Very truly yours,

Title  
(Project Manager)



# **ANNEXURE – IX**

## **GENERAL INFORMATION**

The bidder shall furnish general information in the following format.

1. Name of the Firm:

2. Head office address:

3. Contact persons:

Telephone No.

Office:

Residence:

4. Fax No.

Telex:

5. Place of incorporation/Regn.

Year of incorporation/Regn.



## ANNEXURE – XI

### ABSTRACT OF GENERAL TERMS AND CONDITIONS OF CONTRACT [COMMERCIAL] TO ACCOMPANY PART-I

1	(a) OPTCL Money Receipt No. & Date towards purchase of Tender. (b) Earnest money furnished. (A) Bank Guarantee, (B) Bank Draft.	
2	Manufacturer's supply experience including user's certificate furnished or not.[As per clause No.7 of Section-II.]	Yes/No
3	Deviations to the specification if any[list enclosed or not] [As per clause-9 of the Section-II] (a) Commercial 31 Technical.	Yes/No Yes/No
4	<b>Delivery</b> (period in months from the date of purchase order)	
5	<b>Guarantee:-</b> Whether agreeable to OPTCL's terms. [As per clause-18 of Section-II]	Yes/No
6	Whether agreeable to furnish Composite B.G. in case his tender be successful [As per clause-19 of Section-II]	Yes/No
7.	<b>Terms of payment:-</b> Whether agreeable to OPTCL's terms or not [As per clause-21 of Section-II]	Yes/No.
8.	Nature of price:- FIRM	Yes/No
9.	<b>Penalty:-</b> Whether agreeable to OPTCL's terms or not (As per clause-22 of Section-II)	Yes/No
10.	Whether STCC/ P&L A/C, Balance Sheet for the required period are furnished as per clause-25 of Section-II	Yes/No
11.	<b>Validity: -</b> Whether agreeable to OPTCL's terms or not [As per clause-28 of Section-II]	Yes/No
12.	Whether recent type test certificates from any Government approved laboratory are furnished or not. [As per clause-34[viii] of section-II]	Yes/No
13.	Whether guaranteed technical particulars in complete shape are furnished or not	Yes/No
14.	Whether dimensional design/drawings furnished or not	Yes/No
15.	Whether materials are ISI/ISO marked.	Yes/No
16.	Manufacturer's name and it's trademark.	Yes/No
17.	<b>Whether registered under Orissa Sales Tax Act. 1947</b>	Yes/No
18.	<b>Whether declaration form duly filled in furnished or not.</b>	Yes/No

**Place: -**

**Date: -**

**Signature of the Tenderer  
with seal of the company**

# ANNEXURE – XII

## PERSONNEL CAPABILITIES

### Name of Applicant:

Details of persons available with necessary qualifications and experience in erection of transmission Bay extensions, both managerial supervisory & workmen with necessary license/workman permit issued by the Electrical Licensing Board, Orissa shall be furnished in the following formats.

### A) PERSONNEL IN MANAGERIAL POSITION:

Sl. No.	Name of person with designation	Educational/ Tech. Qualification	Year of experience	Details of License from ELB (O)
---------	---------------------------------	----------------------------------	--------------------	---------------------------------

### B) PERSONNEL IN SUPERVISORY POSITION:

Sl. No.	Name of person with designation	Educational/ Tech. Qualification	Year of experience	Details of Licence from ELB(O)
---------	---------------------------------	----------------------------------	--------------------	--------------------------------

### C) PERSONNEL IN WORKMEN CATEGORY:

Sl. No.	Name of person with designation	Educational/ Tech. Qualification	Year of experience	Details of Licence from ELB(O)
---------	---------------------------------	----------------------------------	--------------------	--------------------------------

Place: -

Date: -

Signature of the Tenderer  
with seal of the company

## ANNEXURE – XIII

### EQUIPMENT CAPABILITIES

**Name of the Applicant:**

The bidder shall provide as the capability to meet the requirements for each and all items of equipment in their possession, for manufacturing, erection and testing in the following format:

**(A) Erection**

Sl. No.	Description of equipment	Model/ Power rating	Capacity	Year of manufacture

**(B) Testing:**

Sl. No.	Description of equipment	Model/ Power rating	Capacity	Year of manufacture

**(C) Concreting (Foundation Casting).**

**Place: -**

**Date: -**

**Signature of the Tenderer  
with seal of the company**

# ANNEXURE – XIV

## FINANCIAL CAPABILITY

### (A) ANNUAL TURNOVER:

**Name of the bidder:**

(The bidder is requested to complete the information in this Annexure. The information supplied should be the annual turnover duly audited by the Chartered Accountant for preceding three years for work in progress or completed).

**ANNUAL TURNOVER DATA:**

YEAR	TURNOVER	INDIAN RUPEES

**(B) The bidder shall also furnish the following information:**

1. Name of Banker:
2. Address of Banker:
3. Telephone:
4. Contact Name and Title:
5. Fax No-

Financial information In Rupees	Actual previous three years	Projected: Next two Years:
	1.      2.      3.	4

1. Total assets:
2. Current assets:
3. Total liabilities:
4. Current liabilities
5. Profit before taxes:

**( C ) Proposed sources of financing:**

- | Sources of financing | Amount (Rs.) |
|----------------------|--------------|
| 1.                   |              |
| 2.                   |              |
| 3.                   |              |

Attach audited financial statements for the last three years.

## ANNEXURE - XV

### EXPERIENCE RECORD

The bidder shall furnish details of work orders for similar nature of erection work received during the last three years and already completed and under execution.

Sl. No.	Work order/ No. & Date	Name & address of the owner	Value of contract	Scheduled date of delivery/completion of work	Slippage with	Remarks
---------	------------------------	-----------------------------	-------------------	---	---------------	---------

SIGNATURE OF  
TENDERER

NAME:

DESIGNATION:

(SEAL)

## ANNEXURE – XVI

### (DEPARTURE FROM SPECIFICATION)

#### Technical commercial

(A) Tenderer shall enter below particulars of his alternative proposals for deviation from the specification, if any.

Sl. No.	Clause No. of Specification	Particulars of deviation	Price
---------	-----------------------------	--------------------------	-------

Date:

Place:

SIGNATURE OF  
TENDERER  
NAME:  
DESIGNATION:  
(SEAL)



## ANNEXURE – XVII

### (DEPARTURE FROM SPECIFICATION)

#### Financial

**(B) Tenderer shall enter below particulars of his alternative proposals for deviation from the specification, if any.**

Sl. No.	Clause No. of Specification	Particulars of deviation	Price
---------	-----------------------------	--------------------------	-------

Date:

Place:

SIGNATURE OF  
TENDERER  
NAME:  
DESIGNATION:

## ANNEXURE – XVIII

### LITIGATION HISTORY

Name of the Bidder:

Bidder should provide information on any history of litigation or arbitration resulting from contracts executed in the last five years or currently under execution. **Furnishing False declaration may liable for rejection of the Tender**

Year.	Award for or against bidder	Name of client, cause of litigation and matter in dispute	Disputed amount (current value in Rs.)
-------	-----------------------------	---	--

SIGNATURE OF  
TENDERER

NAME:

DESIGNATION:

(SEAL)

## ANNEXURE-XIX

### SCHEDULE OF QUANTITY AND DELIVERY

(To be filled up by the tenderer )

SL No	Description of materials	Quantity required	Desired Delivery/completion Time	Destination	Remarks.
1	2	3	4	5	6
1	Design,supply,testing,commissioning of 33 KV Capacitor Bank at Different Grid S/S	AS PER T.S	Twelve months from the date of issue of Detailed PO	As indicated in the spec.	

Place:

Date:

Signature of Tenderer  
with seal of Company

## **ANNEXURE-XX**

### **ABSTRACT OF PRICE COMPONENT [TO ACCOMPANY PRICEBID]**

1	Price basis	F.O.R. Purchaser's destination Stores/site.
2	Packing & forwarding	
3	Rate of Insurance charges	
4	Rate of Freight charges	
5	Rate of excise duty	
6	Rate of sales Tax	
7	Rate of other taxes/levies /duties etc.	
8	Rate of entry tax.	
9.	Rate of Service Tax on supervision of erection testing and commissioning	
10.	Nature of price.	

**Place**

Date:  
**Tenderer**

**Signature of**

**With seal of  
company**

NB:- Abstract of price component shall be done for equipment/material offered, for testing & commissioning charges, if any. All the above prices will be taken during bid price evaluation.

# SECTION – V

## **COMPREHENSIVE AMC( FOR CAPACITOR BANK INSTALLATION SCHEME)**

### SCOPE OF AMC(Comprehensive) FOR CAPACITOR BANK INSTALLATION SCHEME

**(I) Annual Maintenance Contract (Comprehensive)** for the Capacitor Bank Installation Scheme( in the 33 KV side of the Grid sub-stations )to be provided by the contractor for a period of 10(Ten) Years beyond the Guarantee period and shall have following scope:-

There shall be four nos. of operation of the Capacitor Bank installations in a day. AMC shall be inclusive of all materials, T&P's, Technical personnels and labours.

**(a) Preventive Maintenance** Quarterly(every three months): Bidder to Check Properly to ascertain the performance to the satisfaction of OPTCL in each quarter. These inspections to be carried out in presence of OPTCL Engineer and your representative. A report on inspection & testing along with the status of the Capacitor Bank Installation Scheme to be jointly signed for reference and record. In case any defects are noticed during Preventive Maintenance, such defects are to be rectified within 15 days.The materials/equipments required to rectify the defects are to be supplied by the bidder free of cost to OPTCL.In case bidder fails to perform the Preventive maintenance within the scheduled stipulated time, the purchaser shall recover from the supplier/bidder a penalty for the delay as per the Penalty clause indicated below **(III-A)**.

**(b) Break down maintenance:**In case any defect is noticed, the contractor shall be intimated by the owner, and contractor shall attend the spot within 07 days from the date of intimation(Date of issue of Letter) positively and shall ascertain the defects and shall rectify the same within 15 days from the date of intimation (Date of issue of Letter) for minor defects and within 30 days rom the date of intimation (Date of issue of Letter) for the major defects to the contractor. In case contractor fails to rectify the defects within the scheduled time, the purchaser shall recover from the supplier/contractor a penalty for the delay as per the Penalty clause indicated below **(III-B)**. The date of intimation to the bidder regarding the troubles/defects of the Capacitor Bank

Installation scheme, shall be reckoned as the base date for computing the Penalty amount

**( II) TERMS OF PAYMENT:** (For AMC Contract of Capacitor Bank Installation Scheme)

The terms of payments under this contract shall be governed as per the following:

1. Your unconditional acceptance of this order.
2. A performance Bank Guarantee as per the proforma enclosed for 10% of the total Maintenance Contract price(for 10 years) , which will remain valid for more than two months from the expiry of the contract period.
3. Payment will be made equally at the end of each half(every six months) period starting from the date of contract agreement as per the details below:

(a) Release of payment for the 1<sup>st</sup> instalment:- All the Capacitor Bank Installation schemes need to be Checked Properly under Preventive Maintenance (PM) to ascertain the performance to the satisfaction of OPTCL in each quarter. This inspection to be carried out in presence of OPTCL Engineer and your representative and a report on inspection & testing along with the status of the Capacitor Bank Installation Scheme should be jointly signed and furnished to the verifying authority(Concerned A.G.M of O&M Division) for verification and onward transmission to C.G.M (O&M)/Nodal Officer. C.G.M (O&M)/Nodal Officer shall intimate/forward the documents along with the invoice to Sr.G.M( CPC) for release of the payment. You have to furnish the draft format for the inspection/testing& Status report of the Capacitor Bank Installation scheme,which shall be approved by the C.G.M (O&M),OPTCL, Bhubaneswar.

(b) Similarly the payment of 2<sup>nd</sup> installments (last Instalment of the each year)of each year are to be paid to you at the end of each year (12 months) , during which the inspection of Capacitor Bank Installation Scheme to keep the Bus Bar protection schemes in a healthy and functional condition, shall be carried out by the bidder, on production of documents as indicated above.

**(III) PENALTY:**

(A) In the event of failure on your part to comply with the provisions of the contract regarding attending to the **Break down** of the Capacitor Bank Installation scheme at various grid substations as indicated elsewhere, a penalty @0.5% of the total contract value for each day of delay, or part thereof, for such delay, subject to no upper ceiling, will be levied, without prejudice to any other remedies to which OPTCL may also be entitled, under the provisions of the contract/bid specifications.

(B) In the event of failure on your part to comply with the provisions of the contract regarding attending to the **Preventive maintenance**(PM) of the Capacitor Bank

Installation scheme at various grid substations as indicated elsewhere, a penalty @30% of the total AMC value for the period shall be imposed for that quarter.

**(IV) PERFORMANCE SECURITY:**

(a) You are requested to furnish a **composite bank guarantee** of 10% of the contract value in our standard bank guarantee format (as enclosed) towards security payment and performance from any Nationalised/Scheduled Bank having a place of business at Bhubaneswar on non-judicial stamp paper worth of Rs.29.00 (Rupees twenty nine) only or as applicable as per the prevailing laws. The said B.G. shall be accompanied with the confirmation letter from the issuing bank & should be capable of being encashed at Bhubaneswar, in order that the B.G. is accepted. The B.G. shall be furnished in favour of Senior General Manager (CPC), OPTCL, Bhubaneswar-751022 within 30 days from the date of issue of AMC order and shall remain valid for two months more than the expiry of the contract period. Where the contract is extended, the B.G. should also be suitably extended, to cover the entire contract period.

(b) No interest is payable on the Composite Bank Guarantee.

(c) In case of non-fulfillment of contractual obligation in any manner, performance bank guarantee shall be invoked without intimation to you.

**(V) GUARANTY:**

It will be your responsibility to maintain the entire Capacitor Bank Installation schemes, as described in the scope of the contract in healthy and functional manner. The repair and replacement work will be completed within 15 days from the registering of the complaints by OPTCL Engineers of the concerned Grid substations or AGM/DGM/GM of the concerned Division or Circles respectively failing which the penalty clause as at **clause-III** shall be applied. The replacement of equipments will be done by using materials from the stock to be kept under you. Any equipment removed from the Capacitor Bank Installation scheme location and taken for rectification, will be rectified and returned back to OPTCL at your own risk and expense, within 15 days from the date of such removal. The date of removal will be reckoned as the date of handing over & taking over report jointly signed by OPTCL Engineer of the concerned Grid substations and your representative.

(a) An indemnity bond shall be furnished before receiving materials from OPTCL .

(b) In case the materials are not returned back to OPTCL within 15 days , a penalty shall be levied on the bidder as per clause **III-B**. In case the bidder did not return the materials taken from the Capacitor Bank Installation scheme the BG furnished towards the AMC shall be encashed without any intimation to you.

**(VI) NODAL OFFICER:**

A nodal officer shall be appointed by OPTCL, who will monitor the execution of entire maintenance activities within the scope of this contract. You will furnish all the records, reports, receipts etc., to the Nodal Officer, who will forward the documents, after due verification, for initiation of quarterly payment activities.

**(VII) CONTRACT AGREEMENT:**

You shall prepare and finalise the Contract Document for signing of the formal Contract Agreement with us, as per the proforma to be provided to you, on non-judicial stamp paper of appropriate value within fifteen days from the date of this order. The contract papers shall be prepared in 2(two) originals and copies shall be 1(one) no for each sub-station, where the Bus- Bar protection is proposed.

**(VIII) DURATION OF CONTRACT:**

**This AMC shall be in force for a period of 10(ten) Years, beyond the Guarantee period of 36 months as stipulated in the Specification.**





**ORISSA POWER TRANSMISSION CORPORATION LIMITED**  
(A Government of Orissa Undertaking)

**TECHNICAL SPECIFICATION**

**FOR**  
**(33KV SHUNT CCAPACITOR BANK&ASSOCIATED EQUIPMENT)**

SUPPLY & ERECTION OF EQUIPMENTS & STRUCTURES INCLUDING ALL CIVIL WORKS AND TESTING & COMMISSIONING & TROUBLE FREE MAINTENANCE FOR 10 YRS BEYOND GUARANATEE PERIOD OF CAPACITOR BANK INCLUDING OTHER EQUIPMENTS LIKE CURRENT LIMITING REACTOR,CIRCUIT BREAKER, CURRENT TRANSFORMERS & NCT, CONTROL & PROTECTION SYSTEM OF DIFFERENT CAPACITY TO BE INSTALLED IN 33 KV SIDE AT DIFFERENT GRID SUB-STATION OF OPTCL.



**ORISSA POWER TRANSMISSION CORPORATION LIMITED**  
**(A Government of Orissa Undertaking)**

**SCOPE OF THE CONTRACT**

The scope of the contract shall be to design, manufacture, supply of all type of equipments/materials as per the specification at the consignee's site, and rendering services in accordance with the enclosed technical specification and bill of quantity. It also includes Leveling of site, excavation of pits, casting of foundation for elevating structures on concrete plinth and other mounting structures as applicable as per approved drawing, erection, elevating structure and mounting rack, painting wherever required, assembling of capacitor units on the rack, individual connection to make bank formation, associated equipments like Surge arrestor, Circuit Breaker, Current limiting reactor, Current Transformer and NCT, Control & Relay panel, control cable, earthing, conductor, insulators, Isolators etc. in complete manner, testing and commissioning of the capacitor bank. It includes supply of all the equipments and materials. Also includes construction of cable trenches, provision cable trays and racks and laying of cables for control and protection. The Harmonic studies of each sub-station are to be conducted by the Bidder and furnish the same to OPTCL for further necessary action. The Bidder has to conduct harmonic study before participating in the tender.

**Site surfacing** are also to be done by spreading 20mm nominal crusher broken HG metals in two compacted layers to maintain 100 mm thickness for the entire area of the proposed capacitor bank. The spreading of metal shall be done after spreading of good quality organic free river bed sand of 150mm thickness(compact). The spreading of sand shall be done after making antiweed treatment as per standard practice and instruction of Engineer in Charge.

**Laying of earth mat (75X10 mm GI Flat) and other earth riser(50 X 6 mm GI Flat)** to the equipment and structural (50X6 mm GI Flat) and treated earth pit are also under the scope of this contract.

Under this scope , the bidder has the responsibility for **10 years maintenance (includes supply of materials and labour)** of the installed capacitor Bank for trouble free operation beyond the guarantee period. Bidder has to ascertain that the breakdown occurred in the capacitor bank shall be rectified in a very reasonable time (preferably within two days of occurring of fault). Minimum spare list is enclosed for reference and quoting the AMC price, which shall be on LOT/Package basis. Bidder has liberty to visit the different sites to ascertain the quantum of works required to be taken up before quoting of price.

### **TECHNICAL SPECIFICATION 33KV STATIC SHUNT CAPACITOR of 20,15,10 & 5 MVAR WITH ALL ASSOCIATED ACCESSORIES & EQUIPMENT.**

1. This specification covers design & engineering, manufacturer, testing at manufacturers works, supply and delivery of 33KV 3 –ph capacitor bank of 20,15,10 & 5 MVAR with all accessories & allied equipment including structures, support insulators and clamp connectors at site for outdoor installation complete in all respect as on 'Turn Key Supply' basis. Mounting racks for Capacitor Bank and series reactors shall be suitable for mounting on plinth in outdoor switch yard. The scope includes supply and erection including civil works of 36 KV Capacitor Bank of different capacity, current limiting series reactor, Vacuum Circuit Breaker, and associated equipment like Current Transformer, NCT, Isolators, LA, conductor & control cables, Galvanising structures (complete mounting structures as per requirement) for the equipments, etc. and associated Control & Relay Panel .
2. **STANDARD:**

The capacitor banks and accessories covered by this specification shall conform to latest edition of IS or IEC publication as amended up to date, unless specifically stated otherwise in this specification, as follows:

- |    |                                   |                                 |
|----|-----------------------------------|---------------------------------|
| a) | Shunt capacitors for Power System | : IS:13925- 1998                |
| b) | Power capacitors                  | : IEC Publication No.70         |
| c) | Series Reactors                   | : IS: 5553-1990                 |
| d) | Vacuum Circuit Breakers           | : IEC 56 & IS:1516              |
| e) | Gap less Lighting Arrestors       | : IEC:60099-4/2001,IS-3070-1993 |

f) Current Transformers. : IS:2705

3. **DEVIATION:**

Normally the offer should be as per Technical Specification without any deviation. But any deviation felt necessary to improve performance, efficiency and utility of equipment must be mentioned in the Deviation Schedule' with reasons of such deviation. Such deviation suggested may or may not be accepted. Deviations not mentioned in Deviation Schedule will not be considered.

4. SPECIFIC TECHNICAL PARAMETERS.

4.1 CAPACITOR BANK:

System Description:

The Capacitor Bank are fore use for a 3-phase, 50Hz, 33KV system 20 MVAR, 15 MVAR, 10MVAR and 5 MVAR Capacitor Bank shall consist of individual small units connected in series/phase and parallel/phase combination each with required output and voltage rating suitable to adopt in 36 KV system (HSV) connected in double star formation and unbalance protection by neutral current transformer . (Preferred rating of Capacitor Unit & Reactor enclosed in Note-A).

Vacuum Circuit breaker suitable for Capacitor Bank duty and line CTs are to be provided for protection purpose. CTs are provided for metering and O/C and E/F protection. NCT is provided to detect the unbalance on account of failure of element in any of the capacitor unit and will trip the breaker through unbalance protection relay provide in the control & relay panel. O/V, U/V relays and metering system are to be provided in the control & relay panel to be energized from sub-station PT secondary and shall trip the breaker in case of O/V and U/V of the system.

4.2 CAPACITOR LOSSES:

The capacitor shall be of low loss type. The losses in Watts for each capacitor unit including losses in fuses and discharge resistors forming integral part of capacitors along with losses for series reactor shall be guaranteed. If the test figures of capacitor losses exceed 0.2 W / KVAR the capacitor will be liable for rejection. Total losses shall be complied as below:

Total Loss:  $6 * (W * n + \text{losses in series reactor / phase / star connection})$

Where “n” is the no. of capacitor units per phase of star connection and “W” is the total loss in a capacitor unit.

Losses in series reactor shall be furnished separately.

#### 4.3 CAPITALISATION OF LOSSES AND LIQUIDATED DAMAGES:

***The dielectric losses of capacitors, and I<sup>2</sup>R loss of series reactors etc. will be capitalized during evaluation of the bid at the rate of Rs.90,054.00(Rupees Ninety thousand fifty four only) per KW. The losses shall be quoted as guaranteed maximum figures. The losses found during testing will be compared with corresponding guaranteed figures and the liquidated damages will be calculated at the rate of Rs.180108.00(Rupees One lakh eighty thousand one hundred eight only) per KW for the excess of differences between the test figures over the corresponding guaranteed figures.. For fraction of KW, penalty shall be applied pro-rata basis. No bonus shall be payable for losses, which are less than those stated in the bid.***

Capacitor banks shall comply with the following technical requirements.

i)	Nominal system voltage (KV)	:	33
ii)	Highest system voltage (KV)	:	36
iii)	Minimum MVAR capacity required at nominal system voltage (33 kv)	:	20,15,10 & 5 MVAR
iv)	a) Rated voltage of capacitor banks (KV):	:	38
	b) Rated output of capacitor bank at rated voltage (MVAR)	:	26.520,19.890,13.260 & 6.630 MVAR
v)	Permissible overloads:		
	a) Current	:	180%
	b) Voltage	:	110%
	c) KVAR	:	130%
vi)	Capacitor Tolerance	:	-0, +10%
vii)	Discharge Time per bank	:	600 sec to $\leq$ 50 V (Max.)
viii)	Case	:	CRCA with minimum thick-

			ness 1.25 mm
ix)	Paint	:	Epoxy/Poly Urethane
x)	Bushing	:	Two bushings shall be welded/ press fit to the case. Solder system is not acceptable.
xi)	Dielectric System	:	Polypropylene.
xii)	Reliability	:	Average annual failure rate shall be low and annual failure rate is to be furnished.
xiii)	Connection of capacitor bank	:	Double star with ungrounded neutral.
xiv)	Rating of capacitor units	:	Preferred data as per note (A) below.
	(Note: Improved design of units With different higher ratings May be considered.)		
xv)	No.of units per bank for	:	Preferred data as per Note (A) below.
xvi)	Min. capacitor KVAR available At nominal system voltage (with no series reactor)	:	As per requirement of design and to be specified with supporting calculation for verification.
xvii)	Fuse	:	Internal element fuse/fuseless
xvii)	Power loss (Tan Delta) including Loss in fuse.	:	<b><u>Not to exceed 0.2W/KVAR</u></b>
xviii)	Dielectric medium in capacitor unit	:	Non Toxic,Non PCB(Poly Chlorinated Biphenyl oil)

Note: A) Preferred ratings (min.) of each capacitor unit of the Capacitor Bank are as follows.

Nominal rating of bank in kvar (at 33kV)	Rating of each unit of Capacitor bank
-1-	-2-
5	208.33
10	416.67
15	416.67
20	416.67

Rating in KVAR (In 38 KV)	Rating of each unit of the Capacitor Bank(kvar)	Voltage in KV for each unit.	Normal Currents in Amps for each Bank.	No. of series group/p hase/Star.	No. of parallel units/SG/ Star/ Phase	Total No. of units/ phase/ Star	Total No. of units per Bank.
-3-	-4-	-5-	-6-	-7-	-8-	-9-	-10-
6630	276.25	10.97	96.23	2	2	4	24
13260	552.5	10.97	192.46	2	2	4	24
19890	552.5	10.97	288.68	2	3	6	36
26520	552.5	10.97	384.91	2	4	8	48

#### 4.4 33 KV CIRCUIT BREAKER:

33 KV Vacuum Circuit Breaker of standard design and suitable for breaking capacitor bank current shall be used for isolation of capacitor bank in case of fault or failure of capacitor unit. The breaker will be tripped through protective relays provided in the control and relay panel for O/V, U/V, O/C, E/F and unbalance current between neutral of double star connected capacitor bank.

The breaker shall be designed for remote control operation from the control & relay panel in the control room, Provision shall be kept for local/manual operation of the circuit breaker. Annunciation and audible alarm shall be provided in control & relay panel in case of fault.

Circuit breakers (VCB) shall comply with the following technical requirements:

i)	Nominal system voltage (KV)	:	33
ii)	Highest system voltage (KV)	:	36
iii)	Type	:	Vacuum
iv)	Location	:	Outdoor
v)	Nominal current (Amps)	:	1250
vi)	Short circuit withstand current (KA):		25.1 KA for 3 sec.
vii)	Operating duty	:	Suitable for capacitor bank.
viii)	Insulation level		
	a) Impulse withstand		
	Voltage KV (peak)	:	170
	b) Power frequency. Withstand		
	Voltage KV (rms)	:	70
ix)	The breaker shall be rated		
	For switching in/out the		
	Capacitor bank for which		
	Relevant Test Reports shall	(Re strike free & suitable for C2 duty)	
	Be submitted.	:	As per IEC:62271-100/200
x)	Creepage distance (mm)	:	900
xi)	Auxiliary voltage (volts)	:	D.C.-220V+/-10% A.C.-230 V+/-
			10% or 400 V +/- 10%
xii)	Breaking time	:	Not exceeding 60 ms
xiii)	Closing time	:	Not exceeding 130 ms
xiv)	System earthing	:	Earthed through grounding
			Transformer.
xv)	Operating mechanism	:	Spring
xvi)	Trip Coils	:	2 Nos.
xvii)	Shunt Capacitor Bank switching	:	400A ( Over Voltage factor
	Braking Capacity		<2.5 p.u.)
xviii)	Making Capacity.	:	As per IS

**Note C.B. should be capable of capacitor Bank duty.**

#### 4.5 SERIES REACTOR:

Series Reactor shall be provided to limit the inrush current in line with I.S. The reactor shall be air cored cooled of Cu materials.

Series reactors shall comply with the following technical requirements.



i)	Nominal system voltage (KV)	:	33
ii)	Highest system voltage (KV)	:	36
iii)	Type	:	Air core (dry type)
iv)	Linear characteristic	:	Up to 1.5 P.U.
v)	Rating of reactor (KVAR)	:	XL = 0.2% of XC
vi)	Short time withstand capacity	:	16.5 times of 130% of rated current & duration.
vii)	Basic Insulation level		
	a) Impulse withstand voltage (KV peak)	:	170
	b) Power frequency withstand Voltage (KV (rms))	:	70
viii)	Fittings and accessories	:	as required
ix)	Creepage distance (mm)	:	900
x)	Temperature rise	:	As per IS:5553 Part-II
xi)	Material of windings.	:	<b><u>Copper.</u></b>

#### 4.6 CURRENT TRANSFORMER:

Current Transformers shall be of standard design with class. A insulation. It shall be oil filled, hermetically sealed, ONAN cooled outdoor type having temperature rise not more than a) **for oil : 40°C and for b) Winding: 45°C** for full load. CT characteristic shall be such as to provide satisfactory performance from 5% to 120% of rated burden in case of metering Core and up to knee point voltage in case of protection core.

Current transformers shall conform with the following technical requirements.

i)	Nominal system voltage (KV)	:	33
ii)	Highest system voltage (KV)	:	36
iii)	Type	:	Outdoor, Oil-cooled wound Primary type.
iv)	No. of cores	:	2
v)	No. of primary winding	:	1
vi)	Primary rated current (Amps)	:	400-200/1-1
vii)	Secondary rated current (Amps.)-		1
viii)	Indicative- Rated burden (VA)		

	a) Core I & II	:	- / 20
ix)	Accuracy class		
	a) Core-I	:	PS
	b) Core-II	:	0.2
x)	Accuracy Limit factor (Core II)	:	Not less than 10
xi)	Instrument security factor (Core II):		Not exceeding 5
xii)	Rated short time current	:	25.1 KA for 3 sec.
xiii)	Dynamic current (KA peak)	:	2.5 times of above.
xiv)	Insulation level		
	a) Lightning Impulse withstand voltage (KV peak)	:	170
	b) Power frequency withstand Voltage (KV (rms)	:	70
xii)	Creepage distance (mm)	:	900

4.7 Neutral current transformers shall comply with the following technical requirements.

i)	Nominal system voltage (KV)	:	33
ii)	Highest system voltage (KV)	:	36
iii)	Ratio		2/1-1A or as required for unbalance Protection.
iv)	No. of cores	:	2
v)	Indicative Rated burden (VA)		
	Core-II	:	20
vi)	Accuracy class Core- I&II	:	5P10/0.5
vii)	Accuracy limit factor (Core-I&II)	:	Not less than 10
viii)	Creepage distance (mm)	:	900
ix)	Insulation level		
	a) Impulse withstand voltage (KV peak)	:	170
	b) Power frequency withstand Voltage KV (rms)	:	70

Note: Calculation for rated burden of CT and NCT shall be furnished and may be finalized during detail engineering. Calculations of unbalancing should be submitted for approval/ record.

#### 4.8 LIGHTNING ARRESTOR:

The Lightning Arrestor shall be capable of discharging lightning and switching surge and temporary power frequency over voltage. The LA shall be of heavy duty station class gapless zinc oxide type and hermetically sealed units suitable for out door installation.

Lightning Arrestors shall comply with the following technical requirements.

i)	Nominal system voltage (KV)	:	33
ii)	Highest system voltage (KV)	:	36
iii)	Type	:	Gapless, Station-type
iv)	Rated voltage (KV)	:	30
v)	Continuous operating voltage (KV)	:	33
vi)	Nominal discharge current (KA)	:	10
vii)	Rated frequency	:	50 Hz
viii)	Discharge class	:	3
ix)	Maximum steep front impulse (1/20 Micro secs) Residual Voltage (KVp) at nominal Discharge current (KA)-	:	130
x)	Lightning impulse (8/20 micro secs) Residual voltage (KVp) at nominal Discharge current of 10 KA	:	90
xi)	Min. Creepage Distance (mm)	:	900
xii)	Pressure relief current	:	As per IEC
xiii)	Basic Ins. Level for arrester housing.		
	a) Power frequency withstand voltage (KV rms)	:	70
	b) Lighting impulse withstand Voltage (KV peak)	:	170
4.0	ISOLATOR FOR 33 KV	:	As per Annexure-II
4.10	CLAMPS AND CONNECTORS	:	Do
4.11	EQUIPMENT FOUNDATION & STRUCTURES	:	Do

## 5. C&R PANEL:

This specification covers manufacture, assembly, testing at manufacturers works, supply, delivery of simplex type 33 KV C&R panel complete in all respect.

The control and relay panel shall be simplex type, self supporting steel cu bide for use in indoor installation. The panel shall be fully enclosed with access door at the rear side.

The panel shall be 2250 mm in height with channel base, 610 mm in depth and of suitable width to accommodate the equipment as specified hereinafter. It shall be made of steel plate of 3 mm thick in the front of panels and light sections of structural steel and side panels, door and top covers shall be of 2 mm thick steel plate.

The control board frame shall be suitable for erection on flush on base channel and secured to it by means of evenly spaced bolts. The channel shall be fixed to the floor by grouting bolts.

The panel shall be dust and vermin proof and suitable for use in tropical climate. All ventilating louvers and holes shall be covered with fine wire mesh from inside.

All unfinished surface of the steel panel and frame works shall be sand blasted. The exterior and interior surface of the panel shall be painted with three coats of paints, the first coat to serve as rust resisting prime and second coat to serve as base and binder for the third and finished coat. The finishing coat on the exterior of the panel shall be light gray polished cellulose enamel as peer shade 631 of IS:5, while on the interior faces the finishing coat shall be of white shaded paint.

The panel shall be complete with space heater, illumination lamp with door switch, cable glands, terminal blocks, necessary small wiring, safety earthing connections, name plate and all usual accessories.

The panel shall be supplied complete with channel base, grouting bolts, nuts, lock nuts, washers etc.

Coloured mimic diagram and symbol showing exact representation of the system shall be provided in front of control panel. When semaphore indicator are used for isolators they shall also be mounted in the mimic.

All equipments mounted on the front and rear side as well as equipment inside the panels shall be provided with individual name plates with the equipment designation engraved.

i) **WIRING:**

All wiring shall be carried out with 1100 V grades, single core, stranded copper conductor shall be as follows:

- i) All current transformer and voltage transformer circuits : : 2.5 sq. mm per lead
- ii) All other circuits : : 2.5 sq. mm per lead

Each wire shall be continuous from end to end and shall not have any joint within itself. Terminal ends of all wires shall be provided with numbered ferrules suitably coloured for phase identification. At the terminal connection, washers shall be interposed between terminals, wire terminals and holding nuts. All holding nuts and bolts shall be secured by locking nuts. The connection stud shall project at least 6 mm from the lock nut surface. All studs, nuts, bolts, screws etc. shall be treated.

ii) **TERMINAL BLOCK CONNECTION:**

Terminal block connectors built from cells or molded dielectric and brass stud inserts shall be provided for terminating the outgoing ends of the cubicle wiring and the corresponding incoming tail ends of the control cables. The terminal block shall be 1100 Volt grade and 10 A continuous rating. 20% spare terminal shall be provided and spare terminals shall; be uniformly distributed on all terminal blocks.

iii) **AUXILIARY POWER CIRCUIT:**

D.C. Circuit:

220-V D.C. +/-10% incoming supply will be made through suitable MCB in addition to fuses & link from D.C. board of respective s/s.

D.C. supply for control, protection, indication and supervision of circuit breaker and other equipment shall be teed off in each- panel from above D.C. incomer bus through a set of suitable HRC fuse & link for positive and negative side respectively.

A.C. Circuit:

230 A.C. +/- 10% single phase incoming supply will be made from A.C., board through MCB in addition to fuse & links. Heater circuit and illuminating lamp circuit shall be connected with the above A.C. bus through H.R.C. fuse and links. 3-pin plug circuit shall be connected through H.R.C. fuse and links.

Carrier and base for the fuses and links for all D.C. and A.C. circuits shall have imprints of rating voltage and circuit designation.

Necessary monitoring scheme for failure of panel D.C. supply A.C. supply with audible and visual alarm and its acceptance through accept relay shall be provided.

iv) CONTROL SWITCHES:

Control switches for C.B. shall be of three position spring return type with pistol grip handle with ON & OFF indication through lamps. The switches shall be of robust construction and shall have three position indications, namely, close/Normal/Trip.

v) SAFETY EARTHING:

Earthing of current free metallic parts or metallic bodies of the equipment on the panel shall be done with soft drawn single copper conductor. Provision shall be made at two points at the bottom of the panel for earth connection of the panel with the substation earthing system.

vi) INDICATING INSTRUMENTS-AMMETERS, VOLTMETER VARIMETERS:

*All instrument shall be switch board type, back connected, suitable for semi flush mounting and provided with dust tight cases for tropical use with black enamel finish. Marking of scale shall be black on white back ground. Spring controlled instruments shall be provided with zero adjuster. Ammeter, voltmeter and VAR meter shall conform to IS-1248.*

**REMARKS: All the indicating instruments shall be digital type.**

All ammeters and MVAR meter shall be of 1.0 class accuracy and shall be provided with direct reading scales. Full scale value of the ammeters shall be 110% of the nominal current of maximum C.T. Current. The ammeter shall be connected to measuring C.T. core. It shall be of 144 sq. mm. & 900 scale suitable for R.Y.B. phase correct measurement through selector switch. These shall be capable of withstanding applied load of 20% greater than the rated capacity for a period of eight hours. Voltage supply to MVARH meter shall be taken from star connected protection P.T. The voltmeter shall be suitable for R, Y, B phase and phase to phase measurement.

vii) RELAYS:

Main Relays shall be numerical type and suitable for semi-flush mounting on the panel board. All the relays shall be back connected, protected with dust tight cases for tropical use. If testing devices are not incorporated in the relay itself, separate test blocks shall be provided. The adjusting devices shall be accessible with the relay mounted on the panel board. Flag type operating indicators and flag indicator reset devices shall be provided. The latter shall be suitable for operation from the front of the relay case without opening the cover.

The relays shall comply in all respects with the requirement of IS-3231-1965 or equivalent standards. The contacts of the relays shall be silvered and precautions shall be taken to prevent or minimize damage due to arcs which have to be successfully broken against 220 V.D.C. +/-10%. When open, the contacts shall withstand a voltage of 115% of the normal circuit voltage.

viii) SCHEDULE OF EQUIPMENT OF CONTROL & RELAY BOARD

Each panel shall be comprising of the following relays (numerical) and accessories:

Sl. No.Nos.	I t e m s
1. (i)	1no. Ammeters (Digital) with selector switch for measuring capacitor bank current
(ii)	1 no. Voltmeters (Digital)with selector switch
(iii)	1 no. Power factor meter. (Digital)
(iv)	1no. Ammeters (Digital) for measuring capacitor bank unbalance current.
2.	1 No. Triple pole non-directional IDMT (numerical type) over current relay with wide range of time & current settings of current 1A.
3.	1 no. Single pole non-directional IDMT (numerical type) earth fault relay with wide range of time & current settings of current 1A.
4.	1 set Unbalance protection scheme relays for double star connected capacitor bank with floating neutral. The relay used shall detect two current level. One for alarm and another for tripping, It shall be able to provide alarm in the event of failure of one or two units (as per requirement) before tripping.
5.	1 no. Pistol grip type C.B. control switch.
7.	1 no. Under voltage protective relay (numerical type) with inverse time characteristic
8.	1 no. Over voltage relay (numerical type) with inverse time characteristic.
9.	1 no. C.B. closing interlock with a timer having 3 to 15 minutes range as per capacitor discharge time so that the C.B. cannot be closed within the capacitor discharging time
10.	1 no. MVAR meter-3 element. (Digital)
11.	1 no. Semaphore indicator for isolator.
12.	5 nos. Indicating lamps (LED type) for C.B. spring charge, trip circuit healthy (2 nos.) circuit breaker ON and OFF.
13.	1 no. Push button for circuit breaker spring charge supervision. 2 nos. Auxiliary relay for C.B. trip circuit healthy supervision.
14.	1 set. Panel D.C. fail alarm scheme comprising of: <ul style="list-style-type: none"> <li>a) D.C, operated No-volt auxiliary relay with reverse flag indicator with test P.B-1 no.</li> <li>b) A.C. operated Hooter-1 no.</li> <li>c) Push button for cancellation of Hooter-1 no.</li> </ul>



- d) Panel D.C. fail indicating lamp 1 no.
- e) A.C. operated alarm accept relay with self reset contacts-1 no.
- 15. 1 no. Master trip relay with hand resort contact.
- 16. 1 no. Space heater with switch & thermostat.
- 17. 1 no. 12 points facia annunciation scheme DC operated complete with relays accept, reset, test push button, flusher relays and audible alarm, AC fail annunciation shall be provided in annunciation facia.
- 18. 1 no. Door operated panel illumination lamp.
- 19. 1 no. 5 Amps., socket & switch.
- 20. Other panel accessories such as fuse, links, terminals, earth bus, mimic diagram, wiring & accessories, auxiliary relays etc. as per requirement of the scheme considering site condition.

Note: (1) The control and relay panels shall be co-ordinated in respect of matching and wiring with all the relevant equipments such as breakers, CTs, PTs, Isolators etc.

(2) Specification of Circuit Breaker, CT, Isolator, C&R panel and LA are enclosed separately.

#### 6. TENDER DRAWINGS, CATALOGUE AND TEST CERTIFICATE:

Following drawings catalogue and type test certificates shall be submitted for information purpose with each copy of tender:

- i) Equipment layout elevation and plan with all technical details.
- ii) Dimensional front & rear view of control & relay panel with instrument, relays, control switch, terminal block, indicating lamp, test block etc. position marked. Make & type of relays, meters etc. should be clearly mentioned.
- iii) Schematic diagram of capacitor bank with series reactor along with protection scheme.
- iv) Descriptive literature, catalogue etc.
- v) Type test certificates of capacitor units carried out on similar capacitor from recognized reputed laboratory shall be submitted along with each tender. Type test results of other equipments (REACTOR, CB, CT, LA, relay and control units etc.) shall also be submitted.

## 7. CONTRACT DRAWINGS, CATALOGUE AND MANUAL

After placement of purchase order or letter of acceptance (LOA) five (5) copies of various drawings, data and catalogue manual as mentioned below shall be submitted to the Sr. General Manager (CPC), 1<sup>st</sup> Floor, Multi storied Building, Bhoi Nagar, Janpath, Bhubaneswar-751022 for approval.

- i) Dimensional General arrangement drawing of control & relay panel with instrument, relays, control switch terminal block, indicating lamp, test block etc. position marked.
- ii) Schematic drawings of control & relay panel.
- iii) Dimensional General arrangement drawing of each equipment with technical data.
- iv) Manuals on capacitor bank for erection, operation and maintenance purpose, descriptive leaflet / catalogue of different equipments.
- v) Elevation and Plan layout of all equipments with technical data.

The (10) set of approved drawings and ten (10) sets of manuals on operation and maintenance shall be submitted for our record and distribution to site.

## 8. TEST AT FACTORY AND TEST CERTIFICATES:

Routine tests at manufacturer's works shall be carried out on selected number of Capacitor and Reactor, CT, CB, LA, isolator, C&R Panel units in presence of representative of OPTCL as per relevant IS and six(6) copies of test results along with routine test results of brought out items shall be submitted for approval. The contractor shall give a notice to the Chief Engineer ( TR. PROJECT) of at least 15 (Fifteen) days in advance of the date when the tests will be carried out.

## 9. SPARES:

Spares for AMC as per annexure -III of Price schedule.

## 10 PROTECTIVE COATING:

All ferrous parts including bolts, nuts and washers of the equipments shall be galvanized to withstand at least four one minute dips in copper sulphate solution of requisite strength as per latest relevant IS.

**NOTE – 1 : LIST OF ANNEXURE**

- 1) Annexure I : equipment lay out in switch yard (plan & Elevation) for reference purpose. **Note: Equipment Layout (Plan & Elevation) is enclosed as per Annexure-I for illustration/ reference purpose and may be finalized during detail engineering.**
- 2) Annexure – II : Specific Technical Parameters for Isolator, Clamps-connectors, Equipment Structures & foundation and other information.
- 3) Annexure – III : Format of Guaranteed Technical Parameters for all Equipments.
- 4) Any deviation, if necessary, for the successful execution of works should be finalized at the time of detailed engineering / drawing approval stage. Bidders are to furnish the GTP duly filled in at the time of tender submission.

# ANNEXURE-I

SLD , PLAN & SECTIONAL ELEVATION DRAWING OF  
PROPOSED 33 CAPACITOR BANK SCHEME FOR OPTCL  
PROJECT

ENCLOSED

# **ANNEXURE –II**

## **TECHNICAL SPECIFICATIONS**

### **IMPORTANT NOTE**

**The participants are advised to visit the sites before quoting for the Bid. They should ascertain the volume of filling and height of foundation to be raised since the foundations are inclusive of cost for equipment and structurals for the Sub- Station.**

### **GENERAL**

The entire works are covered as Package-I,II,III,IV & V are to be carried out on turn-key basis upto final commissioning of the work with Design, manufacture, testing and supply of all materials for both the works including erection, testing and commissioning also includes 10 years trouble free maintenance.

### **ELECTRICAL WORKS:**

**(Materials to be supplied as per the requirement & schedule for different rating capacitor banks to be installed in different grid sub-station of OPTCL in 33 KV Side.)**

1. Supply of all materials required for installation of capacitor banks in 33 KV side of the sub-station.
2. ACSR Zebra Conductor as per instruction of Engineer in Charge or at the time of drawing approval.
3. Disc Insulators
4. Hardwares for Conductor .
5. Aluminium Flat as per requirement for connection from reactor to capacitor bank and NCT, as per details drg.
6. GI Bolts and Nuts
7. GI washers
8. Sub-station structure, equipment structure and its Accessories etc.(All structure shall be of Galvanised )
9. Control cables, Cable GI tray with racks.
10. Capacitor banks of 5 ,10,15 & 20 MVAR capacity.

11. Reactor to suit the above rating capacitor banks.
12. Current transformers and Neutral current transformers.
13. Surge arrestors.
14. Isolators.
15. Control and protection panel.
16. CT console.
17. All earthing materials (G.I Earth flat for laying in the yard shall be of size 75X10 mm as earth mat and riser to the equipment and structure column).The maximum gap for earth mat both way crossing shall be 5mtrs. Treated earth pits as per requirement to meet the safety rules.

Detailed technical particulars of different equipments have been specified in the respective specifications in the subsequent section. If any technical particulars are missed from this volume the same may please be referred from relevant IS: specification for bidding purpose.

#### 1. DESIGN WORK

The Bidder shall furnish detailed design of the substation. The design work shall include but not limited to technical calculations, preparation of drawings and bill of materials and specifying equipments not specified in the specification but necessary for the completion of the substation on the turnkey basis. The technical calculation design drawings, etc. shall be submitted to the Employer for approval.

#### 2. STANDARDS

All materials and equipments shall generally comply in all respects with the latest edition of the relevant Indian Standards. International Electro-Technical Commission (IEC) or any other Internationally accepted Standard equivalent or better than relevant Indian Standard. Equipment complying with all other authoritative standards such as British, ASA, VDE, etc. will also be considered if performance equivalent or superior to Indian Standard is ensured. In the event of supply of equipment conforming to any International or Internationally recognized Standard other than the Standard listed in the Specification. The salient features of comparison shall be brought out and furnished along with the bid. In case of adopting any standard other than that IS or IEC, a complete set of adopted standard shall be supplied by the bidder. However it is desirable and preferred that the equipment offered shall comply with one consistent set of standard unless other than exceptional cases. The equipment shall also comply with the latest revision of Indian Electricity Act and Indian Electricity Rules and any other Electrical Statutory Provision, Rules and Regulations.

#### 3. REFERENCE DRAWINGS

Drawings showing indicating scope of work are enclosed in other Section as annexure. Drawings are complementary to specifications and shall be referred to for better understanding as well as for estimation of quantities and bill of materials for arising at lump sum bid price on turnkey basis.

The bidder shall submit with the tender, all the drawings quadruplicate enumerated in conformity with relevant cause stipulated in the Technical Section.

These drawings shall show proposed layout plan with section. Drawings sufficient overall dimension, clearance etc. required for assembling and dismantling and space requirements of all the apparatus to be supplied to enable the Employer to examine the design and layout at the installation.

#### 4. PACKING AND MARKING

The bidder shall include and provide for securely protecting and packing the plant so as to avoid damage in transit under proper condition and shall be responsible for all loss or damage caused by any defect in packing.

Large and heavy items such as 33kV equipments and structural steel shall be packed and shipped as per standard international practice.

Container/Containers, boxes, trunks and other packages shall be strong and sturdy in construction to withstand Ocean shipping. Several times loading and unloading at ports, transport on rough roads, storage in tropical area and hauling and handling during erection etc. Boxes and packages shall also be protected by suitable lagging or galvanized steel strips.

A layer of water proof material shall be provided inside the container/boxes/packages to protect the equipment from water seepage and to avoid rust.

The following information shall be marked on the container/boxes/packages etc.

- i) Contractor's/manufacturer's name, project title and contract reference.
- ii) Plant/accessory identification No. and title.
- iii) Net/gross weight.
- iv) Employer's name with other dispatch particulars such as destination.

The employer shall take no responsibility for any damage done to the plant on route to the site of work or place of delivery whichever is applicable.

#### 5. TEST

**a)** Unless otherwise specified in respective section, all equipment shall be subjected routine and type test as covered and specified in any standard in presence of the authorized representative of the employer. OPTCL may not insist for Type test if the equipments are type tested within last five years but the firms shall furnish the type test cost of the equipment separately.

b) Bidder shall submit type test report from a recognized laboratory along with the bid.

c) At least 15 days advance notice shall be given by the contractor to the employer for witness the tests

#### 6. COMPLIANCE TO IE RULE 1956

- i) The construction agency shall possess a safety manual duly approved by competent authority in the Govt. of his State Governing the safety in work by the personnel and staff.
  - ii) The agency shall possess valid contractor's license issued by the Electrical Licensing Board of ORISSA (ELBO) failing which he will not be allowed to start the work.
  - iii) All supervisory of works shall possess appropriate valid supervisory certificate of competency issued ELBO, ORISSA.
  - iv) At least 50% of electrical workmen employed in the project shall possess valid workmen permit by ELBO.
7. Bidder has to follow submission of drawings, data, document as per the format enclosed.

**8.** Minimum clearance for substation design shall be as per ISS and enclosed drawings.

#### 5.0 MINIMUM CLEARANCES FOR SUB-STATION

Highest system voltage (kV)	Basic Insulation level (kVP)	Switching Impulse Voltage (KVP)	Minimum clearance		Sectional Clearance (mm)	Ground Clearance (mm)
			Between phase and Earth (mm)	Between phases (mm)		
36	170	-	320	320	2800	3700
72.5	325	-	630	630	3000	4000
123	450	-	900	900	3500	4600
	550	-	1100	1100	4000	4600
145	550	-	1100	1100	4000	4600
	650	-	1300	1300	4000	4600
245	950	-	1900	1900	4500	5500
	1050	-	2100	2100	5000	5500

#### 9) EQUIPMENT FOUNDATION AND STRUCTURE:

All equipment shall be furnished complete with hot dip galvanized steel support structure, anchor / foundation bolts and hard ware.

Suitable holes with bolts and washers shall be provided on structure for connection to grounding strip. Foundation design and details of calculation for Dynamic Stability of the Support Structure shall have to be submitted for approval. Confirmation towards Dynamic Stability is to be made. Detail structure drawing incorporating dimensions of all components, Bill of Materials etc shall have to be furnished for approval.

##### General Requirements:

Plinth height should be considered as 30 mm for all outdoor equipments.



Section of leg members should not be less than 60X60X6 mm

Section of bracing should not be less than 45X45X5 mm

Total weight of the circuit breaker including structure and uplift / down thrust during operation should be mentioned in the General Arrangement drawings.

All concrete work shall be properly treated by water for its strength as per standard practice. Concrete shall be properly mixed and during concreting care shall be taken for proper edging and vibrator shall be used for proper compaction.

Construction of cable trenches, provision of cable trays and racks and laying of cables for control and protection.

Site surfacing are also to be done by spreading 20mm nominal crusher broken HG metals in two compacted layers to maintain 100 mm thickness for the entire area of the proposed capacitor bank. The spreading of metal shall be done after spreading of good quality river bed sand free from organic materials of 150mm thickness (compacted). The spreading of sand shall be done after making antiweed treatment as per standard practice.

Under this scope, the bidder has the responsibility for 10 years maintenance of the installed capacitor Bank for trouble free operation beyond the guarantee period. Bidder has to ascertain that the breakdown occurred in the capacitor bank shall be rectified in a very reasonable time (preferably within two days of occurring of fault).

**Laying of earth mat (75X10 mm GI Flat) and other earth riser** to the equipment and structural (50X6 mm GI Flat) and treated earth pit are also under the scope of this contract. Earth mat shall be laid at a depth of 700 mm below the leveled soil and shall be laid both way at a maximum gap of 5mtrs. All riser to the equipment/structural shall be by using 50X6mm GI flat as per standard practice. Proper welding with proper lap & application of paint as per standard practice to be carried out.

Bidder should quote reasonable price for 10 years maintenance contract (beyond guarantee period) as stipulated in the specification.

PVC unarmoured stranded copper cables of core size 2.5 sq mm as per relevant IS standard shall be used for control and protection of capacitor bank. The cable core size for CT /NCT shall be of 2X2.5 Sq mm for each lead. For each length of cable laying there shall be at least 10% spare core and 10% extra length.

#### 10 ) Approved Make Of Switchgear And Equipments.

The following make of the equipments/materials shall be supplied with prior approval from OPTCL.

- i) Breakers-Alstom /Siemens /ABB/ Crompton /BHEL.
- ii) CT,PT&CVT- Areva /Siemens/ABB/ Compton/ BHEL.
- Iii) SA- Areva /CGL/Oblum.
- iv) CR Panels-Siemens/ Areva/ABB.

- v) Battery and charger- Exide for Battery, Caldyne for Charger
- vi) Isolator- ABB/Siemens/Switch gear and structural /GR Power/Areva .
- Vii) Station transformer-Alstom / Crompton
- viii)Hardware fittings-Rashtriya Udhog / Eritech /IAC.
- ix)Conductors- APAR/Gupta Cables/ Hightech Powercon / Eritech / Cabcon / Sterlite
- x)Fire fighting: Mini Max, Cease Fire.
- xi)Lighting fixtures: Philips, Bajaj, CGL.
- xii)Wave trap: BPL, ABB, AREVA.
- xiii)Tower Structure: Either from the OPTCL Rate contract holders or from Reputed make to be approved by OPTCL
- xiv)PVC insulated Control and XLPE insulated Power cable- Nicco, Gloster, CCI, KEI, Crystal, Poly Cab
- xv)Insulators: BHEL, WS, MGK Birla, Modern Insulator
- xvi)Earth Wire: Bharat Wire ropes, Usha Martin, UIC Wires.
- xvii)Cement: OPC Grade 43: ACC, Ultra Tech, Lafarge.
- xviii)Steel: SAIL, TISCO (TATA), RINL
- xix)GI Pipe: TATA, JINDAL
- xx)Air Conditioners: Hitachi, Carrier, Blue Star.
- xxi)PVC wires (FRLS type): L&T, Finolex
- xxii)All Switches-Anchor/ABB/ Cona
- xxiii)All MCB-L&T(Hager)/MDS/ indo Asian
- xxiv)ACB and MCCB-L&T, Siemens/Merlin Gerin
- xxv)All PVC Wires-FRLS type –Anchor/L&T/ Finolex /KDK/ Indo Asian
- xxvi)All Clamps and Connectors- Heavy duty type of reputed make to be approved by OPTCL.
- xxvii)All Civil Engineering Materials- reputed make to be approved by OPTCL.
- xxviii) Foundation Bolts- Reputed make
- xxix) GI Bolts and Nuts-Nexo or reputed make to be approved by OPTCL
- xxx) Capacitor Bank: BHEL/ABB/SHREEM/ or any other reputed manufacturer to be approved by OPTCL.

Any other items required for completion of the project shall be considered as included & the make of such items shall be subject to approval by OPTCL.

**A) ISOLATOR FOR 33 KV:-**

Sl. No.	DESCRIPTION	33 KV
1	Nominal System Voltage (KV)	33
2	Rated Voltage (KV)	36
3	Frequency (Hz)	50
4	No. of Phases	3-phase
5	System Neutral Earthing	Earthed Through Grounding Transformer
6	No of poles	3
7	Location	Outdoor
8	Rated Insulation Level	
A	1.2/50 micro-sec. lightning Impulse withstand voltage (KVp)	.
.	i) To earth & between poles	170
.	ii) Across the isolating distance	195
B	One minute PF withstand voltage (KV rms)	75
	i) To earth & between poles	80
	ii) Across the isolating distance	
9	Rated Normal Current (Amps)	1250
10	Rated Short Time withstand current of Main Contacts and Earth Switch (KA) and duration (for 3 sec)	20
11	Mounting Condition	On Structure
12	Method of operation Main / Earthing Switch	Manual / Manual
13	Number of auxiliary switches for main isolator	6 NO + 6 NC
14	Number of Make before make and break after break auxiliary switches	-
15	Number of auxiliary Switches in Earth Switch	4 NO + 4 NC
16	Rated auxiliary AC Supply (Volt)	400//230V + // -10%
17	Rated auxiliary DC Supply (Volt)	220 +/- 10%
18	Creepage distance of support insulators (mm)	900
19	Phase to phase spacing (mm)	1200
20	Total Operating Time	Less than 12 seconds
21	Mechanical terminal loading for horizontal centre break Isolator	-
	ii) Straight Load (N)	

	iii) Cross Load (N)	
22	Rated magnetizing / capacitive current make and break	Suitable for capacitor Bank duty
23	All Contracts	Silver-plated not less than 20 micron
24	Temperature rise above ambient temperature of 50 deg C	55der C
25	Contilever strength of support insulator (Kgf)	400
26	Current Density of Copper (max.) (A/Sq.mm)	1.75

## B) CLAMPS & CONNECTORS :

- i) Rated voltage of the system (KV) : 33
- ii) Rated short time current (KA for 3 Sec) : 25.1
- iii) Rated current (Amp) : Depending upon point of application as per IS
- iv) Current density of Al. (A/Sqmm) (max0) : 1.75
- v) Type of Clamps & Connectors : Aluminium casting
- vi) Purity of Alluminium : More than 99%
- vii) Minimum thickness of bimetal in Bimetallic connectors : 2 mm
- viii) Temp rise (Max) : 45°C above ambient of 50°C
- ix) Minimum thickness : 10mm

- Note :
- a) Compression length should be more than 110 mm.
  - b) Thickness of all current carrying parts should be more than 12 mm
  - c) All the corners & edges should be rounded off
  - d) Distance of outermost hole edge to nearest edge should be more than 10 mm.

## **(C) CONDUCTORS**

### TECHNICAL SPECIFICATION OF ACSR 'ZEBRA' CONDUCTORS FOR BUSBAR AND OTHER WORKS.

#### 1. **SCOPE** :-

1.1. This specification provides for the manufacture, testing, supply and delivery at destination of the steel cored aluminum conductors as per Appendix-I attached.

#### 2. **STANDARDS** :-

2.1 The conductors shall comply in all respects with the INDIAN Standard Specification International/standards with latest amendments. Some of the standards are

- i) IS 398 - Specification for Aluminum Conductors for overhead transmission purposes,  
IS 398, Part-II-1976 -
- ii) IS 1521, 1972 - Method of tensile testing of steel
- iii) IS 1778 -1989 - Reedurms for bare conductors.

#### 3. **MATERIALS** :-

3.1 The material offered shall be of best quality and workmanship. The steel Cored Aluminum conductor strands will consist of hard-drawn aluminum wire manufactured from 99.5% pure electrolytic aluminum rods of E.C. Grade. The steel wire shall be made from materials produced either by the acid or basic open hearth process or by electric process. No steel wire drawn from pessemer process shall be used. The steel wire shall not contain sulphur or phosphorus exceeding 0.05 percent, and the total of sulphur and phosphorus shall not exceed 0.085 percent.

3.2 The steel wires shall be evenly and uniformly coated with zinc complying with Indian Standard 4826-1968 specification for galvanized coatings on round steel wires. The uniformity of zinc coating and the weight of coating shall be in accordance with Appendix-II. The coating on the galvanized steel wires may be applied by the hot process or the electrolytic process.

#### 4. **SIZES** :-

4.1 The size of steel-cored Aluminum Conductors shall be as given in Appendix-I. The resistance and weights shall be in accordance with the values given in the same appendix.

5. **TOLERANCES :-**

5.1 The following tolerances shall be permitted on standard diameter of aluminum wires.

Tolerance on standard diameter of aluminum wire  $\pm 1$  percent. wires.

Note : - The cross-section of any wire shall not depart from circularity by more than an amount corresponding to a tolerance of 2 percent on the standard diameter.

5.2 A tolerance of + 2 percent shall be permitted on the standard diameter of the galvanized steel wires. The variation from the approximate weights shall not be more than plus or minus 5 percent.

6. **MECHANICAL PROPERTIES :-**

6.1 The value of the final modules of elasticity for steel cored aluminum conductor in the average of values obtained from actual stress strain tests. The co-efficient of linear expansion for steel Cored Aluminum Conductors has been calculated on the basis of co-efficient of linear expansion of  $23.0 \times 10^{-6}$  per degree centigrade of aluminum and  $11.5 \times 10^{-6}$  per degree centigrade for steel and represent only the average values. These values shall however, be given by the bidder under the guaranteed technical particulars.

7. **SURFACE CONDITIONS :-**

7.1 The wires shall be smooth and free from inequalities, spills and splits. The surface 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 up to 50% of the ultimate strength of the conductor, the surface shall not depart from its 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.

8. **JOINTS IN WIRES :-**

8.1 Aluminum wires : No joints shall be permitted in the aluminum wires in the outermost layer of the ACSR conductor. Joints in the inner layers are permitted, in addition to those made in the base rod or wire before final drawing, but no two such joints shall be less than 15 meter. apart in the complete stranded conductor. Such joints shall be made by cold pressure butt-welding.

Joints are not permitted in the outermost layer of the conductor in order to ensure a smooth conductor finish and reduce radio interference levels and corona losses on the extra high voltage lines.

8.2 Galvanized steel wires : - There shall be no joints except those in the base rod or wire before final drawing, in steel wires forming the core of the steel-reinforced aluminum conductor.

Joints have not been permitted in the steel wires after final drawing in order to avoid reduction in the breaking strength of the conductor that may occur as a result of failure of the joints.

## 9. **STRANDING** :-

9.1 The wires used in construction of a stranded conductor shall before stranding, satisfy all requirements of IS-398/ (part-II)1976 with latest amendments. For steel-cored aluminum conductors the lay ratio of the different layers shall be within the limits given under Appendix-I.

9.2 For all, constructions, each alternate layer shall be stranded in opposite directions. The wires in each layer shall be evenly and closely stranded round the under laying wire or wires. The final layer of wires shall have a right hand lay.

## 10. **PACKING AND MARKING** : -

10.1 The conductor shall be wound in non-returnable reels or drums conforming to Indian Standard 1978-1961 specification for Reels and Drums for Bare Wire, or any other authoritative standard and marked with the following : -

- |                         |  |
|-------------------------|--|
| a) Trade name, if any   | b) Contract/Award letter Number        |
| c) Name of manufacturer | d) Name & Address of Consignee         |
| e) Drum Number          | f) Length of conductor                 |
| g) Size of conductor    | h) Gross Weight of drum with conductor |
| i) Weight of empty drum | j) Net and gross of conductor.         |

**with lagging.**

k) Arrow marking of un-winding

10.2 The reel shall be of such construction as to assure delivery of conductor in the field from displacement and damage and should be able to withstand all stresses due to handling and the stringing operations so that conductor surface is not dented, scratched or damaged in any way during manufacture, transport and erection. The conductor shall be properly lagged on the drums and the method of lagging to be employed may be clearly stated

in the tender. It should be stocked to suit the reel and held in place by steel strapping. Lagging shall not be nailed or bolted in place.

10.3 The conductor drum should be suitable for wheel mounting. Before reeling, the card-board or other suitable material shall be secured to the drum and inside flanges of the drums. After reeling the conductor, the exposed surfaces should be wrapped with suitable soft material to prevent the conductor from dirt and grit. Any space between the drum lagging and conductor should be suitably filled with soft filler material compactly packed. 11. **LENGTHS** :-

11.1 The conductor shall be supplied in the standard lengths **as below** with a permitted variation of 5%. Not less than 90% of the total quantity of the conductor shall be supplied in the standard lengths. Thus the quantity of the conductor in lengths shorter than standard ones shall not exceed 10% of the total quantity to be supplied. Further no single conductor lengths in respect of such 10% (Maximum supply) in random lengths, shall be shorter than 50% of the standard lengths.

<u>Type of conductor</u>	<u>Max Length per drum.</u>
ZEBRA ACSR	1.1 K.M.

## 12. **TESTS AND TEST CERTIFICATES** :-

12.1 Individual wire and finished steel cored Aluminum Conductor shall be subjected to before dispatch from the works to the tests as per the provision of the Indian standard Specification 395 (Part-II-1976) with the latest amendments.

12.2 Samples for individual wires for test shall be taken before stranding form not less than 10 percent of the spiels in the case of aluminum wire and ten percent of the wire coils in the case of steel wires. If samples are taken after stranding, they shall be obtained by cutting 5 meters from the outer end of the finished conductor from not more than 10 percent of the finished reels.

12.3 The mechanical tests shall be carried out on single wires only.

12.4 The Tensile test shall apply to wires of all diameters forming part of steel cored aluminum conductors. If it is not possible to test the component wires before stranding the test may be made on wires taken from stranded conductors. The tensile strength of any of the wires shall not be less than the minimum values given in Appendix-II.

12.5 A suitable tensile testing machine shall be used the accuracy of which can easily be checked and the machine adjusted if necessary. The test sample before being placed in



the machine, shall be straightened, if necessary in such a way as to cause the minimum alteration in its physical properties.

The load shall be applied gradually and rate of separation of the Jaws of the testing machine shall not be greater than 10cm/min. and less than 2.5cm/min.

#### 12.6 **Wrapping Test** : -

12.6.1 Samples of aluminium wires shall be wrapped round a wire of its own diameter to form a close helix of eight turns. Six turns shall then be unwrapped and again clearly wrapped in the same direction as before. The wire shall not break.

12.6.2 Samples of steel wires shall be closely wrapped eight times round a mandrel of diameter equal to four times the wire diameter. Six turns shall then be unwrapped and again closely wrapped in the same direction as before. The wire shall not break.

#### 12.7 **Galvanizing Test** : -

12.7.1 The uniformity of zinc coating and the weight of coating shall be as given in Appendix-II and shall be determined according to Indian Standard Specification 4826-1968. with latest amendments.

12.7.2 This test shall be made whenever practicable, on wires before stranding and before the specimen has been bent, straightened or tested in any other way.

#### 12.8 **Ductility Test** : -

This test shall be made on galvanized steel wires only by any of the proceedings given in 12.8.1 and 12.8.2.

12.8.1 **Torsion Test** : - One specimen cut from each of the sample shall be gripped at its ends in two vices, one of which shall be free to move longitudinally during the test. A small tensile bond not exceeding 2% of the breaking load of the wire, shall be applied to the sample during testing. The specimen shall be twisted by consisting one of the vices to revolve until fracture occurs and the number of twists shall be indicated by a counter or other suitable device. The rate of twisting shall not exceed 60 rev/min.

When tested before stranding, the number of complete twists before fracture occurs shall not be less than 18 on a length equal to 100 times the diameter of the wire. The fracture shall show a smooth surface at right angles, to the axis of the wire.

When tested after stranding, the number of complete twists before fracture occurs shall be not less than 16 on a length equal to 100 times the diameter of the wire. The fracture shall show a smooth surface at right angles to the axis of the wire.

**12.8.2 Elongation Test** : - The elongation of one specimen cut from each of the samples shall be determined. The specimen shall be straightened by hand and on original gauge length of 200 mm shall be marked on the wire. A tensile load shall be applied as described in 12.5 and the elongation shall be measured after the fractured ends fitted together. If the fracture occurs outside the gauge marks, or within 25mm of either mark and the required elongation is not obtained, the test shall be disregarded and another test made. When tested before stranding, the elongation shall be not less than 4 percent. When tested after stranding, the elongation shall be not less than 3.5 percent.

### **12.9 Surface Condition Test**

A sample of the finished conductor having a minimum recommended length of 5 meters with compression type dead end clamps compressed on both ends in such a manner as to permit the conductor to take its normal straight line shape, shall be subject to a tension of 50% of the UTS of the conductor. The surface shall not depart from its cylindrical shape nor shall the strands move relative to each other so as to get out of place or disturb the longitudinal smoothness of conductor. The measured diameter at any place shall be not less than the sum of the minimum specified diameters of the individual aluminum and steel strands.

### **12.10 Ultimate Strength (UTS) Test on Stranded Conductor**

Circles perpendicular to the axis of the conductor shall be marked at two places on a sample of conductor of minimum 5 m length suitably compressed with dead end clamps at either end. The load shall be increased at a steady rate up to specified 50% of UTS and held for one minute. The circles drawn shall not be distorted due to Relative movement of strands. Thereafter the load shall be increased at a steady rate to the minimum UTS specified in Appendix-I and held for one minute. The applied load shall then be increased until the failing load is reached and the value recorded.

### **12.11 Corona Extinction Voltage Test**

One sample of conductor of 5m length shall be strung. In case of twin conductor, two samples shall be arranged with the actual sub-conductor spacing between them. This sample assembly when subjected to power frequency voltage shall have a corona extinction voltage of not less than 320 KV (rms) for 400 KV and 176 KV (rms) for 220 KV system line to ground under dry condition. There shall be no evidence of corona on any part of sample when all possible sources of corona are photographed in a darkened room. The test shall be conducted without corona control rings. The voltage shall be corrected for standard atmospheric conditions.

### **12.12 Radio Interference Voltage Test**

Under the conditions as specified in 12.11 above, the conductor samples shall have a radio interference voltage level below 1500 microvolts at one MHZ when subjected to 50HZ AC voltage of 1.1 times maximum line to ground voltage under dry condition. This test may be carried out with corona control rings and arcing horns.

### **12.13 D.C. Resistance Test on Stranded Conductor**

On a conductor sample of minimum 5 m length two contact clamps shall be fixed with a pre-determined bolt torque. The resistance shall be measured by a Kelvin double bridge by placing the clamps initially zero meter and subsequently one meter apart. The test shall be repeated at least five times and the average value recorded. The value obtained shall be corrected to the value at 20 degree centigrade as per clause No.12.8 of IS : 398 (part V). The resistance corrected at 20 degree centigrade shall conform to the requirements of this specification.

### **12.14 Stress-Strain Test**

12.14 (i) This test is contemplated only to collect the creep data of the conductor from the supplier. A sample of conductor of minimum 10 metres length shall be suitably compressed with dead end clamps.

#### **12.14 (ii) Test Set-up**

**12.14 (ii) (a)** The test sample shall be supported in a trough over its full length and the trough adjusted so that the conductor will not be lifted by more than 10 mm under tension. This shall be ascertained by actual measurement.

**12.14 (ii) (b)** The distance between the clamp and the sleeve mouth shall be monitored with callipers during the test to ensure that, after the test, it does not change by more than 1 mm +/-0.1mm from the value before the test.

**12.14 (iii) (c)** The conductor strain shall be evaluated from the measured displacements at the two ends of the gauge length of the sample. The gauge reference targets shall be attached to the clamps which lock the steel and aluminum wires together. Target plates may be used with dial gauges or displacement transducers and care shall be taken to position the plates perpendicular to the conductor. Twisting the conductor, lifting it and moving it from side-to-side by the maximum amounts expected during the test should introduce no more than 0.3mm error in the reading.

#### **12.14 (iii) Test Loads for Complete Conductor**

The loading conditions for repeated stress-strain tests for complete conductor shall be as follows :

**12.14 (iii) (a)** 1 KN load shall be applied initially to straighten the conductor. The load shall be removed after straightening and then the strain gauges are to be set at zero at zero tension.

**12.14 (iii) (b)** For non-continuous stress-strain data, the strain reading at 1 KN intervals at lower tensions and 5KN intervals above 30% of UTS shall be recorded.

**12.14 (iii) (c)** The sample shall be reloaded to 50% of UTS and held for 1 hour. Readings are to be noted after 5, 10, 15, 30, 45 and 60 minutes during the hold period. The load shall be released after the hold period.

**12.14 (iii) (d)** Reloading up to 70% of UTS shall be done and held for 1 hour. Readings are to be noted after 5, 10, 15, 30, 45, and 60 minutes and then the load shall be released.

**12.14 (iii) (e)** Reloading up to 85% of UTS shall be done and hold for 1 hour. Readings are to be noted after 5, 10, 15, 30, 45 and 60 minutes and then the load shall be released.

**12.14 (iii) (f)** Tension shall be applied again and shall be increased uniformly until the actual breaking strength is reached. Simultaneous readings of tension and elongation shall be recorded up to 90 % of UTS at the intervals described under Clause 12.14 (iii) (e).

**12.14 (iv) Test Loads for Steel core Only.**

The loading conditions for repeated stress-strain tests for the steel core of ACSR shall be as follows :

**12.14 (iv) (a)** The test shall consist of successive application of load applied in a manner similar to that for the complete conductor at 30%, 50%, 70% and 85% of UTS.

**12.14 (iv) (b)** The steel core shall be loaded until the elongation at the beginning of each hold period corresponds to that obtained on the complete conductor at 30%, 50%, 70% and 85% of UTS respectively.

**12.14 (v) Stress Strain Curves**

The design stress-strain curve shall be obtained by drawing a smooth curve through the 0.5 and 1 hour points at 30%, 50%, and 70% of UTS loadings. The presence of any aluminum slack that can be related to any observed extrusion entering the span from the compression dead ends shall be removed from the lower ends of the design curves. Both the laboratory and design stress-strain curves shall be submitted to the

purchaser along with test results. The stress-strain data obtained during the test shall be corrected to the standard temperature i.e. 20 degree centigrade.

**12.15 Chemical Analysis of Zinc**

Samples taken from the Zinc ingots shall be chemically/ spectrographically analyzed. The same shall be in conformity to the requirements stated in this specification.

**12.16 Chemical Analysis of Aluminum and Steel**

Samples taken from the Aluminum ingots/ coils/ strands shall be chemically/ spectrographically analyzed. The same shall be in conformity to the requirements stated in this specification.

**12.17 Visual and Dimensional Check on Drums**

The drums shall be visually and dimensionally checked to ensure that they conform to the requirements of this specification.

**12.18 Visual Check for Joints, Scratches etc.**

Conductor drums shall be rewound in the presence of the inspector. The inspector shall visually check for scratches, joints, etc. and that the conductor generally conform to the requirements of this specification.

**12.19 Dimensional Check of Steel and Aluminum Strands**

The individual strands shall be dimensionally checked to ensure that they conform to the requirements of this specification.

**12.20 Check for Lay-ratios of various Layers**

The lay-ratios of various layers shall be checked to ensure that they conform to the requirements of this specification.

**12.21 Breaking load test on welded Aluminum strand.**

Two Aluminum wires shall be welded as per the approved quality plan and shall be subjected to tensile load. The welded point of the wire shall be able to withstand the minimum breaking load of the individual strand guaranteed by the supplier.

**13. RETEST AND REJECTION : -**

**13.1** Each coil or spool selected for testing shall be tested for compliance with the requirements of Indian Standard Specification 398 (part-II) 1976 with latest amendment if any selected coil or spool not fulfill any of the test requirements, that particular coil or spool shall be withdrawn. In respect of each failure, two test pieces shall be selected from two different coils in the lot and subjected to the test under which the failure occurred. If either of the two retest pieces fails to pass that test, the lot concerned shall be rejected.

If samples are taken for test after stranding and if any selected reel fails in the retest, the manufacturer may test each and every reel and submit them for further inspection. All rejected materials shall be suitably marked and segregated.

14. **GUARANTEED TECHNICAL PARTICULARS :-**

The bidder shall fill in the guaranteed technical particulars in the Performa at Appendix-IV and submit the same with his tender, without which bid will not be considered.

15. **SAG TENSION CHARTS AND SAG TEMPLATES :-**

The contractor shall supply each six copies of sag tension charts and sag templates in respect of each type of the steel core aluminum conductor. The Contractor shall also supply sag template in celluloid which shall be subject to the approval by the purchaser and without involving any extra charges. The design data of the lines on which these conductors will be used are given in **Appendix-III.**

**A P P E N D I X – I**

**ZEBRA**

1.	Size of conductor	54/7/3.18 mm
2.	Stranding and wire diameter	
	Aluminum	54/3.18 mm
	Steel	7/3.18 mm
3.	Nominal Aluminum Area	428.9 mm <sup>2</sup>
4.	Approximate total mass	1622 Kgs/KM
5.	Calculated resistance at 20° C Max.	0.06868 Ohm/KM
6.	Calculated breaking load of composite conductor (U.T.S) (Min)	130.32 KN
7.	<u>Lay Rating</u> :-	
	Steel Core	Max - 28 Min - 13
	<u>Aluminum Layers</u>	
	12 Wire layer (Layer below outside layer)	Max - 17 Min - 10
	18 Wire layer (Outside Layer)	Max - 16 Min - 10
	24 Wire layer(Outside Layer)	Max - 14

		Min - 10	
8.	Modulus of elasticity (Kg/sq mm)	8158	
		0.7036 x 10 <sup>6</sup> Kg/CM <sup>2</sup> (69GN/M <sup>2</sup> )	
9.	Co-efficient of Linear expansion of conductor.	19.3 x 10 <sup>-6</sup> °C	
10.	Standard area of cross Section in sq. mm of conductor	484.5 Sq. mm	
11.	Diameter of complete conductor in mm	28.62 mm	
12.	Diameter standard(in mm)	Steel	Aluminium
	Maxm(in mm)	3.18	3.18
	Minimum(in mm)	3.24	3.21
		3.12	3.15
13.	Cross sectional Area of wire(in sq mm)	7.942	7.942
14.	Weight (in Kg/Km)	61.95	21.47
14.	Minimum Breaking load before stranding(in KN)	9.91	1.23
16.	Minimum purity of Aluminium		99.5%
17.	Zinc coating	As per IS-4826-1979	
	Minimum coating(in gm/sq mtr)	260	

## **(D) TECHNICAL SPECIFICATION FOR SUB- STATION TOWER NUTS & BOLTS.**

### **1.0 SCOPE:**

It covers the requirements for hot-dip galvanized hexagon-head transmission tower bolts with nut and Washers in the size range of M-16 and M-12 for use in the construction of transmission towers, sub-stations & similar steel structure in Arunachal Power System. The firm must enclose the dimensional drawings of all bolts, nuts and washers with the bid.

1.1 These bolts are not suitable for applications requiring improved low temperature characteristics.

### **2.0 DIMENSION:**

2.1 The dimensions of the bolts shall be as given in Table-1 of IS: 12427-1988

2.2 The preferred length size combinations as well as grip ranges shall be as given in Table-2 of IS:12427-1988 and specification of OPTCL.

2.2 Prior to hot-dip galvanizing, the bolt threads shall conform to tolerance class 8g of IS:4218-(Pt.6)-1978. "ISO metric screw threads: Part-6, limit of sizes for commercial bolts & nuts (Dia Range: 1 to 52mm) (First Revision)".

### **3.0 GRADES:**

Unless otherwise specified, the bolts shall be of product grade 'C' as specified in IS: 1367 (Pt.2)-1979 "Technical Supply Conditions for threaded steel fasteners: Part-2, products grades and tolerances (Second Revision)".

### **4.0 MATING NUTS & WASHERS:**

**4.1** Unless otherwise specified, the hexagon nuts used with these bolts shall conform to the requirements of IS:1363 (Part-3)-1984/1992./12427/1988

The nuts shall be property Class-5 as specified in IS:1357(Pt.6)-1980 with the proof stress values shall be as follows:

Sl. No.	Nominal Nut size.	Proof stress (SP) N/Sq.mm
1.	M-16	490
2.	M-12	490



Sl. No.	Nominal Bolt size.	Proof stress (SP) Kgf
1.0	M-16	4488
2.0	M-12	4488

Wedge test breaking load/Kgf-8007 min

Hardness HRB for Bolt-79/99.5

Hardness HRB for Nuts 71/107

**4.2** Unless otherwise specified, all plain washers used on these bolts shall conform to the requirements of IS: 2016-1967 (First revision). The washers shall be punched washers Type A except that the thickness of washers shall be  $\pm 1/0$  mm. The Spring washers of Type 'A' & 'B' shall conform to IS: 3063-1972.

4.3 Nuts & Washers supplied under the standard shall be hot-dip galvanized in accordance with Clause-6.

5.0 MECHANICAL PROPERTIES:

5.1 The bolt shall be of property Class-5.6 as specified in IS: 1367 (Pt.3)-1979 (Second Revision) and shall be tested full size.

**5.1.1** For tensile, proof load and wedge loading tests three threads only shall be exposed between the grips. This is obtained by freely running the nut or fixture to the fullest extent and then unscrewing the specimen three full turns. These tests are to be done after chemically de-galvanizing the bolts.

**5.1.2.** Bolts having nominal lengths less than three times the nominal diameter (which are too short for full size tensile testing) shall meet the hardness requirements of HB-147 to HB-242 (or HRB-79 to HRB-100 or HV-155 to HV-255).

6.0 FINISH:

6.1 The bolts & Nuts shall be hot-dipped galvanized in accordance with the requirements of IS-1367 (Pt.XIII) 1983. "Technical supply conditions for threaded steel fasteners: Part-13. Hot-dip galvanized coatings on threaded fasteners (Second Revision) except as specified in clause-6(ii).

- 6.2** The use of the test for uniformity of zinc coating shall be as per IS:2633-1986 (Second Revision).
- 6.3** Hot-dip galvanized bolts, nuts and washers shall be passivated by dipping immediately after galvanizing in a 0.15 percent solution of sodium dichromate with 0.5 percent concentrated sulphuric acid maintained at a temperature more than 32° C to provide protection against wet storage.

**7.0** SHEAR STRENGTH:

Sl.No.	Nominal Bolt Thread Size.	Nominal Shank Area.	Minimum single shear load KN
1.	M-16	201	62
2.	M-12	113	35

**8.0** SAMPLING

Sampling and criteria of acceptance shall be in accordance with IS: 2614-1969 (First Revision).

**9.0** MARKING:

9.1 Transmission tower bolts shall be marked with the following symbols on the top surface of the bolt head either embossed or indented as given below.

**9.1.1.** The Manufactures identification symbol.

**9.1.2.** Transmission tower bolt identification symbol 'T'.

**9.1.3.** The minimum height of marking shall be 3.0 mm when embossed marking shall project and not less than 0.3 mm above the surface of the head and total head height (head plus marking) shall not exceed the specified maximum head height plus 0.4 mm.

**10.0** TEST:

The test mechanical properties and test method shall be as per IS: 1367 (Part-2/1979, Part-3/1991, Part-6/1980, Part-XIII/1983) for Transmission Tower Bolts & Nuts.

**ROUTINE TESTS TO BE CONDUCTED AT THE MANUFACTURER'S PREMISES.**

Hex Bolt: 12427 – 1988

Hex Nut: 1363 – 1992

Grade: 5.6/5

**(1)** Dimension of Bolt to be measured:

- (a) Diameter (b) Pitch (c) B – min  
(d) Ds (e) E-min (f) K (g) S=

**(2)** Dimension of Nut to be measured.

**(3)** Physical properties as per IS – 1367/1991 (Part-III) programme “B” for Bolts and Part VI for Nuts to be done.

**(4)** Galvanization test as per IS 2629 to be done such as:

- (a)** Uniformity of coating  
**(b)** Weight of coating  
**(c)** Adhesion test  
**(d)** Coating thickness

#### WASHERS:

I. Galvanised Steel washers: They shall comply with IS-2016 or IS-6610. The washer shall be of electro-galvanized steel and of the positive lock type and thickness as mentioned in the tender and shall be suitable for 16 mm dia bolts. The basic inside diameter of spring washer shall be 16.2 mm and maximum outside diameter shall be 27.4 mm.

# INSULATORS

## TECHNICAL SPECIFICATION FOR DISC INSULATORS FOR SUBSTATION WORK

### 1.0 SCOPE.

- 1.1 This specification provides for design, manufacture, engineering, inspection and testing before despatch packing and delivery FOR (destination) for Indian manufacturers of disc. Insulators as per technical requirements furnished in this specification.

These insulators are to be used in suspension and tension insulators strings for the suspension and anchoring of the conductors on EHV transmission line towers.

- 1.2 Following is the list of documents constituting this package.

- (i) Technical specification.
- (ii) Technical data sheet.
- (iii) Drawings of insulators
- (ii)

- 1.3 All the above volumes alongwith amendments there of shall be read and interpreted together. However, in case of a contradiction between the “Technical Specification ” and any other volume, the provisions of this volume will prevail.

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

### 2.0 STANDARDS:

- 2.1 Except as modified in this specification, the disc insulators shall conform to the following Indian Standards, which shall mean latest revisions and amendments. Equivalent International and Internally recognized standards to which some of these standards generally correspond are also listed below.

## 2.2

Sl. No.	Indian Standard	Title.	International Standard.
1.	IS: 206	Method for Chemical Analysis of Slab Zinc.	
2.	IS: 209	Specification for Zinc.	BS: 3436
3.	IS: 731	Porcelain insulators for overhead power lines with a normal voltage greater than 1000V	BS: 137(I&II); IEC 274 IEC 383
4.	IS: 2071 Part-(I) Part-(II) Part-(III)	Method of High Voltage Testing.	
5.	IS: 2121  (Part-I)	Specification of Conductors and Earth wire Accessories for Overhead Power lines. Armour Rods, Binding wires and tapes for conductor.	
6.	IS: 2486	Specification for Insulator fittings for overhead power lines with a nominal voltage greater than 1000V.	
	Part – I	General Requirement and Tests.	BS: 3288
	Part – II	Dimensional Requirements.	IEC: 120
	Part – III	Locking devices.	IEC: 372
7.	IS: 2629	Recommended practice for Hot Dip Galvanisation for iron and steel.	
8.	IS: 2633	Testing for Uniformity of Coating of Zinc coated articles.	
9.	IS: 3138	Hexagonal Bolts & Nuts.	ISO/R 947 & ISO/R 272
10.	IS: 3188	Dimensions for Disc Insulators.	IEC: 305
11.	IS: 4218	Metric Screw Threads	ISO/R 68-1969 R 26-1963, R 262-1969 & R965-1969
12.	IS: 6745	Determination of weight of zinc coating on zinc coated iron and steel articles.	
13.	IS: 8263	Methods of RIV Test of HV insulators.	IEC 437 NEMA Publication No.107/1964

			CISPR
14.	IS: 8269	Methods for switching impulse test on HV insulators.	IEC: 506
15.		Thermal mechanical performance test and mechanical performance test on string insulator units.	IEC: 575
16	IEC	Long Rod Insulators	IEC-433

2.3 The standards mentioned above are available from:

Reference.	Abbreviation	Name & Address:
BS		British Standards, British Standards Institution, 101, Pentonville Road, N-19 ND,U
IEC / CISPR		International Electro technical commission Electro Technique International. 1, Rue de verembe Geneva SWITZERLAND.
IS		Bureau of Indian Standards, Manak Bhavan, 9 Bahadurshah Zafar Marg, New Delhi-110001, ORISSA
ISO		International Organisation for Standardization. Danish Board of Standardization Dansk Standardizing Sraat Aurehoegvej-12 DK-2900 Hellestrup DENMARK.
NEMA		National Electric Manufacturers Association 1`55, East 44 <sup>th</sup> . Street New York, NY 10017 USA

### 3.0 PRINCIPAL PARAMETERS.

#### 3.1 DETAILS OF DISC INSULATORS:

3.1.1 The Insulator strings shall consist of standard discs for use in three phases. 50 Hz effectively earthed 33/132/220 KV transmission system of OPTCL in a moderately polluted atmosphere. The discs shall be cap and pin, ball and socket type, radio interference and have characteristics as shown in Table-I and all ferrous parts shall be hot dip galvanized as per the latest edition of IS 2629. The zinc to be used for making sleeves shall be 99.95 % pure.

4.11.1. The size of disc insulator, minimum creepage distance the number to be used in different type of strings, their electromechanical strength and mechanical strength

4.11.2. of insulator string alongwith hardware shall be as follows:

Sl. No	Type of String.	Size of disc. Insulator (mm)	Minimum creepage distance of each disc(mm)	No. of standard discs 33 KV	Electro-mechanical strength of insulator string fittings (KN)
1.	Single suspension	255 x 145	430	1x4	90 KN
2.	Double suspension.	-do-	-do-	2x4	2x90
3.	Single Tension	280x170	-do-	1x4	120
4.	Double Tension	-do-	-do-	2x4	2x120

### 3.2 SPECIFICATION DRAWINGS:

3.2.1 A list of specification drawings in respect of the disc insulators indicated above given at Annexure-I. These specification drawings are attached herewith for information and guidance of the Bidder only. The drawings to be furnished by the supplier shall be as per his own design and manufacture and shall be distinct and separate from these specification drawings.

### 4.0 GENERAL TECHNICAL REQUIREMENTS:

#### 4.1 Porcelain:

The porcelain used in the manufacture of the shells shall be ivory white nonporous of high dielectric, mechanical and thermal strength, free from internal stresses blisters, laminations, voids, forgone matter imperfections or other defects which might render it in any way unusable for insulator shells. Porcelain shall remain unaffected by climatic conditions ozone, acid, alkalis, zinc or dust. The manufacturing shall be by the wet process and impervious character obtained by through vetrification.

The insulator shall be made of highest grade, dense, homogeneous, wet-process porcelain, completely and uniformly vitrified throughout to produce uniform mechanical and electrical strength and long life service. The porcelain shall be free from warping, roughness, cracks, blisters, laminations, projecting points foreign particles and other defects, except those within the limits of standard accepted practice. Surfaces and grooves shall be shaped for easy cleaning. Shells shall be substantially symmetrical.

#### 4.1.1 Porcelain glaze:

Surface to come in contact with cement shall be made rough by stand glazing. All other exposed surfaces shall be glazed with ceramic materials having the same temperature coefficient of expansion as that of the insulator shell. The thickness of the glaze shall be uniform throughout and the colour of the glaze shall be down. The Glaze shall have a

visible luster and smooth on surface and be capable of satisfactory performance under extreme tropical climatic weather conditions and prevent ageing of the porcelain. The glaze shall remain under compression on the porcelain body through out the working temperature range.

## 4.2 METAL PARTS:

### 4.2.1 Cap and Ball Pins:

Ball pins shall be made with drop forged steel caps with malleable cast iron. They shall be in one single piece and duly hot dip galvanized. They shall not contain parts or pieces joined together welded, shrink fitted or by any other process from more than one piece of materials. The pins shall be of high tensile steel, drop forged and heat-treated. The caps shall be cast with good quality black heart malleable cast iron and annealed. Galvanizing shall be by the hot dip process with a heavy coating of zinc of very high purity. The bidder shall specify the grade composition and mechanical properties of steel used for caps and pins. The cap and pin shall be of such design that it will not yield or distort under the specified mechanical load in such a manner as to change the relative spacing of the insulators or add other stresses to the shells. The insulator caps shall be of the socket type provided with nonferrous metal or stainless steel cotter pins and shall provide positive locking of the coupling.

### 4.2.2 Security Clips:

The security ceps shall be made of phosphor bronze or of stainless steel.

## 4.3 FILTER MATERIAL:

Cement to be used, as a filler material be quick setting, fast curing Portland cement. It shall not cause fracture by expansion or loosening by contraction. Cement shall not react chemically with metal parts in contact with it and its thickness shall be as small and as uniform as possible.

## 4.4 MATERIALS DESIGN AND WORKMANSHIP:

### 4.4.1 GENERAL:

- (II) All raw materials to be used in the manufacture of these insulators shall be subject to strict raw material quality control and to stage testing/ quality control during manufacturing stage to ensure the quality of the final end product.



Manufacturing shall conform to the best engineering practices adopted in the field of extra high voltage transmission. Bidders shall therefore offer insulators as are guaranteed by them for satisfactory performance on Transmission lines.

- (III) The design, manufacturing process and material control at various stages be such as to give maximum working load, highest mobility, best resistance to corrosion, good finish elimination of sharp edges and corners to limit corona and radio interference voltages.

#### 4.4.2 INSULATOR SHELL:

The design of the insulator shells shall be such that stresses due to expansion and contraction in any part of the insulator shall not lead to deterioration. Shells with cracks shall be eliminated by temperature cycle test followed by mallet test. Shells shall be dried under controlled conditions of humidity and temperature.

#### 4.4.3 METAL PARTS:

- i) The pin and cap shall be designed to transmit the mechanical stress to the shell by compression and develop uniform mechanical strength in the insulator. The cap shall be circular with the inner and outer surfaces concentric and of such design that it will not yield or distort under loaded conditions. The head portion of the pinball shall be suitably designed so that when the insulator is under tension the stresses are uniformly distributed over the pinhole portion of the shell. The pinball shall move freely in the cap socket either during assembly of a string or during erection of a string or when a string is placed in position.
- ii) Metal caps shall be free from cracks, seams, shrinks, air holes, blowholes and rough edges. All metal surfaces shall be perfectly smooth with no projecting part or irregularities, which may cause corona. All load bearing surfaces shall be smooth and uniform so as to distribute the loading stress uniformly. Pins shall not show any microscopically visible cracks, inclusions and voids.

### 4.4.4 GALVANIZING:

All ferrous parts, shall be hot dip galvanized in accordance with IS: 2629. The zinc to be used for galvanizing shall conform to grade Zn 99.5 as per IS: 209. The zinc coating shall be uniform, smoothly adherent, reasonably light, continuous and free from impurities such as flux, ash, rust stains, bulky white deposits and blisters. Before ball fittings are galvanized, all die flashing on the shank and on the bearing surface of the ball shall be carefully removed without reducing the designed dimensional requirements.

#### **4.4.5** CEMENTING:

The insulator design shall be such that the insulating medium shall not be directly engaged with hard metal. The surface of porcelain shall be coated with resilient paint to offset the effect of difference in thermal expansions of these materials. High quality Portland cement shall be used for cementing the porcelain to the cap & pin.

#### **4.4.6** SECURITY CLIPS (LOCKING DEVICES)

The security clips to be used as locking device for ball and socket coupling shall be 'R' shaped hump type to provide for positive locking of the coupling as per IS: 2486 (Part-IV). The legs of the security clips shall allow for spreading after installation to prevent complete withdrawal from the socket. The locking device shall be resilient, corrosion resistant and of sufficient mechanical strength. There shall be no possibility of the locking device to be displaced or be capable of rotation, when placed in position, and under no circumstances shall it allow separation of insulator units and fittings. 'W' type security clips are also acceptable. The hole for the security clip shall be counter sunk and the clip shall be of such design that the eye of the clip may be engaged by a hot line clip puller to provide for disengagement under energized conditions. The force required for pulling the clip into its unlocked position shall not be less than 50 N (5 kg.) or more than 500 N (50 kgs.).

#### **4.4.7** MARKING:

Each insulator shall have the rated combined mechanical and electrical strength marked clearly on the porcelain surface. Each insulator shall also bear symbols identifying the manufacturer, month, and year of manufacture. Marking on porcelain shall be printed, not impressed, and shall be applied before firing.

#### **4.5** BALL AND SOCKET DESIGNATION:

*The dimensions of the ball and sockets for 70 and 90 KN discs shall be of 16 mm and for 120 KN and 160 KN discs shall be of 20 mm designation in accordance with the standard dimensions stated in IS: 2486 (Part-II).*

#### **4.6** DIMENSIONAL TOLERANCE OF INSULATOR DISCS:

It shall be ensured that the dimensions of the disc insulators are within the limits specified below:

a) Diameter of Disc (mm)	Standard.	Maximum	Minimum
70/90 KN Disc/ 120 KN	255/280	266/293	244/267
160 KN Disc	280	293	267
b) Ball to Ball spacing Between Discs (mm)	Standard.	Maximum	Minimum
70/90 KN Disc/ 120 KN	145	149	141
160 KN Disc	170	175	165

4.7 INTERCHANGEABILITY:

The insulators inclusive of the ball and socket fittings shall be of standard design suitable for use with hardware fittings of any make conforming to relevant Indian Standards.

4.8 CORONA AND RIV PERFORMANCE:

All surfaces shall be even, smooth, without cuts, abrasions or projections. No part shall be subject to excessive localized pressure. The metal parts and porcelain shall not produce any noise-generating corona under all operating conditions.

## 4.9 SUITABILITY FOR LIVE LINE MAINTENANCE:

The insulator shall be compatible for use with hot line or live line maintenance techniques so that usual hot line operation can be carried out with easy speed and safety.

## 4.10 FREEDOM FROM DEFECTS:

Insulators shall have none of the following defects:

- 1) Ball pin shake.
- 2) Cementing defects near the pin like small blow holes, small hair cracks lumps etc.
- 3) Sand fall defects on the surface of the insulator.

4.11 INSULATOR STRINGS:

4.11.1 TYPE AND RATING:

The insulator strings shall be formed with standard discs described in this specification for use on 3 phases 132/22 KV 50 Hz effectively earthed systems in an atmosphere with pollution level as indicated in project synopsis. Suspension insulator strings for use with

suspension/tangent towers are to be fitted with discs 70/90 KN EMS rating while tension insulator strings for use with Anchor/ Tension towers are to be fitted with discs of 120 KN / 160 KN EMS level rating.

#### 4.11.2 STRING SIZE:

The sizes of the disc insulator, the number to be used in different types of strings, their electro-mechanical strength and minimum nominal creep age distance shall be as given in clause 3.12

#### 4.12 STRING CHARACTERISTICS:

4.12.1 The characteristics of the complete string shall be as follows:

4.12.2 Insulator units after assembly shall be concentric and coaxial within limits as permitted by Indian Standards.

4.12.3 The strings design shall be such that when units are coupled together there shall be contact between the shell of one unit and metal of the adjacent unit.

## **5.0** SPECIFICATION DRAWINGS:

6.1 A list of specification drawings in respect of the long rod insulators indicated above is given at Annexure-II. These specification drawings are attached herewith for information and guidance of the bidder only. The drawings to be furnished by the supplier shall be as per his own design and manufacture and shall be distinct and separate from these specification drawings.

## **6.0** GENERAL TECHNICAL REQUIREMENT:

### 7.1 PORCELAIN:

The porcelain used in the manufacture of the shell shall be ivory white, nonporous of high dielectric, mechanical and thermal strength free from internal stress blisters and thermal strength from internal stresses blisters, laminations, voids, foreign matter. Imperfections or other defects, which might render it in any way unsuitable for insulator shells. Porcelain shall remain unaffected by climatic conditions, ozone, acid alkalis, and zinc of dust. The manufacturing shall be by the wet process and impervious character obtained by through vetrification.

### 7.2 PORCELAIN GLAZE:

Surfaces to come in contact with cement shall be made rough by stand glazing. All other exposed surfaces shall be glazed with ceramic materials having the same temperature coefficient of expansion as that of the insulator shell. The thickness of the glaze shall be

uniform throughout and the colour of the glaze shall be brown. The glaze shall have a visible luster and smooth on surface and be capable of satisfactory performance under extreme tropical climatic weather conditions and prevent ageing of the porcelain. The glaze shall remain under compression on the porcelain body throughout the working temperature range.

### 7.3 METAL PARTS:

#### 7.3.1 Cap and Ball pins:

Twin Ball pins shall be made with drop forged steel and caps with malleable cast iron. They shall be in one single piece and duly hot dip g galvanized. They shall not contain parts or pieces joined together, welded, shrink fitted or by any other process from more than one piece of material. The pins shall be of high tensile steel, drop forged and heat malleable cast iron and annealed. Galvanizing shall be by the hot dip process with a heavy coating of zinc of very high purity with minimum of 6 dips. The bidder shall specify the grade, composition and mechanical properties of steel used for caps and pins.

#### 7.3.2 SECURITY CLIPS:

The security clips shall be made of phosphor bronze or of stainless steel.

### 7.4 FILLER MATERIAL:

Cement to be used as a filler material shall be quick setting, for curing Portland cement. It shall not cause fracture by expansion or loosening by contraction. Cement shall not react chemically with metal parts in contact with it and its thickness shall be as small and as uniform as possible.

## **7.0** MATERIAL DESIGN AND WORKMANSHIP:

### 8.1 GENERAL:

- i) All raw materials to be used in the manufacture of these insulators shall be subject to strict raw materials quality control and to stage testing quality control during manufacturing stage to ensure the quality of the final end product. Manufacturing shall conform to the best engineering practices adopted in the field of extra high voltage transmission. Bidders shall therefore offer insulators as are guaranteed by them for satisfactory performance on Transmission lines.
- ii) The design, manufacturing process and material control at various stages be such as to give maximum working load, highest mobility, best resistance to corrosion good finish, elimination of sharp edges and corners to limit corona and radio interference voltage

## **8.2** INSULATOR SHELL:

The design of the insulator shell shall be such that stresses due to expansion and contraction in any part of the insulator shall not lead to deterioration. Shells with cracks shall be eliminated by temperature cycle test followed by temperature cycle test followed by mallet test. Shells shall be dried under controlled conditions of humidity and temperature.

## **8.3** METAL PARTS:

- i) The twin ball pin and cap shall be designed to transmit the mechanical stresses to the shell by compression and develop uniform mechanical strength in the insulator. The cap shall be circular with the inner and outer surfaces concentric and of such design that it will not yield or distort under loaded conditions. The head portion of the insulator or is under tension the stresses are uniformly distributed over the pinhole portion of the shell. The pinball shall move freely in the cap socket either during assembly of a string or during erection of a string or when a string is placed in position.
- ii) Metal caps shall be free from cracks, seams, shrinks, air holes, blowholes and rough edges. All metal surfaces shall be perfectly smooth with no projecting parts or irregularities which may cause corona. All load bearing surfaces shall be smooth and uniform so as to distribute the loading stresses uniformly. Pins shall not show any macroscopically visible cracks, insulations and voids.

## **8.4** GALVANIZING:

All ferrous parts shall be hot dip galvanized six times in accordance with IS: 2629. The zinc to be used for galvanizing shall conform to grade Zn 99.5 as per IS: 209. The zinc coating shall be uniform, smoothly adherent, reasonably light, continuous and free from impurities such as flux ash, rust stains, bulky white deposits and blisters. Before ball fittings are galvanized, all die flashing on the shank and on the bearing surface of the ball shall be carefully removed without reducing the designed dimensional requirements.

### **8.4.1** CEMENTING:

The insulator design shall be such that the insulating medium shall not directly engage with hard metal. The surfaces of porcelain and coated with resilient paint to offset the effect of difference in thermal expansions of these materials.

## **8.5** SECURITY CLIPS (LOCKING DEVICES)

The security clips to be used as locking device for ball and socket coupling shall be 'R' shaped hump type to provide for positive locking of the coupling as per IS: 2486 (Part-IV). The legs of the security clips shall allow for sore adding after installation to prevent complete withdrawal from the socket. The locking device shall be resilient corrosion resistant and of sufficient mechanical strength. There shall be no possibility of the locking device to be displaced or be capable of rotation when placed in position and under no circumstances shall it allow separation of insulator units and fitting 'W' type security clips are also acceptable. The hole for the security clip shall be countersunk and the clip shall be of such design that the eye of the clip may be engaged by a hot line clip puller to provide for disengagement under energized conditions. The force required for pulling the clip into its unlocked position shall not be less than 50 N (5 Kgs.) or more than 500N (50 Kgs.)

## **8.6** BALL AND SOCKET DESIGNATION:

The dimensions of the balls and sockets for 80 KN long rod insulators shall be of 16mm and for 120 KN shall be of 20mm designation in accordance with the standard dimensions stated in IS: 2486 (Part-III).

### **8.7** DIMENSIONAL TOLERANCE OF INSULATORS DISCS

It shall be ensured that the dimensions of the long rod insulators are within the limits as per relevant IEC/ISS.

## **8.0** TESTS (FOR DISC INSULATORS) :

9.1 The following tests shall be carried out on the insulator string and disc insulators.

## **9.2** TYPE TEST:

This shall mean those tests, which are to be carried out to prove the design, process of manufacture and general conformity of the material and product with the intents of this specification. These tests shall be conducted on a representative number of samples prior to commencement of commercial production. The Bidder shall indicate his schedule for carrying out these tests.

## **9.3** ACCEPTANCE:

This shall mean these tests, which are to be carried out on samples taken from each lot offered for pre-despatch inspection for the purpose of acceptance of the lot.

## **9.4** ROUTINE TESTS:

This shall mean those tests, which are to be carried out on each insulator to check **the** requirements, which are likely to vary during production.

## **9.5** TESTS DURING MANUFACTURE:

Stage tests during manufacture shall mean those tests, which are to be carried out during the process of manufacture to ensure quality control such that the end product is of the designed quality conforming to the intent of this specification.

## **9.6** TEST VALUE:

For all type and acceptance tests the acceptance values shall be the value guaranteed by the bidder in the guaranteed technical particulars of the acceptance value specified in this specification of the relevant standard whichever is more stringent for that particular test.

## **9.7** TEST PROCEDURE AND SAMPLING NORMS:

The norms and procedure of sampling for the above tests shall be as per the relevant Indian Standard or the Internationally accepted standards. This will be discussed and mutually agreed to between the supplier and purchaser before placement of order. The standards and normal according to which these tests are to be carried out are listed against each test. Where a particular test is a specific requirement of this specification, the norms and procedure for the same shall be as specified in Annexure-IV attached hereto as mutually agreed to between the supplier and the purchaser in the quality assurance programme.

## **9.8** TYPE TESTS:

The following type test shall be conducted on a suitable number of individual unit components, materials or complete strings.

9.8.1 On the complete insulator string with hardware fittings.

- a) Power frequency voltage withstand test with corona control : BS:137(Part-I) rings and under wet condition.
- b) Switching surge voltage withstand test under wet condition (400 : only)
- c) Impulse voltage withstand test under dry condition. : IEC: 383



- d) Impulse voltage flashover test under dry condition. :
- e) Voltage distribution test. :
- f) Corona & RIV test under dry condition. : As per this specification.
- g) Mechanical strength test. : As per this specification.
- h) Vibration. :
- 9.8.2 On Insulators:
- a) Verification of dimensions. : IS: 731
- b) Thermal mechanical performance test: : IEC:575
- c) Power frequency voltage withstand and flashover (I) dry (ii) wet. : BS: 173
- d) Impulse voltage withstand flashover test (dry) : IEC: 383
- e) Visible discharge test (dry) : IS:731
- f) RIV test (dry) : IS:8263
- 9.8.3 All the type tests given under clause No.6.8.1 above shall be conducted on single suspension and Double Tension insulator string alongwith hardware fittings.
- 9.9 ACCEPTANCE TESTS:
- 9.9.1 For insulator:
- a) Visual examination : IS:731
- b) Verification of dimensions. : IS:731
- c) Temperature cycle test. : IS:731
- d) Galvanizing test. : IS:731
- e) Mechanical performance test. : IEC:575
- f) Test on locking device for ball and socket coupling. : IEC:372
- g) Eccentricity test. : As per this specification.
- h) Electro-mechanical strength test. :
- i) Puncture test. : IS:731
- j) Porosity test. : IS:731
- 9.10 ROUTINE TESTS:
- 9.10.1 For insulators:
- a) Visual inspection. : IS:731
- b) Mechanical routine test. :
- c) Electrical routine test. : IEC:383
- 9.11 TEST DURING MANUFACTURE:
- On all components as applicable.
- a) Chemical analysis of zinc used for galvanizing. :

- b) Chemical analysis, mechanical and metallographic test and magnetic particle inspection for malleable castings. :
- c) Chemical analysis, hardness test and magnetic particle inspection for forgings. : As per this specification.
- d) Hydraulic Internal Pressure tests on shell. :
- e) Crack detection test for metal parts. :

## 9.12 ADDITIONAL TEST:

The purchaser reserves the right for carrying out any other tests of a reasonable nature at the works of the supplier/ laboratory or at any other recognized laboratory/ research institute in addition to the above mentioned type, acceptance and routine tests at the cost of the purchaser to satisfy that the material complies with the intent of this specification.

## 9.13 CO-ORDINATION FOR TESTING:

For insulator strings, the supplier shall arrange to conduct testing of their disc insulators with the hardware fittings to be supplied to the purchaser by other suppliers. The supplier is also required to guarantee overall satisfactory performance of the disc insulator with the hardware fittings.

### NOTE:

In respect of electrical tests on a complete string consisting of insulators and hardware guarantee of values of responsibility of testing shall be with hardware manufacturer of RIV corona and voltage distribution test and with insulator manufacturer for all other tests.

## 9.14 TEST CHARGES AND TEST SCHEDULE:

### 9.14.1 TYPE TEST:

The insulator offered shall be fully type tested as per this specification. In case the equipment of the type and design offered, has already been type tested in an independent test laboratory. The bidder shall furnish four sets of type test reports alongwith the offer. These tests must not have been conducted earlier than five years. The purchaser reserves the right to demand repetition of some or all type tests in the presence of purchasers' carrying representative. For this purpose the bidder may quote unit rates for carrying out each type test. These prices shall be taken into consideration for bid evaluation. For any change in the

design/type already type tested and the design/type offered against this specification, purchaser reserves the right to demand repetition of tests without any extra cost.

## **9.14.2** ACCEPTANCE AND ROUTINE TEST:

All acceptance and routine tests as stipulated herein shall be carried out by the supplier in the presence of purchaser's representative.

9.14.3 Immediately after finalisation of the programme of type/ acceptance/ routine testing, the supplier shall give sufficient advance intimation to the purchaser to enable him to depute his representative for witnessing the tests.

9.14.4 For type tests involving tests on a complete insulator string with hardware fittings, the purchaser will advise the supplier of the hardware fittings to provide the necessary fittings to the place of the test.

9.14.5 In case of failure of the complete string in any type tests, the supplier whose product has failed in the tests, shall get the tests repeated at his cost. In case of any dispute, assessment of the purchaser as to the items that has caused the failure in any of the type tests shall be final and binding.

## **10.** INSPECTION:

- 10.1 i. Purchaser and its representative shall at all times be entitled to have access to the works and to all places of manufacturer where insulators are manufactured and the supplier shall afford all facilities to them for unrestricted inspection of the works, inspection of materials, inspection of manufacturing process of insulators and for conducting necessary tests as specified herein.
- ii. The supplier shall keep the purchaser informed in advance of the time of starting and of progress of manufacture of insulators in its various stages so that arrangements could be made for inspection.
- iii. No material shall be dispatched from its point of manufacture unless the materials has been satisfactorily inspected and tested.
- iv. The acceptance of any quantity of insulators shall in no way relieve the supplier of his responsibility for meeting all the requirement of this specification and shall not prevent subsequent rejection, if such insulators are later found to be defective.

## **10.2** IDENTIFICATION MARKING:

- 10.2.1 Each unit of insulator shall be legibly and indelibly marked with the trade mark of the supplier, the year of manufacture, the guaranteed combined mechanical and electrical strength in kilo-newtons abbreviated by 'KN' to facilitate easy identification and proper use.
- 10.2.2 The marking shall be on porcelain for porcelain insulators. The marking shall be printed and not impressed and the same shall be applied before firing.

11. QUALITY ASSURANCE PLAN:

- 11.1 The bidder hereunder shall invariably furnish following information alongwith his offer, failing which the offer shall be liable for rejection.
- i. Statement giving list of important raw materials, names of sub-suppliers for the raw materials, list of standards according to which the raw material are tested, list of tests normally carried out on raw materials in presence of bidder's representative, copies of test certificates.
  - ii. Informations and copies of test certificates as in (i) above in respect of bought out materials.
  - iii. List of manufacturing facilities available.
  - iv. Level of automation achieved and lists of area where manual processing exists.
  - v. List of areas in manufacturing process, where stage inspections are normally carried out in quality control and details of such tests and inspection.
  - vi. Special features provided in the equipment to make it maintenance free.
  - vii. List of testing equipping 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 specified test requirements.
- 11.2 The supplier shall within 30 days of placement of order submit the following information to the owner.
- i) List of raw material and the names of sub-suppliers selected from those furnished alongwith the offer.

POST INSULATORS.

Post insulator shall conform in general to IS 2544, IEC 168 and IEC 815.

3.1 constructional features

Post type insulators shall consist of a porcelain part permanently secured in a metal base to be mounted on the supporting structures. They shall be capable of being mounted upright and be designed to withstand any shocks to which they may be subjected to by the operation of the associated equipment. Only solid core insulators will be acceptable. Porcelain used shall be homogeneous, free from lamination, cavities and other flaws or imperfections that might affect the mechanical or dielectric quality and shall be thoroughly vitrified, tough and impervious to moisture.

Glazing of the porcelain shall be of uniform brown in colour, free from blisters, burrs and other similar defects.

The insulator shall have alternate long and short sheds with aerodynamic profile. The shed profile shall also meet the requirements of IEC 815 for the specified pollution level.

When operated at normal rated voltage there shall be no electric discharge between conductor and insulators which would cause corrosion or injury to conductors or insulators by the formation of substance produced by chemical action.

The design of the insulators shall be such that stresses due to expansion and contraction in any part of the insulator shall not lead to deterioration.

All ferrous parts shall be hot dip galvanized in accordance with the latest edition of IS 2633, and IS 4579. The zinc used for galvanizing shall be grade Zn 99.95 as per IS 209. The zinc coating shall be uniform, adherent, smooth, reasonably bright, continuous and free from imperfections such as flux ash, rust stains, bulky white deposits and blisters. The metal parts shall not produce any noise generating corona under the operating conditions. Flat washer shall be circular of a diameter 2.5 times that of bolt and of suitable thickness. Where bolt heads/nuts bear upon the beveled surfaces they shall be provided with square tapered washers of suitable thickness to afford a seating square with the axis of the bolt.

Bidder shall make available data on all the essential features of design including the method of assembly of shells and metal parts, number of shells per insulator, the manner in which mechanical stresses are transmitted through shells to adjacent parts, provision for meeting expansion stresses, results of corona and thermal shock tests, recommended working strength and any special design or arrangement employed to increase life under service conditions.

#### TEST DETAILS.

1. VOLTAGE DISTRIBUTION TEST:

The voltage across each insulator unit shall be measured by sphere gap method. The result obtained shall be converted into percentage and proportionate correction be applied as to give a total of 100% distribution. The voltage across any disc. Not exceed the values given in clause 4-12.1

2. CORONA EXTINCTION VOLTAGE TEST (DRY):

The sample assembly when subjected to power frequency voltage shall have a corona extinction voltage of not less than the value specified at clause 4.12.1 (iv) under dry condition. There shall be no evidence of corona on any part of the sample when all possible sources of corona are photographed in a darkened room.

3. RIV TEST (DRY):

Under the conditions as specified in (2) above, the insulator string along with complete hardware fittings shall have a radio interference voltage level below 500 micro volts at one MHz when subjected to 50 Hz AC voltage of 1.1 times maximum time to ground voltage under dry condition. The test procedure shall be in accordance with IS: 8263.

4. eg and again vibrated for 5 million cycles without any failure, after the test, the disc insulators shall be examined for looseness of pins and cap or any crack in the cement. The hardware fittings shall be examined to fatigue fatter and mechanical strength test. There shall be no deterioration of properties of hardware components and disc insulators after the vibration test. The disc insulators shall be subjected to the following tests as per relevant standards.

Test.	Percentage of disc To be tested.
<p>a) Temperature cycle test followed by MechanicaThe complete insulator string along with its hardware fitting excluding arcing horn corona controlling/grading ring and suspension assembly/dead end assembly shall be subject to a load equal to 50% of the specified minimum ultimate tensile strength (UTS) which shall be increased already rate to 68% of the minimum UTS specified. The load shall be held for five minutes and then removed. After removal of the load, the string components shall not show any visual deformation and it shall be possible to disassemble them by hand,. Hand tools may be used to remove cotter pins and loosen the nuts initially. The string shall then be reassembled and loaded to 50% of UTS and the load shall be further increased at a steady rate till the specified minimum UTS and held for one minute. No fracture should occur during this period. The applied load shall then be increased until the failing loads reached and the value recorded.</p>	<p>60</p>

5. VIBRATION TEST:

The suspension string shall be tested in suspension mode, and tension string in tension mode itself in laboratory span of minimum 30 meters. In the case of suspensions string a load equal to 600 Kg. shall be applied along with the axis of the suspensions string by means of turn buckle. The insulators string along with hardware fittings and two sub conductors throughout the duration of the test vibration dampers shall not be used on the test span. Both the sub-conductors shall be vertically vibrated simultaneously at one of the

resonance frequencies of the insulator string (more than 10Hz) by means of vibration inducing equipment. The amplitude of vibration at the antipode point nearest to the string shall be measured and the same shall not be less than 120.4 being the frequency of vibration. The insulator strings shall be vibrated for five million cycles then rotated by 90 degrees for performance test. 40

b) Puncture test (for porcelain insulator only)

6. CHEMICAL ANALYSIS OF ZINC USED FOR GALVANIZING.

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

7. TEST FOR FORGINGS:

The chemical analysis hardness tests and magnetic particle inspection 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 supplier and purchaser in quality assurance programme.

TEST ON CASTING:

The chemical analysis mechanical and metallographic tests and magnetic particle inspection 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 supplier and purchaser in quality assurance programme.

HYDRAULIC INTERNAL PRESSURE TEST ON

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

THERMAL MECHANICAL PERFORMANCE TEST:

The thermal mechanical performance test shall be carried out on minimum 15 number of disc insulators units as per the procedure given in IEC 575. The performance of the insulator unit shall be determined by the same standard.

#### ECCENTRICITY TEST:

The insulator shall be vertically mounted on a fixture using dummy pin and socket. A vertical scale with horizontal slider shall be used for the axial run out. The pointer shall be positioned in contact with the bottom of the outermost petticoat of the disc. The disc insulators shall be rotated with reference to the fixture and the slider shall be allowed to move up and down on the scale but always maintaining contact with the bottom of the outermost petticoats. After one full rotation of the disc the maximum and minimum position the slider has reached on the scale can be found out. Difference between the above two readings shall satisfy the guaranteed value for axial run out.

Similarly using a horizontal scale with vertical slider the radial run out shall be measured. The slider shall be positioned on the scale to establish contact with the circumference of the disc insulator and disc insulator rotated on its fixture always maintaining the contact. After one full rotation of the disc the maximum and minimum position the slider has reached on the scale can be found out. Difference between the above two readings shall satisfy the guaranteed value for axial run out.

#### v. CRACK DETECTION TEST:

Crack detection test shall be carried out on each ball and pin before assembly of disc unit. The supplier shall maintain complete record of having conducted such tests on each and every piece of ball pin. The bidder shall furnish full details of the equipment available with him for crack test and also indicate the test procedure in detail.



# **HARDWARES**

## **TECHNICAL SPECIFICATION FOR HARDWARE**

### **FITTINGS.**

SUITABLE FOR POWER CONDUCTOR (ACSR PANTHER & ZEBRA)

#### **1.0 SCOPE**

This Specification covers design (if required), manufacture, testing at manufacturer's Works, supply and delivery of GSS), power conductor and ground wire accessories, insulator and hardware fittings for string insulators suitable for use in 33 KV side of the sub-station(for capacitor Bank bays) of OPTCL. The hard wares to be supplied shall be as per approved drawings of OPTCL. Any change there of shall be with due permission of Sr. G.M (CPC).The firm shall submit his drawings for approval of OPTCL and only after which the manufacturing shall be started.

The materials/equipment offered, shall be complete with all components, which are necessary or usual for the efficient performance and satisfactory maintenance. Such part shall be deemed to be within the scope of contract.

#### **2.0 STANDARDS**

The materials covered under this Specification shall comply with the requirement of the latest version of the following standards as amended upto date, except where specified otherwise.

- i) IS:2486 Part-II & III : Insulator fitting for overhead power lines with a nominal voltage greater than 1,000 volts.
  
- ii) IS:2121 Part I & II Conductor & earth wire accessories for overhead power lines.
  
- iii IS:9708 Stock Bridge Vibration Dampers on overhead power lines.  
)
- iv) IS:2633 Method of testing of uniformity of coating on zinc coated articles
  
- v) IS:209 Specification for Zinc.

### ***3.0 MATERIALS AND DESIGN***

Aluminium and aluminium alloys, malleable iron and forged steel, having required mechanical strength, corrosion resistance and machinability depending on the types of application for which accessories / fittings are needed, shall be employed.

In manufacturer of the accessories / fittings, the composition of the aluminium alloys used shall be made available to Employer if required for verification.

The materials offered shall be of first class quality, workmanship, well finished and approved design. All castings shall be free from blow-holes, flaws, cracks of other defects and shall be smooth, close grained and true forms and dimensions. All machined surfaces should be free, smooth and well finished.

Metal fittings of specified material for conductor and earthwire accessories and string insulator fittings are required to have excellent mechanical properties such as strength, toughness and high resistance against corrosion. All current carrying parts shall be so designed and manufactured that contact resistance is reduced to the minimum.

All bolts, nuts, bolt-heads shall be the white worths standard thread. Bolt heads and nuts shall be hexagonal. Nuts shall be locked in an approved manner. The treads in nuts and tapped holes shall be cut after galvanising and shall be well fabricated and greased. All other treads shall be cut before galvanising. The bolt treads shall be undercut to take care of increase in diameter due to galvanising.

All nuts shall be made of materials to Clause 4.8 of IS:1367 (latest edition) with regard to its mechanical properties.

The general design conductor and earth wire accessories and insulator fittings shall be such as to ensure uniformity, high strength, free from corona formation and high resistance against corrosion even in case of high level of atmosphere pollution.

All hooks, eyes, pins, bolts, suspension clamps and other fittings for attaching to the tower or to the line conductor or to the earthwire shall be so designed that the effects of vibration, both on the conductor and the fittings itself, are minimized.

Special attention must be given to ensure smooth finished surface throughout. Adequate bearing area between fittings shall be provided and point or line contacts shall be avoided.

All accessories and hardwares shall be free from cracks, shrinks, slender air holes, burrs or rough edges.

The design of the accessories and hardwares shall be such as to avoid local corona formation or discharge likely to cause interference to tele-transmission signals of any kind.

### **4.0 GALVANISING :**

All ferrous parts of conductor and ground wire accessories and insulator hardwares shall be galvanised in accordance with IS:2629-Recommended Practice for hot dip galvanising of iron and steel or any other equivalent authoritative standards. The weight of zinc coating shall be determined as per method stipulated in IS:2633 for testing weights, thickness and uniformity of coating of hot dip galvanised articles or as per any other equivalent authoritative standards. The zinc used or galvanisation shall conform to grade zn 98 of IS:209. The galvanised parts shall withstand four (4) dips of 1 minute each time while testing uniformity of zinc coating as per IS:2633.

**Spring washers shall be electro galvanised.**

## **11.0 INSULATOR HARDWARES**

The insulator disc hardwares and string assemblies to be offered by the tenderer shall be suitable to meet the requirement given in the specific technical particulars as detailed hereinafter.

Hardwares for suspension and tension insulator shall be suitable for insulator with normal pin shank diameter of 20 mm. in case of tension string unit and 16mm. for suspension string unit.

Each insulator string shall generally include the following hardware components.

Single Suspension Set.

a) Ball Hook

b) tower side arcing horn

c) Socket Eye with R-Type security clip.

d) Line side arcing horn.

e) Armour grip suspension clamps

Double Suspension Set.

a) Ball Hook.

b) Socket clevis with R-Type security clip-3 Nos.

c) Yoke Plate-2 Nos.

d) Tower side arcing horns-2Nos.

e) Ball clevis – 2 Nos.

f) Line side arcing horns-2 Nos.

g) Clevis Eye.

h) Armour Grip Suspension Clamp.

Single Tension Set :

a) Anchor Shackle.

b) Ball Eye.

c) Tower side arcing horn.

d) Socket Clevis with R-Type security clip.

e) Line side arcing horn

f) Compression type dead end clamp.

Double Tension Set :

a) Anchor Shackle.

b) Chain Link.

c) Yoke Plate – 2 Nos.

d) Tower side arching horn.

e) Ball Clevis – 2 Nos.

f) Socket Clevis with R-Type security clip – 2 Nos.

g) Line side arcing horns.

h) Compression type dead end clamps.

## **12.0 CLAMP**

### **12.1 ARMOUR GRIP SUSPENSION CLAMPS**

Armour Grip Suspension Clamp shall consist of 2 neoprene insert, one set of armour rods made of aluminium alloy, two aluminium housing having inner profile matching with the profile of the armour rods and supporting strap made of aluminium alloy. The A.G. type suspension clamp shall be designed, manufactured and finished as to have a suitable shape without sharp edges at the end and to hold the respective conductor properly. It should, however, have sufficient contact surface to minimise damage due to fault current. The clamp shall be of Armour Grip Type.

The A.G. type suspension clamp shall permit the conductor to slip before the occurrence of failure of the conductor and shall have sufficient slip strength to resist the conductor tension under broken wire conditions. The clamp shall have slip strength of not less than 15 % of respective conductors.

### **12.2 TENSION CLAMPS**

The Tension Clamps shall be made out of aluminium alloy and of compression type suitable for PANTHER conductor. The tension clamps shall not permit slipping or damage to failure of the complete conductor or any part thereof at a load less than 90% of the ultimate strength of conductor. The mechanical efficiency of tension / clamps shall not be affected by method of erection involving come / along or similar clamps or tension stringing operation during or after

assembly and erection of tension clamp itself. The tension clamp shall be of a design that will ensure unrestricted flow of current without use of parallel groove clamps. The clamps shall be as light as possible.

### 12.3 ARCING HORNS

Each hardware assembly shall have provision for attaching arcing horns of both adjustable and non/adjustable type across the suspension and tension strings or tower side. However each hardware assembly shall be provided with arching horn of fixed type on line side only.

### 12.4 UNIVERSAL JOINTING COMPOUND

BENDEX-HV' Universal jointing compound which is a chemically inert compound to be used as filler for the compression joints and dead end clamps to be supplied.

## TESTS, TEST CERTIFICATE AND PERFORMANCE REPORTS

The fittings and accessories for the power conductor and G.S.S. ground wire, insulator and hardwares shall be tested in accordance with IS:2121, IS:2486, IS:9708 (For V Dampers), BS:916 for hexagonal bolts and nuts or any other authoritative equivalent standards. Six sets of type and routine test certificates and performance reports are to be submitted by the bidder.

The Employer however, reserves the right to get all the tests performed in accordance with the relevant I.S. Specification as Acceptance Test in presence of Employer-s representatives.

The tenderer shall clearly state the testing facilities available in the laboratory at his Works and his ability to carry out the tests in accordance with this Specification. All the specified tests shall be carried out without any extra cost.

Acceptance Test for power conductor and G.S.S. ground wire accessories.

- a) Visual examination
- b) Dimensional verification
- c) Failing load test
- d) Slip strength test (for clamps)
- e) Electrical resistance test
- f) Resonance frequency test (for vibration dampers)
- g) Fatigue test (for vibration dampers)
- h) Mass pull off test (for vibration dampers)
- i)** Galvanising test.

## 13.1 ACCEPTANCE TEST FOR HARDWARES

- a) Dimensional verification.
- b) Ultimate tensile test.
- c) Slip strength test.
- d) Electrical resistance test.
- e) Heating cycle test
- f) Breaking strength of full string assembly.
- g) Galvanising test.

### 13.2 SPECIFIC TECHNICAL REQUIREMENTS FOR CONDUCTOR ACCESSORIES AND INSULATOR HARDWARES

Conductor	Panther/zebra	GSS ground wire
a) Type	ACSR Panther/zebra	Ground wire.
b) Material	Aluminium conductor steel reinforced. Aluminium 30/3mm	Galvanised stranded steel wire.
c) Strand & Wire diameter.	Steel 7/3mm & all.54/3.18mm steel-7/3.18mm resp.	7/3.15 mm.
d) Weight per Km.	974/1622 Kg/Km. 21/28.62 mm	426 Kg/Km.
e) Overall diameter	0.13750/0.06915 Ohms/Km.	9.4mm.
f) A.C. Resistance at 20 deg. C when corrected to standard weight.		
g) Minimum Breaking load/Ultimate tensile strength.	144/13289 Kg	5710 Kg.

- h) Maximum working tension at minimum temperature & 2/3 full wind. 3806/4325 Kg. 1393 Kg.
- i) Maximum Sag at maximum temperature & no wind. 6120/9240 mm. 5150mm.

**DISC Insulator (for suspension & tension Insulator strings)**

Disc Insulators	Suspension 33KV	Tension 33KV
a) Type	Ball & Socket	Ball & Socket.
b) Ball size	16mm. Alt. B	20mm. Alt. B/20mm
c) Diameter	(IS:2486 Pt.II)	(IS:2486 Pt.II)
d) Spacing	254/255 mm.	255/280 mm
e) E.M. strength	146/145 mm. 90/120 KN,.	145/170mm. 120/160 KN.

**INSULATOR HARDWARES**

- vi) String hardware :

Material and strength

Description of item.	Material	UTS
i) Bolt hook	Forged Steel	11,500 Kgs (90 KN)
ii) Anchor Shackle	-do-	15,500 Kgs (120 KN)
iii) Socket Eye Horn Holder.	- do-	11,500 Kgs (90 KN)
iv) Socket Clevis.	-do-	15,500 Kgs.

- v) Ball Clevis -do- 15,500 Kgs.
- vi) Clevis Eye -do- 15,500 Kgs.
- vii) Socket Eye. -do- 15,500 Kgs.
- ii) Bottom / Top Yoke plate :
  - Double suspension Mild Steel 11,500 Kgs.
  - Double Tension -do- 15,500 Kgs.
- ix) Arcing Horn -do- —
- x) Suspension Clamp. Aluminium Alloy and Neoprene. —
- xi) Tension Clamp. All.Alloy & Steel. 11,500 Kgs.
- xii) Ball Pin High tensile forged steel (hot-dip galvanised) 90% of UTS of conductor.
- xiii) Security Clip Brass (R-Type)
  - Minimum failing load String (KN) Single Suspension : 11,500
  - Single Tension: 11,500/15,500
  - Double Suspension : 11,500
  - Double Tension : 11,500/15,500

vii) CLAMPS

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<b>Single suspension string</b>	<b>Single tension string</b>	<b>Double suspension string</b>	<b>Double tension string.</b>
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i) Type	AGS Type	Compression Type	AGS Type	Compression Type
ii) Material	<b><u>Aluminium Alloy and neoprene</u></b>	Aluminium Alloy and Steel	Aluminium Ally and Neoprene	Aluminium Alloy and Steel
ii) Minimum slip strength	Not less than 15%	90% of UTS of conductor	Not less than 15% of UTS of conductor	90% of UTS of conductor
iv) Minimum failing load (kg)	11,500	90% of UTS of conductor	11,500 90%	Of UTS of conductor

**C. Suspension assembly: armour grip clamp.**

1. The armour grip suspension clamp shall comprise of retaining strap, support housing, elastomer inserts with aluminum reinforcements and AGS preformed rod set.
2. Elastomer insert shall be resistant to the effects of temperature up to 85 deg. C, ozone, Ultraviolet radiation and other atmospheric contaminants likely to be encountered in service. The physical properties of the elastomer shall be of approved standard. It shall be electrically shielded by a cage of AGS preformed rod set. The elastomer insert shall be so designed that the curvature of the AGS rod shall follow the contour of the neoprene insert.
3. The AGS preformed rod set shall be as detailed above in general except that the length of the AGS preformed rods shall be such that it shall ensure sufficient slipping strength and shall not introduce unfavourable stress on the conductor under all operating conditions.

**D. Fasteners: bolts, nuts & washers.**

1. All bolts and nuts shall conform to IS-6639 – 1972. All bolts and nuts shall be galvanized. All bolts and nuts shall have hexagonal heads, the heads being truly concentric, and square with the shank, which must be perfectly straight.

2. Bolts upto M16 and having length upto ten times the diameter of the bolt should be manufactured by cold forging and thread rolling process to obtain good and reliable mechanical properties and effective dimensional control. The shear strength of bolt for 5.6 grade should be 310 Mpa minimum as per IS-12427. Bolts should be provided with washer face in accordance with IS-1363 Part-I to ensure proper bearing.
3. Fully threaded bolts shall not be used. The length of the bolt shall be such that the threaded portion shall not extend into the place of contact of the component parts.
4. All bolts shall be threaded to take the full depth of the nuts and threaded enough to permit the firm gripping of the component parts but not further. It shall be ensured that the threaded portion of the bolt protrudes not less than 3 mm and not more than 8 mm when fully tightened. All nuts shall fit and be tight to the point where shank of the bolt connects to the head.
5. Flat washers and spring washers shall be provided wherever necessary and shall be of positive lock type. Spring washers shall be electro-galvanized. The thickness of washers shall conform to IS-2016-1967.
6. The bidder shall furnish bolt schedules giving thickness of components connected, the nut and the washer and the length of shank and the threaded portion of the bolts and size of holes and any other special details of this nature.
7. To obviate bending stress in bolt, it shall not connect aggregate thickness more than three time its diameter.
8. Bolts at the joints shall be so staggered that nuts may be tightened with spanners without fouling.
9. Fasteners of grade higher than 8.8 are not to be used and minimum grade for bolts shall be 5.6.

**GENERAL:**

1. All ferrous parts including fasteners shall be hot dip galvanized, after all machining has been completed. Nuts may however be tapped (threaded) after galvanizing and the threads oiled. Spring washers shall be electro-galvanized. The bolt threads shall be undercut to take care of the increase in diameter due to galvanizing. Galvanizing shall be done in accordance with IS-2629-1985 and shall satisfy the tests mentioned in IS

2633-1986. Fasteners shall withstand four dips while spring washers shall withstand three dips of one-minute duration in the standard Preece test. Other galvanized materials shall be guaranteed to withstand at least six successive dips each lasting one minute under the Standard Preece test for galvanizing.

2. The zinc coating shall be perfectly adherent of uniform thickness, smooth, reasonably bright, continuous and free from imperfections such as flux, ash, rust stains, bulky white deposits and blisters. The zinc used for galvanizing shall be of grade Zn 99.95 as per IS 209-1979.
3. Pin balls shall be checked with the applicable “G” gauges in at least two directions, one of which shall be across the line of die flashing and the other 90 deg. to this line. ‘NO GO’ gauges shall not pass in any direction.
4. Socket ends, before galvanizing shall be of uniform contour. The bearing surface of socket ends shall be uniform about the entire circumference without depressions or high spots. The internal contours of socket ends shall be concentric with the axis of the fittings as per IS 2486/IEC-120. The axis of the bearing surfaces of socket ends shall be coaxial with the axis of the fittings. There shall be no noticeable tilting of the bearing surfaces with the axis of the fittings.
5. All current carrying parts shall be so designed and manufactured that contact resistance is reduced to minimum.
6. Welding of aluminum shall be by inert gas shielded tungsten arc or inert gas, shielded metal arc process. Welds shall be clean, sound, smooth, and uniform without overlaps, properly fused and completely sealed. There shall be no cracks, voids incomplete penetration, incomplete fusion, under-cutting or inclusions Porosity shall be minimized so that mechanical properties of the aluminum alloys are not affected. All welds shall be properly finished as per good engineering practices.

#### Electrical Design:

The normal duty and heavy duty suspension, light duty, normal duty and heavy duty tension insulator sets shall all comply with the technical requirements of schedule C and satisfy the test requirements stated in Section-7.

#### Mechanical design:

The mechanical strength of the insulators and insulator fittings shall be as stated in Schedule-C

The design shall be such that stresses due to expansion and contraction in any part of the insulator shall not lead to the development of defects.

Insulating material shall not engage directly with hard metal. All fixing materials shall be of approved quality, shall be applied in an approved manner and shall not enter into chemical action with the metal parts or cause fracture by expansion in service. Where cement is used as a fixing medium, cement thickness shall be as small and even as possible and proper care shall be taken to correctly centre and locate the individual parts during cementing.

- Technical Specification for Design, Supply and Testing of Hard ware fittings.

Type tests:

The following type tests shall be conducted on hardware fittings.

A. On suspension hardware fittings only.

- (a) Magnetic power loss test.
- (b) Clamp slip strength Vs torque
- (c) Mechanical strength test.
- (d) On one test on elastomer.

B. On Tension hard ware fittings only.

Electrical resistance test for IS 2486 (Part-I) 1971  
Dead end assembly.

(a) Heating cycle test for -do-  
dead end assembly.

(b) Slip strength test for IS 2486 (Part-I)  
dead end assembly.

(c) Mechanical strength test.

C. On both suspension and tension hardware fittings.

(a) Visual examination. IS-2486 (Part-I) 1971

(b) Verification of dimension. -do-

- (c) Galvanizing / electroplating test. -do-
- (d) Mechanical strength test of each component  
(including corona control ring/grading ring and arcing horn)
- (e) Mechanical strength test of welded joint.
- (f) Mechanical strength test for corona control ring/  
grading ring and arcing horn. BS-3288 (Part-I)
- (g) Test on locking device for ball and socket coupling. IEC – 3721984
- (h) Chemical analysis, hardness tests, grain size,  
inclusion rating and magnetic particle inspection for forging/casting.

D. On suspension hardware fittings only.

- (a) Clamp slip strength ver as torque test for suspension clamp.
- (b) Shore hardness test of elastomer cushion for AG suspension clamp.
- (c) Bend test for armour rod set. IS-2121 (Part-I)
- (d) Resilience test for armour rod set. -do-
- (e) Conductivity test for armour rod set. -do-
- (a) Slip strength test for dead end assembly. IS-2121 (Part-I)

All the acceptance tests stated at clause shall also be carried out on composite insulator unit, except the eccentricity test at clause. In addition to these, all the acceptance tests indicated in IEC 1109 shall also be carried out without any extra cost to the employer.

F. For hardware fittings.

- (a) Visual examination. IS-2121 (Part-I)
- (b) Proof & test.

- G. Tests on conductor accessories.
- H. Type tests.
- I. Mid span compression joint for conductor and earthwire.
  - (a) Chemical analysis of materials.
  - (b) Electrical resistance tests. IS-2121 (Part-II) 1981 clause 6.5 & 6.6
  - (c) Heating cycle test. -do-
  - (d) Slip strength test. -do-
  - (e) Corona extinction voltage test (dry)
  - (f) Radio interference voltage test (dry)
- J. Repair sleeve for conductor.
  - (a) Chemical analysis of materials.



**ORISSA POWER TRANSMISSION CORPORATION LIMITED  
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**TECHNICAL SPECIFICATION**

**FOR  
CONTROL & POWER CABLES**

**TECHNICAL SPECIFICATION FOR  
CONTROL AND POWER  
CABLES**



# Technical specification for control and power cables.

## PART 1 : SCOPE AND CONDITIONS

### 1. SCOPE

This specification covers the testing and performance requirements of power and control cables for installation in capacitor bank in 33 KV side of different GRID S/S.

The equipment offered shall have been successfully type tested and the design shall have been in satisfactory operation for a period not less than two years on the date of bid opening. Compliance shall be demonstrated by submitting with the bid, (i) authenticated copies of the type test reports and (ii) performance certificates from the users..

The power and control cables 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 Project Manager shall have the power to reject any work or material, which, in his judgement, is not in full accordance therewith.

### 2. STANDARDS

Except where modified by this specification, the power and control cables shall be designed, manufactured and tested in accordance with the latest editions of the following standards.

IEC / ISO	Indian Standard	Title
IEC 811	IS-18-10810:1982	Testing cables
IEC 502	IS-7098:1985 (part 2)	LT and 3.3 - 33kVXLPE cables
IEC 502	IS - 1554:1988 (part 1)	PVC Cables .65/1.1kV
IEC 227	IS - 5819 :1970	Short circuit ratings for PVC cables
IEC 228	15-8130:1984	Conductors for insulated cables
IEC 502	IS - 6474: 1984	XLPE Cables

IEC 502	Extruded solid dielectric insulated power cables for rated voltages from 1kV to 30kV
IEC 540 IS - 5831: 1984	Test Methods for insulation and sheaths of electric cables and cords
IEC 287	Calculation of the continuous current rating of cables.
IS - 3975 : 1979	Mild steel wires, strips and tapes for armouring of cables

The Bidder may propose alternative standards, provided it is demonstrated that they give a degree of quality and performance equivalent to or better than the referenced standards. Acceptability of any alternative standard is at the discretion of the Project Manager. The Bidder shall furnish a copy of the alternative standard proposed along with his bid. If the alternative standard is in a language other than English, an English translation shall be submitted with the standard. In the case of conflict the order of precedence shall be 1) IEC or ISO Standards, 2) Indian Standards, 3) other alternative standards.

This list is not to be considered exhaustive and reference to a particular standard or recommendation in this Specification does not relieve the Contractor of the necessity of providing the goods complying with other relevant standards or recommendations.

### **3. SERVICE CONDITIONS**

The service conditions shall be as follows:

- maximum altitude above sea level 11,000m
- maximum ambient air temperature 50°C
- maximum daily average ambient air temperature 35°C
- minimum ambient air temperature 0°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) 70

- average number of rainy days per annum 120
- average annual rainfall 150cm
- wind pressures as per IS 802 (Part I/ Sect.1) : 1995

Wind Zones (Orissa)	2	3	5
Terrain Category 1	57.4 kg/m <sup>2</sup>	73.1 kg/m <sup>2</sup>	94.3kg/m <sup>2</sup>
Terrain Category 2	49.3	62.6	80.9
Terrain Category 3	35.6	45.3	58.4
	Light	Medium	Heavy

Environmentally, the region where the work will take place includes coastal areas, subject to high relative humidity, which can give rise to condensation. Onshore winds will frequently be salt laden. On occasions, the combination of salt and condensation may create pollution conditions for outdoor insulators.

Therefore, outdoor material and equipment shall be designed and protected for use in exposed, heavily polluted, salty, corrosive and humid coastal atmosphere.

#### 4. SYSTEM CONDITIONS

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

- Frequency 50Hz
- Nominal system voltages 33kV  
11 kV  
400/230V
- Maximum system voltages: 33kV System 36.3kV

	11kV System	12.1kV
	LV System	476V
• Minimum LV voltage		340V
• Nominal short circuit levels:	33kV System	25kA
	11kV System	12.5kA
• Insulation Levels:		
1.2/50 (µs impulse withstand voltage		
(positive and negative polarity):	33kV System	170kV
	11kV System	75kV
• Power frequency one minute withstand		
voltage (wet and dry) rms	33kV System	70kV
	11kV System	28kV
	LV System	3kV
• Neutral earthing arrangements:	33kV System	solidly earthed
	11kV System	solidly earthed
	LV System	solidly earthed

---

## **PART 2 : TECHNICAL**

All power and control cables to be used in the OPTCL distribution system shall be of the cross-linked polyethylene (XLPE) or polyvinyl chloride (PVC) insulated with PVC sheathing types.

### **5. 1.1KV POLYVINYL CHLORIDE (PVC) INSULATED CABLES**

#### **5.1 RATED VOLTAGE AND TEMPERATURE**

The rated voltage of the cable shall be 1.1 kV and the maximum operating voltage shall not exceed 110% of the rated voltage.

These cables are suitable for use where the combination of ambient temperature and temperature rise due to load results in a conductor temperature shall not exceeding 70°C\* under normal operation and 160°C under short circuit conditions.

\*See 13.2.4 for heat resisting and general purpose applications.

**8.2. CABLE DESIGN**

ALL LV Power cable shall be of XLPE insulation armoured type.

The cable offered shall be single-core, four core or multi-core armoured or unarmoured XLPE insulated / PVC insulated, PVC sheathed to meet the following requirements:

**8.2.1. Conductor**

- L.V System Cables (Power Cable XLPE insulated)

The conductor shall be of compacted round shape in single core cables and sector shaped in 3.5 or 4 core cables, made up from stranded aluminum wires complying with IS -8130:1984 / IEC 228. The Cable shall be of XLPE insulated with armoured.

Cables with reduced neutral conductors shall comply with the cross-sections shown in the table below.

- Control and Panel Wiring Cables (PVC insulated)

The conductor shall be of round stranded plain copper wires complying with IS - 8130:1984/IEC 228.

The conductors shall be of Flexibility Class 2 as per IS - 8130 : 1984.

**8.2.2. Cross-Sectional area of reduced Neutral Conductors:**

Nominal cross-sectional area of main conductor (mm <sup>2</sup> )	25	35	50	70	95	120	150	185	240	300	400	500	630
Cross-sectional area of reduced neutral conductor (mm <sup>2</sup> )	16	16	25	35	50	70	70	95	120	150	185	240	300

**8.2.3. Conductor Screening Not required**

**8.2.4. Insulation**

The insulation shall be of Polyvinyl Chloride (PVC) compound. The 'General Purpose' Type A shall be used for the LV cables and 'Heat Resisting' Type C for the Control and Panel Wiring cables. Both shall conform to the requirements of IS - 5831: 1984.

Type of Insulation	Normal Continuous Operation	Short Circuit Operation
General Purpose	70° C	160° C

Heat Resisting	85°C	160°C
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The PVC insulation shall be applied by extrusion and the average thickness of insulation shall not be less than the specified nominal value and the maximum value not more than 0.1mm plus 0.1 of nominal and as specified in IS - 1554(part 1): 1988.

The insulation shall be applied so that it fits closely on to the conductor and it shall be possible to remove it without damage to the conductor.

8.2.5. Insulation Screening Not required

8.2.6. Core Identification and Laying Up of Cores

3.5 and 4 core cables shall be identified by colouring of the PVC insulation and multi core by numbers as per IS- 1 554 (part 1): 1988

Panel wiring shall have a single colour except for power supplies which shall be as per the above IS standard.

In multi-core cables, the cores shall be laid up together with a suitable lay as recommended in IS - 1554 (Part 1): 1988. The layers shall have successive right and left hand lays with the outermost layer having a right hand lay.

8.2.7. Inner Sheath

The laid up cores of the 3.5, 4 and multi core cables shall be covered with an inner sheath made of thermoplastic material (PVC) applied by extrusion.

The thickness of the sheath shall conform to IEC 502/IS - 1554: 1988. Single core cables shall have no inner sheath.

8.2.8. Armouring Only the 3.5 and 4 core LV cables will be armoured. The armour shall be applied helically in a layer of steel wires over the inner sheath of the cable. The armour shall consist of round or flat steel wires and comply with the requirements of IEC 502/IS - 1554: 1988. The steel wires shall comply with IS - 3975:

8.2.9. Outer Sheath

An outer sheath of polyvinyl chloride (PVC) shall be applied over the armour wires (where fitted). The sheath shall be embossed at regular intervals as per the Cable Identification clause of this specification and the minimum thickness and properties shall comply with the requirements of IEC 502/IS - 1554: 1988. The outer sheath for cables with general purpose insulation shall be of the type ST1 PVC compound and for cables with heat resisting insulation type ST2 PVC compound conforming to the requirements of IEC 502/IS - 5831: 1984.

The outer serving shall incorporate an effective anti-termite barrier and shall be capable of withstanding a 10kV DC test voltage for five minutes after installation and annually thereafter.

Cables shall be installed as a single four core cable or three single phase cables plus neutral in a close trefoil formation.

Current ratings shall be calculated in accordance with IEC 287 "Calculation of the continuous current rating of cables with 100% load factor".

#### 8.2.10. Conductor Sizes

- The following conductor sizes will be used on the Employer's LV distribution system: 300, 120 and 50 mm<sup>2</sup> single core, 300 mm<sup>2</sup> three and a half core and 120 mm<sup>2</sup> four core.
- The following shall be used for Control and Panel Wiring:  
2.5 mm<sup>2</sup> single core, 2.5 and 4.0 mm<sup>2</sup> four core and 2.5 mm<sup>2</sup> multicore

#### 8.2.11. Cable Drum Length

The cable shall be supplied in 500metre lengths.

**NB: The Control cable conductor shall be of copper & stranded of 2.5 Sq mm size. For CT wiring, 2 Nos. core of size 2.5 Sq mm should be considered for each length.**

Technical Specification for Power and Control Cables

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### 9.0 CABLE IDENTIFICATION

The manufacturer's and Employer's name or trade mark, the voltage grade, cable designation and year of manufacture shall be indented or embossed along the whole length of the cable. The indentation or embossing shall only done on the outer sheath. The alphanumerical character size shall be not less than 20% of the circumference of the cable and be legible.

The following code shall be used to designate cables:

Constituent	Code Letter
Aluminium conductor	A
XLPE insulation	2X
PVC insulation	Y
Steel round wire armour	W
Non-magnetic round wire armour	Wa
Steel strip armour	F
Non-magnetic strip armour	Fa
Double steel round wire armour	WW
Double steel strip armour	FF
PVC outer sheath	Y

Note: No code letter is required for copper conductor

## 10. SAMPLING OF CABLES

### 10.1. Lot

In any consignment the cables of the same size manufactured under essentially similar conditions of production shall be grouped together to constitute a lot.

### 10.2. Scale of Sampling

Samples shall be taken and tested from each lot to ascertain the conformity of the lot to specification.

### 10.3. Sampling Rates

The number of samples to be selected shall be as follows:

Number of drums in the Lot	Number of Drums to be taken as samples	Permissible number of defective drums
Up to 25	3	0
26 to 50	5	0
51 to 100	8	0
101 to 300	13	1
301 and above	20	1

### Technical Specification for Power and Control Cables

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The samples shall be taken at random. In order to achieve random selection the procedure for selection detailed in IS - 4905: 1968 shall be followed.

#### 11. NUMBER OF TESTS AND CRITERION FOR CONFORMITY

Suitable lengths of test samples shall be taken from each of the selected drums. These samples shall be subjected to each of the acceptance tests. A test sample shall be classed as defective if it fails any of the acceptance tests. If the number of defective samples is less than or equal to the corresponding number given in 8.3 the lot shall be declared as conforming to the requirements of acceptance test.

#### 12. TESTS ON 1 . 1 KV PVC INSULATED CABLES

##### 12.1. Type Tests

Certification of type tests already completed by independent test laboratories shall be presented with the bid for each cable type. These tests shall be carried out in accordance



with the requirements of IS -8130: 1984/IEC 502, IS - 5831:1984/IEC 540 and IEC 811 unless otherwise specified.

Type testing of 33kV, 11kV and 1.1 kV cables shall include the following:

<b>Test</b>	<b>Requirement Reference</b>	<b>Test Method as a Part of IS-10810/IEC 811</b>
<b>(a) Tests on conductor</b>		
Annealing test (copper)	IS-8130: 1984/IEC 502	1
Tensile test (aluminium)	IS-8130: 1984/IEC 502	2
Wrapping test (aluminium)	IS-8130: 1984/IEC 502	3
Resistance test	IS-8130: 1984/IEC 502	5
<b>(b) Tests for Armour wires/strips</b>	IS - 3975: 1979/IEC 502	36 - 42
<b>(c) Tests for thickness of insulation and sheath</b>	IS-5831:1984/IEC 540	6
<b>(d) Physical tests for Insulation</b>		
Tensile strength and elongation at break	IS-5831:1984/IEC 540	7
Ageing in air oven	IS-5831:1984/IEC 540	11
Hot test	IS-5831:1984/IEC 540	30
Shrinkage test	IS-5831:1984/IEC 540	12
Water absorption (gravimatic)	IS-5831:1984/IEC 540	33
<b>(e) Physical tests for outer sheath</b>		
Tensile strength and elongation at break	IS-5831: 1984/IEC 540	7
Ageing in air oven	IS-5 831: 1984/IEC 540	11
Shrinkage test	IS-5831: 1984/IEC 540	12
Hot deformation	IS-5831: 1984/IEC 540	15

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<b>Test</b>	<b>Requirement Reference</b>	<b>Test Method as a Part of IS-10810/IEC811</b>
Loss of mass in air oven	IS-5831: 1984/IEC540	10
Heat shock	IS-5831: 1984/IEC540	14
Thermal stability	IS-5831: 1984/IEC540	IS-5831: 1984 Appendix B
(f) Partial discharge test (11 and 33kV only)	Section 13.2 of this specification	46
(g) Bending test (11 and 33kV only)	Section 13.2 of this specification	50
(h) Dielectric power factor test (11 and 33kV only)	Section 13.4 of this specification	48
As a function of voltage		
As a function of temperature		
(j) Insulation resistance (volume resistivity) test	IS-8130: 1984/IEC502	43
(k) Heating cycle test (11 and 33kV only)	Section 13.5 of this specification	49
(l) Impulse withstand test (11 and 33kV only)	Section 13.6 of this specification	47
(m) High voltage test	Section 13.7 of this specification	45
(n) Flammability test	Section 13.8 of this specification	53

Tests (g), (h), (j), (l) and (m) are only applicable to screened cables.

Notwithstanding the conditions of the above paragraph the following tests on screened 11 and 33kV cables shall be performed successively on the same test sample of completed cable.

1. Partial discharge test
2. Bending test followed by partial discharge test
3. Dielectric power factor as a function of voltage
4. Dielectric power factor as a function of temperature
5. Heating cycle test followed by dielectric power factor as a function of voltage and partial discharge tests
6. Impulse withstand test
7. High voltage test

If a sample fails in test number 7, one more sample shall be taken for this test, preceded by tests 2 and 5.

## Technical Specification for Power and Control Cables

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### 12.2. Acceptance Tests

The following shall constitute acceptance tests:

- Tensile test (aluminium)
- Annealing test (copper)
- Wrapping test
- Conductor resistance test
- Test for thickness of insulation and sheath
- Hot set test for insulation\*
- Tensile strength and elongation at break test for insulation and outer sheath
- Partial discharge test (for screened cables only)\*\*
- High voltage test
- Insulation resistance (volume resistivity) test.
- XLPE insulation only

\*\* test to be completed on full drum of cable

### 12.3. Routine Tests

Routine tests shall be carried out on all of the cable on a particular order. These tests shall be carried out in accordance with the requirements of IS - 8130: 1984/IEC 502 and IS - 5831:1984/IEC 540 unless otherwise specified.

The following shall constitute routine tests.

- Conductor resistance test
- Partial discharge test (for 1 kV and 33kV screened cables only)\*
- High voltage test

\* test to be completed on full drum of cable

### 12.4. Optional Test

Cold impact test for outer sheath (IS - 5831 - 1984), which shall be completed at the discretion of the Project Manager and at the same time as test at low temperature for PVC as stipulated in the section on special tests.

## **12.5. Special tests**

Special tests shall be carried out at the Project Manager's discretion on a number of cable samples selected by the Project Manager from the contract consignment. The test shall be carried out on 10% of the production lengths of a production batch of the same cable type, but at least one production length. Special tests shall be carried out in accordance with the requirements of IEC 502 and IEC 540 unless otherwise specified.

The following special tests shall be included:

- Conductor Examination (IEC-228)
  - Check of Dimensions
  - 4-Hour High Voltage Test for 11 kV and 33kV Cables only
  - Hot set test for XLPE Insulation
- 

- Test at low temperature for PVC

## **13. DETAILS OF TESTS**

### **13.1. General**

Unless otherwise stated, the tests shall be carried out in accordance with the appropriate part of IS -10810/IEC 502: 1994 and the additional requirements as detailed in this specification.

### **13.2. Partial Discharge Test**

Partial discharge tests shall only be made on cables insulated with XLPE of rated voltages above 1.9/3.3kV.

For multicore cables, the test shall be carried out on all insulated cores, the voltage being applied between each conductor and the metallic screen.

The magnitude of the partial discharge at a test voltage equal to  $1.5U_0$  shall not exceed 20pC for XLPE and 40pC for PVC, where  $U_0$  is the power frequency voltage between the conductor and earth or J metallic screen.

### **13.3. Bending Test**

The diameter of the test cylinder shall be  $20(d + D) \pm 5\%$  for single core cables and  $15(d + D) \pm 5\%$  for multicores, where D is the overall diameter of the completed cable in millimetres and d is the diameter of the conductor. After completing the bending operations, the test samples shall be subjected to partial discharge measurements in accordance with the requirements of this specification.

### **13.4. Dielectric Power Factor Test**

#### **13.4.1. Tan $\delta$ as a Function of Voltage**

For cables of rated voltage 1.1 kV and above

The measured value of  $\tan \delta$  at  $U_0$  shall not exceed 0.004 and the increment of  $\tan \delta$  between  $0.5 U_0$  and  $2 U_0$  shall not be more than 0.002.

13.4.2.  $\tan \delta$  as a Function of Temperature For cables of rated voltage 1.1 kV and above

The measured value of  $\tan \delta$  shall not exceed 0.004 at ambient temperature and 0.008 at 90°C for XLPE cables.

### **13.5. Heating Cycle Test**

The sample which has been subjected to previous tests shall be laid out on the floor of the test room and subjected to heating cycles by passing alternating current through the conductor until the conductor reaches a steady temperature 10°C above the maximum rated temperature of the insulation in normal operation. After the third cycle the sample shall be subjected to a dielectric power factor as a function of voltage and partial discharge test.

## **Technical Specification for Power and Control Cables**

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### **13.7. High Voltage Test**

13.7.1. Type/Acceptance Test

The cable shall withstand, without breakdown, at ambient temperature, an ac voltage equal to  $3U_0$ , when applied to the sample between the conductor and screen/armour (and between conductors in the case of unscreened cable). The voltage shall be gradually increased to the specified value and maintained for a period of 4 hours.

If while testing, interruption occurs during the 4 hour period the test shall be prolonged by the same extent. If the interruption period exceeds 30 minutes the test shall be repeated.

13.7.2. Routine Test

Single core screened cables, shall withstand, without any failure, the test voltages given in this specification for a period of five minutes between the conductor and metallic screen.

Single core unscreened cables shall be immersed in water at room temperature for one hour and the test voltage then applied for 5 minutes between the conductor and water.

Multicore cables with individually screened cores, the test voltage shall be applied for 5 minutes between each conductor and the metallic screen or covering.

Multicore cables without individually screened cores, the test voltage shall be applied for 5 minutes in succession between each insulated conductor and all the other conductors and metallic coverings, if any.

13.7.3. Test Voltages

The power frequency test voltage shall be  $2.5 U_0 + 2\text{kV}$  for cables at rated voltages, up to and including 3.8/6.6kV, and  $2.5 U_0$  for cables at higher rated voltages.

Values of single phase test voltage for the standard rated voltages are as given in the following table:

Voltage Grade kV	Test Voltage	
	Between conductors and screen/armour kV(rms)	Between conductors kV(rms)
1.1	3	3

If, for three core cables, the voltage test is carried out with a three phase transformer, the test voltage between the phases shall be 1.732 times the values given in the above table.

When a DC voltage is used, the applied voltage shall be 2.4 times the power frequency test voltage. In all instances no breakdown of the insulation shall occur.

### **13.8. Flammability Test**

The period for which the cable shall burn after the removal of the flame shall not exceed 60 seconds and the unaffected portion (uncharred) from the lower edge of the top clamp shall be at least 50mm.

## **14. CABLE ACCESSORIES**

The accessories are for the following types of cable:

33kV XLPE, single core round stranded plain aluminium conductor to IEC 228/IS - 8130: 1984, semi-conducting conductor screen, XLPE insulation, non - metallic semi-conducting insulation screen with non - magnetic tape or metallic cover, inner PVC sheath, non-magnetic wire or strip armour and PVC outer sheath.

11kV XLPE, single or three core round stranded plain aluminium conductor to IEC 228/IS - 8130: 1984, semiconducting conductor screen, XLPE insulation, non - metallic semiconducting insulation screen with non - magnetic tape or metallic cover, inner PVC sheath , non-magnetic wire or strip armour for single core cables, and steel wire armour on three core cables and PVC outer sheath.

LV (1100V) PVC, single, three and a half and four core round or sector shaped stranded plain aluminium grade H4 conductor, PVC insulation, inner PVC sheath, steel wire armour for three phase cables and P.V.C. outer sheath.

### **14.1. JOINTS AND TERMINATIONS**

Joints and terminations shall be supplied in complete kit form with all materials and components required to complete the installation. A complete set of instructions for the joint or termination shall also be included in each kit.

Heat shrink pre-moulded joints and terminations shall be required for all XLPE and PVC cables and for transition joints. All components shall be capable of being stored without damage or deterioration at temperatures up to 50°C. The material expiry date shall be marked on all packages, where appropriate.

Details of all equipment, tools and protective clothing required to complete the joint or termination shall be included with each joint or termination kit.

Components shall not be adversely affected in any manner by contact with other materials normally used in the construction of cable joints or terminations and shall not increase the rate of corrosion of any metals with which they may come into contact.

Components supplied with adhesive coatings shall have means to prevent the coated surfaces from adhering to each other.

Joints and terminations for armoured or screened cables shall include all items needed for wire or tape clamping. Rings shall be provided for such application.

The recovered thickness of insulation over the connector shall be uniform and equal to or greater than the cable insulation thickness as given in IEC 502/IS - 1554/IS - 7098.

The protection provided by the galvanised steel wire armouring shall be reinstated over the joint (s). Electric field stress control shall be provided on all of the High Voltage joints and terminations.

Joints shall provide waterproofing, mechanical and electrical protection, and be completely sealed from cable jacket to cable jacket. Joints shall accommodate crossing of the cores.

Where required 33kV, 1 IkV and 1.1 kV cable joints shall be straight through joints only.

Terminations shall be designed to provide a complete moisture seal, including the crotch area of multi-core cables and complete rejacketing of the individual cores, conforming to Class 1 terminations as per IEEE 48. They shall be generally suitable for indoor and outdoor installation, be resistant to ultra violet radiation and chemical attack.

**Minimum creepage distance for outdoor terminations shall not be less than:**

Adhesives used shall have a softening temperature of not less than 90° C, be compatible with other components and after curing shall not flow at temperatures of normal service.

1.1 kV, 1 IkV and 33kV joints and terminations shall be designed so that no insulating or semi-conducting tapes shall be required. Reinstallation of the insulation and semi - conducting cover shall be achieved with the use of multiple layers of heat shrinkable tubes possessing high dielectric strength and thermal stability.

Phase identification colours shall be marked on the cable box, cable tail ends and single core cables at all connecting points and/or any positions the Project Manager may determine.

Cable boxes shall be provided with suitable labels indicating the purpose of the supply where such supply is not obvious or where the Project Manager may determine.

All cables shall be identified and shall have phase colours marked at their termination.

**14.2. CONNECTORS/TERMINALS**

Connectors and terminals shall perform without distress under normal loading, cyclic loading and fault conditions, and shall not limit the rating of the cables which they joint.

33kV connections shall be compressed by hydraulically operated tools and 1 IkV/LV connectors by hand operated tools. The range of connectors/terminals should be kept to a

minimum so as limit the the range of dies which may required and the use of die-less compression tools of the tension or non-tension type shall be permitted. Only approved and proven compression tools supplied by a reputable manufacturer shall be used.

The ends of connectors/terminals shall be suitably chamfered or coned to facilitate insertion of the conductors. Connectors shall have a solid central barrier to facilitate the insertion of the conductor to the correct depth.

The following items of information shall be clearly stamped on each connector/terminal:

- Manufacturer's name or trade mark.
- The conductor size (metric) for which the connector/terminal is suitable.
- The die number or size suitable for compressing the connector/terminal.
- The part of the connector/terminal surface to be compressed.
- The sequence of die action from the starting point and finishing point.

Compounds or greases for improving contact between the connector/terminal and the conductor are permitted. They must, however, be chemically neutral to the connector/terminal and conductor materials and must be present in position in the delivered connectors/terminals.

Cable connectors/terminals shall be able to accommodate typical variations in dimensions of cables supplied by different manufacturers.

Connector/terminal material shall not react chemically with the cable conductors to which they are connected.

#### Size and type of connectors required:

Straight through connectors for the following conductors:

- 300 - 300 mm<sup>2</sup> stranded round plain aluminium
  - 185-185 mm<sup>2</sup> stranded round plain aluminium
- 

• 120-120 stranded sector shaped plain aluminium Termination lugs for the following conductors:

- 300 mm<sup>2</sup> stranded round and sector shaped plain aluminium
- 185 mm<sup>2</sup> stranded round plain aluminium
- 150 mm<sup>2</sup> stranded sector shaped plain aluminium for the neutral of the 3.5 core 300 mm<sup>2</sup> cable.
- 120 mm<sup>2</sup> stranded round and sector shaped plain aluminium
- 70 mm<sup>2</sup> stranded round plain aluminium
- 50 mm<sup>2</sup> stranded round plain aluminium

Termination lugs shall be suitable for bi-metallic connections.



Terminals for pole top terminations of 33kV and 1 IkV cables shall be of the post type capable of accepting a tap off connector. Appropriate tap off connectors shall be provided for making connections from the cable to the line conductors.

#### 14.3. CONTROL/LV WIRING ACCESSORIES 14.3.1. Terminations

Control wire terminations shall be made with solderless crimping type and tinned copper lugs which firmly grip the conductor. Insulated sleeves shall be provided at all the wire termination. 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 from terminal blocks. All wires directly connected to trip circuit breaker or device shall be distinguished by the addition of red coloured unlettered ferrule. Numbers 6 and 9 shall not be included for ferrules purposes except where underlined and identified as 6 and 9.

LVAC cable terminals shall be provided with adequate size crimp type lugs. The lugs shall be applied with the correct tool, which shall be regularly checked for correct calibration. Bi-metallic joints between the terminals and lugs shall be provided where necessary.

Terminals shall be marked with the phase colour in a clear and permanent manner.

A removable gland plate shall be provided by the contractor at every cable entry to mechanism boxes, cabinets and kiosks. The Contractor shall be responsible for drilling the cable gland plate to the required size.

Armoured cables shall be provided with suitable glands for terminating the cable armour and shall be provided with an earthing ring and lug in order to connect the gland to the earth bar.

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### **PART 3 : GENERAL PARTICULARS AND GUARANTEES**

#### **15. COMPLIANCE WITH SPECIFICATION**

The power and control cables shall comply in all respects with the requirements of this specification. However, any minor departure from the provisions of the specification shall be disclosed at the time of bidding in the Non Compliance Schedule in this document.

The mass and dimensions of any item of equipment shall not exceed the figures stated in the schedules.

#### **16. COMPLIANCE WITH REGULATIONS**

All the equipment shall comply in all respects with the Indian Regulations and Acts in force.

The equipment and connections shall be designed and arranged to minimise the risk of fire and any damage which might be caused in the event of fire.

## **17. QUALITY ASSURANCE, INSPECTION AND TESTING**

### **17.1. General**

To ensure that the supply and services under the scope of this Contract, whether manufactured or performed within the Contractor's works or at his sub-contractor's premises or at any other place of work are in accordance with the Specification, with the regulations and with relevant authorised international or Indian Standards, the Contractor shall adopt suitable Quality Assurance Programmes and Procedures to ensure that all activities are being controlled as necessary.

The quality assurance arrangements shall conform to the relevant requirements of ISO 9001 or ISO 9002 as appropriate.

The systems and procedures which the Contractor will use to ensure that the Plant complies with the Contract requirements shall be defined in the Contractor's Quality Plan for the Works. The Contractor shall operate systems which implement the following:

**Hold Point** "A stage in the material procurement or workmanship process beyond which work shall not proceed without the documented approval of designated individuals or organisations."

The Project Manager's written approval is required to authorise work to progress beyond the Hold Points indicated in approved Quality Plans.

**Notification Point** "A stage in material procurement or workmanship process for which advance notice of the activity is required to facilitate witness."

If the Project Manager does not attend after receiving documented notification in accordance with the agreed procedures and with the correct period of notice then work may proceed.

### **17.2. Quality Assurance Programme**

Unless the Contractor's Quality Assurance System has been audited and approved by the Project Manager, a Quality Assurance Programme for the Works shall be submitted to the Project Manager for approval a minimum of one month from contract award, or such other period as shall be agreed with the Project Manager. The Quality Assurance Programme shall give a description of the Quality System for the Works and shall, unless advised otherwise, include details of the following:

- The structure of the organisation;
- The duties and responsibilities assigned to staff ensuring quality of work;
- The system for purchasing, taking delivery and verification of materials;
- The system for ensuring quality of workmanship;

- The system for control of documentation;
- The system for the retention of records;
- The arrangements for the Contractor's internal auditing;
- A list of the administration and work procedures required to achieve and verify Contract's quality requirements. These procedures shall be made readily available to the Project Manager for inspection on request.

### **17.3. Quality Plans**

The Contractor shall draw up for each section of the work Quality Plans which shall be submitted to the Project Manager for approval at least two weeks prior to the commencement of work on the particular section. Each Quality Plan shall set out the activities in a logical sequence and, unless advised otherwise, shall include the following:

- An outline of the proposed work and programme sequence;
- The structure of the Contractor's organisation for the Contract;
- The duties and responsibilities assigned to staff ensuring quality of work for the Contract;
- Hold and Notification Points;
- Submission of engineering documents required by the specification;
- The inspection of materials and components on receipt;
- Reference to the Contractor's Work Procedures appropriate to each activity;
- Inspection during fabrication/construction;
- Final inspection and test.

### **17.4. Non-conforming product**

The Project Manager shall retain responsibility for decisions regarding acceptance, modification or rejection of non-conforming items.

### **17.5. Sub-contractors**

The Contractor shall ensure that the Quality Assurance requirements of this specification are followed by any sub-contractors appointed by him under the Contract.

The Contractor shall assess the sub-contractor's Quality Assurance arrangements prior to his appointment to ensure compliance with the appropriate ISO 9000 standard and the specification.

Auditing of the sub-contractor's Quality Assurance arrangements shall be carried out by the Contractor and recorded in such a manner that demonstrates to the Project Manager the extent of the audits and their effectiveness.

### **17.6. Inspection and testing**

The Project Manager shall have free entry at all times, while work on the contract is being performed, to all parts of the manufacturer's works which concern the processing of the equipment ordered. The manufacturer shall afford the Project Manager without charge, all reasonable facilities to assure that the equipment being furnished is in accordance with this specification.

The equipment shall successfully pass all the type tests, acceptance tests and routine tests referred to in the section on Tests and those listed in the most recent edition of the standards given in this specification.

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The Project Manager reserves the right to reject an item of equipment if the test results do not comply with the values specified or with the data given in the technical data schedule.

Type tests shall be carried out at an independent testing laboratory or be witnessed by a representative of such laboratory or some other representative acceptable to the Project Manager. Routine and acceptance tests shall be carried out by the Contractor at no extra charge at the manufacturer's works.

Type Test certificates shall be submitted with the bid for evaluation. The requirement for additional type tests will be at the discretion of the Project Manager.

The Project Manager may witness routine, acceptance and type tests. In order to facilitate this, the Contractor shall give the Project Manager a minimum of four weeks notice that the material is ready for testing. If the Project Manager does not indicate his intention to participate in the testing, the manufacturer may proceed with the tests and shall furnish the results thereof to the Project Manager.

Full details of the proposed methods of testing, including connection diagrams, shall be submitted to the Project Manager by the Contractor for approval, at least one month before testing.

All costs in connection with the testing, including any necessary re-testing, shall be borne by the Contractor, who shall provide the Project Manager with all the test facilities which the latter may require, free of charge. The Project Manager shall have the right to select the samples for test and shall also have the right to assure that the testing apparatus is correct. Measuring apparatus for routine tests shall be calibrated at the expense of the Contractor at an approved laboratory and shall be approved by the Project Manager.

The Contractor shall be responsible for the proper testing of the materials supplied by sub-contractors to the same extent as if the materials were completed or supplied by the Contractor.

Any cost incurred by the Project Manager in connection with inspection and re-testing as a result of failure of the equipment under test or damage during transport or off-loading shall be to the account of the Contractor.

The Contractor shall submit to the Project Manager five signed copies of the test certificates, giving the results of the tests as required. No materials shall be dispatched until the test certificates have been received by the Project Manager and the Contractor has been informed that they are acceptable.

The test certificates must show the actual values obtained from the tests, in the units used in this specification, and not merely confirm that the requirements have been met.

In the case of components for which specific type tests or routine tests are not given in this specification, the Contractor shall include a list of the tests normally required for these components. All materials used in the Contract shall withstand and shall be certified to have satisfactorily passed such tests.

No inspection or lack of inspection or passing by the Project Manager's Representative of equipment or materials whether supplied by the Contractor or sub-contractor, shall relieve the Contractor from his liability to complete the contract works in accordance with the contract or exonerate him from any of his guarantees.

#### **17.7. Guarantee**

The Contractor shall guarantee the following :

- Quality and strength of materials used;
  - Satisfactory operation during the guarantee period of one year from the date of commissioning, or 18 months from the date of acceptance of the equipment by the Project Manager following delivery, whichever is the earlier;
  - Performance figures as supplied by the Bidder in the schedule of guaranteed particulars.
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#### **18. PROGRESS REPORTING**

The Contractor shall submit for approval within four weeks of the starting date of the contract, an outline of production, inspection, delivery (and installation) in a chart form. Within a further period of four weeks, the Contractor shall provide a detailed programme of the same information in a form to be agreed by the Project Manager. The Contractor shall submit two copies of monthly progress reports not later than the 7th day of the following month. The reports shall show clearly and accurately the position of all activities associated with the material procurement, manufacture, works tests and transport, with regard to the agreed contract programme.

(The preferred format for presentation of programmes is MS Project Version 4.0. Programmes and monthly updates should be submitted on 3.5" diskettes.)

The design aspect of the progress report shall include a comprehensive statement on drawings, calculations and type test reports submitted for approval.

The position on material procurement shall give the dates and details of orders placed and indicate the delivery dates quoted by the manufacturer. If any delivery date has an adverse effect on the contract programme, the Contractor shall state the remedial action taken to ensure that delays do not occur.

The position on manufacture shall indicate the arrival of raw material and the progress of manufacture. Any events that may adversely affect completion in the manufacturer's works shall also be reported.

All works tests done shall be listed and test results shall be remarked upon. Any test failure shall be highlighted.

The dispatch of each order shall be monitored on the progress report giving the date by which the equipment will be available for transport, the estimated time of arrival on site and the dates actually achieved.

Delays or test failures in any part of the programme which may affect any milestone or final completion dates shall be detailed by the Contractor who shall state the action taken to effect contract completion in accordance with the contract programme.

## **19. SPARE PARTS AND SPECIAL TOOLS**

The Contractor shall provide prices for spare conductor, joints and termination equipment. The Project Manager may order all or any of the spare parts listed at the time of contract award and the spare parts so ordered shall be supplied as part of the definite works. The Project Manager may order additional spares at any time during the contract period at the rates stated in the Contract Document.

A spare parts catalogue with price list shall be provided for the various cables, joints and termination equipment and this shall form part of the drawings and literature to be supplied.

Any spare apparatus, parts or tools shall be subject to the same specification, tests and conditions as similar material supplied under the Contract. They shall be strictly interchangeable and suitable for use in place of the corresponding parts supplied with the equipment and must be suitably marked and numbered for identification.

Spare parts shall be delivered suitably packed and treated for long periods in storage. Each pack shall be clearly and indelibly marked with its contents, including a designation number corresponding to the spare parts list in the installation and maintenance instructions.

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## **20. PACKING AND SHIPPING**

### **20.1. Packing**

The cable shall be wound on strong drums or reels capable of withstanding all normal transportation and handling.

Each length of cable shall be durably sealed before shipment to prevent ingress of moisture. The drums, reels or coils shall be lagged or covered with suitable material to provide physical protection for the cable during transit and during storage and handling operations.

In the case of steel drums adequate precautions shall be taken to prevent damage being caused by direct contact between the cable sheath and the steel. These precautions shall be subject to the approval of the Project Manager.

If wooden drums are used then the wood shall be treated to prevent deterioration from attack by termites and fungi.

Each drum or reel shall carry or be marked with the following information:

- Individual serial number
- Employer's name
- Destination
- Contract Number

- Manufacturer's Name
- Year of Manufacture
- Cable Size and Type
- Length of Conductor (metres)
- Net and Gross Mass of Conductor (kg)
- All necessary slinging and stacking instructions.
- Destination;
- Contractor's name;
- Name and address of Contractor's agent in Orissa;
- Country of origin;

The direction of rolling as indicated by an arrow shall be marked on a flange.

### **20.2. Storage**

The site selected for the storage of cable drums shall be well drained and preferably have a concrete/firm surface which will prevent the drums sinking into the ground or being subjected to excess water thus causing flange rot.

All drums shall be stood on battens, in the upright position, and in such a manner to allow sufficient space between them for adequate air circulation. During storage the drums shall be rotated 90° every three months. In no instances shall the drums be stored "flat" on their flanges or one on top of each other.

### **20.3. Shipping**

The Contractor shall be responsible for the shipping of all cables, drums and reels supplied from abroad to the ports of entry and for the transport of all goods to the various specified destinations including customs clearance, offloading, warehousing and insurance.

The Contractor shall inform himself fully as to all relevant transport facilities and requirements and loading gauges and ensure that the equipment as packed for transport shall conform to these limitations. The Contractor shall also be responsible for verifying the access facilities specified.

The Contractor shall be responsible for the transportation of all loads associated with the contract works and shall take all reasonable steps to prevent any highways or bridges from being damaged by his traffic and shall select routes, choose and use vehicles and restrict and distribute loads so that the risk of damage shall be avoided. The Contractor shall immediately report to the Project Manager any claims made against the Contractor arising out of alleged damage to a highway or bridge.

All items of equipment shall be securely clamped against movement to ensure safe transit from the manufacturer's facilities to the specified destinations (work sites.)

The Contractor shall advise the storage requirements for any plant and equipment that may be delivered to the Project Manager's stores. The Contractor shall be required to accept

responsibility for the advice given in so far as these arrangements may have a bearing on the behaviour of the equipment in subsequent service.

#### **20.4. Hazardous substances**

The Contractor shall submit safety data sheets in a form to be agreed for all hazardous substances used with the equipment. The Contractor shall give an assurance that there are no other substances classified as hazardous in the equipment supplied. The Contractor shall accept responsibility for the disposal of such hazardous substances, should any be found.

The Contractor shall be responsible for any injuries resulting from hazardous substances due to non compliance with these requirements.

### **21. SUBMITTALS**

#### **21.1. Submittals required with the bid**

The following shall be required in duplicate :

- completed technical data schedule;
- descriptive literature giving full technical details of equipment offered;
- type test certificates, where available, and sample routine test reports;
- detailed reference list of customers already using equipment offered during the last 5 years with particular emphasis on units of similar design and rating;
- details of manufacturer's quality assurance standards and programme and ISO 9000 series or equivalent national certification;
- deviations from this specification. Only deviations approved in writing before award of contract shall be accepted;

#### **21.2. Submittals required after contract award**

21.2.1. Programme Five copies of the programme for production and testing.

21.2.2. Technical particulars

Within 30 days of contract award five bound folders with records of the technical particulars relating to the equipment. Each folder shall contain the following information:

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- general description of the equipment and all components, including brochures;
- technical data schedule, with approved revisions;
- calculations to substantiate choice of electrical and mechanical component size/ratings;
- statement drawing attention to all exposed points in the equipment at which copper, aluminium or aluminium alloy parts are in contact with or in close proximity to other metals and stating clearly what protection is employed to prevent corrosion at each point;
- detailed installation and commissioning instructions;



At the final hold point for Project Manager approval prior to delivery of the equipment the following shall be submitted:

- inspection and test reports carried out in the manufacturer's works;
- Installation and maintenance instructions. 21.2.3. Operation and maintenance instructions

A copy of the detailed installation and commissioning instructions shall be supplied with each type cable joint and termination equipment.

### **21.3. Drawings**

Within 30 days of contract commencement the Contractor shall submit, for approval by the Project Manager, a schedule of the drawings to be produced detailing which are to be submitted for "Approval" and which are to be submitted "For Information Only". The schedule shall also provide a programme of drawing submission, for approval by the Project Manager, that ensures that all drawings and calculations are submitted within the period specified above.

All detail drawings submitted for approval shall be to scale not less than 1:20. All important dimensions shall be given and the material of which each part is to be constructed shall be indicated on the drawings. All documents and drawings shall be submitted in accordance with the provisions of this specification and shall become the property of the Employer.

All drawings and calculations submitted to the Project Manager shall be on international standard size paper, AO, A1, A2, A3, or A4. All such drawings and calculations shall be provided with a contract title block, which shall include the name of the Employer and Consultants and shall be assigned a unique project drawing number. The contract title block and project numbering system shall be agreed with the Project Manager.

Lettering sizes and thickness of lettering and lines shall be selected so that if reduced by two stages to one quarter of their size, the alphanumeric characters and lines are still perfectly legible so as to enable them to be microfilmed.

For presentation of design drawings and circuit documents IEC Publication 617 or equivalent standards for graphical symbols are to be followed.

## **22. APPROVAL PROCEDURE**

The Contractor shall submit all drawings, documents and type test reports for approval in sufficient time to permit modifications to be made if such are deemed necessary and re-submit them for approval without delaying the initial deliveries or completion of the contract work. The Project Manager's representative shall endeavour to return them within a period of four weeks from the date of receipt.

Three copies of all drawings shall be submitted for approval and three copies for any subsequent revision. The Project Manager reserves the right to request any further additional information that may be considered necessary in order to fully review the drawings. If the Project Manager is satisfied with

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the drawing, one copy will be returned to the Contractor marked with "Approved" stamp. If the Project Manager is not totally satisfied with the drawing, then "Approved Subject to Comment" status will be given to it and a comment sheet will be sent to the Contractor. If the drawing submitted does not comply with the requirements of the specification then it will be given "Not Approved" status and a comment sheet will be sent to the Contractor. In both these cases the Contractor will have to modify the drawing, update the revision column and resubmit for final Approval. Following approval, twenty copies of the final drawings will be required by the Project Manager.

Any drawing or document submitted for information only should be indicated as such by the Contractor. Drawings and documents submitted for information only will not be returned to the Contractor unless the Project Manager considers that such drawing needs to be approved, in which case they will be returned suitably stamped with comments.

The Contractor shall be responsible for any discrepancies or errors in or omissions from the drawings, whether such drawings have been approved or not by the Project Manager. Approval given by the Project Manager to any drawing shall not relieve the Contractor from his liability to complete contract works in accordance with this specification and the condition of contract nor exonerate him from any of his guarantees.

If the Contractor needs approval of any drawing within a period of less than four weeks in order to avoid delay in the completion of supply, he shall advise the Project Manager when submitting the drawings and provide an explanation of the document's late submission. The Project Manager will endeavour to comply with the Contractors timescale, but this cannot be guaranteed.

## **23. SURFACE TREATMENT**

Where galvanised steel armour wire is used then the Contractor shall indicate his galvanising process utilised and its conformance with this specification

### **23.1. Galvanising**

All galvanising shall be carried out by the hot dip process, in accordance with Specification ISO 1460 or IS 2629. However, high tensile steel nuts, bolts and spring washers shall be electro galvanised to Service Condition 4. The zinc coating shall be smooth, continuous and uniform. It shall be free from acid spots 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 pickling, all welding, drilling, cutting, grinding and other finishing operations must be completed and all grease, paint, varnish, oil, welding slag and other foreign matter completely removed. All protuberances which would affect the life of galvanising shall also be removed.

The weight of zinc deposited shall be in accordance with that stated in Standard BS 729, ISO 1460 or IS 2629 and shall be not less than 0.61kg/m<sup>2</sup> with a minimum thickness of 86

microns for items of thickness more than 5mm, 0.46 kg/m<sup>2</sup> (64 microns) for items of thickness between 2mm and 5mm and 0.33 kg/m<sup>2</sup> ( 47 microns ) for items less than 2mm thick.

Parts shall not be galvanised if their shapes are such that the pickling solution cannot be removed with certainty or if galvanising would be unsatisfactory or if their mechanical strength would be reduced. Surfaces in contact with oil shall not be galvanised unless they are subsequently coated with an oil resistant varnish or paint.

In the event of damage to the galvanising the method used for repair shall be subject to the approval of the Project Manager or that of his representative.

**Repair of galvanising on site will generally not be permitted.**

The threads of all galvanised bolts and screwed rods shall be cleared of spelter by spinning or brushing. A die shall not be used for cleaning the threads unless specifically approved by the Project Manager. All nuts shall be galvanised. The threads of nuts shall be cleaned with a tap and the threads oiled.

Partial immersion of the work shall not be permitted and the galvanising tank must therefore be sufficiently large to permit galvanising to be carried out by one immersion.

After galvanising no drilling or welding shall be performed on the galvanised parts of the equipment excepting that nuts may be threaded after galvanising. To avoid the formation of white rust, galvanised material shall be stacked during transport and stored in such a manner as to permit adequate ventilation. Sodium dichromate treatment shall be provided to avoid formation of white rust after hot dip galvanisation.

The galvanised steel shall be subjected to test as per IS-2633.

## **24. COMPLETENESS OF CONTRACT**

All fittings or accessories, although not specifically mentioned herein, but necessary or usual for similar equipment and their efficient performance shall be provided by the Contractor without extra charges. The bid shall clearly indicate if any additional equipment or parts would be necessary to give a complete offer and if so, the details and the prices shall be included in the bid.

## **PART 4: SCHEDULES**

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### **25. TECHNICAL DATA SCHEDULES**

#### **3. 1100V Cable Schedule**

**Remarks:- a) All the LV Power Cable shall be XLPE with insulated armoured Aluminum Cable.**

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**b) All the Contral Cable shall be PVC insulated stranded copper Cables having size 2.5 Sq.mm.**



**ORISSA POWER TRANSMISSION CORPORATION LIMITED  
OFFICE OF THE SR. GENERAL MANAGER,  
CENTRAL PROCUREMENT CELL,  
JANAPATH, BHUBANESWAR – 751022.**

**TECHNICAL SPECIFICATION**

**FOR**

**36 KV**

**VACUUM CIRCUIT BREAKERS**

# **TECHNICAL SPECIFICATION**

**FOR**

**36 KV VACCUM CIRCUIT BREAKERS  
(OUT DOOR TYPE)**

# **TECHNICAL SPECIFICATION FOR 36 K.V. VACCUM CIRCUIT BREAKERS (OUTDOOR TYPE)**

## **1.1 SCOPE:**

36 K.V. 1430 MVA Circuit Breakers are intended to be purchased for installation at different Sub-stations. Some of the Sub-stations for which equipment are tendered are situated in coastal areas where saline climate prevails. The base structure of the circuit breakers must be galvanized.

## **1.2 POWER SUPPLY TO AUXILIARIES :**

A.C. supply to auxiliaries will be 3 phase, 3 wire, 430 volt or single phase 250 volts at 50 C/s. The voltage variation will be within 10% and the frequency variation  $\pm 5\%$ .

## **1.03 33 K.V. CIRCUIT BREAKERS TYPE AND RATING :**

The circuit breakers shall be vacuum type suitable for outdoor operation under the climatic conditions specified without any protection from sun and rain.

The circuit breaker shall have the following ratings :

- |     |                                     |   |  |
|-----|-------------------------------------|---|--|
| 1.  | Number of poles                     | : | 3 (One unit with three phase making and breaking). |
| 2.  | Frequency.                          | : | 50 C/s.  |
| 3.  | Nominal system voltage              | : | 33 KV rms.   |
| 4.  | Highest system voltage              | : | 36.0 KV rms.                                       |
| 5.  | Basic insulation level              | : | 170 KVP  |
| 6.  | Power frequency test Voltage (wet). | : | 75 KV (rms.)                                       |
| 7.  | <b><u>Nominal Current.</u></b>      | : | 1250 Amps rms.                                     |
| 7a. | First pole to clear factor          | : | 1.5  |

8. Breaking capacity.
- (a) Symmetrical. : 25 KA/1430 MVA.
- (b) A symmetrical. : 33 KA Peak.
9. Making capacity. : 62.5 KA Peak.
10. Continuous current rating. : 1250 Amps (RMS)
11. Operating Duty. : 0-0.3 Sec-CO-3 Min-CO.
- 12.(a) Break time : 3 Cycles
- (b) Make time : 5 Cycles.
- (c) Minimum reclosing time : 15 Cycle.
- (d) Minimum dead time for reclosing : 15 Cycle
13. Dry one minute power frequency withstand test voltage
- a) Between line terminal : 75 KV rms.
- b) Between line and body : 75 KV rms.
14. Impulse withstand test voltage ;
- a) Between terminal : 170 KV (Peak)  
with C.B. open.
- b) Between body & terminal : 170 KV (Peak)
15. Insulator or bushing
- a) Dry one minute power : 75 KV  
Frequency voltage,
- b) Wet one minute power : 75 KV  
Frequency withstand Voltage.
- c) Creepage distance : 580 mm (Minimum)



- 16.Short time current : Not less than 25 KA for  
rating for 3 seconds. 3 seconds.
- 17.Control circuit voltage : 220 V D.C
18. Rated line charging/breaking current In Amp: Suitable for Capacitor Bank operation
19. Rated cable charging/breaking current (Amp): Suitable for Capacitor Bank operation
20. Rated single capacitive making/breaking  
current without switching over voltage: Suitable for Capacitor Bank operation
21. Rated small inductive making/breaking  
current(Amp) without switching over voltage: As per IEC
22. Operating mechanism: Spring charged.
- 23.Minimum clearance of live part in air & ground (in mm): 3700.

1.04

**STANDARDS :**

The circuit breakers shall comply with the requirements of latest issue of IEC-62271-100,IEC-60694/IS12729:2004,IS-13118:1991, except wherein specified otherwise. Where the equipment offered confirm to any other standard the silent points of difference between the standard adopted and the IS or IEC recommendations shall be brought out in the tender. Equipment meeting any other authoritative standard which ensures an equal or better quality than the standard mentioned above is also acceptable.

**CLIMATIC CONDITIONS :**

The climatic conditions at site under which the equipment shall be operated satisfactorily are as follows :

- Peak ambient air temperature : 50° C
- Maximum temperature attainable by : 60° C  
an object exposed to sun.
- Minimum temperature of the air : 0° C  
in shade.
- Maximum yearly weighted average : 32° C

ambient Temp.

Maximum daily average ambient temp	:	35deg C
Maximum humidity.	:	100%
Average number of thunder storm	:	70 Days per annum.
Average number of rainy days per Annum.	:	120
Average annual rainfall.		1500 mm
Number of months of tropical Monsoon conditions per annum.		4
Maximum wind pressure.		260 kg/Sq.m.
Altitudes not exceeding.	:	1000 M

For the purpose of the specification, the limit of ambient temperature shall be 50° C peak and 45° C average over a 24 hours period.

Some of the breakers to be purchased against this specification are intended to be installed on the sea coast having extremely saline climate. Necessary anticorrosive provisions need be incorporated.

#### 1.5 **GENERAL :**

- 1.6 The circuit breakers shall be of vacuum type. The breakers shall be furnished as a complete unit with all accessories and equipment in place and all internal wiring installed and terminated in the mechanism.
- 1.7 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 of leading or lagging reactive current. The details of any device incorporated to limit or control the rate of rise of restricting voltages across the circuit breaker contacts shall be

stated. The over voltages caused by the circuit breaker switching on inductive or capacitive load shall not exceed, 2.5 times the normal phase to neutral voltage. The total break time for the circuit breakers throughout the range of their operating duty shall be stated in the tender and guaranteed.

#### **1.8 CONSTRUCTIONAL FEATURES :**

Each circuit breaker shall comprise 3 identical poles complete with a gang operated mechanism for specified duty. All these poles of the C.B. shall be linked together Electrically, Mechanically for specified duty.

The breaker shall be capable of interruptions of low reactive current (lagging/leading) without undue over voltage and restrike.

#### **1.9 CONTROL CUBICLE :**

A common control cubicle shall be furnished to house electrical controls, monitoring devices and all other accessories. The cubicle shall be of gasketed weather proof construction, fabricated from sheet Aluminum alloy sheet having minimum 3 mm thick.

1.10 The cubicle shall have front access door with lock and keys and removable gland plate at the bottom for owner's cable entry. Thermostat controlled space heater, internal illumination lamp, 5 A 3 pin socket with individual on off switches shall be provided in the cubicle.

#### **1.11 MOUNTING :**

The circuit breakers shall be suitable for mounting on steel galvanized structures. The prices of necessary frames for mounting the circuit breaker shall be included with the offer.

1.12 The circuit breakers shall consist of three identical single phase units with a common operating mechanism. All joints shall be welded so as to have adequate mechanical strength. The breaker porcelain shall be capable of withstanding all pressure resulting from any specified performance of the breaker.

The circuit breaker shall be supplied complete with the necessary lifting tools, foundation bolts and other accessories.

**1.13 TEMPERATURE RISE :**

The maximum temperature attained by any part of the equipment when in-service at site under continuous full load conditions and exposed to direct rays of sun shall not exceed the permissible limits fixed by approved specifications. When the standards specifies the limits of temperature rise these shall not exceed when corrected for the difference between ambient temperature at site and the ambient temperature specified in the approved specification. The corrections proposed shall be stated in the tender and shall be subject to approval of the purchaser.

**1.14 INSULATION OF THE CIRCUIT BREAKERS :**

1.15 The insulation to ground, the insulation between open contacts, the insulation between phases of the completely assembled circuit breakers, should be capable of withstanding satisfactorily die-electric test voltages corresponding to basic insulation level specified in clause-1.03.

1.16 The clearance in open air shall be as follows, unless the apparatus is impulse tested after complete assembly.

i) Minimum clearance between phase : 505 mm

- ii) Phase to Earth. : 305 mm
- iii) Minimum clearance between live : 1400 mm  
Parts and grounded objects.
- iv) Minimum ground clearance to live: 3700 mm  
part.

1.17 **BUSHING AND INSULATIONS :**

The basic insulation level of the insulating porcelains shall be as specified and shall be suitable for installation in contaminated atmospheres. The porcelains used 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. The puncture strength of the bushings shall be greater than the flashover value. The bushings shall be entirely free from radio disturbance when operating at a voltage 10% above rated voltage and also be free from external corona.

Adequate means shall be provided to accommodate conductor expansion and there should not be any undue stressing of any part due to temperature change.

1.12 **OPERATION MECHANISM :**

1.12.1 The operating mechanism shall be spring operated type. In case of spring operating mechanism it shall be of motor operated having provision of hand operated spring charging type of by local/remote electric control under normal operation. The mechanism shall be trip from electrically and mechanically. All working parts in the mechanisms shall be corrosion resistant material and all bearings which require greasing shall be equipped with pressure grease fittings. The mechanism shall be strong, positive, quick in action and shall be removable without disturbing the other parts

of the circuit breakers. The mechanisms of breaker shall be such that the failure of any spring will not prevent tripping.

1.12.2 The operating mechanism along with its accessories shall be mounted in a weather proof cabinet with hinged doors located near the breakers. A local control switch and the breaker position indicator shall be provided in the cabinet. The circuit breakers shall also be provided with means for manual operation for maintenance purposes.

1.12.3 The control circuits shall be designed to operate on 220V. d.c. It shall be possible to adopt to work on other voltages by simply changing the operating coils. The closing and operating coils shall be designed to operate satisfactorily at any control voltage from 70% to 115% of the normal rated voltage. A heater shall be provided in the cabinet to prevent moisture condensation.

1.12.4 Necessary cable glands for the cables of the operating mechanism shall be provided.

#### 1.13 **TERMINAL CONNECTORS** :

Technical connectors suitable for all Aluminum Alloy Conductor zebra shall be provided, Suitable terminal earth connector for earthing connections shall also be supplied.

#### 1.14 **AUXILIARY SWITCHES** :

Adequate number of auxiliary switches (contacts) both of the normally open and normally closed types shall be provided on each circuit breaker for use in the remote indication and control scheme of the circuit breaker and for providing safety interlocking. Special contact for use with trip coil and single short reclosing operation which permits relative adjustment with respect to the travel of the moving contact of the circuit breaker shall also be provided. There shall be provision to add more auxiliary switches at the later date if required.

#### 1.15 **COMPLETENESS OF EQUIPMENT** :

Any fittings, accessories or apparatus which may not have been specifically mentioned in those specification but which are usual or necessary in the equipment of similar plant shall be deemed to be included in the contract and shall be supplied by the contractor without extra charges. All plant and equipment shall be complete in all details whether such details are mentioned in the specification or not. The detail bill of materials list to be furnished along with the tender.

**1.16 AFTER SALES SERVICE :**

1.16.1 The supplier should guarantee for after sales service for a minimum period of one and half years from the date of receipt of the equipment or one year from the date of commissioning of the equipment whichever is earlier.

1.16.2 The supplier also should guarantee after sales service beyond the free service period.

1.16.3 Supplier also should provide after sales service within 15 days of receipt of intimation from the field Engineer-in-charge of the equipment or the purchaser.

**1.16.4 COMMISSIONING :**

The manufacturers shall render all help for commissioning of the breakers. Supervision of erection , testing & Commissioning charges per breaker to be quoted in the schedule of prices (Annexure-v) for evaluation of the Price bid or else it will be presumed that the charges towards Supervision of erection , testing & Commissioning per Breaker are included in the unit price offered.

**1.17 EXPERIENCE :**

The list of supplies already made by the supplier/manufacturers are to be enclosed along with the tenders.

## 1.18 RECOMMENDED SPARES AND TOOLS :

For 5 (five) years operation, price are to be enclosed along with the tenders for each item of spares and special tools.

## 2.0 TEST :

2.1 Type test : - All the equipment offered shall be fully type tested as per the relevant standards. In case the equipment of the type and design offered, has already been type tested in an Govt. Approved test Laboratory, the bidder shall furnish four sets of type test reports along with the offer. These tests **must not have been conducted earlier than five years from the date of opening of bids**. The purchaser reserves the right to demand repetition of some or all the type tests in the presence of owner's representative. For this purpose the bidder may quote unit rates for carrying out each type test. These prices shall be taken into consideration for bid evaluation. For any change in the design/type offered against this specification, if accepted by the purchaser, the purchaser reserves the right to demand repetition of tests without any extra cost. Reports of Type tests as stipulated in relevant IS along with Impulse and short circuit test documents conducted shall be supplied along with the tender. All the test reports should be submitted and shall be approved by the purchaser before dispatch of the material.

**Note :- Tender not accompanying with the type test reports alongwith Impulse and short circuit tests are liable for rejection.**

### **Type Tests:--( As per IEC-62271-100)**

1) Dielectric Test(LI Voltage,PF Voltage Withstand(Dry&Wet)& etc)



- 2) RIV Test
- 3) Measurement of resistance of the main circuit
- 4) Temperature rise Test
- 5) Basic short circuit duty test ,Short Time withstand current & Peak withstand current Test
- 6) Mechanical Operation Test, Mechanical endurance test
- 7) Out of phase / Short Circuit making & Breaking Test
- 8) Capacitive Current, Switching Test ,a) cable charging current Test b) Single capacitor Bank current switching test
- 9) Test to verify degree of protection

**Routine Tests:-**

- 1) Dielectric Tests on the main Circuit ,auxiliary & control circuits
- 2) Measurement of resistance of the main circuit.
- 3) Design & Visual Checks(Dimensions,clearances&etc)
- 4) Mechanical operation Test
- 5) Operating time of the device, motor Characteristics, measurement of coil current & resistance , Sf6 gas pressure monitoring ,electrical scheme,control Circuit,antipumping, vaccum interrupter(type,make&etc),dimensions, name plate details , contact travel & timing checks .

**Acceptance and Routine Tests.**

2.1.1 All acceptance and routine tests as stipulated in the relevant standards & above shall be carried out by the supplier in presence of owner's representative.

2.1.2 Immediately after finalization of the programme of type/acceptance/routine testing, the supplier shall give twenty days advance intimation to the purchaser, along with the shop routine test certificate and valid calibration certificates of the equipments/instruments calibrated in a govt. approved test house ,to be used during testing for scrutiny,to enable him to depute his representative for witnessing the tests.

3.0 **INSPECTION** :The inspection may be carried out by the purchaser at any stage of manufacture. The successful tendered shall grant free access to the purchaser's

representative at a reasonable time when the work is in progress. Inspection and acceptance of any equipments under this specification by the purchaser, shall not relieve the supplier in his obligation of furnishing equipment in accordance with the specification and shall not prevent subsequent rejection if the equipment is found to be defective.

The supplier shall keep the purchaser informed in advance, about the manufacturing programme so that arrangement can be made for inspection.

The purchaser reserves the right to insist for witnessing the acceptance/routine testing of the bought out items.

#### 4.0 **QUALITY ASSURANCE PLAN** :

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

- (i) Statement giving list of important raw materials names of sub-suppliers for the raw materials, list of standards according to which the raw materials are tested. List of tests normally carried out on raw materials in presence of tenderer's representative, copies of test certificates.
- (ii) Information and copies of test certificates as in (i) above in respect of bought out accessories.
- (iii) List of manufacturing facilities available.
- (iv) Level of automation achieved and list of areas where manual processing exists.

- (v) List of areas in manufacturing process, where stage inspections are normally carried out for quality control and details of such tests and inspections.
- (vi) Special features provided in the equipment to make it maintenance free.
- (vii) List of testing equipments available with the tenderer for final testing of equipment specified and test plant limitation. If any, vis-avis the type, special acceptance and routine tests specified in the relevant standard. These limitations shall be very clearly brought out in schedule of deviations from specified test requirements.

4.1 The successful tendered shall within 30 days of placement of order, submit following information to the purchaser.

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

4.3 The successful bidder shall submit the routine test certificates of bought out accessories and central excise passes for raw material viz. oil, copper, aluminum, conductors, insulating materials, core material at the time of routine testing of the fully assembled equipment.

## **5 DOCUMENTATION :**

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5.1 All drawing shall conform to International Standards organization (ISO). A series of drawing sheet/Indian standards specification IS.656. All drawings shall be in ink and suitable for micro filming. All dimensions and data shall be in S.I. Units.

5.1 **List of drawings and documents.**

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

- a) General outline and assembly drawings of the equipment.
- b) Graphs showing the performance of equipments
- c) Sectional views showing :-
  - i) General Constructional features.
  - ii) The materials/gaskets/sealing used.
  - iii) method of connections.
  - iv) Porcelain used and its dimensions along with the mechanical and electrical characteristics.
- d) Arrangement of terminal's and details of connection studs provided.
- e) Name Plate.
- f) Schematic drawing :-
- g) Type test reports in case the equipment has already been type tested.

h) Test reports, literature, pamphlets of the bought out items, and raw material.

5.2 The successful tender shall, within 2 weeks of placement of order, submit four sets of final version of all above said drawings for purchaser's approval. The purchaser shall communicate his comments/ approval on the drawings to the supplier within four weeks. The supplier shall, if necessary modify the drawings and resubmit three copies of the modified drawings for owner's approval within two weeks from the date of owner's comments. After receipt of owner's approval, the supplier shall within two weeks, submit. 15 prints and two good quality reproducible of the approved drawings for purchaser's use.

5.3 Six sets of the type test reports, duly approved by the purchaser, shall be submitted by the supplier for distribution before commencement of supply. Adequate copies of acceptance and routine test certificates, duly approved by the purchaser, shall accompany the dispatched consignment.

5.4 The manufacturing of the equipments shall be strictly in accordance with the approved drawings and no deviation shall be permitted without the 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.

5.5 15 sets of nicely printed and bound volumes of operation, maintenance and erection manuals in English language for each type and rating of equipment supplied shall be submitted by the supplier for distribution, prior to the dispatch of the equipment. The manual shall contain all the drawings and information required for erection, operation and maintenance of the equipment. The manual shall also contain a set of all the approved drawings, type test reports etc.

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

## **6 PACKING AND FORWARDING**

6.1 The equipments shall be packed in crates suitable for vertical/horizontal transport as the case may be, and suitable to withstand handling during transport and outdoor storage during transit. The supplier shall be responsible for any damage to the equipment during transit, due to improper and inadequate packing. The easily damageable material shall be carefully packed and marked with the appropriate caution symbol. Wherever necessary, proper arrangement for lifting, such as lifting books etc. shall be provided. Any material found short inside the packing cases shall be supplied by supplier without any extra cost.

Each consignment shall be accompanied with a detailed packing list containing the following information.

- a) Name of the consignee.
  
- b) Details of consignment.

- c) Destination
- d) Total weight of consignment.
- e) Sign showing upper/lower side of the crate.
- f) Handling and unpacking instructions.
- g) Bill of material indicating contents of each package.

The supplier shall ensure that the packing list and bill of material are approved by the purchaser before dispatch.

### **TOPOGRAPHICAL AND METEOROLOGICAL SITE CONDITIONS**

Location of installations	State of Orissa
Altitude	1000 m
Maximum Temperature	60°C
Minimum Temperature	0°C
Maximum daily average temperature	35°C
Maximum humidity	100%
Pollution level	Heavy
Airborne contamination, if any	Highly Polluted
Seismic withstand factor	0.3 g
Maximum wind pressure	260 kg/m <sup>2</sup>
Wind velocity	50m/sec

Maximum rainfall per annum	2000 mm
Average rainfall per annum	1500 mm
Average no. of thunder-storm days/annum	70
Average no. of dust storm days per annum	20





**ORISSA POWER TRANSMISSION CORPORATION  
LIMITED**

**TECHNICAL SPECIFICATION**

**FOR**

**CURRENT  
TRANSFORMERS.**

**I: - 33KV CT**

**a) RATIO-400-200A-100/1-1A**

# TECHNICAL SPECIFICATION FOR 33KV CURRENT TRANSFORMERS WITH METERING CORES OF ACCURACY CLASS 0.2

## 1.0 SCOPE :

1.1. The specification covers the design, manufacture, assembly, inspection and testing at the manufacture's work, packing and delivery F.O.R. (destination) of the outdoor mounted dead tank type, single phase, single unit type current Transformers and CT console( one CT console per 3 CT's) for protection and metering services in 33KV, solidly grounded system.

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

1.2. The current transformers shall be of the outdoor type, single phase, 50 C/S, oil immersed, self cooled, hermetically sealed and suitable for operating in the tropical conditions with maximum ambient temperature upto 50°C. The C.TS should be suitable for use in the areas subject to heavy lightning storms and highly polluted conditions.

1.3. Followings are the list of documents constituting this specification.

[i]	Technical specification(TS)	
[ii]	Technical Requirements	Appendix I
[iii]	Quantity and Delivery Schedule (Appendix II)	Appendix II
[iv]	Guaranteed Technical Particulars	Annexure –A
[v]	Calibration Status of testing equipments and meters / Instruments	Annexure – B
[vi]	Check-List towards Type Test Reports	Annexure-C
[vii]	Check-List for Delivery Schedule	Annexure-D
Note :	Annexure- A, B, C & D are to be filled up by the Bidder	

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

1.5 Bidders are required to quote for 0.2 accuracy class of metering cores with the following data / informations etc.

[a] Guaranteed Technical particulars.

[b] Technical literatures, brochures and drawings as per this specification.

[c] Type Test Reports.

[d] List of orders, executed and User's certificates, failing submission of the above particulars with the offer, the tender may not be considered for evaluation.

## 2.0 STANDARDS

2.1 Except to the extent modified in the specification, the C.TS shall conform to the latest editions and amendments of the standards listed hereunder.

Sl. No.	Standard Ref. No.	Title
1	IEC-44	Instrument transformer-measurement of PDS
2.	IEC-60	High Voltage Testing Technique.
3.	IEC-171	Insulation co-ordination
4.	IEC-185	Current Transformers.
5.	IEC-270	Partial Discharge Measurement
6.	IEC-8263	Method for RIV Test on High Voltage Insulators.
7.	IS-335	Insulating oil for Transformers
8.	IS:2071	Method of High Voltage Testing
9.	IS:2099	High Voltage porcelain Bushings
10.	IS:2147	Degree of Protection Provided by Enclosures for Low Voltage Switchgear and Control.
11.	IS:2165	Insulation Co-ordination for equipment of 100KV and above
12.	IS:2705	Current Transformers

	[Part-I to IV)	
13.	IS:3347	Dimensions of Porcelain Transformer Bushing
14.	IS:5621	Specification for Large Hollow Porcelain for use in Electrical installation.
15.	IS:4201	Application guide for CTS
16.		Indian Electricity Rules, 1956
17.	<i>IS:13072 –of1991</i>	<i>SF6 Gas (for 220kv SF6 gas filled CTs only)</i>
18.	<i>IEC:60376</i>	<i>SF6 Gas(for 220kv SF6 gas filled CTs only)</i>

2.2 Current Transformers with the requirements of other authoritative standards, which ensure equal or better quality than the standards, mentioned above, shall also be acceptable, Where the equipment, offered by the supplier conforms to other standards, salient points of difference between the standards adopted and specified standards shall be brought out in th offer. 4 (four) copies of the reference standards in English language shall be furnished along with the offer.

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

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

**3.0 CLIMATIC & SERVICE CONDITIONS :**

3.1 The current Transformers are required to operate satisfactorily under the following conditions.

[a]	Maximum ambient temperature	50°C
[b]	Minimum ambient temperature	0°C
[c]	Maximum daily average ambient air temperature	45°C
[d]	Maximum relative humidity	100%

[e]	Average no. of rainy days in a year.	120 days
[f]	Average annual rainfall	150 cm
[g]	Maximum wind pressure	260 Kg/Sq.m
[h]	Altitude not exceeding	1000 m

### 3.2 EARTHQUAKE INCIDENCE

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

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

### 4.0 PUCHASER'S AUXILIARY POWER SUPPLY :

4.1 Following power supplies shall be made available at site.

- (a) A.C. Three phase, 415V, 50HZ earthed
- (b) A.C. Single Phase, 240V, 50HZ earthed.
- (c) 220 V D.C. ungrounded.

4.2 All the equipments and devices shall be capable of continuous satisfactory operation on AC and DC supplies of normal voltage mentioned above with the variation given below.

[a]	AC voltage variation	$\pm 10\%$
[b]	Frequency variation	$\pm 5\%$
[c]	Combined voltage and frequency variation	$\pm 10\%$
[d]	DC Voltage Variation	<u>190V to 240V</u>

4.3 The supplier shall make his own arrangements for the power supplies other than those specified under clause 4.1 above.

## **5.0 GENERAL TECHNICAL REQUIREMENTS :**

- 5.1 The C.T. shall be of dead tank design and shall be so constructed that it can be easily transported to site within the allowable limitation and in horizontal position if the transport limitations so demand.
- 5.2 For compensation of variation in the oil volume due to ambient variation, nitrogen cushion / metal bellows shall be used. Rubber diaphragms shall not be permitted for this purpose.
- 5.3 The C.T. secondary terminals shall be brought out in a weather proof terminal box. The terminal box shall be provided with removable gland plate and gland (s) suitable for 1100 volts grade PVC insulated, PVC sheathed, multicore 4 Sq. mm stranded copper conductor cable. The terminal blocks shall be stud-type and provided with ferrules, indelibly marked or numbered. The terminals shall be rated for not less than 10 Amps. The terminal box shall be dust and vermin proof. Suitable arrangements shall be made for drying of air inside the secondary terminal box. The dimensions of the terminal box and its openings shall be adequate to enable easy access and working space with the use of normal tools.
- 5.4 Polarity shall be indelibly marked on each primary and secondary terminal. Facility shall be provided for short-circuiting and grounding of the C.T. secondary terminals inside the terminal box.
- 5.5 The C.T. shall be provided with non-corrosive, legible name plate with the information, specified in the relevant standards, duly engraved/punched on it.
- 5.6 The current Transformer shall be vacuum filled with oil after processing and thereafter hermetically sealed to eliminate breathing and to prevent air and

moisture from entering the tanks. Oil filling and / or sampling cocks, if provided to facilitate factory processing should be properly sealed before despatching the C.T.,  
The method adopted for hermetic sealing shall be described in the offer

- 5.7 The castings of base, collar etc. shall be diecast and tested before assembly to detect cracks and voids, if any.
- 5.8 The instrument security factor of metering core shall be low enough and not greater than '5'. This shall be demonstrated on all the ratios of the metering core in accordance with procedure, specified in IEC-185 OR IS:2705. In case the instrument security factor of 5 or less is not possible to be achieved on higher ratios, auxiliary CTS of ratio 1/1 and 0.2 accuracy class shall be deemed to be included in the supplier's scope of supply. This shall also be specifically brought out by the supplier in his offer. However, all parameters, specified shall have to be met treating auxiliary CT/ reactor as an integral part of the current Transformer. The auxiliary C.TS/reactor shall be inbuilt construction of the C.TS.
- 5.9 Current transformers' guaranteed burdens and accuracy class are to be intended as simultaneous for all cores.
- 5.10 36 KV Current Transformers, characteristics shall be such as to provide satisfactory performance for burdens ranging from 25% to 100% of rated burden over a range of 5% to 120% of rated current in case of metering CTS and upto accuracy limit factor / knee point voltage in case of relaying C.TS.
- 5.11 Current Transformers shall be designed so as to achieve the minimum risk of explosion in service. The Bidder shall bring out in his offer, the measures taken to achieve this.

#### **5.12 PRIMARY WINDING**

5.12.1 Primary winding may be either ring type or hair pin type or the type, which has been type tested. For 33KV class C.Ts, the rated extended primary current shall be 120% on all cores of the C.Ts, specified in tables.

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

### **5.13 SECONDARY WINDINGS:**

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

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

### **5.14 PRIMARY TERMINALS**

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

### **5.15 SECONDARY TERMINALS**

5.15.1 Secondary terminal studs shall be provided with at least three nuts and adequate plain and spring washers for fixing the leads. The studs, nuts and washers shall be of brass, duly nickel plated. The minimum outside diameter of the stud shall be 6 mm. The length of at least 15 mm shall be available on the studs for inserting the leads. The horizontal spacing between the centers of the adjacent studs shall be at least 1.5 times the outside circum-dia of the nuts.

5.15.2 The current transformer shall be provided with suitable test tap for measurement of capacitance, tan delta as well as partial discharges. Provision shall be made on a



screw cap for solid and secured earthing of the test tap connection, when not in use. A suitable caution plate shall be provided duly fixed on the cover of the secondary terminal box indicating the purpose of the test tap and the necessity of its solid earthing as per prescribed method before energising the Current Transformer.

5.15.3 The secondary terminals shall be provided with shorting arrangements.

## **5.16 CORE**

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

## **5.17 TANK**

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

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

## **5.18 SECONDARY TERMINAL BOX :**

5.18.1 Secondary Terminal Boxes shall be weather proof with a rating not less than IP 55

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

5.18.3 The exterior of this terminal box shall be of aluminium sheets of minimum 3 mm thickness.

5.18.4 A terminal board which shall have arrangement for connection and arrangement for shorting of secondary terminals shall be provided.

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

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

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

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

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

## **5.19 PORCELAIN HOUSING**

5.19.1 The housing shall be made up of homogeneous, vitreous porcelain of high mechanical and dielectric strength, Glazing of porcelain shall be of uniform brown or dark brown colour with a smooth surface, arranged to shed away rain water or condensed water

particles (fog.) The details of location and type of joint, if provided on the porcelain, shall be furnished by the Bidder along with the offer.

5.19.2 The bushings of the Current Transformers shall conform to the latest edition of IS:2099.

The hollow porcelain insulator shall conform to the latest edition of IS:5621.

5.19.3 The insulators shall be cemented with Portland cement to the flanges resulting in high mechanical, tensile and breaking strength.

5.19.4 The bushings shall have ample insulation, mechanical strength and rigidity for the condition under which they shall be used and shall be designed to prevent accumulation of explosive gases and provide adequate oil circulation to remove the internal heat.

5.19.5 Cast metal end caps for the bushings shall be of high strength, hot dip galvanized malleable iron. They shall have smooth surface to prevent discharge taking place between the metal parts and porcelain as a result of ionisation.

5.19.6 The insulation of bushings shall be coordinated with that of the current transformer such that the flashover, if any, will occur only external to the Current Transformer.

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

5.19.8 End shields should be provided for distribution of stresses.

5.19.9 Corona shields for bushings, if required should be provided.

## **5.20 INSULATING MEDIUM ( OIL TYPE)**

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

### **PREVENTION OF OILLEAKAGE AND ENTRY OF MOISTURE :**

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

- (a) locations of emergence of primary and secondary terminals.
- (b) Interface between porcelain housing and metal tank/s
- (c) Cover of the secondary terminal box.

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

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

5.21 **FITTINGS AND ACCESSORIES :**

Fittings and accessories, listed below shall be supplied with each Current

Transformer. Any fitting, required essential other than those listed below shall also be supplied alongwith each Current Transformer without any extra cost to the purchaser

- (a) Oil level gauge.
- (b) Oil filling hole and cap.
- (c) Pressure relieving device.
- (d) Phase terminal connectors.
- (e) Lifting lugs for core and windings, bushings and complete Current Transformers.

- (f) Tank earthing pads/terminals with necessary nuts, bolts and washers for connecting to purchaser's earth strip.
- (g) Name / Rating plate.

5.21.1 **(A) OIL LEVEL GAUGE :**

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

5.21.2 **PRESSURE RELIEVING DEVICE :**

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

5.21.3 **(A) OIL DRAIN COCK :**

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

5.21.4 **EARTHING :**

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

5.21.5 **LIFTING ARRANGEMENT :**

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

**5.21.6 NAME PLATE & MARKING :**

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

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

**5.21.7 TERMINAL CONNECTORS :**

All the Current Transformers shall be provided with bimetallic solderless clamp type, rigid type terminal connectors, suitable for

(i) 33KV C.T. – ACSR ‘Zebra’ conductor.

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

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

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

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

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

5.21.7.5 For bimetallic connectors, copper alloy liner of minimum thickness of 2 mm shall be cast integral with aluminium body.

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

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

## **6.0 TEST :**

### **6.1 TYPE TESTS & SPECIAL TESTS:-**

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

- (a) Lightning Impulse Voltage Test.
- (b) High Voltage power frequency wet withstand voltage Test.
- (c) Short time current test.
- (d) Temperature rise test.
- (e) Determination of errors or other characteristics according to the requirements of the appropriate designation and accuracy class as per individual parts of IS:2705.
- (f) Instrument Security Factor Test.
- (g) IP-55 Test on Secondary Terminal Box.

(In addition to the above tests, following type tests/special tests should have been conducted exclusively for 220KV/400 KV C.T)

- (h) Radio Interference voltage test.
- (i) Corona Extinction test.
- (j) Thermal stability test.
- (k) Thermal Co-efficient test.
- (l) Fast transient test.
- (m) Seismic withstand test.
- (n) Mechanical terminal load on bushing.
- (o) Magnetisation and internal burden tests..
- (p) Effectiveness of sealing tests.
- (q) capacitance and dielectric loss angle test. (For 400 KV ,220KV & 132KV C.Ts.)

**N.B :**

- Lightning Impulse Test, switching Impulse Voltage test and High Voltage power frequency wet withstand voltage Tests should have been carried out on the same current transformer.
- After the current transformers have been subjected to lightning Impulse Test, and High Voltage power frequency wet withstand voltage tests, these must have been subjected to all the routine tests as per IS:2705 (Part-I to IV).

**6.2 ROUTINE TESTS :**

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



- (i) Appearance and Dimensional Check.
- (ii) Verification of Terminal Marking and polarity.
- (iii) Verification of all individual parts / components of the Current Transformer so as to ensure to have complied the above specification.
- (iv) Measurement of Insulation Resistance.
- (v) Power Frequency Dry withstanding Test on Primary and Secondary winding including primary intersections.
- (vi) Over – Voltage Interturn test.
- (vii) Partial discharge Test for 400 KV,220 KV and 132KV C.TS
- (viii) Knee point voltage and Excitation current measurement for ‘PS’ class cores.
- (ix) Secondary winding resistance measurement.
- (x) Determination of errors.
- (xi) ISF Test.
- (xii) Leakage Test.
- (xiii) Magnetization Characteristics of the Current Transformers.
- (xiv) Turn ratio error on ‘PS’ class cores.
- (xv) Measurement of capacitance for 400 KV,220KV and 132KV C.TS.
- (xvi) Measurement of tan delta at 0.3, 0.7, 1.0 and  $1.1U_M/\sqrt{3}$  for

- The Method For Conducting Partial Discharge Test.

The test circuit for the measurement of partial discharge (PD) should have been in accordance with sub-clause 4.2 of IEC-270. The applied voltage should be raised to the rated voltage of the Current Transformers and should have been maintained for a period greater than or equal to 10 seconds. The voltage should have been reduced to measuring voltage of

1.1 X145/245/400KV rms/phase

3½

to ground and maintained for a period greater than or equal to 1 minute. The PD should not exceed 10 picco-coulombs.

**7.0 INSPECTION :**

7.1 The purchaser shall have access at all times to the works and all other places of manufacture, where the Current Transformers are being manufactured and the supplier shall provide all facilities for unrestricted inspection of the supplier's works, raw materials, manufacture of all the accessories and for conducting the necessary tests.

7.2 The supplier shall keep the purchaser informed in advance of the time of starting and of the progress of manufacture of equipment in its various stages so that arrangement could be made for inspection.

7.3 No material shall be despatched from its point of manufacture unless the material has been satisfactorily inspected, tested and despatch clearance

issued. However, the purchaser reserves the right to alter the despatch schedule, attached to this specification without any extra financial liability to OPTCL.

7.3.1 The acceptance of any quantity of equipment shall in no way relieve the supplier of his responsibility for meeting all the requirements of this specification and shall not prevent subsequent rejection, if such equipments are found to be defective.

**8.0 QUALITY ASSURANCE PLAN :**

8.1 The Bidder shall invariably furnish following information alongwith his offer.

(i) Statement giving list of important raw materials, names of sub-suppliers for the raw materials, list of standards, according to which the raw materials are tested, list of tests, normally carried out on raw material in presence of Bidders' representative, copies of test certificates.

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

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

- (i) List of raw materials as well as bought out accessories and the names of the materials as well as bought-out accessories and the names of sub-suppliers, selected from those, furnished alongwith the offer.
- (ii) Type Test Certificates of the raw material and bought out accessories.

- (iii) Quality Assurance plan (QAP) with hold points for the purchaser's inspection.  
The QAP and hold points shall be discussed between the purchaser and the supplier before the QAP is finalized.
- 8.3 The supplier shall submit the routine test certificate of bought-out items and raw materials at the time of acceptance testing of the fully assembled equipment.
- 9.0 **DOCUMENTATION :**
- 9.1 All drawings shall conform to relevant Indian Standard as per relevant IS. All drawings shall be in ink and suitable for microfilming. All dimensions and data shall be in S.I. units.
- 9.2 The supplier shall furnish four sets of following drawings/documents along with his offer for 0.2 accuracy class metering core CTs.
  - (a) General outline and assembly drawings of the Current Transformers.
  - (b) Sectional views showing.
    - (i) General constructional features.
    - (ii) Materials / gaskets / sealing used.
    - (iii) The insulation of the winding arrangement, method of connection of the primary / secondary winding to the primary / secondary terminals etc.
  - (c) Schematic drawing
  - (d) Rating and Diagram plate.
  - (e) Secondary Terminal Box.
  - (f) Assembly Sectional view of Primary Terminal
  - (g) Assembly drawing for secondary terminal.
  - (h) The detailed dimensional drawing of Porcelain Housing such as ID, OD, thickness and Insulator details such as height, profile of petticoats, angle of

inclination and gap between successive petticoats, total creepage distance etc.

- (i) Sectional view of Pressure Release device.
- (j) Drawing showing details of Oil level Indicator.
- (k) All type and special test reports relating to tests, as mentioned at Cl. No. 6.1 of this Technical Specification.
- (l) Ratio and phase angle error curves for CTS.
- (m) Magnetization characteristic curves such as B-H curves and sp.loss vs. flux density curves.
- (n) Drawings for Terminal Connector.

#### **10.0 TEST REPORTS :**

- (i) Four copies of type test and special test reports shall be furnished to the purchaser with the tender offer for 0.2 accuracy class metering core CTs.
- (ii) Copies of acceptance test reports and routine test reports shall be furnished to the purchaser. One copy will be returned, duly certified by the purchaser and only thereafter shall the materials be despatched.
- (iii) All records of routine test reports shall be maintained by the supplier at his works for periodic inspection by the purchaser.
- (iv) All test reports of tests, conducted during manufacture shall be maintained by the supplier. These shall be produced for verification as and when required for by the purchaser.

#### **11.0 SPARE PARTS**

A list of spare parts recommended for five years operations for each Current Transformer shall be furnished with the tender. The purchaser will decide the actual

quantities of spare parts to be ordered on the basis of the list and the item wise price of spare parts.

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

13.0 **PACKING AND FORWARDING :**

13.1 The equipment shall be packed in suitable crates so as to withstand handling during transport and outdoor storage during transit. The supplier shall be responsible for any damage to the equipment during transit, due to improper and inadequate packing. The easily damageable material shall be carefully packed and marked with the appropriate caution symbols. Wherever necessary, proper arrangement for lifting such as lifting hooks

etc. shall be provided. A material found short inside the packing cases shall be supplied by supplier without any extra cost.

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

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

13.2.1 The supplier shall ensure that the bills of materials are approved by the purchaser before despatch.

13.3 Any tender without complete information, as asked for in the above specification, is likely to be rejected.

## APPENDIX-I

### **TECHNICAL REQUIREMENT FOR 33 KV CURRENT TRANSFORMERS**

The Current Transformers under this specification shall conform to the parameters given below :-

Sl. No.	Item.	Specification		
		36 KV		
1	Type of CT/Installation.	Single phase, dead tank, oil filled, hermetically sealed, outdoor, self-cooled.		
2	Type of mounting.	Pedestal type		
3	Suitable for system frequency.	50 HZ $\pm$ 5 %		
4	Rated voltage (KV rms)	33		
5	Nominal system voltage (KV rms)	33		
6	Highest system voltage (KV rms)	36		
7	Current ratio (A/A)	a)400-200A-100/ 1-1A		
8.	Method of earthing the system where the current transformer will be installed.	Solidly Effectively earthed.		
9	Rated continuous thermal current (A)	120 % of rated primary current		
10	Acceptable limit of temperature rise above 50°C ambient temperature for continuous operation at rated continuous thermal current.			
(a)	Winding	45°C		
(b)	Oil	40°C		



(c)	External surface of the core, metallic parts in contact with or adjacent to, insulation.	45°C
11	Acceptable partial discharge level	Less than 10 picco coulombs
12.	Maximum radio interference voltage at 1.1 times the maximum rated voltage.	Less than 500 micro volts
13.	1.2/50 micro second lightning impulse withstand voltage (KVP) (dry)	170
14.	1 minute dry power frequency withstand voltage primary (KV rms)	70
15.	Switching Impulse with stand and voltage (KVP)	--            -                            -
16.	1 Minute dry power frequency withstand voltage secondary (KV rms)	3
17.	Minimum creepage distance of porcelain Housing (mm)	900
18.	Rated short time withstand current for 1 second at all ratios (KA rms)	25KA

19.	Instrument security factor at all ratios for metering core.	Not more than 5.0
20.	Minimum rated short time thermal current density of the primary winding at all ratios (A/mm <sup>2</sup> )	As per clause No9.6.3- Note of IS: 2705 (Part-I)/1992
21.	Application, current ratio, output burden, accuracy class, minimum knee point voltage, secondary winding resistance, maximum excitation current at minimum knee point voltage etc.	Enclosed in separate sheets for each rating of the Current Transformers.
22.	Type of core	Torroidal type
23.	Seismic acceleration	0.15g (Vertical) 0.3g (Horizontal)
24.	Dielectric dissipation factor at 245/1.732KV (for 220KV C.T) & 145/1.732KV ( for 132 KV C.T.) at ambient temperature	0.005 or less
25.	Accuracy class of standard C.T. to be used during testing towards determination of ratio errors and phase angle errors for metering cores.	0.05 or better.

**SPECIFIED PARAMETERS FOR KPV,  
SEC. WDG. RESISTANCE, EXCITATION  
CURRENT FOR PS CLASS CORES**

**AND**

**BURDEN, ISF FOR METERING CORES**

**OF**

**ACC.CLASS 0.2**

**FOR**

**33KV C.TS**

## REQUIREMENT FOR 36KV CURRENT TRANSFORMERS OF RATIO

a) 400-200A-100/1-1A

No . of Co res	Cor e No.	Applicati on	Current Ratio	Outp ut burde n in VA	Accur acy class as per IS: 2705	Minimu m knee point voltage ( $V_k$ ) at all ratios in volts.	Maximu m CT resistanc e RCT in ohms at 75 °C at all ratios	Maximu m excitatio n current at $V_k$ in mA at all ratios.	Instrum ent security factor
1	2	3	4	5	6	7	8	9	10
3.	1	Protectio n	400/1 200/1 100/1	- -	PS PS PS	400	5.0	25	
	2.	Metering	400/1 200/1 100/1	20 20 20	0.2 0.2 0.2	-	-	-	5 or less 5 or less 5 or less

**ANNEXTURE – B.**

**CALLIBRATION STATUS OF TESTING EQUIPMENTS AND INSTRUMENTS / METERS**

Name of the Test	Meters & Equipments required for the corresponding test with range accuracy, make & SI.No.	Date of Calibration	Due Date of Calibration	Name of the Calibrating Agency	Whether Calibration Agency is Govt. approved	Whether documents relating to Govt. approval of the calibrating Agency furnished	Whether the meters / equipments fulfill the accuracy class as per calibration report	Whether the calibrating agency has put any limitation towards the use of the particular meter / equipment. If yes state the limitations.	Whether green sticker or Blue Sticker or Yellow Sticker has been affixed on the body of the particular equipment / meter. State the colour of the affixed sticker	In spite of imposed limitations, whether the particular meter / equipment can still be used ? Justify its use for corresponding test (s)	Remarks
1	2	3	4	5	6	7	8	9	10	11	12

Signature of the tenderer with seal & date

ANNEXURE – C

CHECK-LIST TOWARDS TYPE TEST & SPECIAL TEST REPORTS

Name of the Type Test & special test	Date of Test.	Name of the Laboratory where the Test has been conducted	Whether the Laboratory is Government approved	Whether the Test report is valid as per Cl.No. 6.1 of TS	Whether the copy of test report in complete shape along with drawings etc. furnished or not ?	Whether the tested Transformers fulfill the technical requirements as per TS	If the tested Current Transformer does not fulfill the technical requirements as per this specification, whether the bidder agrees to conduct the particular type test again at their own cost without any financial liability to OPTCL in the presence of OPTCL's representative(s) within the specified delivery period.	Remarks
1	2	3	4	5	6	7	8	9

Signature of the Tenderer with seal and date



**ORISSA POWER TRANSMISSION CORPORATION  
LIMITED  
OFFICE OF THE SR. GENERAL MANAGER,  
CENTRAL PROCUREMENT CELL,  
JANAPATH, BHUBANESWAR – 751022.**

**TECHNICAL SPECIFICATION  
FOR  
33 KV ISOLATORS**

# **TECHNICAL SPECIFICATION**

## **FOR**

**A) 33 KV DOUBLE/SINGLE ISOLATOR  
WITH EARTH SWITCH**

**B) 33 KV SINGLE ISOLATOR WITHOUT  
EARTH SWITCH**



**1. TECHNICAL SPECIFICATION FOR 220 KV. 132 KV & 33 KV ISOLATOR**

<b><u>Type:</u></b>	<b><u>220 KV</u></b>	<b><u>132 KV</u></b>	<b><u>33 KV</u></b>
1. Main switch	Double end break centre post rotating, gang operated		
2. Service	----- Outdoor -----		
3. Applicable standard	- IS : 9921 / IEC-129/IEC-62271-102.		
4. Pole :	3 pole gang operator -----		
5. Rated voltage nominal / maximum	220/245	132/145	33/36
6. Rated requery	----- 50 HZ $\pm$ 5%-----		
7. System earthing	----- effectively earthed -----		
8. Temperature rise	As per relevant IS/IEC publication		
9. Insulation level impulse with stand voltage :			
a) Across Isolating distance (kV peak)	1200	750	195
b) To earth & between poles (kV Peak)	1050	650	170
10. 1 minute power frequency with stand voltage			
a) Across Isolating distance (kV Peak)	530	315	80

	b) To earth & between poles (kV Peak)	460	275	75
11.	Rated current	2000	1250	1250
12.	Short time current for 3 sec.	40 KA	31.5 KA	25KA
13.	Operating mechanism	Motor	Motor	Motor
14.	Auxiliary voltage	220 KV	132 KV	33 KV
	a) Control & Inter lock	----- 220V DC 80% to 110% -----		
	b) Motor voltage	3 phase 415 V (+/- 10%) 50HZ-----		
	c) Heater, lamp & socket	230 V (+/- 10%) 50HZ		
15.	Safe duration of overload			
	a) 150% of rated current	----- 5 minute -----		
	b) 120% of rated current	----- 30 minute -----		
16.	(a) Minimum creepage distance of support and Rotating insulator	-----6125mm-----3625 mm ---900mm		
	(b) Phase to Phase spacing(mm)	----- 4500-----2700-----1200----		
17.	Mounting structure	----- Upright on steel structure -----		
18.	Terminal connector type	Bimetallic clamp size as per Requirement		
19.	Control	-----Local / Remote-----		
20.	Operating time	12 sec, or less(for 220 & 132KV)		
21.	No. of aux switches for Main Iso & E/S :	6 N/O & 6 N/C.		
22.	Rated magnetising/capacitive current make and break: suitable for capacitor bank duty.			
23.	All contacts: Silver plated not less than 20 microns.			
24.	Temperature above ambient temp of 50 deg C: 55 deg C.			
25.	Cantilever strength of support Insulator(Kgf) :	600 – 600 – 400		
26.	Current density of copper (Max)(A/Sq. mm):	1.75		

## REMARKS:

- 1) **The operating mechanism for earth switch of 33 KV only shall be manual operated.**

\*\* Insulator for 400/220/132/33 kv Isolators:

Top PCD: 127mm/127mm/127/76mm

No of holes: 4XM16

Bottom PCD: 300mm/254mm/254/76mm

No of holes: 8X18 dia/4xM16

## 2. SCOPE

This specification provides for design, manufacturer, testing at manufacturer's Works and delivery ,supervision of erection, commissioning(if required )of outdoor station type 400 KV/220KV /132KV /33KV, 3 phase triple pole double break gang operated centre rotating type (Single / Double) Isolator with / without earth switches, with electrical inter lock, insulators and complete in all respect with bimetallic connectors arcing horns operating mechanism, auxiliary switches, indicating devices, fixing detail etc. as described hereinafter.

### 3. STANDARDS

Disconnecting switches covered by this specification shall conform to latest edition IEC-129/IEC 62271-102 I.S.1813 and IS: 9921,IS-325,and unless specifically stated otherwise in this specification.

### 4. TYPE

The 220&132 &33 KV Isolators shall be outdoor type with three phase double break centre rotating type [Single (SI) / Double (DI) ] Isolators suitable for electrical as well as manual operation and local/remote operation. They shall have crank and reduction gear mechanism.

All Isolators offered shall be suitable for horizontal upright mounting on steel structures. Each pole unit of the multiple Isolators shall be of identical construction and mechanically linked for gang operation.

Each pole of the Isolator shall be provided with two sets of contacts to be operated in series and the moving contact blades shall rotate in horizontal plane.

The design shall be such that the operating mechanism with the linkages shall be suitable for mounting on any of the outer pole ends without much difficulty and with minimum shifting of parts.

Moving contacts of all isolators shall rotate through 90 deg from their “fully closed position” to “fully open position so that the break is distinct and clearly visible from ground level.

The Isolators offered by the Bidder shall be designed for Normal rating current for

Isolator	400 KV	220 kV	132 kV	33kV
	3600A	2000A	1250A	1250 amp

It should be suitable for continuous service at the system voltages specified herein. The Isolators shall be suitable to carry the rated current continuously and full short circuit current of 40/31.5/25 KA for 400 and 220/132/33 KV respectively for 3 second at site condition without any appreciable rise in temperature. These shall also be suitable for operation at 110% rated (normal) voltage. The Isolators shall be suitable for Isolating low capacitive / inductive currents of 0.7amp at 0.15 power factor. The isolators shall be so constructed that they don't open under the influence of short circuit conditions.

The Isolators and earthing switches are required to be used on electrically exposed installation and this should be taken into account while fixing the clearance between phases and between phase and earth.

#### 5. MAIN CONTACTS

All Isolators shall have heavy duty, self aligning and high pressure line type contacts made of high conductivity, corrosion resistant, hard-drawn electrolytic copper strips of proper thickness and contact area. Fixed contact should consist of loops of above copper strips suitable for 3600 Amps, 2000 Amps, 1250 Amps, and 1250Amps ratings for 400 KV, 220 KV, 132 KV and 33 KV Isolators respectively. The hard drawn electrolytic copper strips should be silver plated 10 micron thickness or more as per the requirement and fixed contacts should be backed by powerful phosphor bronze/stainless steel springs of suitable numbers. However, the thickness and contact area of the contact should conform to the drawing approved during type test.

These fixed and moving contacts shall be able to carry the rated current continuously and the maximum fault current of 40/31.5/25 KA for 400 and 200/132/33KV respectively for 3 seconds without any appreciable rise in temperature. The Isolator blades shall retain their form and straightness under all conditions of operation including all mechanical stress arising out of operation as well as under rated short circuit condition.

Fixed guides shall be provided so that even when the blades are out of alignment by one inch (maximum), closing of the switches, proper seating of the blades in between contacts and adequate pressure to give enough contact surface is ensured. Wherever

possible, the blades shall be counter balanced by weights and springs. The contact shall be self cleaning by the wiping action created by the movements of the blades. The surface of the contacts shall be tendered smooth and silver plated.

The Isolator shall be self cleaning type so that when isolator remain closed for long periods in a heavily polluted atmosphere, binding does not occur. No undue wear or scuffing shall be evident during the mechanical endurance tests, contacts and springs shall be designed so that adjustment of contact pressure shall not be necessary throughout the life of the isolator. Each contact or part of contacts shall be independently sprung so that full pressure is maintained on all contact at all times.

#### 6. ARCING HORN AND GRADING HORN

Suitable arcing horn made of tinned electrolytic copper which are required for guiding contacts shall be provided on the fixed and moving contacts of all Isolators. The contacts shall be of ‘make before and break after’ type.

#### 7. ELECTRICAL INTERLOCK / MECHANICAL INTERLOCK

The disconnecting switches whenever required shall be with an approved type electrical interlock for interlocking with the associated circuit breakers and earth switch. Electrical interlock assembly should be more right in construction and properly mounted to ensure reliable operation. The design should be such that the electrical circuit for the interlocking mechanism will only remain energised during operation of the switches.

#### 8. AUXILIARY SWITCHES

All isolators and earthing switches shall be provided with 220VDC auxiliary switches for their remote position indication on the control board and for electrical interlocking with other equipment. The auxiliary switch shall be provided with a minimum of auxiliary contacts-10 normally open and 10 normally closed and 10 normally open and 10 normally closed for earth switch. Separate auxiliary switches shall be provided for isolating and earth switches. 6 additional NO and NC contact to be provided as spare in each case.

The auxiliary switches and auxiliary circuits shall have a continuous current carrying capacity of at least 10 Amps. Auxiliary switches shall not be used as limit switches. Details of make, rating and type of limit switch shall be furnished in the offer.

#### 9. EARTH SWITCH

Line earth switch shall consist of three earthing blades for Isolator which normally rest against the frame when the connected Isolator is in closed position. The earthing blades for three phase shall be mechanically linked to a coupling shaft which shall be capable of being fitted on either side of the Isolator. The earthing blades shall match and be similar to the main switch blades and shall be provided at the hinge; with suitable

flexible conductors with terminal lugs for connecting to the station ground bus. The earthing blades shall be operated by a separate mechanism but shall be mechanically interlocked with the main switch so that the earthing blades can be closed only when the main switches are in open position and vice-versa. The earthing blades shall be gang operated and all the three blades will operate simultaneously.

#### 10. OPERATING MACHANISM

The operating mechanism shall be simple and shall ensure quick and effective 1000 operation. The design shall be such as to enable one man to operate it with nominal effort. The operating mechanism box shall be made out of stainless steel sections of minimum 1.6 mm thickness.

The Isolator blades shall be in positive continuous control throughout the entire cycles of operation. The operating rods and pipes shall be rigid enough to maintain positive control under most adverse conditions and to withstand all torsional and bending stresses arising from operation. Operation of the switches at any speed should not result in improper functioning, in displacement of parts / machines after final adjustment has been made. All holes in cranks, linkages etc. having moving pins shall be drilled and fitted accurately so as to prevent slackness and lost motion.

Provision shall be made for padlocking the operating mechanism of disconnecting and earth switches in both open and closed positions.

Bearings shall be ball and roller type shall be protected from weather and dust by means of cover and grease retainers. Bearings pressures shall be kept low to ensure long life and care of operation.

Each power operated isolator shall be motor driven as well as manually operated and shall be complete with local / remote selector switch and open / close push buttons. The function of all control facilitates operating isolators.

Provision shall be made in the control cabinet to disconnect power supply to prevent local / remote power operation. Limit switches for open and close positions of re-isolations and earth switches.

#### 11. DESIGN, MATERIALS AND WORKMANSHIP

The live parts shall be designed to eliminate sharp points, edges and similar corona producing surfaces, where this is impracticable, adequate shields to be provided. All ferrous metal parts shall be hot dip galvanized, as per IS 2629. All metal parts shall be of such materials or treated in such a way so as to avoid rust, corrosion and deterioration due to continued exposure to atmosphere and rain. All current carrying parts shall be made from high conductivity electrolytic copper / aluminium.

Bolts, screws and pins shall be provided with standard locking device viz. Locknuts, spring washers, keys etc. and when used with current carrying parts, they shall be made of copper silicon or other high conductivity and wear resistant alloys.

The switches should not need lubrication of any parts except at very long interval of five year minimum.

## 12. PROTECTIVE COATINGS

All ferrous parts including bolts, nuts and washers of the switches assembly shall be galvanised to withstand at least six one minute dips in copper sulphate solution of requisite strength (Prece tests) except the threaded portions which should withstand four dips.

13. Insulators – Support insulators for all type of isolators shall be of solid core type. The insulator shall be made of homogeneous and vitreous porcelain of high mechanical and dielectric strength. It shall have sufficient mechanical strength to sustain electrical and mechanical loading on account of wind load, short circuit forces etc. Glazing of the porcelains shall be of uniform dark brown colour with a smooth surface arranged to shed away rain water. The porcelain shall be free from laminations and other flaws or imperfections that might affect the mechanical or dielectric quality. It shall be thoroughly vitrified, tough and impervious to moisture. The porcelain and metal parts shall be assembled in such a manner and with such material that any thermal differential expansion between the metal and porcelain parts throughout the range of temperature specified in this specification shall not loosen the parts or create under internal stresses which may affect the mechanical or electrical strength or rigidity. The assembly shall not have excessive concentration of electrical stresses in any section or across leakage surfaces. The cement used shall not give rise to chemical reaction with metal fittings. The insulator shall be suitable for water washing by rain or artificial means in service condition. Profile of the insulator shall also conform to IEC-815. Insulator shall have a minimum cantilever strength of 800 kgs. Caps to be provided on top of the insulator shall be of high grade cast iron or malleable steel casting. It shall be machine faced and hot dip galvanized. The cap shall have four numbers of tapped holes spaced on a pitch circle diameter of 127mm. The holes shall be suitable for bolts with threads having anti corrosive protection. The effective depth of threads shall not be less than the nominal diameter of the bolt. The cap shall be so designed that it shall be free from visible corona and shall have radio interference level within 500 micro volts. Casing shall be free from blow holes cracks and such other defects.
14. Control Cabinet : The control cabinet of the operating mechanism shall be made out of stainless steel sheet of minimum 1.6 mm thickness. Hinged door shall be provided with pad locking arrangement. Sloping rain hood shall be provided to cover all sides. 15 mm thick neoprene or better type of gaskets shall be provided to ensure degree of protection of at least IP 55 as per IS 2147/IS-3947. The cabinet shall be suitable for mounting on support structure/or on a separate plinth foundation with adjustment for vertical, horizontal and

longitudinal alignment. Details of these arrangements shall be furnished along with the offer.

15. Motor : Motors rated 1 Kw and above shall be suitable for operation on 3 phase, 415 V, 50 HZ supply. Motors of lower rating shall be single phase type suitable for 240V, 50HZ system. It shall be totally enclosed type if mounted outside the control cabinet. The motor shall withstand without damage stalled torque for atleast 3 times the time lag of tripping device. The motor shall, in all other respects, conform to the requirement of I.S. 325.
16. Gear : The dis-connector / isolator may be required to operate occasionally, with considerably long idle intervals. Special care shall be taken for selection of material for gear and lubrication of gears to meet this requirement. The gear shall be made out of aluminium bronze or any other better material lubricated for life with graphite or better quality non-drawing and non-hardening type grease. Wherever necessary automatic relieving mechanism shall be provided suitable relay, Device shall be provided to prevent over loading of the motor. Single phase preventer (for 3 phase meter) shall be provided to operate on open circuiting of any phase and shall trip off the motor. Complete details of the devices shall be furnished in the offer.
17. Space heaters : Space heaters with thermostat auto control suitable for 1 phase 240V AC supply shall be provided for each motor operated operating mechanism to prevent condensation and shall be operated by MCB.
18. Terminal block and Wirings – Each operating mechanism shall be provided with 1100V grade stud type terminal block. All auxiliary switches, interlocks and other terminals shall be wired upto terminal block. The terminal block shall have at least 20% extra terminals. All wiring shall be carried out with 1.1KV grade insulated 2.5 sqmm copper wires.
19. Interior Illumination : A light fixture suitable for a 240 V CFL tube light shall be provided in each of the motor operated mechanism of three poles & shall be door operated type.
20. Control and auxiliary supply – A 3 phase switch with MCB for phases and link for neutral, shall be provided for power supply and a 2 pole MCB shall be provided for control supply.
21. Position indicator : A position indicator to show the isolator is in ON or OFF position to be provided.
22. Name plate : Isolator, earthing switches and their operating devices shall be provided with name plate. The name plate shall be weather proof and corrosion proof. It shall be mounted in such a position that it shall be visible in the position of normal service and installation. It shall carry the following information's duly engraved or punched on it.

A. Isolator Base



Name : OPTCL

Name of manufacturer –

Order No. –

Type Designation –

Manufacturers serial No. –

Rated voltage –

Rated normal current –

Rated short time current (rms) and duration –

Rated short time peak current (KAP)

Weight

B. B. Earthing Switch

Name : OPTCL

Name of manufacturer –

Order No. –

Type Designation –

Manufacturers serial No. –

Rated voltage –

Rated normal current –

Rated short time current (rms) and duration

Rated short time peak current (KAP)

Weight

C. Operating Device

Name – OPTCL

Name of manufacturer –

Order No.

Type Designation –

Reduction gear ratio –

AC motor

- i) Rated auxiliary voltage
- ii) Starting current
- iii) Designation of AC motor as per I.S 4722/325
- iv) Starting torque at 80% of supply voltage
- v) Over travel in degrees after cutting off supply

Total operating time in seconds

- i) Close operation – Electrical
- ii) Open operation – electrical
- Open operation – manual

All components shall be given adequate treatment of climate proofing as per IS:3202 so as to withstand corrosive and severe service conditions.

All metal parts not suitable for painting such as structural steel, pipes, rods ,levers, linkages, nuts and bolts used in other than current path etc. shall be hot dip galvanized as per IS -2629

Complete details of painting, galvanising and climate proofing of the equipment shall be furnished in the offer.

#### 24. TESTS

##### Type Tests

Isolators offered, shall be fully type tested as per the relevant standards. The Bidder shall furnish Three sets of the following valid type test reports for their different type of offered Isolators along with the offer. The Purchaser reserves the right to demand repetition of some or all the type tests in the presence of purchaser's representative. For this purpose the Bidder may quote unit rates for carrying out each type test and this will be taken during bid price evaluation ,if required.

- a) short time withstand & peak withstand current test for Isolator & Earth Switch.
- b) power frequency (Dry & Wet), Lightning Impulse dry withstand Test
- c) Mechanical endurance Test
- d) IP-55 test

During type tests the isolator shall be mounted on its own support structure or equivalent support structure and installed with its own operating mechanism to make the type tests representative. Drawing of equivalent support structure and mounting arrangements shall be furnished for Purchaser's approval before conducting the type tests.

The type tests shall be conducted on the isolator along with approved insulators and terminal connectors.

Mechanical endurance test shall be conducted on the main switch as well as earth switch of one isolator of each type

##### Acceptance and Routine Test :

All acceptance and routine test as stipulated in the relevant standards shall be carried out by the supplier in presence of Purchaser's representative.

Mechanical operation test (routine test) shall be conducted on isolator (main switch and earth switch) at the supplier's works as well as purchaser's substation site.

Immediately after finalisation of the programme of type / acceptance, routine testing the supplier shall give sufficient advance intimation (clear 20 days advance intimation), along with shop routine test certificates, valid calibration reports from Govt. approved test house for the equipments, instruments to be used during testing for scrutiny by the purchaser to enable him to depute his representative for witnessing the tests. If there will be any discrepancies in the shop routine test certificates and calibration reports

furnished by the firm then after settlement of the discrepancies only, purchaser's representative will be deputed for witnessing the tests.

Special tests proposed to be conducted (if decided to conduct ) as type test on isolators, are given at Annexure- II. These special type test charges shall be quoted alongwith all other type tests as per relevant IEC standard and these charges shall be included in the total bid price.

Test certificates of various items including but not limited to the following shall be furnished at the time of routine tests.

- a) Chemical analysis of copper alongwith a copy of excise certificate indicating genuine source of procurement of electrolytic grade copper.
- b) Bearings
- c) Fasteners
- d) Universal / swivel joint coupling
- e) Insulators
- f) Motor
- g) Gears
- h) Auxillary switch
- i) Limit switch
- j) Timer
- k) Overload / single phase preventer relay
- l) Interlocking devices
- m) Terminal block
- n) Any other item

#### 25. INSPECTION

- i) The Purchaser shall have access at all times to the works and all other places of manufacture, where the disconnectors, earth switches and associated equipment are being manufactured and the supplier shall provide all facilities for unrestricted inspection of the works raw materials manufacture of all the accessories and for conducting necessary tests as detailed herein.
- ii) The supplier shall keep the purchaser informed in advance of the time of starting of the progress of manufacture of equipment in its various stages so that arrangements could be made for inspection.
- iii) No material shall be dispatched from its point of manufacture unless the material has been satisfactorily inspected and tested.
- iv) The acceptance of any quantity of the equipment shall in no way relieve the supplier of his responsibility for meeting all the requirements of this specification and shall not prevent subsequent rejection if such equipment are later found to be defective.

#### 26 QUALITY ASSURANCE PLAN

The Bidder shall invariably furnish following information alongwith his offer, failing which his offer shall be liable for rejection.

- (i) Names of sub suppliers for 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 Supplier's representative, copies of test certificate
- (ii) Information and copies of test certificates as in (I) and (ii) above in respect of bought out accessories.
- (iii) List of manufacturing facilities available
- (iv) Level of automation achieved and list of areas where manual processing still exists.
- (v) List of areas in manufacturing process, where stage inspections are normally carried out for quality control and details of such tests and inspections.
- (vi) List of testing equipments with calibration certificates from Govt. approved test house available with supplier for final testing equipment and test plant limitation if any, vis-à-vis the type, special acceptance and routine test specified in the relevant standards. These limitations shall be very clearly brought out in the specified test requirements.

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

- i) List of raw material as well as bought out accessories and the names of sub-suppliers selected from the lists furnished alongwith offer.
- ii) Type test certificates of the raw material and both bought out accessories.
- iii) Quality Assurance Plan (QAP) with hold points for purchaser's inspection.

The supplier shall submit the routine test certificates of bought out accessories and raw material viz. Copper, aluminium conductors, lubricating material, gear material etc. at the time of routine testing of the fully assembled isolator.

## 27. DOCUMENTATION

All drawings shall conform to relevant international standards organisation (ISO). All drawings shall be in ink and suitable for micro filming. All dimensions and data shall be in S.I. Units.

### List of Drawings and Documents

The Bidder shall furnish four sets of following drawings / documents along with his offer.

- a) General outline and assembly drawings of the dis-connector operating mechanism, structure, insulator and terminal connector.
- b) Sectional views and descriptive details of items such as moving blades, contacts, arms contact pressure, contact support bearing housing of bearings, balancing of heights, phase coupling pipes, base plate, operating shaft, guides, swivel joint operating mechanism and its components etc.
- c) Loading diagram
- d) Drawings with structure for the purpose of type tests.

- e) Name plate.
- f) Schematic drawing.
- g) Type test reports.
- h) Test reports, literature, pamphlets of the bought out items and raw material.

The supplier shall within 2 weeks of placement of order submit four sets of final versions of all the above said drawings for Purchaser's approval. The purchaser shall communicate his comments / approval on the drawings to the supplier. The supplier shall, if necessary, modify the drawings and resubmit four copies of the modified drawings for Purchaser's approval within two weeks from the date of comments. After receipt of approval the supplier shall within three weeks submit 15 prints and two good qualities re-producible of the approved drawings for purchaser's use.

Six sets of the type test reports, duly approved by the Purchaser shall be submitted by the supplier for distribution, before commencement of supply Adequate copies of acceptance and routine test certificates, duly approved by the Purchaser shall accompany the despatched consignment.

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 risk.

## 28. INSTRUCTION MANUALS :

Fifteen copies of the erection, operation and maintenance manuals in English be supplied for each type of disconnecter one month prior to despatch of the equipment. The manual shall be bound volumes and shall contain all drawings and information required for erection, operation and maintenance of the disconnecter including but not limited to the following particulars.

- (a) Marked erection prints identifying the component parts of the disconnecter as shipped with assembly drawings.
- (b) Detailed dimensions and description of all auxiliaries.
- (c) Detailed views of the insulator stacks, metalics, operating mechanism, structure, interlocks, spare parts etc.

## 29. PACKING AND FORWARDING.

The equipment shall be packed in crates suitable for vertical / horizontal transport, as the case may be and suitable to withstand handling during transport and outdoor storage during transit. The supplier shall be responsible for any damage to the equipment during transit, due to improper and inadequate packing. The easily damageable material shall be carefully packed and marked with the appropriate caution symbols. Wherever

necessary, proper arrangement for lifting, such as lifting hooks etc. shall be provided. Any material found short inside the packing cases shall be supplied by supplier without any extra cost.

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

- (a) Name of the consignee.
- (b) Details of consignment.
- (c) Destination.
- (d) Total weight of consignment.
- (e) Handling and unpacking instructions.
- (f) Bill of material indicating contents of each package.

The supplier shall ensure that the bill of material is approved by the purchaser before despatch.

### **30. SUPERVISION OF ERECTION TESTING AND COMMISSIONING**

#### **(ET & C)**

Purchaser proposes to utilize the services of the supplier for supervision of testing and commissioning of the equipment being supplied by him, if it is required. For this purpose, the supplier should make available the services of trained personnel (Engineers) who shall correct in the field, any errors or omissions in order to make the equipment and material properly perform in accordance with the intent of this specification. The Engineer shall also instruct the plant operators in the operation and maintenance of the commissioned equipment. The supplier shall be responsible for any damage to the equipment on commissioning the same, if such damage results for the faulty or improper ET&C. Purchaser shall provide adequate number of skilled / semi skilled workers as well as ordinary tools and equipment and cranes required for equipment erection, at his own expenses. Apart from the above, the Purchaser shall not be responsible for providing any other facilities to the supplier. Special tools if required for erection and commissioning shall be arranged by the supplier at his cost and on commissioning these shall be supplied to the purchaser free of cost for future use.

#### **31. QUATITY AND DELIVERY REQUIREMENTS :**

- (i)** The scope of supply shall include a supply of 2.5% extra quantity of gal vanised bolts, nuts, washers, split pins, cotter pins and such other small loose items free of cost.

ANNEXURE – I  
(Isolators)

LIST OF SPECIAL TESTS TO BE CARRIED OUT IF DECIDED BY THE  
PURCHASER

Sl. No.	Name of the Test	Standard to which it conforms.
1.	Test for visible Corona and Radio interference voltage (RIV) on disconnectors and terminal connector	NEMA Pub No. 107-1964 ISRI Pub No. 1-1972
2.	Tests on insulators	IS-2544 IEC. 168
3.	Tests on terminal connectors	IS:5561
4.	Tests on galvanised components	IS:2633
5.	Stalled torque test on motor operating mechanism	At 110% of supply voltage

**A) ISOLATOR FOR 33 KV:-**

Sl. No.	DESCRIPTION	33 KV
1	Nominal System Voltage (KV)	33
2	Rated Voltage (KV)	36
3	Frequency (Hz)	50
4	No. of Phases	3-phase
5	System Neutral Earthing	Earthed Through Grounding Transformer
6	No of poles	3
7	Location	Outdoor
8	Rated Insulation Level	
A	1.2/50 micro-sec. lightning Impulse withstand voltage (KVp)	.
.	i) To earth & between poles	170
.	ii) Across the isolating distance	195
B	One minute PF withstand voltage (KV rms)	.
.	i) To earth & between poles	75
.	ii) Across the isolating distance	80
9	Rated Normal Current (Amps)	1250
10	Rated Short Time withstand current of Main Contacts and Earth Switch (KA) and duration (for 3 sec)	20

11	Mounting Condition	On Structure
12	Method of operation Main / Earthing Switch	Manual / Manual
13	Number of auxiliary switches for main isolator	6 NO + 6 NC
14	Number of Make before make and break after break auxiliary switches	-
15	Number of auxiliary Switches in Earth Switch	4 NO + 4 NC
16	Rated auxiliary AC Supply (Volt)	400//230V + // -10%
17	Rated auxiliary DC Supply (Volt)	220 +/- 10%
18	Creepage distance of support insulators (mm)	900
19	Phase to phase spacing (mm)	1200
20	Total Operating Time	Less than 12 seconds
21	Mechanical terminal loading for horizontal centre break Isolator 2) Straight Load (N) 3) Cross Load (N)	-
22	Rated magnetizing / capacitive current make and break	Suitable for capacitor Bank duty
23	All Contacts	Silver-plated not less than 20 micron
24	Temperature rise above ambient temperature of 50 deg C	55der C
25	Contilever strength of support insulator (Kgf)	400
26	Current Density of Copper (max.) (A/Sq.mm)	1.75





**ORISSA POWER TRANSMISSION CORPORATION LIMITED  
OFFICE OF THE SR. GENERAL MANAGER,  
CENTRAL PROCUREMENT CELL,  
JANAPATH, BHUBANESWAR – 751022.**

## **TECHNICAL SPECIFICATION**

**FOR**

**36 KV(HSV) SYSTEM SURGE ARRESTER  
(SUITABLE FOR CAPACITOR BANK USE)**

**TECHNICAL SPECIFICATION FOR SURGE ARRESTERS  
FOR 36 KV(HSV) SYSTEMS.  
(SUITABLE FOR CAPACITOR BANK USE)  
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**TECHNICAL SPECIFICATION FOR SURGE ARRESTERS FOR 33 KV  
SYSTEMS(CAPACITOR BANK USE)**

**1.0 SCOPE :**

- 1.1 This Specification provides for the design, manufacture, inspection and testing before despatch, packing and delivery F.O.R. (destination) of metal oxide (gapless) Surge Arresters with discharge counters, insulating base, terminal connectors and other accessories as specified here in.

Following is the list of documents constituting this Specification. :

(i)	Technical Specification (TS)	
(ii)	Technical Requirements.	Appendix-I
(iii)	Quantity and delivery schedule.	Appendix-II
(iv)	Guaranteed Technical Particulars.	Annexure-A
(v)	Check-List.	Annexure-B
(vi)	Calibration Status of testing equipments and meters/Instruments.	Annexure-C
(vii)	Check-list towards Type Test Reports.	Annexure-D
Note : Annexure-A,B,C,& D are to be filled up by the Bidder.		

- 1.1 All the above along with amendments thereof shall be read and interpreted together. However, in case of a contradiction between the Technical Specification and any other volume, the provisions of this volume will prevail.
- 1.2 The Surge Arrester shall conform in all respects to high standards of engineering, design, workmanship and latest revisions of relevant standards at the time of offer and purchaser shall have the power to reject any work or materials, which in his judgement is not in full accordance therewith.

## 2.0 STANDARDS:-

2.1 Except to the extent modified in the Specification, the Surge Arrester shall conform to the latest editions and amendments of the standards listed hereunder.

Sl. No.	Standard Ref. No.	Title.
1	IEC-99-4	Specification for Surge Arresters without gap for AC System.
2	IS:2147	Degree of protection, provided by enclosures for low voltage switchgear and control.
3	IS:2629	Recommended practice for hot dip galvanization of iron and steel.
4	IS:2633	Method for testing uniformity of coating on zinc coated articles.
5	IS:3070	Specification for surge arresters for alternating current system.
6	IS:5621 & IEC-621155	Specification for large hollow porcelain for use in electrical installation.
7	IEC-60-1	High-Voltage Test technique.
8	IEC-270	Partial discharge measurements.
9	IEC-99-1	Non-linear resistor type gapped arresters for a.c. systems.
10		Indian Electricity Rules, 1956.
11.	IEC-60815	Shed profile of hollow porcelain Insulator.

2.2 Surge Arresters with the requirement of other authoritative standards, which ensure equal or better quality than the standards, mentioned above shall also be acceptable. Where the equipment offered by the supplier conforms to other standards, salient points of difference between the standards adopted and the specified standards shall be clearly brought out in the

offer. 4 (Four) copies of the reference standards in English language shall be furnished along with the offer.

**3.0 GENERAL TECHNICAL REQUIREMENTS :**

3.1 The Surge Arrester shall confirm the technical requirements as per Appendix-I and this TS.

3.2 The energy handling capability of each rating of Arrester offered, supported by calculations, shall be furnished with the offer.

3.3 The Surge Arresters shall be fitted with pressure relief devices and arc diverting paths and shall be tested as per the requirements of IEC for minimum prospective symmetrical fault current as specified in Appendix-I.

3.4 A grading ring shall be provided if required, (for attaining all the relevant technical parameters) on each complete Surge Arrester.

**3.5 PROTECTIVE LEVELS :**

**Surge Arresters shall be capable of providing protection to sub-station equipments, designed for the withstand levels, given in the following table.**

Sl. No.	Equipment to be protected	Insulation Level of 36KV System
		L.I. Level (KVP)
1	Auto Transformers/Power Transformers.	± 170
2	Instrument Transformers.	± 170
3	Reactors	± 170
4	Circuit Breakers/Isolators.	
(i)	Phase to ground.	± 170
(ii)	Across open contacts.	

Surge arrester shall be suitable for the following duty cycles of circuit breaker at the following system voltages:

1	36 KV Circuit Breaker	0-0.3 sec-co-3 min-co
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**3.1 DUTY REQUIREMENT :**

**3.6.1 Surge Arresters shall be of heavy-duty station class and gapless type without any series or shunt gaps.**

**3.6.1 Surge Arresters shall be capable of discharging over voltages occurring during switching of un-loaded transformers, lines, capacitors and reactors.**

**3.6.2 The Surge Arresters shall be capable of discharging lightning and switching surges and temporary power frequency over-voltages.**

**3.6.3 The Surge Arresters shall be capable of discharging the energy equivalent to class 3 of IEC-99-4.**

**3.7 The reference current of the arrester shall be high enough to eliminate the influence of grading and stray capacitance on the measured reference voltage. The supplier shall submit values and the supporting evidence along with calculations on above.**

**3.8 Surge Arresters shall be fully stabilized thermally to give a life expectancy of 100 years under site conditions.**

**3.1 Surge Arresters shall be able to withstand maximum wind load of 260 Kg/sq.m.**

**3.2 Surge Arresters shall be capable of withstanding effects of direct solar radiation**

**3.3 Surge arresters shall be capable of spark over on severe switching Surges and multiple strokes.**

**3.4 The Surge Arrester should be adequately designed to operate satisfactorily under temporary power frequency over-voltage as given in specific technical requirements, after discharging two shots of respective long duration surges.**

**3.5 Unless otherwise brought out separately by the Bidder in the schedule of deviations, the Surge Arresters, offered shall conform to the specification scrupulously. All deviations from the specification shall be brought out in the schedule of deviations. The**

**discrepancies between the specification and the catalogues or literature, submitted as part of the offer shall not be considered as valid deviations unless specifically brought out in the schedule of deviations.**

4.0 **CONSTRUCTION** :

- 4.1 Non linear blocks shall be sintered metal oxide material. These shall be provided in such a way as to obtain robust construction with excellent electrical and mechanical properties even after repeated operations.
- 4.1.1 All the units of arresters of same rating shall be inter-changeable without adversely affecting the performance.
- 4.2 The Surge Arresters shall be suitable for pedestal type mounting.
- 4.3 All the necessary flanges, bolts, nuts, clamps etc. required for assembly of complete arrester with accessories and mounting on support structure to be supplied by the purchaser, shall be included in supplier's scope of supply.
- 4.4 The drilling details for mounting the Arrester on owner's support shall be supplied by the supplier.
- 4.5 The minimum permissible separation between the Surge Arrester and any earthed object shall be indicated by the Bidder in his offer.
- 4.6 Surge Arresters shall be designed to incorporate pressure relief devices and arc diverting paths to prevent shattering of the blocks or the porcelain housing, following prolonged current flow or internal flash over and providing path for flow of rated fault currents in the event of arrester failure.
- 4.7 Surge Arresters shall incorporate anti-contamination feature to prevent arrester failure, caused by uneven voltage gradient across the stack, resulting from contamination of the arrester porcelain.
- 4.8 Seals shall be provided in such a way that these are always effectively maintained even when discharging rated lightning current.
- 4.9 The heat treatment cycle details alongwith necessary quality checks used for individual blocks alongwith insulation layer, formed across each block are to be furnished. Metalised coating thickness for reduced resistance between adjacent discs is to be furnished alongwith the

procedure for checking the same. Details of thermal stability test for current distribution of current on individual disc is to be furnished.

4.10 Each individual unit of Surge Arresters shall be hermetically sealed and fully protected against ingress of moisture. The hermetic seal shall be effective for the entire lifetime of the arrester and under the service conditions as specified. The supplier shall furnish sectional view of the arrester showing details of sealing employed.

4.11 The Surge Arresters shall be suitable for hot line washing.

**4.12 PORCELAIN HOUSING :**

4.13.1 All porcelain Housings shall be free from lamination cavities or other flaws, affecting the maximum level of mechanical and electrical strengths.

4.13.1 The porcelain shall be well vitrified and non-porous.

4.13.2 The minimum creepage distance of the arrester housing shall be as per Appendix-I.

4.13.3 The porcelain petticoat shall be preferably of self-cleaning type (Aerofoil design). The details of the porcelain housing such as height, angle of inclination, shape of petticoats, gap between the petticoats, diameter (ID and OD) etc. shall be indicated by the Bidder in his offer in the form of detailed drawing.

4.13.4 Porcelain housings shall be so co-ordinated that external flash over will not occur due to application of impulse or switching Surge voltages up to the maximum design value for arrester.

**4.1 GALVANISATION, NICKEL PLATING ETC. :**

4.1.1 All ferrous parts exposed to atmosphere shall be hot dip galvanised as per IS: 2629, as amended from time to time. Tinned copper/brass lugs shall be used for internal wiring of discharge counter. Screws used for electrical connections shall be either made of brass or shall be nickel-plated.

4.1.2 Ground terminal pads and nameplate brackets shall be hot dip galvanised.

4.1.3 The material shall be galvanised only after completing all shop operations

**4.15 ACCESSORIES AND FITTINGS :**



#### 4.15.1 Surge Counters:

4.15.1.1 A self- contained Surge counter, suitably enclosed for outdoor use and requiring no auxiliary of battery supply for operation shall be provided for each unit. The surge counter shall be operated by the discharge current, passed by the surge arrester and shall be suitable for mounting on the support structure of the Arrester.

4.15.1.1 Surge counters shall be of the Electro-mechanical type and designed for continuous service.

4.15.1.3 The cyclometer counter shall be visible through an inspection window from ground level. The counter terminals shall be robust and adequate size and shall be so located that the incoming and outgoing connections are made with minimum possible bends.

4.15.1.4 Internal parts shall be unaffected by atmospheric conditions at site. Alternatively, a weather proof housing to IP 55 shall be provided and this shall be designed to allow the recording device to be read from ground level without exposing the internal parts to the atmosphere.

**4.15.1.5 The Surge Counter shall be connected in the main earth lead from the arrester in such a manner that the direction of the earth lead is not changed or its surge impedance materially altered. A bolted link shall be provided so that the surge counter may be short circuited and removed without taking the arrester out of service.**

4.15.1.1 All necessary accessories and earthing connection leads between the bottom of the Arrester and discharge counter shall be in the supplier's scope of supply.

#### 4.15.2 LEAKAGE CURRENT METERS :

4.15.2.1. Leakage current meters (suitable milli-ammeter) shall be connected in the earthing path of the surge arresters to measure the resistor grading leakage current. Meters shall be designed for continuous service.

4.15.2.2. The ammeter shall be suitable for mounting on the support structure of the arrester. The push buttons shall be mounted such that it can be operated from the ground level.

4.15.2.3. The internal parts shall be fully weather - proof to IP 55 or better with a transparent cover to provide an unobstructed view of the ammeter..

- 4.15.3. Arresters shall be complete with insulating base having provision for bolting to flat surface of the structure.
- 4.15.4. Grading /corona rings shall be provided on each complete Arrester unit, as required, for proper voltage stress distribution.
- 4.15.5. The grounding terminals shall be suitable for accommodating purchaser's grounding connection to steel earth mat.
- 4.15.6. The Bidder has to quote unit rates of the insulating base and the surge counter separately. The purchaser reserves its option to procure insulating base and surge counter.
- 4.15.7. Clamp type terminal connector, suitable for 33KV-ACSR MOOSE Conductor shall be provided having both horizontal and vertical take-off.
- 4.15.8. Two clamp type ground terminal connectors, suitable for G. I. Strip (50 x 6) or (50 x 8) should be provided.
- 4.15.9. All interconnecting hard wares such as nuts, bolts, spring washers etc. with 5% spares shall be supplied for different units
- 4.15.10. Pollution Shunt (Copper braid) shall be supplied along with each surge Arrester for by-passing the surface current..
- 4.15.11. Other standard accessories, which are specifically not mentioned, but are usually, provided with Surge Arrester of such type and rating for efficient and trouble free operation should be supplied.

4.16 **NAME PLATE :**

Each single pole Arrester shall be provided with non-corrosive legible name plate, at the base bearing thereon, voltage rating of the complete pole and the number of demountable sections with the following data, indelibly marked

- (a) ORISSA POWER TRANSMISSION CORPORATION LIMITED.
- (b) Purchase order No. & Date.
- (c) Name of device.
- (d) Manufacturer's name and trademark and identification no. Of the arrester being supplied.
- (e) Year of manufacture
- (f) Rated voltage

- (g) Rated Frequency
- (h) Maximum continuous operating voltage.
- (i) Type
- (j) Nominal discharge current.
- (k) Long duration discharge class.
- (l) Pressure relief current in KA(rms)
- (m) Energy discharge capability ( KJ/KV rating).

## 5.0 **TEST :**

### 5.1 **Type Tests:**

The surge Arrester offered should have been subjected to the following type tests in an independent Government approved test laboratory. The bidder shall furnish four sets of type test reports alongwith the offer. These tests must not have been conducted earlier than five years from the date of opening of technical bid. For any change in the design, type already type tested and the design type offered against this specification, the purchaser reserves the right to demand repetition of some or all type tests without any extra cost to OPTCL in the presence of Purchaser's representative at the cost of the supplier.

- 1 Insulation withstands tests :
  - (a) Lightning Impulse Voltage Test.
  - (b) Wet switching impulse test. (For 390KV/216KV only).
- 2 Residual voltage tests.
- 3 Long duration current impulse withstand tests.
- 4 Operating duty tests.
- 5 Pressure relief tests.
  - (a) High current test.
  - (b) Low current test.
- 6 Power frequency voltage vs. time curve.  
(Temporary over voltage test)
- 7 Contamination test. (artificial pollution test).
- 8 Seismic withstand test.
- 9 IP-55 test on surge counter.
- 10 Minimum current operation tests of the surge counter.
- 11 Maximum current withstand test of the surge counter.
- 12 Mechanical terminal load test on bushing.
- 13 Partial discharge test.

N.B. :- Even if the condition i.e. ‘ the dry arcing distance or the sum of the partial dry arcing distances is larger than the test voltage divided by 500 KV/m’, the lightning impulse voltage test must have been conducted or is to be conducted without any financial liability to OPTCL.

Even if the type test reports are found to be valid as per this specification, the purchaser reserves the right to demand the repetition of some or all the type tests in the presence of purchaser’s representative. For this purpose, the bidder shall quote unit rates for carrying out each type test. These prices, if necessary, will be taken into consideration for bid evaluation.

## 5.2 **ROUTINE TESTS** :

The following routine tests shall be conducted at the supplier’s cost on each surge arrester and shall be submitted alongwith or before offering for inspection for purchaser’s approval.

- (a) Measurement of reference voltage.
- (b) Residual voltage tests.
- (c) Measurement for partial discharge and contact noise.
- (d) Sealing test for units with sealed housings.

## 5.3 **ACCEPTANCE TESTS** :

The following tests, considered as acceptance tests, shall be conducted in the presence of purchasers representative for which no charges will be payable by OPTCL. The acceptance tests, whenever possible shall be conducted on the complete arrester unit. The number of samples to be subjected to acceptance test shall be decided by the purchaser at the time of actual testing.

- I Temperature Cycle Test on Housing.
- II Measurement of Power Frequency Voltage at the reference current.
- III Measurement of leakage current and capacitive current at M.C.O.V.
- IV Lightning Impulse Residual Voltage Test at N.D.C., 50% of N.D.C. & 200% of N.D.C.
- V Partial Discharge Tests on complete arresters/units at 1.05 times M.C.O.V.
- VI Special Thermal stability test.
- VII Porosity test on porcelain components.
- VIII Galvanisation test on metal parts.
  
- IX The functional (operational) test on the Surge Counter by way of checking its operation at following nominal discharge currents :

- (i) 100 Amps with 8/20 micro second wave shape.
- (ii) 10 KA with 8/20 micro second wave shape.

X Check of calibration of leakage current meters.

## 6 **INSPECTION :**

- I The purchaser shall have access at all time to the works and all other places of manufacture, where the Surge Arresters are being manufactured and the supplier shall provide all facilities for unrestricted inspection of the supplier's works, raw materials, manufacture of all the accessories and for conducting the necessary tests.
- II The supplier shall keep the purchaser informed in advance of the time of starting and the progress of manufacture of equipment in its various stages so that arrangements could be made for inspection.
- III No material shall be despatched from its point of manufacture unless the material has been satisfactorily inspected, tested and despatch schedule attached to this specification.
- IV The acceptance of any quantity of equipment shall in no way relieve the supplier of his responsibility for meeting all the requirements of this specification and shall not prevent subsequent rejection, if such equipments are later found to be defective.

## 7 **QUALITY ASSURANCE PLAN :**

- 7.1 The Bidder shall invariably furnish following informations alongwith his offer, failing which the offer shall be liable for rejection.
- (i) Statement giving list of important raw materials, names of sub-suppliers for the raw materials, list of standards according to which the raw materials are tested, list of tests, normally carried out on raw materials in presence of Bidder's representative, copies of test certificates.
  - (ii) Information and copies of test certificates as in (I) above in respect of bought-out items.
  - (iii) List of manufacturing facilities available.
  - (iv) Level of automation, achieved and list of areas where manual processing exists.
  - (v) List of areas in manufacturing process where stage inspections are normally carried out for quality control and details of such tests and inspections.

- (vi) Special features provided in the equipment to make it maintenance free
- (vii) List of testing equipments, meters available with Bidder for final testing of equipment, specified and test plant limitation, if any, vis-à-vis the type, acceptance and routine tests, specified in the relevant standards and this specification. These limitations shall be very clearly brought out in the offer.
- (viii) All the testing equipments, meters etc. should have been calibrated in a Government approved laboratory. The Bidder must submit the list of testing equipments and meters test-wise as per Annexure-C of this Technical Specification.

7.2 The suppliers, within 30 days of placement of order submit the following informations to the purchaser.

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

7.3 The supplier shall submit the routine test certificates of bought out item and raw martial at the time of acceptance testing of the fully assembled equipment.

## 1.0 **DOCUMENTATION** :

8.1 All drawings shall conform to relevant Indian Standard as per relevant IS. All drawings shall be in ink and suitable for microfilming. All dimensions and data shall be in S.I. Units.

8.1 The supplier shall furnish four sets of following drawings/documents' along with his offer.

- (i) General outline drawings of the complete Arrester with technical parameters.
- (ii) Drawings showing clearance from grounded and other line objects and between adjacent poles of Surge Arresters, required at various heights of Surge Arresters.
- (iii) Drawings showing details of pressure relief devices.
- (iv) Detailed drawing of discharge counters along with the wiring and schematic drawing of discharge counter and meter.
- (v) Outline drawing of insulating base.
- (vi) Details of grading rings, if used.
- (vii) Mounting details of Surge Arresters.

- (viii) Details of line terminal and ground terminals.
- (ix) Volt-time characteristics of Surge Arresters.
- (x) Details of galvanization being provided on different ferrous parts.
- (xi) The detailed dimensional drawing of porcelain Housing such as ID, OD, thickness and insulator details such as height, profile of petticoats, angle of inclination and gap between successive petticoats, total creepage distance etc.
- (xii) Cross-sectional view of the Surge Arrester Units showing all components.

## 8.2 **TEST REPORTS :**

- (i) Four copies of type test reports shall be furnished to the purchaser with the tender specification. Copies of acceptance test reports and routine test reports shall be furnished to the purchaser. One copy will be returned duly certified by the purchaser and only thereafter shall the materials be despatched.
- (ii) All records of routine test reports shall be maintained by the supplier at his works for periodic inspection by the purchaser.
- (iii) All test reports of tests, conducted during manufacture shall be maintained by the supplier. These shall be produced for verification as and when requested for by the purchaser.

## 9.0 **PACKING AND FORWARDING :**

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

9.2 Each consignment shall be accompanied by a detailed packing list containing the following informations :

- (a) Name of the consignee :
- (b) Details of consignment :
- (c) Destination :
- (d) Total weight of consignment :
- (e) Sign showing upper/lower side of the crate :
- (f) Handling and unpacking instructions :

(g) Bill of materials indicating contents of each package :

9.3 The supplier shall ensure that the bill of materials is approved by the purchaser before despatch.

10.0 **QUANTITY AND DELIVERY REQUIREMENT :**

(i) The scope of supply shall include a supply of 2.5% extra quantity of bolts, nuts, washers, split pins, cotter pins and such other small loose items free of cost.

]

**APPENDIX – I.**



## **(TECHNICAL REQUIREMENTS)**

### **TECHNICAL REQUIREMENTS FOR METAL OXIDE (GAPLESS) SURGE ARRESTERS FOR 36 KV SYSTEM(SUITABLE FOR CAPACITOR BANK USE)**

The Surge Arrester under this Specification shall conform to the parameters given below :- 30KV

Sl. No.	Particulars.	Technical Parameters for 33 KV Surge Arrester
1	Nominal system voltage (phase to phase) (KV rms).	33
2	Highest system voltage (phase to phase) (KV rms).	36
3	System Frequency (HZ).	50 ± 5%
4	System Neutral earthing.	Effectively earthed
5	Installation.	Outdoor
6	Class.	Station class, 10 KA, heavy duty type.
7	Type of construction for 10 KA rated arrester.	Single column, single phase
8	No. of phases.	Three
9	Maximum duration of earth fault (Sec.)	3
10	Maximum prospective symmetrical fault current at arrester location (KA rms.)	40
11	Rated arrester voltage (KV rms)	30
12	Nominal discharge current (KAP) Discharge current at which insulation coordination will be done	10 KA of 8/20 micro-second Wave.
13	Minimum energy discharge capability (KJ/KV)	As per relevant ISS/IEC
14	Maximum continuous operating voltage at 50°C(KV rms)	25
15	Maximum switching surge(30/60 μs wave) residual voltage (KVP) at 500A	72
16	Maximum lightning Impulse( at 8/20 micro ) residual voltage(KVP)	
	(i) 5 KA.	112
	(ii) 10 KA Nominal discharge current.	120
	(iii) 20 KA.	140
17	Long duration discharge class	3

18	Minimum High current Impulse short duration test value (KAP) (4/10 Micro-second wave).	100
19	Current for pressure relief test (KA-rms)	40
20	Minimum total creepage distance (mm).	1100
21	One minute dry and wet power frequency withstand voltage of Arrester housing (KV-rms).	70
22	Impulse withstand voltage of arrester housing with 1.2/50 micro-second wave (KVP).	+170
(a)	Switching Impulse Voltage (Wet) (KVP)	-
(b)		-
23	Pressure relief class.	A
24	Corona extinction voltage (KV-rms).	-
25	RIV at 92 KV rms.	Less than 500 micro volts
26	RIV/Partial discharge ( $\mu\text{v}/\text{pc}$ ) at 1.05 times continuous over-voltage shall not exceed.	Less than 50 pc
27	Seismic acceleration.	0.3g horizontal 0.15g vertical
28	Reference ambient temperature.	50°C
29	(a) IR at MCOV.	Less than 400 micro amperes
	(b) IC at MCOV.	Less than 1200 micro amperes
30	a) Reference Current (mA)	1 to 5 mA
	b) Reference voltage at reference current.	Greater than rated voltage.
31	Maximum steep current Impulse (1/20 $\mu\text{s}$ ) Residual Voltage (KVP). at 10KA (KVp).	130
32	Maximum cantilever strength of the arresters (KGM).	325
33	Temporary Over Voltage withstand (KVrms).	
	(i) 0.1 sec.	53
	(ii) 1.0 sec.	51
	(iii) 10.0 sec.	49
	(iv) 100.0 sec.	47
34	Minimum Energy Discharge capability (KJ/KV)	5

## **ANNEXURE – B**

### **CHECK – LIST**

- 1 Whether calculation towards energy handling capability of the Surge Arrester furnished as per Clause No.3.2 of TS ?
- 2 Whether there is provision of Corona Grading Ring in the SA as per Clause No.3.4 and 4.15.4 of TS ? ..... If not, whether justification for non-provision of the same furnished ?
- 3 Whether calculations and supporting evidence furnished to satisfy Clause No.3.7 of TS ?
- 4 Whether the heat treatment cycle details alongwith necessary quality checks used for individual blocks furnished as per Clause 4.10 of TS ?
- 5 Whether sectional view of arrester showing details of sealing provided as per Clause No.4.11 of TS furnished ?
- 6 Whether S.A. is suitable for hot line washing as per Clause No.4.12 of TS ?
- 7 Whether porcelain petticoat is of Aero foil design ? Whether drawing of porcelain Housing as per Clause No.4.13.4 of TS furnished ?
- 8 Whether information as per Clause No.7.1 (i) to (viii) of TS furnished ?
- 9 Whether drawings and documents as per Clause No.8.2 (i) to (xii) of TS furnished ?
- 10 Whether special measures in the manufacture of Surge Arrester for operating at ambient temperature of 50°C (against 40°C as per IEC-99-4, Clause No.4.4.1) are to be taken ? ..... State the special measures in details .....

Signature of the Tenderer With Seal & Date

ANNEXURE-D

**CHECK LIST TOWARDS TYPE TEST REPORTS.**

Name of the Type Test.	Date of Test.	Name of the Laboratory where the Test has been conducted.	Whether the Laboratory is Government Approved.	Whether the Test reports are valid as per Clause No.5.1 of T.S.	Whether the copy of Test Report in complete shape alongwith drawings etc. furnished or not ?	Whether the Type Tested Surge Arrester fulfills the technical require-ments as per TS.	<b>If the type tested Surge Arrester does not fulfill the technical requirements as per this specification, whether the bidder agrees to conduct the particular type test again at their own cost without any financial liability to OPTCL in the presence of OPTCL's representative within the specified delivery period.</b>	Remarks
1	2	3	4	5	6	7	8	9

**Signature of the Tenderer with seal and date.**

ANNEXURE-C

**CALIBRATION STATUS OF TESTING EQUIPMENTS AND INSTRUMENTS/METERS.**

Name of the test.	Meters and equipments required for the corresponding test with range accuracy make and Sl. No.	Date of Calibration.	Due date of Calibration.	Name of the Calibrating Agency	Whether Calibrating Agency is Govt. Approved.	Whether documents relating to Govt. Approval of the calibrating Agency furnished ?	Whether the meters/equipment fulfill the accuracy class as per calibration report	Whether the calibrating agency has put any limitation towards the use of the particular meter/equipment. If yes, state the limitations.	<b>Whether green sticker or blue sticker or yellow sticker has been affixed on the body of the particular equipmet/meter. State the colour of the affixed sticker.</b>	Inspite of imposed limitations, whether the particular meter/equipment can still be used? Justify its use for corresponding test(s).	Remarks
1	2	3	4	5	6	7	8	9	10	11	12

Signature of the tenderer with seal and date.



**ORISSA POWER TRANSMISSION CORPORATION LIMITED  
OFFICE OF THE SR. GENERAL MANAGER,  
CENTRAL PROCUREMENT CELL,  
JANAPATH, BHUBANESWAR – 751022.**

**TECHNICAL SPECIFICATION**

**FOR**

**CIVIL WORKS**

## **1. GENERAL**

### **1.1 Scope of work**

The scope of Civil works includes the following items.

The scope shall generally cover switchyard structures, including gantries and equipment support structures and their foundations, cable trenches alongwith covers, cable trench crossings of road and rails, sump pits, marshalling box/control cubicle foundations, switchyard levelling, site clearance, soil investigation, roads, drains, fencing, gravelfilling, Any other items, not specifically mentioned here but required for the commissioning of switchyard/substation shall be deemed to be included in the scope of this Specification. The scope shall further cover design, engineering, erection, testing and commissioning of all civil works at each substation. All civil works shall also satisfy as detailed below.

Excavation, dewatering, carriage of excavated earth, plain cement concrete (PCC), casting of reinforced cement concrete (RCC) foundations, super-structures for switchyard structures, equipment supports, their control cubicles, bus post supports, lighting poles and panels, brick and stone masonry, cable trenches, pipe trenches with necessary precast RCC removable covers, with lifting facility and sump pits, cable supports and their embedment in cable trenches and cable trench crossings road or rail track with backfilling complete as per drawings approved by the OPTCL, shall be carried out by the contractor. The cable trenches inside the control room shall be provided with MS chequered plate with angle stiffeners at the bottom for mechanical strength and painting there of as per the standard practice.

The Contractor shall furnish all designs, (unless otherwise specified) 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 as per direction of the Engg Incharge (Divisional Engr.).

The work shall be carried out according to the design/drawings to be developed by the Contractor, and approved by the Engg Incharge (Divisional Engr.) or supplied to the bidder by the Engg Incharge (Divisional Engr.). For all buildings, structures, foundations etc. necessary layout, levels and details shall be developed by the Contractor keeping in view the functional requirement of the plant and facilities and providing enough space and access for operation, use and maintenance based on the input provided by the Engg Incharge (Divisional Engr.). Certain minimum requirements are indicated in this specification for guidance purposes only. However, the Bidder shall quote according to the complete requirements.

## **2. SITE CLEARANCE**

### **2.1 Clearing and Grubbing**

The work shall consist of numbering of trees, removing and disposing of all materials such as trees, bushes, woods, shrubs, grass, stumps, rubbish, rank vegetation, roots, foreign materials, etc., which in the opinion of the Engg Incharge (Divisional Engr.) are unsuitable for incorporation in the works, from within the limits and such other areas as may be specified on the drawings or directed by the Engg Incharge (Divisional Engr.). Clearing and grubbing shall be performed in advance of earthwork operations and in accordance with the requirements of these Specifications. During clearing and grubbing, the contractor shall take all adequate precautions against soil erosion, water pollution etc., and where required undertake additional works to that effect.

### **2.2 Setting out and making profiles**

After the site has been cleared as per Clause 2.1 above, the limits of excavation shall be set out true to lines, curves, slopes, grades and sections as shown on the drawings or as directed by the Engg Incharge (Divisional Engr.). The Contractor shall provide all labour, survey instruments and materials such as strings, pegs, nails, bamboos, stones, lime, mortar, concrete, etc., required in connection with the setting out of works and the establishment of bench marks. A grid system of co-ordinates shall be established by the Contractor at the site.

Masonry or concrete pillars shall be erected suitably at minimum of four places in the area to serve as bench marks for the execution of the work. Each bench mark shall be protected from damage or disturbance. These bench marks shall be connected with G.T.S. of any other permanent bench mark approved by the Engg Incharge (Divisional Engr.). Necessary profiles with pegs, bamboos and strings or "Burjis" shall be made to show the correct formation levels before the work is started and the same shall be approved by the Engg Incharge (Divisional Engr.).

### **2.3 Programme**

The Contractor shall construct the works in compliance with the outline programme appended to the Bidding Document, and shall submit for the approval of the Engg Incharge (Divisional Engr.) a detailed programme in accordance with the requirements of this Specification.

### **2.4 Inclement weather**

As per relevant Code, during hot weather, precautions shall be taken to avoid premature stiffening of the fresh mix and to reduce water absorption and evaporation losses. During hot weather ( atmospheric temperature above 40 degree C ) or cold weather ( atmospheric temperature at or below 5deg.C ) concreting shall be done as per the procedure set out in IS 7861.

### **3. STANDARDS**

All Civil works shall be carried out as per applicable Indian Laws, latest revision of International Standards and Codes. All materials shall be of best quality confirming to relevant Indian Standards and Codes.

Civil works shall be designed to the required service conditions and /or loads as specified elsewhere in this Specification or implied as per National and International Standards.

A list of code of practice and standards used for civil works in general is enclosed for reference. In case of any conflict between I.S. Code and the Procedures specified herein, the later shall prevail.

### **4. SOIL INVESTIGATION (IF REQUIRED)**

#### **4.1 General**

The Contractor shall perform a detailed soil investigation to arrive at sufficiently accurate general as well as specific information about the soil profile/strata and the necessary soil parameters of the site in order that the foundations of the various structures can be designed and constructed safely and rationally. Foundation systems adopted by the contractor shall ensure that relative settlement shall be as per provision in IS 1904 and any latest IS and other Indian Standards.

This Specification covers all the work required for detailed soil investigation and preparation of a detailed report. The work shall include mobilisation of necessary equipment, provision of necessary engineering supervision and technical personnel, skilled and unskilled labour etc., as required to carry out field investigation and tests, laboratory tests, analysis and interpretation of data and results, preparation of detailed soil report including specific recommendations for the type of foundations and the safe bearing capacity for different sizes of foundations at different founding strata for the various structures of the substation. The Contractor shall make his own arrangements for locating the coordinates and various test positions in field and also for determining the reduced level of these locations with respect to the bench mark .All the test are to be carried out before the OPTCL officials or before any agency engaged by OPTCL. Prior intimation in this effect has to be given to OPTCL.

A report to the effect will be submitted by the Contractor for the Engg Incharge (Divisional Engr.) specific approval giving details regarding his assumed data for Civil structures design.

Any variation in soil data shall not constitute a valid reason for any additional cost and shall not affect the terms and condition of the Contract. Nothing extra what so ever shall be paid to the Contractor on account of any variation in subsoil properties /or conditions. Tests must be conducted under all the critical locations. However, some of the soil parameters given below for substations have to be determined and submitted to Engg Incharge (Divisional Engr.).

- Dry density
- Bulk density
- Angle of internal friction/cohesion



- Specific gravity
- Natural moisture content.

#### **4.2 Bore holes**

Drilling of a specified number of bore holes of 150 mm dia. in accordance with the provisions of IS 1892 at approved locations to specified depths or to refusal which ever occurs earlier. (By refusal it shall mean that a standard penetration blow count (N) of 100 is recorded for 30 cm penetration). However, at least 3 boreholes shall be drilled to the required depth (15 mts. approximately).

Performing Standard Penetration Tests at approximately 2.0 m intervals in the bore hole starting from 0.5 m below ground onwards and at every change of stratum. The disturbed samples from the standard penetrometer shall also be collected for necessary tests.

Collecting undisturbed samples of 100/75 mm diameter 450 mm long from the bore holes at intervals of 2.5 m and every change of stratum starting from 1.0 m below ground level onwards.

The depth of Water Table shall be recorded in each bore hole.

All samples, both disturbed and undisturbed, shall be identified properly with the bore hole number and depth from which they have been taken. The sample shall be sealed at both ends of the sampling tubes with wax immediately after the sampling and shall be packed properly and transported to the Contractor's laboratory without any damage or loss.

The logging of the bore holes shall be compiled immediately after the boring is completed and a copy of the borelog shall be handed over to the Engg Incharge (Divisional Engr.).

#### **4.3 Dynamic cone penetration test**

Two Dynamic cone penetration tests under the locations of auto transformers shall be carried out with the circulation of bentonic slurry at specified location and a continuous record of penetration resistance (NG) upto 15 metre from natural ground level or refusal, shall be maintained by the Contractor.

Dynamic cone penetration tests are conducted to correlate engineering properties such as stratification density, bearing capacity, settlement, etc., of soils which are primarily cohesive in nature. The tests shall be conducted by driving a standard size cone attached loosely or screwed to a string of drill rods. The specification for the equipment and accessories required for performing this test, test procedure, field observations and reporting of results shall confirm to IS 4968 part 11 latest revision. The driving system shall comprise of 65 kg weight having a free fall of 75 cm. The cone size shall be 65 mm diameter, and provided with vents for continuous flow of bentonite slurry through the cone and rods in order to avoid friction between the rods and soil. The location for tests shall be as directed by the Engg Incharge (Divisional Engr.). On completion of the test, the results shall be presented as a continuous record as the number of blows required for every 300 mm penetration of the cone into the soil.

#### **4.4 Trial pits**

Trial pits shall be made at two locations as approved by the Engg Incharge (Divisional Engr.). The trial pits shall two metres square in size extending to (four) metres depth or as specified by the Engg Incharge (Divisional Engr.). Undisturbed samples shall be taken from the trial pits as per the direction of the Engg Incharge (Divisional Engr.).

#### **4.5 Field California Bearing Ratio test**

This test shall be carried out to obtain the properties of soil required for the construction of roads. The equipment and accessories required for carrying out the test, test procedure, recording of observations and presentation of results shall confirm to IS 2770 part **XXXI**. The test locations of CBR test shall be on the road locations as per GA drawing. These tests shall be performed on remoulded and undisturbed, soaked and un soaked samples.

#### **4.6 Electrical resistivity test.**

This test shall be conducted to determine the electrical resistivity of soil required for designing safety grounding system for the entire station area. The specifications for the equipment and other accessories required for performing electrical resistivity test, the test procedure, and reporting of field observations shall confirm to IS 3043. The test shall be conducted using Wagner's four electrode method as specified in IS 1892, Appendix-B2. Unless otherwise specified at each test location, the test shall be conducted along two perpendicular lines parallel to the coordinate axis.

#### **4.7 Plate load test**

Plate load test shall be conducted to determine the bearing capacity and load/ settlement characteristics of soil at shallow depths by loading a plane and level steel plate kept at the desired depth and measuring the settlement under different loads, until a desired settlement takes place or failure occurs. The specification for the equipment and accessories required for conducting the test, the test procedure, field observations and reporting of results shall conform to IS 1888. The location and depth of the test shall be given by the Contractor and approved by the Engg Incharge (Divisional Engr.). Undisturbed tube samples shall be collected at 1.0 m and 2.5 m depths from the natural ground level for carrying out laboratory tests.

The size of the pit shall not be less than five times the plate size and shall be taken upto the specified depth. All provisions regarding excavation and visual examination of pit shall apply here.

If the ground water table is at a depth higher than the specified test depth, the ground water table shall be lowered and maintained at the test depth for the entire duration of the test. Dewatering shall be at Contractor's cost.

Unless othewise specified the reaction method of loading shall be adopted. Settlement shall be recorded from dial guages placed at four diametrically opposite ends of the test plate. The test plate

shall be 600 x 600 mm size and atleast 25mm thick. The bottom of the pit shall be levelled before placing the plate in position for conducting the test.

A seating load of 70 gm/sq.cm shall be applied and after the dial gauge readings are stabilised, the load shall be released and the intital readings of the dial gauges recorded after they indicate constant reading. The load shall be increased in stages. These stages shall be 20, 40, 70, 100, 150, 200, 250, 300, 400. 500, 600 and 800 KN per sq.m. or as directed by the Engg Incharge (Divisional Engr.). Under each loading stage, record of time versus settlement shall be kept as specified in IS 1888.

The load shall be maintained for a minimum duration of one hour or till the settlement rate reduces to 0.02 mm/m. whichever is latter. No extrapolation of settlement rate from periods less than one hour shall be permitted.

Loading shall be carried out in stages as specified above till one of the following conditions occurs:

- Failure of the soil under the plate i.e. the settlement of the plate at constant load becomes progressive and reaches a value of 40 mm or more.
- Total settlement of the plate is more than 40mm.
- Load intensity of 800 kN/sq.m is reached without failure of the soil.

Backfilling of the pit shall be carried out as per the directions of the Engg Incharge (Divisional Engr.). Unless otherwise specified the excavated soil shall be used for this purpose. The quoted rates shall include backfilling.

Dial gauge readings for settlement shall generally be taken at 1, 2, 4, 6, 9, 16, 25, 60, 90 and 120 minutes from the commencement of each stage of loading. Thereafter the readings shall be taken at hourly intervals upto a further four hours and at two hours intervals thereafter for another six hours.

#### **4.8 Laboratory Test (If required)**

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

All samples brought from field, whether disturbed or undisturbed shall be extracted/prepared and examined by competent technical personnel, and the tests shall be carried out as per the procedures laid out in the latest edition of the relevant IS Codes and Standards.

The following laboratory tests shall be carried out:

- Visual and engineering classification.
- Liquid limit, plastic limit and and shrinkage limit.
- Natural moisture content, bulk density, dry density and specific gravity.
- Grain size distribution.

- Unconfined compression test.
- Unconsolidated undrained test.
- Swell pressure and free swell index determination.
- California bearing ratio.
- Consolidated undrained test.
- Consolidated drained test.
- Chemical tests on soil and water to determine the carbonates, sulphates, nitrates, chlorides, Ph value, and organic matter and any other chemicals harmful to the concrete foundation.

#### **4.9 Test results and reports(If required)**

The Contractor shall submit the detailed report in four (4) copies wherein information regarding the geological detail of the site, summarised observations and test data, bore logs, and conclusions and recommendations on the type of foundations with supporting calculations for the recommendations. Initially the report shall be submitted by the Contractor in draft form and after the draft report is approved, the final report in eight (8) copies shall be submitted.

The report shall include, but not be limited to the following :

- A plan showing the locations of an exploration work i.e. bore holes, dynamic cone penetration tests, trial pits, plate load test, etc.
- Bore logs: Bore logs of each bore holes clearly identifying the stratification and type of soil stratum with depth upto the refusal. The values of Standard Penetration Test (SPT) at the depths where the tests were conducted on the samples collected shall be clearly shown against that particular stratum.
- Test results of field and laboratory shall be summarised strata wise as well in combined tabular form. All relevant graphs, charts tables, diagrams and photographs, if any, shall be submitted along with report.
- **Recommendation** The report should contain specific recommendations for the type of foundation for the various structures envisaged at site. The Contractor shall acquaint himself about the type of structures and their functions from the Engg Incharge (Divisional Engr.). The observations and recommendations shall include but not be limited to the following :
  - Geological formation of the area, past observations or historical data, if available, for the area and for the structures in the nearby area, fluctuations of water table, etc..
  - Recommended type of foundations for various structures. If piles are recommended the type, size and capacity of pile shall be given.
  - Allowable bearing pressure on the soil at various depths for different sizes of the foundations based on shear strength and settlement characteristics of soil with supporting calculations for the recommendations.

- Recommendations regarding slope of excavations and dewatering schemes, if required.
- Comments on the chemical nature of soil and ground water with due regard to protective measures.
- If expansive soil is met with, recommendation on removal or retainment of the same under the structure/road etc. shall be given. In the latter case detailed specification of any special treatment required including specification for materials to be used, construction method and equipment to be deployed etc. shall be furnished.
- Recommendations for additional investigation beyond the scope of the present work, if Contractor considers such investigation necessary.

## **5. MATERIALS AND WORKMANSHIP**

### **5.1 General**

All materials used in the works shall be new and of the best quality of their respective kinds. They shall comply with the requirements of the latest edition of any relevant Indian Standard or Code of Practice where such exist, and current at the date of tendering.

All workmanship shall be of the highest standard, and shall be executed by competent men skilled in their respective trades.

### **5.2 Samples(If required)**

In addition to the special provisions made in this specification for sampling and testing of materials by particular methods, samples of any materials and workmanship proposed to be used in the Works may be called for at any time during the Contract by the Engg Incharge (Divisional Engr.) and shall be furnished by the Contractor without delay and at the expense of the Contractor. Samples when approved, shall be regarded as the acceptable standard, and any material or workmanship subsequently not complying with that standard shall be rejected and replaced by those of acceptable standard at the expense of the Contractor. Sample storage boxes shall be provided by the Contractor free of cost if requested by the Engg Incharge (Divisional Engr.).

### **5.3 Tests(If required)**

Whenever considered desirable by the Engg Incharge (Divisional Engr.), Inspectors may be sent to manufacturer's or subcontractors' premises to test materials or supervise their manufacture.

Where specified or requested the Contractor shall obtain from the manufacturer and send to the Engg Incharge (Divisional Engr.) certificates of test, proof sheets, mill sheets, etc., showing that materials have been tested in accordance with this Specification or the relevant Indian Standard.

Notwithstanding any tests which may be directed to be carried out at a manufacturer's and/or subcontractor's works, the Engg Incharge (Divisional Engr.) may carry out any tests or further tests he considers necessary or desirable after delivery of materials to the Site.

The Contractor shall provide all labour, equipment and facilities necessary for carrying out the tests both in works and on site.

The cost of routine tests required by IS and this Specification shall be borne by the Contractor. The cost of other tests shall be borne in accordance with the Conditions of Contract.

#### **5.4 Names of suppliers and copies of orders**

If so required, and before ordering material of any description, the Contractor shall submit for approval the names of makers or suppliers proposed. Copies of orders shall also be submitted if so required. The Engg Incharge (Divisional Engr.) may at any time withdraw his previously given approval to obtaining materials from any maker or supplier should such maker or supplier fail to supply materials of the specified quality or quantity in the requisite time.

#### **5.5 Rejection of materials and workmanship**

The Engg Incharge (Divisional Engr.) shall at any time have power to reject materials and workmanship not complying with this Specification or with the approved Drawings. Materials so rejected shall be immediately removed from site and replaced by materials of an approved standard at the expense of the Contractor. Rejected workmanship shall be broken out and replaced by work of an acceptable standard including the supply of new materials by the Contractor, at the expense of the Contractor, and without delay.

#### **5.6 Explosives and Blasting(If required)**

All rules under the Explosive Act or other local rules in force shall be fully observed. All blasting works shall be done in accordance with the stipulation contained in IS 4081. Written approval shall be obtained from the Engg Incharge (Divisional Engr.) before explosives are used for excavating foundations in rock and the Engg Incharge (Divisional Engr.) may impose conditions for their use. The Contractor shall be responsible for complying with local regulations concerning the use of explosives and for the safe-keeping and handling of explosives. Proper warning shall be given of all blasting operations. During operations involving the handling or use of explosives, the Contractor shall be responsible for the safety of personnel, Site Works and people or properties in the vicinity of the site. The Contractor shall make good at his own expense any damage caused by the use or mishandling of explosives.

### **6. EXCAVATION AND BACKFILL**

Excavation and backfill for foundations shall be in accordance with the relevant Code. The back fill around the foundations shall be compacted according to Clause 6.7 for Compaction.

Whenever water table is met during the excavation, it shall be dewatered and water table shall be maintained below the bottom of the excavation level during excavation, concreting and backfilling.

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 one metre in height.

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 Engg Incharge (Divisional Engr.). Rocks larger than ten centimetres shall not be placed in embankment adjacent to structures.

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.

## **6.1 Rock excavation**

The rock to be excavated shall be classified under the following categories :

### **6.1.1 Ordinary rock**

Rock which does not require blasting, wedging or similar means for excavation is considered as ordinary rock.. This may be quarried or split with crowbars or pickaxes and includes lime stone, sand stone, hard laterite, hard conglomerate and reinforced cement concrete below ground level. It will also include rock which is normally hard requiring blasting when dry but can be excavated without blasting, wedging or similar means when wet. It may require light blasting for loosening materials, but this will not any way entitle the material to be classified as hard rock.

### **6.1.2 Hard Rock**

Any rock or boulder for the excavation of which blasting is required, for example quartzite stone, granite, basalt, reinforced concrete (reinforcement to cut through but not seperated from concrete) below ground level.

### **6.1.3 Hard Rock (Blasting prohibited)**

This shall cover any hard rock requiring blasting as described in above but where blasting is prohibited for any reason and excavation has to be carried out by chieselling, wedging or any other approved method.

### **6.1.4 Authority for classification**

The classification of excavation shall be decided by the Engg Incharge (Divisional Engr.) and his decision shall be final and binding on the Contractor. Merely the use of explosives in excavation will not be considered as a reason for higher classification unless blasting is clearly necessary in the opinion of the Engg Incharge (Divisional Engr.).

## **6.2 Excavations for foundations and other purposes**

Excavations shall be of the minimum sizes necessary for the proper construction of the works, and excavations shall not be kept open for periods longer than that reasonably required to construct the works. The Contractor shall take all precautions necessary to ensure that the bottoms of excavations are protected from deterioration and that the excavations are carried out in such a

manner that adjacent foundations, pipes or such like are not undermined, damaged or weakened in any way. Any excavation taken out below the proper level without approval shall be made good at the expense of the Contractor using concrete or other material as directed.

All excavated materials obtained from excavation shall remain OPTCL's property. The useful portion shall be separated from the useless one and deposited in regular stacks at places indicated and as directed by the Engg Incharge (Divisional Engr.).

### **6.3 Support of excavations**

The Contractor shall be responsible for the stability of the sides of the excavations. Excavations shall be close timbered or sheeted, planked and strutted as and when necessary during the course of the work and shall ensure the safety of personnel working within them. If any slips occur, they shall, as soon as practicable, be made good in an approved manner at the expense of the Contractor. Shoring shall not be removed until the possibility of damaging the works by earth pressure has passed. No payment for shoring or timber left in shall be made, unless agreed in writing by the Engg Incharge (Divisional Engr.).

### **6.4 Works to be in dry**

All excavations shall be kept free from water and the Contractor shall take whatever action is necessary to achieve this. Pumping, well pointing and other means necessary to maintain the excavations free from water shall be at the expense of the Contractor, and carried out in an approved manner.

### **6.5 Backfill**

As soon as possible after the permanent works are sufficiently hard and have been inspected and approved, backfill shall be placed where necessary and thoroughly consolidated in layers not exceeding two hundred (200) millimetres in depth.

On completion of structures, the earth surrounding them shall be accurately finished to the line and grade as shown on the drawings. Finished surfaces shall be free of irregularities and depressions.

The soil to be used for back filling purposes shall be from the excavated earth or from borrow pits, as directed by the Engg Incharge (Divisional Engr.).

### **6.6 Disposal of surplus**

Surplus excavated material not required or not approved for fill or backfill shall be loaded and deposited either on or off site as directed. The Contractor shall not delay disposal of surplus material after receipt of instructions from the Engg Incharge (Divisional Engr.). The contractor shall arrange to transport the excavated earth by mechanical transport, not necessarily on Pucca roads. The soil so transported shall be stacked and levelled neatly and dressed. The location where the soil is to be stacked / disposed shall be as directed by the Engg Incharge (Divisional Engr.).



## **6.7 Compaction**

The method and equipment used to compact the fill material to a density that will give the allowable soil bearing pressure required for the foundations, roads, etc. in each layer of fill material. Each layer of earth embankment when compacted shall be as close to optimum moisture content (OMC) as practicable. Embankment material which does not contain sufficient moisture to obtain proper compaction shall be wetted. If the material contains an excess of 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 rockfills. No compaction shall be carried out in rainy weather.

At all times unfinished construction shall have adequate drainage. Upon completion of the road's surface course, adjacent shoulders shall be given a final shaping, true alignment and grade.

The density to which fill material shall be compacted shall be as per relevant IS and as per direction of Engg Incharge (Divisional Engr.). 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 subgrade for the roads and embankment filling shall be compacted to minimum 95% of the Standard Proctor's density at OMC

## **6.8 Requirement for fill material under foundations**

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.

Where compacted fill is required it shall consist of suitable sand, or other selective inorganic material, subject to approval by the Engg Incharge (Divisional Engr.). The filling shall be done with locally available sand. The filled in sand shall be kept immersed in water for sufficient time to ensure compaction, if so desired by the Engg Incharge (Divisional Engr.).

## **7. SITE SURFACING**

### **7.1 Scope of Work**

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 Engg Incharge (Divisional Engr.).

### **7.2 General Requirement**

The material required for site surfacing/gravel filling shall be free from all types of organic materials and shall be of standard approved quality, and as directed by the Engg Incharge (Divisional Engr.).

The Contractor shall furnish and install the site surfacing to the lines and grades as shown in the drawing and in accordance with the requirements and direction of the Engg Incharge (Divisional Engr.). The soil of the entire switchyard area shall be levelled before placing the site surfacing/gravel fill material. After all the structures and equipment have been erected and accepted the site shall be maintained to the lines and grades indicated in the drawing and rolled or compacted by using three ton roller with suitable water sprinkling to form a smooth and compact surface condition, which shall be matching with finished ground level of the switchyard area. After due compaction of the surface of the entire switchyard area shall be provided with plain cement concrete of 75 mm thickness after proper compaction, and antiweed treatment having cement concrete ratio 1:4:8. Care shall be taken for proper gradient for easy discharge of storm water.

After the PCC is applied and surface prepared to the required slope and grade a base layer of uncrushed/crushed broken gravel of 20 mm nominal size shall be spread, rolled and compacted by using 1/2 ton roller (30" width and 24" dia) with 4 to 5 passes and water sprinkling to form a minimum 50 mm layer on the designed finished formation level of the entire switchyard area.

As a final surface course minimum 50 mm. uniform layers of uncrushed /crushed broken metals (gravel) of 20 mm. nominal size shall be spread over the base layer/course. This final surface course shall be applied in all areas exclusive of roadways and shall extend beyond the fenced area as indicated in the drawing. This surface course shall then be compacted by light roller using 1/2 ton steel roller (width 30" x dia 24") and 4 to 5 passes or any other means with water sprinkling as directed by the Engg Incharge (Divisional Engr.). Water shall be sprinkled in such a manner that bulking does not take place. The 20 mm. nominal size (for both layers) shall pass 100% through IS sieve designation 37.5 mm and nothing through 16.0 mm. IS sieve.

In areas that are considered by the Engg Incharge (Divisional Engr.) to be too congested with foundations and structures for proper rolling of the site base course 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 structure or equipment during rolling or compaction.

Engg Incharge (Divisional Engr.) by no means shall relieve the contractor of their contractual obligations as stipulated in General and Special Conditions of Contract.

## **8. SITE DRAINAGE (IF REQUIRED)**

### **8.1 General**

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 the most intense rainfall that is likely to occur over the catchment area in one hour period on an average of once per ten years. The surfaces of the site shall be sloped to prevent the ponding of water.

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

For design of RCC pipes for drains and culverts, IS 456 and IS 783 shall be followed.

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.

The drainage system shall be adequate without the use of cable or pipe trenches.

For pipe drains, concrete pipes of class NP2 shall be used. However, for road crossings higher strength pipe of class NP3 shall be provided. For rail crossings, pipes conforming to railway loading standards or at least NP4 class shall be provided. Manholes shall be provided at 30 m intervals, at connection points and at every change of alignment. All manholes deeper than 1.2 m shall be provided with galvanised M.S. foot rests. Foot rests shall be of 20 mm M.S. square bars.

Open surface drains shall comprise walls with bricks of class designation 75 in cement mortar 1:4 and 100 mm thick bed concrete of grade 1:3:6, and surface with 12 mm thick cement plaster 1:4 with a floating coat of neat cement on the drain bed and exposed sides. Design and drawings shall have the approval of the Engg Incharge (Divisional Engr.). For expansive soils, the guide lines of IS 9451 shall be followed.

In general, all plant effluent drainage shall be through buried concrete pipes and all storm water drainage shall be through open drains/pipe drains. Open storm water drains shall be provided on both sides of the roads and shall be designed to drain the road surface as well as all the free and covered areas.

Pipe drains shall be connected through manholes at an interval of maximum 30 m. Plant 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 their final disposal.

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 and approved by Engg Incharge (Divisional Engr.). Pumping of drainage water, if required, shall be provided by Contractor.

All internal site drainage systems, including the final connection and disposal to Engg Incharge (Divisional Engr.) acceptance points shall be part of Contractor's scope including all required civil work, mechanical and electrical systems. The Contractor shall connect his drain(s) at one or more points.

Precast manholes shall be preferred against cast-in-situ type. The drainage scheme may either employ open drain system or underground pipe system or a combination of both. A man hole shall be provided at every turn or corner in case of underground type in addition to the normal requirement.

Suitable pumping arrangement shall be provided by the Contractor to pump out the water from sump to the open channel; automatic float valve type pump shall be provided and installed by Contractor.

The Contractor shall locate the outfall point outside the substation vicinity and the substation storm drainage must be connected to this point.

The drainage scheme and associated drawings shall be subject to approval of the Engg Incharge (Divisional Engr.).

## **8.2 Excavation and backfill**

Trench excavations for drains shall be carried out with the minimum disturbance to adjacent ground and in such a way that existing or new work shall not be undermined. No backfill shall be placed until pipes, etc. have been inspected, tested and approved. Backfill shall be carefully placed by hand tools round pipes, etc. and rammed in layers not exceeding one hundred (100) millimetres thick in a manner which will not cause damage. When a minimum thickness of three hundred (300) millimetres above the pipes has been so placed, normal methods of backfilling and ramming may be adopted.

## **8.3 Laying Of Pipes**

Pipes and fittings shall be of the types, qualities and sizes specified and shown on the approved drawings. They shall be laid to the lines and levels shown, and the barrel of each pipe shall bear firmly and uniformly on the trench bottom or prepared foundation bed, any projections in the trench bottom which could cause damage to pipes being first removed. Pipes shall be kept clean during and after laying, and open ends shall be provided with the temporary plugs to prevent entry of foreign matter. Each pipe shall be accurately bonded to gradient between sight rails and drain. Laying shall commence at the lowest end and proceed uphill. Pipes shall be laid with the sockets leading uphill.

## **8.4 Testing of drains**

All drains, other than open channels, stone filled drains and porous drains, shall be of watertight construction, and all soil drains shall be subjected to a water test before backfilling of trenches is commenced. Drains may be tested in sections, and manholes may be tested separately. The Contractor shall submit to the Engg Incharge (Divisional Engr.) for approval his proposals for testing. The drains shall withstand, without leakage, a water pressure of not less than one and one half (1.5) metres at any point for a period of 20 minutes or such other time as the Engg Incharge (Divisional Engr.) may direct. All necessary plugs, temporary connections and other equipment and all labour required for the tests shall be provided by the Contractor and at the expense of the Contractor. For testing of pipes in areas where an adequate supply of water is not readily available, the Engg Incharge (Divisional Engr.) will accept an air (smoke) pressure test, provided that the method of testing is approved by the Engg Incharge (Divisional Engr.). Further testing may be called for after backfilling of trenches to ensure that pipes have not been damaged during that operation.

## **8.5 Regulations**

The regulations and recommendations of any relevant drainage or sanitary authority shall be fully observed, and the Contractor shall be responsible for acquainting himself with any such regulations.

## **9. ROADS AND CULVERTS**

The Contractor shall be responsible for constructing approach roads, sub-station roads and service roads etc. within the substation area. Layout of the roads shall be based on general details and arrangement drawings for the substation. Parking areas shall be provided for Site personnel and a minimum of twenty numbers of visitors at convenient locations. Adequate turning space for vehicles shall be provided and bend radii shall be set accordingly. Roads to the transformer bays shall be as short and straight as possible. Where the substation layout warrants headroom safety barriers shall be installed to prevent vehicles coming into contact with overlying conductors. Such barriers shall be included as part of the scope of the work.

All substation roads shall be constructed so as to permit transportation of all heavy equipment. A minimum seven metres black topping with 1.6 m wide shoulders on either side of the road shall be constructed for double lane roads. The other service roads shall be with 3.75 m black topping and 1.3 m wide shoulders on either side of the road.

Finished top (crest) of roads shall be a minimum of 300 mm above the surrounding grade level (Formation level).

Road construction shall be as per Indian Road Congress (IRC) standards.

Adequate provision shall be made for road drainage.

All culverts and allied structures required for road/rail, drain, trench crossings etc. shall be designed for class AA loading as per IRC standard.

All roads shall be designed for class 'E' of traffic i.e. traffic intensity of 450-1500 vehicles per day (heavy vehicles exceeding 3 tonnes laden weight) as per IRC-37-1984, Guide-lines for the design of flexible pavements.'

California Bearing Ratio (CBR) method shall be followed for the design of roads. A detailed CBR test which is an adhoc penetration test shall be carried out as per the procedure outlined in IS 2720 (Part XVI).

The surface of the hardstanding shall be laid with falls to the drainage system. Care shall be taken during the construction that no materials enter the drainage system.

At the junction of the hard standing and roads due to different thickness of foundations, precautions shall be taken to ensure that sub-surface drainage from the hard standing does not have a detrimental affect upon the road foundations.

### **A) CONCRETE ROAD:**

All the roads except the main, approach and periphery roads shall be of concrete road. The side shoulder of all the roads shall be with kerb stone at two sides. The kerb stones shall be painted yellow and black alternatively. In case of switch yard road (concrete road) the shoulder would be compacted earth 600 mm wide on the sides of the road. The concrete road shall have 100 mm thick PCC (1:2:4 nominal ratio). Below it 100 mm thick PCC (1:4:8) shall be provided. 300 mm thick water bound macadam (WBM) in three equal layers of 100 mm each at the bottom.

PCC and WBM shall extend upto the shoulder width on both sides of the road outside switch yard area as per drawing. In case of road within the switch yard area the PCC and WBM shall be placed only up to the width of the road. Polythene sheet of 125 microns shall be placed between the RCC and PCC slab. Expansion joints (12mm thick) shall be provided at every 8 mtrs. In addition, in case of 7 mtrs wide roads 100 mm Dia hume pipe (NP-3) shall be provided at every 100 mtrs interval across the length of the road for cable crossing.

### **B) BITUMINOUS ROAD:**

The approach road, main road, periphery road and colony road shall be bituminous type. The following procedure shall be followed for the construction of bituminous roads.

1. Compacted WBM at the bottom end of the road up to a thickness of 300 mm in three equal layers 100 mm each. The compaction shall be done by laying stone aggregates of size 100mm. Each layer shall be laid and compacted with water spreading and using rollers as per the standard practice adopted in the CPWD guide line.
2. Above, the compacted WBM 1st layer as stated under (1), 200 mm thick consolidated WBM in two layers with stone aggregates of size 90 – 45mm shall be laid. Each layer shall be laid and compacted with water spreading and using rollers as per recommended.
3. Above the compacted 2nd layer of WBM, 75 mm thick consolidated WBM in two layers with stone aggregates of size 63mm-45mm shall be laid. Each layer shall be compacted with water spreading and using rollers as per recommended.
4. Above the compacted 3rd layer of WBM, 75 mm thick consolidated WBM in two layers with stone aggregates of size 53mm-22.4mm shall be laid. Each layer shall be compacted with water spreading and using rollers as per recommended.
5. Above the 4th layer of compacted WBM, 25mm thick pre mix carpet surfacing has to be done. The carpet surfacing shall be done with 2.25 cum and 1.12 cum of stone chippings of 13.2 mm size and 11.2 mm size respectively per 100 sq mtrs and 52 Kgs of hot bitumen per cum of stone chippings. Complete with paving ASPHALT 80/100 heated and thin mixed with solvent @70g/Kg of ASPHALT. Hot bitumen of grade 80/100 shall be spread on road surface @750g/Kg per sqmtr. There shall be shoulder on both side of the roads as per given data. The curvature of the road shall be R=7M and additional metalling for turning has to be maintained. The shoulder shall also be made compacted morrum filling and other as specified.

### **1.1 Periphery roads out side the fencing:**

Periphery roads to be constructed out side the fencing. The width of the road is 3.5 mtrs having borm of 1 mtr each at both sides of the roads. The roads shall be bitumen grading and as per Indian Road congress standards.

### **1.2 The width and type of other roads are:**

- a) Bituminous road:-Approach and main roads shall be 7 mtr wide with both side shoulder of 1.75 mtrs. The roads shall be of bitumen grade type.
- b) Other roads shall be (peripheral and colony) 3.75 mtrs width having shoulder of 1.3 mtr at both the side. The roads shall be of bituminous type.

## **10. CABLE AND PIPE TRENCHES**

### **10.1 General**

Cable trenches and pre-cast removable RCC covers (with lifting arrangement) shall be constructed using RCC of M20 grade.

The cable trenches shall be designed for the following loads.

- Dead load of 155 kg/ m length of cable support plus 75 kg on one tier at the end.
- Triangular earth pressure plus uniform surcharge pressure of 2 tonnes per sq.metre.
- Cable trench covers shall be designed for (i) self weight of top slab plus concentrated load of 200 kg at centre of span on each panel and a surcharge load of 2 tonnes per sq. metre.

Cable trench crossings of road and rails shall be designed for class AA, class A and class 7OR loading of IRC or relevant IS Code and should be checked for transformer loading.

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

The top of trenches shall be kept at least 250 mm above the finished ground level. The top of cable trench shall be such that the surface rain water does not enter the trench.

All metal parts inside the trench shall be connected to the earthing system.

Cables from trench to equipments shall run in hard conduit pipes(GI pipe and necessary G.I bends and sockets)

A suitable clear gap shall be maintained between trench walls and foundations.

A clear ( vertical ) space of at least 300 mm shall be available for each tier in cable trench. From trench bed to lowest tier, a minimum clearance of 200 mm shall be available for one tier trench and 300 mm for trenches having more than one tier. The spacing between stands shall be 400mm.

The trench bed shall have a slope of 1/500 along the run and 1/250 perpendicular to the run.

All 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 expansion joints shall be provided with approved quality PVC water stops of approximately 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.

Cable trenches shall be blocked at the ends if required with brick masonry in cement sand mortar 1:6 and plaster with 12mm thick 1:6 cement sand mortar.

Cable tray supports( all galvanised structures) shall be designed and constructed to be a single complete fabrication or assembly such that every layer of the horizontal cable tray supports are fixed, either bolted or welded, to a vertical steel support that is embedded in the concrete wall of the cable trough. It shall not be permitted to embed a horizontal support beam directly into the wall of the trough in order to use the concrete wall as a means of load bearing.

Concrete troughs shall be provided with concrete covers of suitable load bearing strength. Where the cable troughs are run across or within 3 m of substation roads, the trough covers shall be capable of bearing an accidental wheel load of 20 kN.

#### **MORE ON CABLE TRENCH.**

#### **(THE REQUIRED SIZE TO BE ASSESSED BY THE BIDDER WHILE QUOTING THE RATES FOR THE CABLE TRENCH. DIFFERENT SIZES OF CABLE TRENCHES ARE INDICATED. CAPACITOR BANK BAY SHALL BE ONE EXTENSION OF BAY IN THE EXISTING SUB-STATION)**

All the cable trenches shall be RCC type with mixing ratio 1:1.5:3. The size of MS rod to be used for the same are of 8mm tor and 6mm. All the vertical rod shall be 8 mm continuous and the wall and raft shall contain 2 nos 8 mm rods at two layers and spacing shall be 150mm. The horizontal binders shall be of 6mm rod two nos in two layers and to be placed at 200mm centre to centre for both on the wall and raft portion of the trench. The mentioned rod placements are for section 1-1,2-2, and 3-3. For section 4-4 instead of two 8mm and 6mm rods single rods can be used.

A frame of hot dip galvanized angles of size 50X50X6 mm having provision of MS chairs on the grouting side on to the walls of the trench preferably at two locations(at top and bottom) of the frame (these chairs have to be welded with the rods of the wall for better rigidity). For section 1-1 there shall be of 4 tier mechanism for fixing of cable tray having width of the angle 450mm (3 nos) and the top angle shall be of 300 mm, and the quantity of such type of frame shall be 2 (for both way). For section 2-2 only one frame of the above mentioned one shall be used. For section 3-3 there shall be one frame but with three tier mechanism for fixing the cable trays. For section 4-4 two tier system of angle width shall be 200 mm width at the bottom and 100 mm width at the top. Fixing of the cable tray support stand (Frame) is to be fixed at a distance of 1 mtrs from one frame to the other.



The thickness of the RCC wall of the trench shall be 100mm and thickness of the raft shall be 75mm. All the frames for fixing of cable trays shall be of hot dip galvanized. A running earth strip has to run all through the cable trench for proper earthing of the cable trays and stand (frame).The size of the earth strip is of 50X6mm G.I flats. Welding the GI flats to the frame to be carried out. Earthing strips to be welded with the running earth mat at 10mtrs interval

The bidder also to supply and fix G.I perforated cable trays (of thickness 2mm) of appropriate size before laying of cables on the cable tray stand.

The other dimensions of the cable trench are as below.

Sl No	Section	No of tiers in each frame/ and no of such frame	Gap between the two angles in mm	Inside clearance in mm		Outside clearance in mm		Concrete thickness in mm	
				Top to Bottom	Wall to wall	Top to bottom of wall	Raft width	Wall	Raft
1	1-1	Four tiers/ Two (both way)	200	1275	1400	1350	1750	100	75
2	2-2	Four tiers/single (one way)	200	1275	900	1350	1450	100	75
3	3-3	Three/ single	200	1075	900	1150	1450	100	75
4	4-4	Two/ single	200	545	250	620	350	75	75

The covers of the slab are also of RCC with ratio mixing 1:1.5:3. The thickness of the slab shall be 75mm for section 1-1 (MS Rods to be used 10mm & 8mm), section 2-2, 3-3 shall be 60mm (MS Rod to be used 8mm) and section 4-4 shall be 50mm (MS Rods to be used 8mm & 6mm). The MS rods to be used shall be placed at 100 mm centre to centre both way and properly binded. The cover slab shall have provision of lifting hooks at two points for easy lifting of the slabs. Slabs having lifting hooks shall be placed at every 10<sup>th</sup> slabs. The lengths of the cable trench cover slabs are as below.

Section	Length of the slab	Thickness of the slab
1-1	1600mm	75mm
2-2	1100mm	60mm
3-3	1100mm	60mm
4-4	400mm	50mm

The covers for the cable trench inside the control room shall be provided with MS chequered plate with MS angle stiffeners at the bottom for proper mechanical strength.

## **10.2 Excavation**

Excavation for cable ducts shall generally be carried out in accordance with Clause no. 6.2 of this specification.

## **10.3 Back fill**

Except where ducts are to be encased in concrete, sand is to be packed and well tamped round the duct until it is covered to a depth of 75 mm above the upper surface of the duct. Filling above this level is to be with suitable excavated material free from large stones. In multiple duct runs the interstices between the ducts are to be filled with sand and compacted. A cover of 75 mm above the uppermost ducts shall be maintained. The sand used shall be the same quality as approved for use in making concrete.

## **10.4 Concrete cable and pipe trenches**

In-situ concrete trenches are to be provided inside and outside the Substation. The trenches are to have falls in the floor and must be drained at regular intervals.

All trenches must have trench covers suitable for their location and loading. Any beams or supporting covers must be as shallow as possible to avoid interfering with the pipes and cables in the trench.

Once the trench covers have been made they are to be stored and not laid until all trench cabling, piping, etc. is finished. Any covers laid before this time which become damaged shall be replaced at the Contractor's expense.

Trench covers and bridging beams for covers, except where heavy duty, shall be light enough for two men to lift.

## **11. FOUNDATION DESIGN**

### **11.1 General**

All foundations 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 M15 corresponding to 1:2:4 nominal mix ratio with 12-20 mm coarse aggregate. Higher grades of concrete than specified above may be used at the discretion of the Bidder without any financial implication to the owner.

Limit state method of design shall be adopted unless stated otherwise in the Specification.

For design and construction of steel-concrete composite beams IS 11384 shall be followed.

For detailing of reinforcement IS 2502 shall be followed. Cold twisted deformed bars ( $F_y = 415$  N/sq mm) conforming to IS 1786 shall be used as reinforcement. However, in specific areas, mild steel (Grade 1) 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.

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 produce the maximum stresses in the foundation or the foundation component, and as per the relevant IS Codes of foundation design. The design calculations shall be submitted by the bidder showing complete details of piles/pile groups proposed to be used.

All foundations shall rest below virgin ground level and the minimum depth of foundation below the virgin ground level shall be maintained.

Design shall consider any sub-soil water pressure that may be encountered.

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 or harmful to the concrete foundations.

RCC columns shall be provided with rigid connection at the base.

Earth pressure for all underground structures shall be calculated using coefficient of earth pressure at rest, coefficient 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.

In 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, and substructures of any underground hollow enclosure etc., to allow for vehicular traffic in the vicinity of the structure.

The following conditions shall be considered for the design of water tanks, pump houses, channels, sumps, trenches and other underground concrete structures such as basements etc.

- Full water pressure from inside and no earth pressure, ground water pressure and surcharge pressure from outside (applicable only to structures which are liable to be filled with water or any other liquid).
- Full earth pressure, surcharge pressure and ground water pressure from outside and no water pressure from inside.

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.

Base slabs of any underground enclosures shall be designed for empty condition during construction and maintenance stages with maximum ground water table (GWT). Minimum factor of safety of 1.5 against buoyancy shall be ensured ignoring the super-imposed loadings.

Base slab of underground enclosures such as water storage tank shall also be designed for the condition of different combination of pump sumps being empty during maintenance stages with maximum GWT. Intermediate dividing piers of such enclosures shall be designed considering water in one pump sump only and the other pump sump being empty for maintenance.

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 foundation of the circuit breaker shall be of block type foundation. Minimum reinforcement shall be governed by IS:2974 and IS:456.

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 factor shall be used as partial safety factor over loads in limit state design also.

All underground concrete structures such as basements, pump houses, water retaining structures etc. shall have plasticizer cum water proofing cement additive conforming to IS 9103. In addition, the limit on permeability as given in IS 2645 shall also be met. 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, leakage repair shall be achieved by the injection method.

## **11.2 Machine Foundations**

All machine foundations shall be designed in accordance the provisions of the relevant parts of the latest revisions of IS 2974, IS 456 and IS 2911. The provisions of DIN 4024 (latest) shall also be followed.

All block foundations resting on soil or piles shall be designed using the elastic half space theory.

The mass of the RCC block shall not be less than three times the mass of the machine. Dynamic analysis shall be carried out to calculate natural frequencies in all the modes including coupled modes, and to calculate vibration amplitudes. Frequency and amplitude criteria as laid down by the relevant IS codes and/or machine manufacturers, shall be satisfied. Minimum reinforcement shall be governed by IS 2974 and IS 456.

For the foundations supporting minor equipments weighing less than one tonne, or if the mass of the rotating parts is less than one-hundredth of the mass of the foundation, no dynamic analysis is necessary. However, if such minor equipment is to be supported on building structures, floors etc. suitable vibration isolation shall be provided by means of springs, neoprene pads etc. and such vibration isolation system shall be designed suitably.

### **11.3 Other Foundations**

All foundations shall be designed in accordance with the provisions of the relevant parts of latest revisions of IS 2911 and IS 456.

Type of foundation system i.e. isolated footing, raft or piling shall be decided based on the load intensity and soil strata.

A minimum three piles shall be provided in any pile group.

Gantry and tower foundations shall be designed for an additional factor of safety of 1.1 for normal/broken wire conditions and for short circuit condition.

Circuit breaker foundations shall be designed for impact loading and shall be strictly in accordance with the Manufacturer's recommendations.

## **12. FOUNDATIONS AND R C C CONSTRUCTION**

### **12.1 General**

Work covered under this Clause of this Specification comprises the design, supply and installation of foundations and other RCC constructions for switchyard structures, equipment supports, trenches, rains, jacking pads, pulling blocks, fencing, control cubicles, bus supports, transformers, marshalling kiosks, auxiliary equipments and systems, buildings and tanks, 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 RCC constructions.

Concrete shall conform to the requirements of IS 456 and all the tests shall be conducted as per relevant Indian Standard Codes.

If the site is sloping, the foundation height will be adjusted to maintain the exact level of the top of structures to compensate for such slopes.

Switchyard foundation plinths and building plinths shall be minimum 300 mm and 500 mm above finished ground level respectively.

A minimum of 75 mm thick lean mix concrete (1:3:6) shall be provided below all underground structures, foundations, trenches etc. to provide a base for construction.

Concrete made with portland cement(OPC-43 grade) shall be carefully cured and special consideration shall be given during the placing of concrete and removal of shuttering.

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 combinations thereof. Spread footing foundations or pile foundations as may be required based on soil and subsoil conditions and superimposed loads shall be provided.

If pile foundations are adopted, the same shall be cast-in-situ, driven, bored, precast or under reamed type as per relevant IS. 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 contractor showing complete details of piles and pile groups proposed to be used. Necessary initial load tests shall also be carried out by the contractor at their entire cost to establish the pile design capacity. Only after the design capacity of piles has been established, shall the Contractor commence of piling. All the design and testing work shall be planned in such a way that these shall not cause any delay in project completion.

## **12.2 Cement**

The cement to be used shall be the best quality of its type.

All cement shall be sampled and tested in accordance with Indian Standards.

The Portland cement(OPC-43 grade) used in concrete shall conform to IS 269.

Requirement of sulphate resistant cement (SRC) for substructural works shall be decided in accordance with the Indian Standards based on the findings of the detailed soil investigation to be carried out by the contractor.

High Alumina cement shall NOT be used.

## **12.3 Delivery and storage of cement**

Cement shall be delivered to the site in bulk or in sound and properly sealed bags and while being loaded or unloaded whether conveyed in vehicles or by mechanical means, and during transit to the concrete mixers, must be protected from the weather by effective coverings. Efficient screens are to be supplied and erected to prevent wastage of cement during strong winds.

If the cement is delivered in bulk, the Contractor shall provide at his own cost approved silos of adequate size and number to store sufficient cement to ensure continuity of work. The cement shall be placed in these silos immediately it has been delivered on the site. Suitable precautions shall be taken during unloading to ensure that the resulting dust does not constitute a nuisance.

If the cement is delivered in bags, the Contractor shall provide at his own cost perfectly waterproof and well-ventilated sheds having a floor of wood or concrete raised at least 150 mm above the ground. The sheds shall be large enough to store sufficient cement to ensure continuity of work.

Each consignment of each type of cement shall be stacked separately therein. On delivery at site the cement shall at once be placed in these sheds and shall be used in the order in which it has been delivered.

All cement shall be used within 3 months of the date of manufacture.

#### **12.4 Aggregate**

Coarse and fine aggregate shall conform to the requirements of IS 383-1970.

Sampling and testing of aggregates shall be in accordance with the relevant Indian Standard.

Fine and coarse aggregates shall be obtained from the same source and the Contractor shall ensure that material from the source is known to have a good service record over a long period of time.

Aggregate shall be hard and dense and free from earth, clay, loam and soft, clayey, shaley or decomposed stone, organic matter and other impurities.

#### **12.5 Storage of aggregates**

Coarse and fine aggregates shall be stored on site in bins or on clean, dry, hard surfaces, and be kept free from all sources of contamination. Aggregates of different gradings shall be stored separately, and no new aggregate shall be mixed with existing stocks until tested, and approved by the Engg Incharge (Divisional Engr.).

#### **12.6 Approval of Supplies**

As soon as possible after the Contract has been placed the Contractor shall submit a list giving details of the sources from which he proposes to obtain concrete and mortar materials. Only materials from approved sources shall be brought to site, but the Engg Incharge (Divisional Engr.) will be prepared to extend his approval to other satisfactory sources of supply which may be proposed by the Contractor. Approval of a source of supply shall not imply acceptance of material found not to conform to this Specification

#### **12.7 Water**

Water used for mixing concrete and mortar shall be clean, fresh water obtained from an approved source and free from harmful chemicals, oils, organic matter and other impurities. Normally potable water may be considered satisfactorily for mixing and curing concrete and masonry work.

#### **12.8 Steel bar reinforcement**

Reinforcement shall comply with the appropriate Indian Standards.

All bar reinforcement shall be hot rolled steel except where the use of cold worked steel is specified on the drawings or otherwise approved.

The bars shall be round and free from corrosion, cracks, surface flaws, laminations, rough, jagged and imperfect edges and other defects.

The bar reinforcement shall be new, clean and of the lengths and diameters described on the Drawings and Schedules. Bars shall be transported and stored so that they remain clean, straight, undamaged and free from corrosion, rust or scale. Bars of different diameters shall be separately bundled.

### **12.9 Bending of reinforcement**

All steel bars are to be accurately bent cold to the shapes and sizes indicated on the Drawings and Schedules unless otherwise approved. Re-bending of bars and bending in position in the works shall not generally be allowed.

### **12.10 Welding of reinforcement**

Spot or tack welding for positioning bars in heavily reinforced areas will only be allowed with the express permission of the Engg Incharge (Divisional Engr.). Extension of lengths of reinforcement by welding will not be permitted.

Welding will be approved only in low stress members, and lap welding will not be approved in any circumstances.

### **12.11 Fixing of reinforcement**

Before fixing in the works bars shall be seen to be free from pitting, mud, oil, paint, loose rust or scale or other adherents harmful to the bond or strength of the reinforcement. Bars shall be fixed rigidly and accurately in position in accordance with the working drawings, unless otherwise approved by the Engg Incharge (Divisional Engr.). Reinforcement at all intersections shall be securely tied together with 1.5 mm soft annealed tying wire the ends of which shall be cut and bent inwards. Cover to the reinforcement shall be in accordance with Clause 15.12 of this specification and sufficient spacers and chairs of precast concrete of approved design shall be provided to maintain the specified cover and position. No insertion of bars in previously placed concrete shall be permitted. Projecting bars shall be adequately protected from displacement. The fixing of reinforcement in the works shall be approved by the Engg Incharge (Divisional Engr.) before concrete is placed. Measurement will be based on the calculated weights of steel actually used in tonnes corrected to second place of decimal.

### **12.12 Concrete cover to reinforcement**

For durability the minimum concrete cover to any reinforcing bar shall be as follows:

#### **Concrete above ground.**

- Internal faces of slabs 25 mm
- Internal faces of beams and walls 30 mm
- Exposed faces of slabs, beams and walls 50 mm
- All faces of columns 50 mm

#### **Concrete below ground (including piles).**



- Faces in contact with soil including blinding concrete      75 mm
- All other faces (i.e. internal faces of basement wall)      50 mm

Only concrete or steel spacers shall be used to achieve the required minimum thickness of concrete cover to reinforcement. Concrete spacers shall have non metallic ties. Timber blocks for wedging the steel off the formwork will not be allowed.

### **12.13 Formwork**

Formwork shall be constructed from timber, metal, lined as necessary for special finishes and designed with the quality and strength required to ensure rigidity throughout placing, ramming, vibration and setting of the concrete, without detrimental effect.

Formwork shall be erected true to line, level and shapes required using a minimum of approved internal ties. Faces in contact with the concrete shall be true and free from defect, jointed to prevent loss of water or fines, in panels or units which permit easy handling, and designed to permit sideforms to be struck independently of soffit shuttering. Ties or spaces remaining embedded shall have the minimum cover specified for reinforcement. Forms for exposed concrete beams, girder casings and columns shall provide for a twenty five millimetre chamfer on external corners.

Wedges and clamps shall be kept tight during vibration operations. Before commencement or resumption of concreting, the interior of forms shall be cleaned and free of sawdust, shavings, dust, mud or other debris and openings shall be formed to facilitate this cleaning and inspection. The inside of the forms shall be treated with a coating of an approved substance to prevent adhesion. Care shall be taken to prevent this substance being in contact with the reinforcement.

### **12.14 Grades of concrete**

Concrete shall be either ordinary or controlled and in grades designated M10, M15, M20 and M25 as specified in IS 456 (latest edition ). In addition, nominal mixes of 1:3: 6 and 1: 4: 8 of nominal size 40 mm maximum, or as indicated on drawings, or any other mix without any strength requirements as per mix design shall be used where specified.

### **12.15 Ordinary concrete**

Ordinary concrete shall be used for all plain cement concrete work and where shown on drawings or allowed by the Engg Incharge (Divisional Engr.). Ordinary concrete shall not require preparation of trial mixes.

In proportioning concrete, the minimum quantity of cement shall be as specified in Table 15.15.1 of this clause and the amount to be used shall be determined by actual weight. The quantities of fine and coarse aggregate may be determined by volume, but preferably by weight.

The water cement ratio shall not be more than those specified in IS 456.

Grade of Concrete	Minimum cement content per c.m. of finished concrete
M 10	236 kg
M 15	310 kg
M 20	360 kg
M 25	410 kg

**Table - 15.15 Minimum Cement content.**

## 12.16 Controlled concrete

### 12.16.1 Mix proportions

The mix proportions for all grades of concrete shall be designed to obtain strength corresponding to the values specified in IS 456 for respective grade of concrete. Preliminary tests as specified in the IS Code or as required by the Engg Incharge (Divisional Engr.), shall be carried out, sufficiently ahead of the actual commencement of the work, with different grades of concrete made from representative samples of aggregate and cement expected to be used on the job. The purpose of this test is to ascertain the water cement ratio required to produce a concrete having specified strength, and to demonstrate sufficient workability to enable it to be well consolidated and to be worked into corners of shuttering and around the reinforcement.

### 12.16.2 Mix design

As a guide to perform the mix design properly, the relationship between water cement ratio, aggregate to cement ratio, workability and strength of concrete will be as per relevant IS.

The cement /total aggregate ratio is not to be increased beyond 1: 9.0 without specific permission of the Engg Incharge (Divisional Engr.). It should be noted that such high aggregate/cement ratios will be required for concretes of very low slump and high water cement ratios which may be required to be used in mass concrete work only.

The actual cement aggregate ratios are to be worked out from the specific gravities of coarse aggregates and sand being used, and from trial mixes.

## 12.17 Strength requirements

The mix proportions for all grades of concrete shall be designed to produce the grade of concrete having the required workability and a characteristic strength not less than the value given table 15.17.

Grade Designation	Characteristic Compressive Strength at 28 days
M 10	10 N / sq. mm

M 15	15 N / sq. mm
M 20	20 N / sq. mm
M 25	25 N / sq. mm

**Table - 15.17 Strength Characteristic**

The strength of concrete given above is the 28 days characteristic compressive strength of 15 cm cube.

### **12.18 Workability**

The workability of concrete shall be checked at frequent intervals by slump test, where facilities exist and if required by the Engg Incharge (Divisional Engr.), alternatively the compaction factor test in accordance with IS 1199 shall be carried out.

### **12.19 Mixing of Concrete**

Unless otherwise approved, concrete for foundations will be M 20 grade, corresponding to nominal mix of 1:1.5:3 as per IS 456. The proportions of fine and coarse aggregate, cement and water shall be as determined by the mix design or according to fixed proportions in case of nominal mix concrete and shall always be approved by the Engg Incharge (Divisional Engr.). The quantities of the cement, fine and coarse aggregates shall be determined by weight, the water shall be measured accurately after giving proper allowance for surface water present in the aggregate. Water shall be added to make a workable mix and it is important to maintain the water-cement ratio at its correct value of 0.55 in accordance with the requirements of IS 456.

Water shall not be added to the mix until all the cement and aggregates constituting the batch are already in the drum and dry mix for at least one minute. Mixing of each batch shall be continued until there is uniform distribution of materials and the mass done for less than 2 minutes and at least 40 revolutions after all the materials and water are in the drum.

When hand mixing is permitted by the Engg Incharge (Divisional Engr.) for concrete to be used in unimportant locations it shall be carried out on a water tight platform and care shall be taken to ensure that mixing is continued until the mass is uniform in colour and consistency. In case of hand mixing, an extra 10% of cement shall be added to each batch and additional cost due to extra cement will be borne by the Contractor.

### **12.20 Conveying Concrete**

Concrete shall be handled and conveyed from the place of mixing to the place of final laying as rapidly as practicable by approved means before the initial setting cement starts. Concrete should be conveyed in such a way which will prevent segregation or loss of any of the ingredients. If segregation does occur during the transport of concrete same shall be re-mixed. The requirements to be fulfilled during transportation are :

- No segregation or separation of materials in the concrete, and

- Concrete delivered at the point of placing should be uniform and of proper consistency.

### **12.21 Placing Concrete**

Form work and reinforcement shall be approved in writing by the Engg Incharge (Divisional Engr.) before concrete is placed. The forms shall be well wetted and all shavings, dirt and water that may have collected at the bottom shall be removed before concrete is placed. Concrete shall be deposited in its final position without segregation, re-handling or flowing. As far as possible concrete shall be placed in the formwork by means approved by the Engg Incharge (Divisional Engr.) and shall not be dropped from a height or handled in a manner which may cause segregation. Any drop over 180 cm. shall have to be approved by the Engg Incharge (Divisional Engr.). Once the concrete is deposited in its final position, it shall not be disturbed. Care should be taken to avoid displacement of reinforcement or movement of formwork.

The placing of concrete shall be a continuous operation with no interruption in excess of 30 minutes between the placing of continuous portions of concrete. When fresh concrete is required to be placed on previously placed and hardened concrete, special care should be taken to clean the surface of all foreign matter. For securing a good bond and water tight joint, the receiving surface should be made rough and a rich mortar placed on it unless it has been poured just before. The mortar layer should be about 15 mm thick with cement and sand proportion as that of the mix in use, and have the same water-cement ratio as the concrete to be placed.

After the concrete has been placed it shall be thoroughly compacted by approved mechanical vibration to a maximum subsidence without segregation and thoroughly worked around reinforcement or other embedded fixtures into the correct form and shape. Vibrators must be operated by experienced men and over vibration shall not be permitted. Care should be taken to ensure that the inserts, fixtures, reinforcement and formwork are not displaced or disturbed during placing of concrete. No concrete shall be placed in open while it rains. If there is any sign of washing of cement and sand, the concrete shall be entirely removed immediately. Slabs, beams and similar structure shall be poured in one operation normally. In special circumstances with the approval of Engg Incharge (Divisional Engr.) these can be poured in horizontal layers not exceeding 50 cm. in depth. When poured in layers, it must be ensured that the under layer is not hardened. Bleeding of under layer if any shall be effectively removed.

### **12.22 Compaction of Concrete**

Compaction is necessary for production of good concrete. After the concrete has been placed it shall be thoroughly compacted by approved mechanical vibrator to a maximum subsidence without segregation and thoroughly worked around reinforcement or other embedded fixtures into the correct form and shape. Vibrators must be operated by experienced men. Care should be taken to ensure that the inserts, fixtures, reinforcement and formwork are not displaced or disturbed during the vibration of the concrete. The Contractors shall provide standby vibrators. Vibration is

commonly used method of compaction of concrete, the use of mechanical vibrators complying with IS 2505, IS 2506, IS 2514 and IS 4656 for compacting concrete is recommended

For all practical purposes, the vibration can be considered to be sufficient when the air bubbles cease to appear and sufficient mortar appears to close the surface and facilitate easy finishing operations. The period of vibration required for a mix depends upon the workability of the mix.

### **12.23 Curing of Concrete**

In order to achieve proper and complete strength of the concrete, the loss of water from evaporation should be prevented. Eighty to eighty five per cent of the strength is attained in the first 28 days and hence this 28-day strength is considered to be the criterion for the design and is called characteristic strength. The concrete after setting for 24 hours shall be cured by keeping the concrete wet continuously for a period of 10 days after laying.

The curing increases compressive strength, improves durability, impermeability and abrasion resistance. Failure to carry out satisfactory curing can lead to cracking in the concrete. This in turn can lead to salt attack of the reinforcement and consequential failure of the structure. If cracks occur in a structure which are severe enough to affect the structure, the Contractor shall cut out and replace the defective concrete at his own cost. The Contractor's attention is, therefore, drawn to this particular aspect of proper and adequate curing.

### **12.24 Construction joints**

Construction joints are a potential source of weakness and should be located and formed with care and their number is kept to a minimum.

When the work is to be interrupted, the concrete shall be rebated at the joint to such shape and size as may be required by the Engg Incharge (Divisional Engr.) or as shown on the drawings. All vertical construction joints shall be made with water bars which are rigidly fixed and shall provide a positive barrier against movement of water through the joint. Great care shall be taken when placing concrete around water bars because the space is often congested. Concreting shall be carried out continuously up to construction joints. Construction joints, if not described on the drawings, shall be in accordance with the following:

- In a column, the joint shall be formed about 75 mm below the lowest soffit of the beams framing into it, at the meeting points of the columns and the raft, and at the point of contraflexure in the columns.
- Concrete in a beam shall be placed throughout without a joint. However if the provision of a joint is unavoidable, the joint shall be vertical and at the middle of the span.
- A joint in a suspended floor slab shall be vertical at one of the quarter points of the span and at right angle to the principal reinforcement.
- Additional reinforcements and shear keys shall be provided at the construction joints.

In forming a joint, concrete shall not be allowed to slope away to thin edge. The locations of construction joints shall be planned by the contractor well in advance of pouring and be approved by the Engg Incharge (Divisional Engr.).

Construction joints in foundation of equipment shall not be provided without the approval of Engg Incharge (Divisional Engr.).

### **12.25 Expansion and separation joints**

Expansion joints shall be as shown on the drawings or as specified in the schedules. Expansion joint filler boards conforming to IS 1838 and sealing strips shall have minimum transverse joints. Joints shall be vertical and straight except where otherwise approved and concrete surfaces and faces shall be flush on bothsides of the joint.

Separation joints shall be with standard water proof paper or with as alkathene sheets about 1 mm in thickness. Lap length and sealing of laps shall be to the satisfaction of the Engg Incharge (Divisional Engr.).

### **12.26 Removal of formwork**

Formwork shall be kept in position fully supported, until the concrete has hardened and gained sufficient strength to carry itself and any loads likely to be imposed upon it. Stripping must be effected in such a manner and at such a time that no shock or other injury is caused to the concrete. The responsibility for safe removal rests with the Contractor but the Engg Incharge (Divisional Engr.) may delay the time of striking if he deems it necessary.

Minimum periods, in the absence of agreement to the contrary, between completion of concreting and removal of forms are given below but due regard must be paid to the method of curing and prevailing conditions during this period.

- |   |         |
|---|---------|
| • Removal of shuttering to sides of rafts, walls, beams and columns   | 2 days  |
| • Removal of shuttering to slabs, beams and arches (props left under) | 6 days  |
| • Removal of props to slabs, beams and arches                         | 16 days |
| • Lifting of precast members  | 16 days |

### **12.27 Precast concrete members**

Precast concrete members shall be used in the works only where specified on the Drawings or approved by the Engg Incharge (Divisional Engr.).

The technical specifications for cement concrete, formwork and reinforcement covered under earlier clauses shall form a part of these specifications and shall be followed for carrying out precast concrete work.

Precast members shall not be disturbed or lifted until the minimum periods specified for formwork removal have elapsed.

### **12.28 Load Test on Parts of Structures**

The load test on concrete , if desired by the Engg Incharge (Divisional Engr.) shall be carried as soon as possible after the expiry of 28 days from the time of placing of concrete as per the clause 16.5 to 16.6 of IS : 456. The structure shall be subjected to a load equal to full dead load of the structure plus 1.25 times the imposed load for a period of 24 hours and then the imposed load shall be removed. The entire cost of load testing shall be borne by the contractor and if any portion of the structure found unacceptable under the relevant clause of IS : 456, the same shall be dismantled and replaced by a new structure as per specification at no extra cost to the Employer. If during dismantling any of the adjacent structure is damaged, the same shall be made good free of charge by the contractor to the satisfaction of the Engg Incharge (Divisional Engr.).

### **12.29 Finish of concrete surface**

#### **12.29.1 Concrete cast against formwork.**

The following finishes to concrete surfaces, unless otherwise specified or shown on the drawings, shall be as follows—

- **Class A1:** All permanently exposed surfaces, including exposed sides of foundations.
- **Class A2:** Surfaces to be covered by backfill, plasters or the like.

Class A1 surfaces shall be dense, fair, smooth, even, free from honeycombing, water and air holes and other blemishes, true to line and surface and free from board or panel marking. They shall be of uniform colour. Rendering of defective surfaces shall not be permitted, and, if ordered by the Engg Incharge (Divisional Engr.), the Contractor shall at his own expense cut out to expose reinforcement and make good any unsatisfactory work. All areas so treated shall be rubbed down and kept moist for several days.

Class A2 surfaces shall be dense, even, free from honeycombing and true to line and surface.

Any special finishes will be to details or instructions given by the Engg Incharge (Divisional Engr.).

#### **12.29.2 Concrete not cast against formwork.**

The following finishes shall be provided unless otherwise specified or shown on the drawings—

- **Class B1:** All permanently exposed surfaces, including tops of equipment foundations, wall copings, window sills, precast items (except paving flags ).
- **Class B2:** Paving flags and paths. Floors and slabs to be surfaced with blocks, tiles or waterproofing materials.
- **Class B3:** Roads, buried concrete and floors or slabs to be covered by screed.

Class B1 surfaces shall first be levelled and screened to produce a true surface. After the moisture film has disappeared, and the concrete has hardened sufficiently, the surface shall be finished with a steel trowel under firm pressure to give a smooth, dense, even and hard surface free from all marks and defects.

Class B2 surfaces shall be levelled and screened to produce a true surface, and be finished with wooden or steel float to give a level surface free from screed marks. Excessive floating shall be avoided.

Class B3 surfaces shall be levelled and screened to produce a true and uniform surface.

### **12.30 Holes, pockets, threaded inserts, etc.**

The threaded inserts for casting into concrete shall be electro-galvanized and of malleable iron or mild steel. Holes, cavities and fixings shall be provided in the works only at the positions indicated on the drawings or as directed and they shall be incorporated as necessary during the work of concreting. Unless otherwise agreed a tolerance in position of plus or minus five millimetres shall be allowed. Inserts and bolts shall be fixed square in the works by means of temporary bolts or nuts, and then concrete cast around them. The projecting portions of such fixings, and concrete within fifty millimetres of them, shall be bitumastic painted and all threads well greased on completion of the work. Holes and pockets shall be stripped down clean on completion.

### **12.31 Blinding**

Blinding concrete shall be made with nominal aggregate sizes of both 20mm and 40mm diameter. They shall be referred to respectively as grade M 10/20 and M 10/40.

Under all foundations and elsewhere as indicated on the drawings a layer of concrete grade M10 (1:3:6) shall be laid immediately the excavation is carried down to foundation level. The blinding surface shall be thoroughly cleaned before foundation concrete is deposited thereon. Sumps shall be provided where necessary to facilitate the control of drained water. The grade shall be applied as shown in Table 15.31.1

<b>Location</b>	<b>Grade</b>	<b>Thickness of layer</b>
Foundations and bases	M 10 / 1:3:6	75 mm
Floors of ducts, trough and reinforced slabs not exceeding 100 mm	M 10 / 1:3:6	50 mm

**Table 15.31.1. Blinding layer thickness values**

### **12.32 Admixtures and 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. Concrete admixtures and additives shall be approved by the Engg Incharge (Divisional Engr.).

The Contractor shall use an approved neutralized vinsol resin air-entraining agent in all concrete. The Air entraining agent shall be supplied and batched as a solution with a solids content not exceeding 15 percent by weight with suitable, stable and consistent pH.

The Contractor may propose and the Engg Incharge (Divisional Engr.) 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 overcoming unusual circumstances and placing conditions.

Water-reducing set-retarding admixture shall be an approved brand of Igno-sulphonate type admixture.

Water proofing cement additives shall be used as required or advised by the Engg Incharge (Divisional Engr.).

### **13. MISCELLANEOUS GENERAL REQUIREMENTS**

Dense concrete with controlled water cement ratio, preferably 0.45, 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.

All joints including construction and expansion joints for the water retaining structures shall be made water tight by using PVC ribbed water stops with general 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.

All steel sections and fabricated structures which are required to be transported by sea shall be provided with anti corrosives paint.

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

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.

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

Monorails, monorail girders and fixtures shall be provided, wherever required.

Doors and windows on external walls of buildings other than areas provided with insulated metal claddings shall be provided with a RCC sun-shade over the openings with 300 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.

All stairs shall have maximum riser height of 180 mm and a minimum tread width of 250 mm. Minimum width of stairs shall be 1200 mm. There shall be provision of of stair case to the roof of the building.

Angles of 50x50x6 mm minimum with lugs shall be provided for edge protection all round cut out and openings in floor slab, edges of drains with grating covers, edges of RCC cable/pipe trenches with covers, edges of manholes with covers, edges of precast covers and any other place where breakage of corners of concrete is expected.

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.

Handrailing of a minimum height of 900 mm shall be provided around all floor or roof openings, projections and balconies walk ways, platforms, steel stairs etc. All handrails and ladder pipes shall be The railing of the staircase shall be made of proper aluminium sections. All rungs for ladders shall also be of aluminium as per IS:.

For RCC stairs, also handrailing with aluminium sections are to be provided.

#### **14. INTERFACING**

Proper coordination and execution of all interfacing civil works activities such as fixing of conduits in roofs/walls/floors, fixing of foundation bolts, fixing of lighting fixtures, fixing of supports/embedments, provision of cutouts etc. shall be the sole 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 such that dismantling, breakage etc. is reduced to minimum.

#### **15. STATUTORY RULES**

The Contractor shall comply with all the applicable statutory rules pertaining to Factories Act (as applicable for ORISSA State), Fire Safety Rules of Tariff Advisory Committee, Water Act for pollution control etc. Provisions for fire proof doors, numbers 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.

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

## **2. ANTIWEED TREATMENT AND SITE SURFACING**

### **SCOPE OF WORK**

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 Engg Incharge (Divisional Engr.).

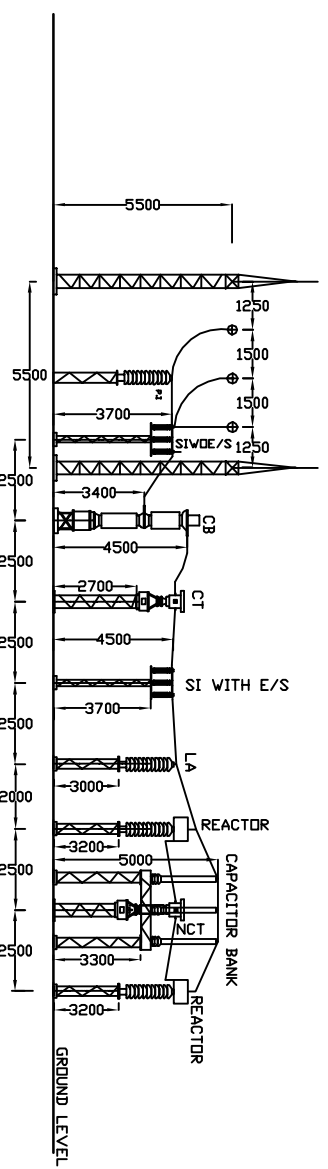
#### **General Requirement**

The material required for site surfacing/gravel filling shall be free from all types of organic materials and shall be of standard approved quality, and as directed by the Engg Incharge (Divisional Engr.).

The Contractor shall furnish and install the site surfacing to the lines and grades as shown in the drawing and in accordance with the requirements and direction of the Engg Incharge (Divisional Engr.). The soil of the periphery area of the switchyard area shall be subjected to sterilisation or anti-weed treatment before placing the site surfacing/gravel fill material or strictly as per instruction or requirement of the manufacturer of the chemical required for soil sterilisation or anti-weed treatment. After all the structures and equipment have been erected and accepted, and soil sterilisation of the peripheral area (except the switch yard area) as specified is complete, the site shall be maintained to the lines and grades indicated in the drawing and rolled or compacted by using three ton roller with suitable water sprinkling to form a smooth and compact surface condition which shall be matching with finished ground level of the switchyard area.

#### **Chemical to be used for soil sterilisation /anti-weed treatment:**

The details of quantities and method of application of chemicals used for soil sterilisation /and anti-weed treatment shall be as per manufacturer`s recommendations. Bidders are required to submit the details of chemicals proposed to be used and recommendations of manufacturer with required guarantee alongwith their bids for necessary approval of the Engg Incharge (Divisional Engr.). Approval of the Engg Incharge (Divisional Engr.) by no means shall relieve the contractor of their contractual obligations as stipulated in General and Special Conditions of Contract.

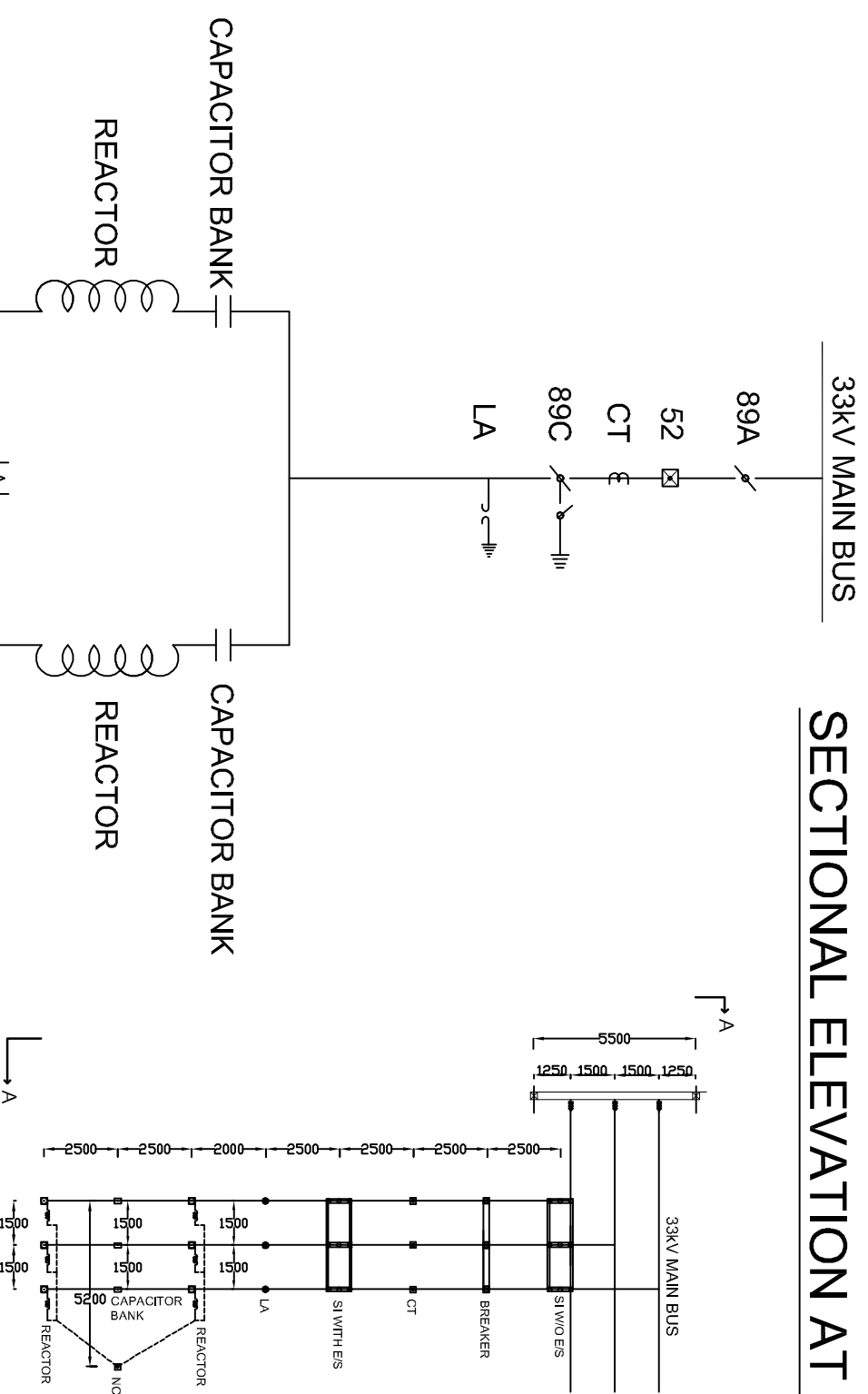


**SECTIONAL ELEVATION AT A-A**

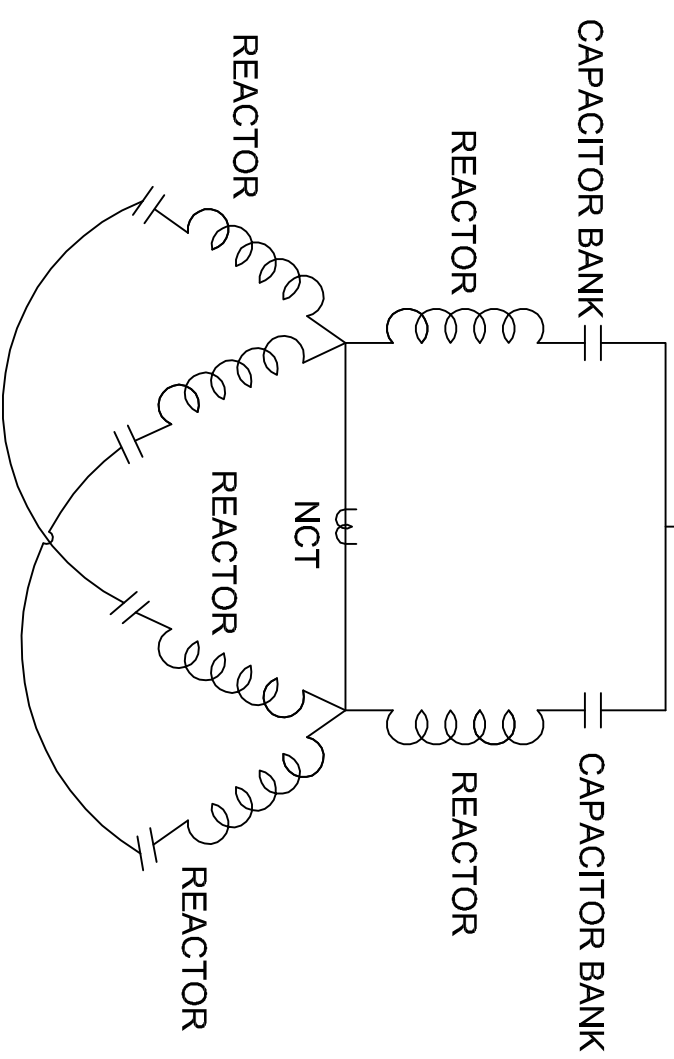
BILL OF MATERIALS		
SL.NO.	DESCRIPTION	QUANTITY
1	SINGLE ISOLATOR WITH OUT EARTH SWITCH	1 SET.
2	SINGLE ISOLATOR WITH EARTH SWITCH	1 SET.
3	BREAKER	1 SET.
4	CURRENT TRANSFORMER INCL. NCT	4 NOS.
5	LIGHTNING ARRESTOR	3 NOS.
6	REACTOR	6 NOS.
7	CAPACITOR BANK	1 SET.
8	POST INSULATOR	1 SET.

NOTE:- ALL DIMENSIONS ARE IN MM.

- 1- 33KV BUS HEIGHT GENERALLY MAINTAINED AT 3.7MTR.
- 2- CONDUCTOR FOR INTER CONNECTION OF ALL EQUIPMENT SHALL BE ACSR ZEBRA..
- 3- INTERCONNECTION FOR REACTOR TO CAPACITOR & REACTOR TO NCT SHALL BE DONE BY USING ALUMINIUM FLAT OF ADEQUATE SIZE TO TAKE CARE OF SIC.
- 4- TERMINAL CONNECTOR FOR RESPECTIVE EQUIPMENT SHALL BE PROVIDED.
5. CAPACITOR 3 ph. 38KV.



**PLAN**



**SINGLE LINE DIAGRAM**

## PROPOSED 33KV CAPACITOR BANK SCHEME FOR OPTCL PROJECT



**ORISSA POWER TRANSMISSION CORPORATION LIMITED**  
(A Government of Orissa Undertaking)

**TECHNICAL SPECIFICATION**

**GUARANTEED TECHNICAL PARTICULARS**  
**EQUIPMENTS/MATERIALS**  
**FOR**  
**(33KV SHUNT CCAPACITOR BANK&ASSOCIATED EQUIPMENT)**

**ANNEXURE-III**

IMPORTANT NOTE:-

(BIDDER SHOULD FILLUP THE SAME DULY SIGNED  
WITH SEAL AT EACH PAGE AND FURNISH ALONG  
WITH TECHNO COMMERCIAL DOCUMENT)

**A) GUARANTEED TECHNICAL PARTICULARS OF CIRCUIT BREAKERS**  
**(To be filled in and signed by the Bidder)**

Sl.No.	DESCRIPTION	36 KV (VACUUM)
1.	Name of Manufacturer & Address	:
2.	Type & designation	:
3.	Conforming Standard	:
4.	Service (outdoor/indoor)	:
5.	Rated voltage KV (Nominal & maxm.)	:
6.	Frequency	:
7.	Insulation Level	:
	a) 1.2/50 micro-sec Li.I. withstand voltage (KVp)	
	i) between line terminals and ground parts	
	ii) between line terminals with breaker contracts open.	
	b) One minute Power frequency withstand KV (rms) for dry & wet conditions	:
	i) between line terminals & ground parts	
	between terminals with breaker contacts open	
8.	Rated normal current Amps (rms)	:
9.	Short time current rating (KA) for 3 Sec.	:
10.	Temperature rise above ambient. Due to Rated current in main contacts (°C)	:

11. Rated operating duty :
12. Short circuit Breaking Current :
13. Asymmetrical Breaking current (including DC component) – KA (rms)
14. Rated TRV for terminal fault (KVP) :
15. Rated making capacity (KA peak) :
16. Date on Restriking Voltage for 100%  
50% and 10% rated capacity :
  - a) Amplitude factor ..... :
  - b) Phase factor ..... :
  - c) RRRV Volts / micro sec. :
17. Breaking capacity under phase  
Opposition condition in KA and the  
Recovery voltage over poles in KV:
18. Short time fault breaking  
Capacity.....MVA. :
19. Line-charging current breaking capacity
  - a) Line charging current...AMP. :
  - b) Corresponding Over voltage (KV) :
20. Maxm. Cable charging current breaking  
Capacity in Amps and corresponding  
over voltage in KV as observed in Tests:
21. Maxm. shunt capacitor bank switching/  
Breaking capacity in MVA and the  
Over voltage factor. :
22. Maxm. Over-voltage in kilovolts on

Switching OFF Transformer on low-load :

23. Total-break time in milli seconds measures  
From the instant of trip- circuit energisation:  
a) at 10% breaking capacity  
b) at 100% breaking capacity.
24. Arcing timje.....(ms)  
a) at 10% breaking capacity :  
b) at 100% breaking capacity. :
25. i) Breaks per pole.... No.  
ii) Length of each break per pole(mm) :  
iii) Length of moving contact travel.. mm :  
iv) Rate of contact travel (m/sec) :
26. Make time (milli. Secs) :
27. Minimum re-closing time at rated  
Interrupting capacity from the instant of  
The trip coil energisation (milisechs.) :
28. Minimum dead time for 1 phase & 3 phase  
re-closing with corresponding limits of  
adjustment of dead time if any (milli.secs):
29. Maximum radio interference voltage  
Between 0.5 MHz to 2 MHz with voltage  
Of 110% of rated rms voltage between  
Phase & ground (Micro-Volt) :
30. Contacts  
a) Type:  
i) Main.... :  
ii) Arcing.... :  
  
b) Material  
i) Main... :  
ii) Arcing.... :



- c) Whether the Main Contacts are Silver plated.
  - d) Thickness of Silver coating of Main contacts in micron.
  - e) Contact-pressure for Main & Arcing contacts... kg/cm<sup>2</sup>.
31. Type of Arc-control Device.
32. Whether main column and interrupter Are pressurized by SF6 gas. Whether One pressure system. Vacuum
34. Auxiliary contacts :
- i) Manufacturer's designation & description.
  - ii) Material.
  - iii) Whether silver plated
  - iv) Rating at 220 VDC for 33KV and above & 30 VDC for 12KV as follows:
    - a) Continuous.... AMPS :
    - b) Inductive..... AMPS. :
35. No. of auxiliary Switch/Multiplied contacts, Operating with all individual poles of a Breaker.
- a) which are closed when breaker is closed:
  - b) which are open when breaker is closed :
36. No. of operations possible without maintenance.
- a) At full rated interruption capacity :
  - b) At 50% rated interruption capacity :
  - c) At full rated current. :
  - d) At 50% rated current. :
37. Power required for –
- i) Trip coil
  - ii) Closing coil. :

38. Type of operating mechanism for  
 a) Opening :  
 b) Closing. :
39. Minimum clearance in air. :  
 a) Between phase... in mm :  
 b) height of live parts from  
 ground level in mm :
40. Impact for foundation design to include  
 Dead load plus impact value on opening  
 At maximum interrupting rating, in terms  
 Of equivalent load. :
41. Shipping weight of the Circuit Breaker...Kg
42. Overall dimensions of the Circuit Breaker  
 Complete with bushing & mechanism  
 Box etc. (mm) :
43. Shipping dimension of the largest  
 Package....mm

**B) GUARANTEED TECHNICAL PARTICULARS FOR ISOLATORS**

(To be filled in and signed by the Bidder)

Sl. No.	Description	33KV HCDB
1.	Manufacturer's Name & Address:	
2.	Type & designation	:
3.	Conforming Standard	:
4.	Number of poles	:
5.	Indoor or Outdoor	:
6.	Rated Voltage (KV)	:
.	Maximum permissible continuous Service voltage	:
8.	Rated Frequency (Hz)	:
9.	Rated Insulation level (1.2//50 micro-sec. Impulse KVp)	:
	a) To earth and between poles	:
	b) Across isolating distance:	
10.	One minute P.F. withstand Voltage (KV rms)	:
	a) To earth and between poles	:
	b) Across isolating distance:	
11.	Rated Normal Current (Amps)	:
12.	Rated Short time withstand Current (Amps for 3 sec)	:

13. Rated short time making Current of main and earth switch (Amps) :
14. Minimum clearance in air (mm) :
  - a) between phases :
  - b) to earth :
  - c) across isolating distance :
15. Type of operating mechanism :
  - a) Main switch :
  - b) Earth switch :
16. Rated auxiliary supply voltage :
  - AC :
  - DC :
17. Number and type of auxiliary Contacts for :
  - a) main blade :
  - b) earth switch :
18. Temperature rise above ambient Of 50°C at rated current (°C) :
19. Operating time for closing (milli-sec) :
20. Operating time for opening (milli-sec) :
21. Power required for closing Operation of AC motor at rated Auxiliary AC supply (wait) :
22. Power required for opening

- Operation of AC motor at rated  
Auxiliary AC supply (wait) :
23. Rated magnetizing /capacitive  
Current make and break  
capacity (Amps) :
24. Number of make before make  
and break after break contacts :
25. Whether contacts are Silver-plated :
26. Thickness of silver coating :
27. Creepage distance (Total) :
28. Type of material of main contacts  
(fixed & moving) :
29. Radio interference voltage  
(micro-volt) :
30. Mechanical Load for Horizontal  
Isolator Straight Load Cross Load :
31. Weight of 3-phase isolator  
Complete with operating  
Mechanism and support insulator  
With/without earth switch :
32. Support Insulator :
- a) Name of Manufacturer :
- b) Conforming Standard :
- c) Type & Designation :
- d) Cantilever Strength (Kg) :

- e) Min. Creepage Distance (mm) :
- f) Weight of Unit (Kg) :
- g) Height of Unit (mm) :
- h) Insulation Level :
- i) 1 minute Power frequency  
voltage withstand test  
(KV rms) :  
Dry :  
Wet :
- ii) 1.2/50 micro-sec Lightning  
Impulse Voltage withstand  
Test (KVp) :

**C) GUARANTEED TECHNICAL PARTICULARS OF CURRENT TRANSFORMERS**

(To be filled in and signed by the Bidder)

- | Sl. No. | Description                                      | 33KV |
|---------|--|------|
| 1.      | Manufacturer's Name & Address                    | :    |
| 2.      | Type & Designation                               | :    |
| 3.      | Conforming Standard                              | :    |
| 4.      | Rated Voltage (KV)                               | :    |
| 5.      | Rated primary current (Amp)                      | :    |
| 6.      | Rated secondary current (Amp)                    | :    |
| 7.      | Extended current rating (Amp)                    | :    |
| 8.      | Details of Cores (for non-PS class):             |      |
|         | i) Current ratio                                 | :    |
|         | Core – I   | :    |
|         | Core – II  | :    |
|         | ii) Accuracy Class / ALF/ISF                     | :    |
|         | Core – I   | :    |
|         | Core – II  | :    |
| 9.      | Short time thermal rating of primary current for |      |
|         | i) 1 sec   | :    |
|         | ii) 3 sec  | :    |
| 10.     | Rated dynamic current of primary (KVp)           | :    |
| 11.     | Rated continuous thermal current KA rms)         |      |
| 12.     | Temperature rise at rated continuous thermal     |      |

Current over 50°C Ambient Temp (°C)

- a) Winding :
- b) Oil at top :
- c) Exposed current carrying parts :

13. Rated insulation level

- a) 1.2/50 micro second Impulse withstand voltage (dry) on primary winding (KV peak) :
- b) One minute power frequency withstand voltage (Dry) on primary winding (KV rms)

- a) One minute power frequency Withstand voltage (Wet) on Primary winding (KV rms) :
- b) One minute power frequency Withstand test voltage in secondary winding (KV rms) :

14. Bushing

- a) Minimum creepage distance (mm) :
- b) Whether CT bushing is hermetically sealed or not :
- c) Cantilever Strength (Kgf) :

15. Reference of Magnetisation

Curve of CT cores :

16. Characteristics

- a) Ratio & Phase angle error :
- b) Magnetisation curves :

17. Total weight :

18. Weight oil (litre) :



- 19. Overall dimensions (mm) :
- 20. Mounting details :
- 21. Applicable standard :
- 22. Partial Discharge level in Pico-Coulomb :

## **D) GUARANTEED TECHNICAL PARTICULARS FOR LIGHTNING ARRESTORS**

(To be filled in and signed by the Bidder)

Sl. No.	Particulars	36 KV
1.	Name of Manufacturer & Address :	
2.	Type & Designation :	
3.	Conforming Standard :	
4.	Performance Data based on Standard No :	
5.	a) No. of Units per Arrestor :	
	b) Voltage rating of units :	
	c) Total rating of Arrestor :	
6.	Nominal Discharge Current (KVp) (for a 8/20 microsecond wave) :	
7.	Maximum continuous operating voltage (KV) :	
8.	L.A. Housing Insulation Withstand (KV) a) Dry (P.F.) :	
	b) Wet (P.F.) :	
	c) Lightning impulse (Dry) :	
9.	a) Reference current :	
	b) Reference voltage :	
	c) IR at MCOV :	
	d) TC at MCOV :	
10.	Protective ratio based on our	

- Transformer BIL. :
11. Lightning Impulse Residual voltage (KVp) (8/20 micro-second wave) :
    - i) 5000 Amps :
    - ii) 10.000 Amps :
  
  12. Residual voltage after passing a Steep current (1 microsecond Front time) with amplitude equal To Nominal Discharge Current :
  
  13. Residual voltage for switching Impulse current (front time of about 30 to 60 microseconds) in KV crest at 500/1000 Amps. :
  
  14. Minimum energy discharge capacity at
    - i) Rated voltage.
    - ii) MCOV
    - b) Long duration current impulse withstand class :
  
  15. High current impulse withstand Capacity (4/10 microsecond) in KAp :
  
  16. Pressure Relief :
    - a) High Current :
    - b) Low Current :
    - c) Standard followed :
  
  17. Temporary over voltage capability (K Vrms)
    - i) 0.1 seconds :
    - ii) 1.0 seconds :
    - iii) 10.0 seconds :
    - iv) 100.00 seconds. :

18. a) Maximum RIV in Micro volts:  
b) Partial Discharge in Pico-Coulomb :
19. Creepage Distance Total (mm) :
20. Cantilever strength (Kgf). :
21. Over Dimensions of Arrestor(mm) :
22. Net weight of Arrestor (kg.)
23. Pitch Circle Diameter & no. of Bolts with dia. Of L.A. base :
24. Corona Extinction Voltage (KVrms):

**E) GUARANTEED TECHNICAL PARTICULARS FOR CLAMPS AND CONNECTORS.**

(To be filled in and signed by the Bidder)

**CLAMPS AND CONNECTORS:**

Sl.No. Description 33 KV

1. Name of Manufacturer & Address :
2. Type & Designation :
3. Conforming Standard :
4. Material designation :
5. Designed rated current (A) :
6. Designed short time current (KArms)  
(a) 220/132/66/33KV for 3 sec. :
7. Composition of aluminum alloy  
In perentage :
8. Current density (A/Sq.mm)  
(a) Aluminium
9. Minimum thickness of bimetallic  
Element (mm) :
10. Temperature rise at full load and  
Above 50°C ambient (°C) :
11. Tensile strength (Kg.) :
12. Corona Extinction voltage (KVrms):
13. Electrical conductivity :

14. Magnetic power loss :

**F) GUARANTEED TECHNICAL PARTICULARS OF CONTROL & RELAY PANEL.**

(To be filled in and signed by the Bidder)

**A. CONTROL AND RELAY PANELS:**

1. Manufacturer's Name & Address
2. Type & Designation :
3. Conforming Standard :
4. Type of sheet steel :
5. Thickness of sheet steel :
  - a) Front :
  - b) Back :
  - c) Sides :
6. Details of Painting :
7. Weight of each panel section :
8. Overall dimensions of each panel  
Section in mm.  
(width x depth x height) :
9. Total weight of all panels :
10. Space required for installation  
Of all panels. :
11. Details of Tropicalisation :
12. Largest package for Transport :

- a) Gross weight :
  - b) Overall dimensions :
- B. SEMAPHORE INDICATORS.
1. Manufacturer's Name & Address
  2. Type & Designation :
  3. Conforming Standard :
  4. Diameter of the Disc :
  5. Operating Voltage :
  6. Burden :
- C. TERMINAL BLOC
1. Manufacturer's Name & Address
  2. Type & Designation :
  3. Conforming Standard :
  4. Applicable standard :
  5. No. of terminal studs per way :
  6. Rated current :
  7. Rated voltage :
  8. Material used :
    - a) Body :
    - b) Terminal studs :
    - c) Connecting links :

- d) Support springs :
9. Minimum no. of conductors of Area 2.5 sq.mm suitable for connection. :
    - a) All circuits except CT :
    - b) CT Circuits. :
- D. CONTROL SWITCHES ; :
1. Manufacturer's Name & Address
  2. Type & Designation :
  3. Conforming Standard
  4. Type of Handle :
  5. No. of possible positions of Handle with diagrams :
    - a) No. of contacts available :
    - b) Maximum No. of contacts which can be accommodated for each position :
  6. Rating Contacts:
    - a) Voltage :
    - b) Make and carry current continuously :
    - c) Make and carry current for 0.5 sec. :
    - d) Break resistive load :
    - e) Break inductive load :
  7. Whether locking arrangement provided :



- 8. Mounting details :
- 9. Dimensions `` :
- 10. Other information, if any :
  
- E. INDICATING LAMPS :
- 1. Manufacturer's Name & Address :
- 2. Type and Designation :
- 3. Conforming Standard :
- 4. Ratings
  - a) Current “
  - b) Voltage :
  - c) Wattage :
- 5. Colour of lamp :
- 6. Permissible voltage variation :
- 7. Whether series resistance is
  - provided , if so :
  - a) Ohmic value :
  - b) Power loss :
- 8). Line of lamp in burning hours :
- 9) Other information if any :
  
- F) PUSH BUTTONS :
- 1. Manufacturer's Name & Address :
- 2. Type and Designation :
- 3. Conforming Standard :
- 4. Contact type momentary/  
Maintained :
- 5. Whether integral integral engraved  
Inspection plates provided :
- 6. No. of NO/NC contacts :
  
- G: ANNUNCIATORS :
- 1. Manufacturer's Name & Address :
- 2. Type and Designation :
- 3. Conforming Standard :

4. No. of windows :
  5. Dimensions of each window  
(Length height x depth) :
  6. No. of lamps per window :
  7. Auxiliary supply voltage :
  8. Power Consumption :
  9. Details of auxiliary equipment  
Such as relays etc. :
  10. Required instantaneous making  
Making capacity of initiating contacts
  11. Type of reset-manual/self :
  12. Overall dimensions of  
Annunciators :
  13. Particulars of wiring :
  14. Technical literature :
  15. Brief write- up of the scheme  
Furnished :
- H. INDICATING METERS :
- (To be furnished separately for each type of meter)
1. Manufacturer's Name & Address :
  2. Type and Designation :
  3. Conforming Standard :
  4. Rate
    - a) Effective Range
    - b) Fiducial value
  5. CT Ratio
  6. PT Ratio
  7. Details of shunt, if any :
    - a) Rated current :
    - b) Rated voltage drop :
  8. Accuracy class :
  9. Total deflection angle :
  10. Total scale length :
  11. Overall dimensions :
  12. Burden :
    - a) Current coil :

- b) Voltage coil. :
- 13. Short time rating :
- a) Current coil :
- b) Voltage coil. :
- c) Time :
- 14. Resolution :
- (i) Time :
- (ii) Amplitude :

I. OVERCURRE RELAYS-NON-DIRECTIONAL:

- 1. Manufacturer's Name & Address :
- 2. Type and Designation :
- 3. Conforming Standard :
- 4. Rated Current :
- 5. Rated DC voltage :
- 6. Operating Principle :
- 7. Solid State or Electro mechanical :
- 8. Thermal Withstand Rating :
- 9. Number of Contact :
- a) Normally open :
- b) Normally closed :
- 10. Contacts- Self reset :
- 11. Burden at highest and lowest tap :
- 12. Operation indicator provided :
- 13. Contact Ratings:
  - a) Make and carry continuously
  - b) Make and carry for 0.5 sec.
  - c) Break:
    - I. Resistive Load :
    - II. Inductive Load :
    - (with  $L/R=40$ ) :
- 14. Operating characteristic at 10 times current setting :
- 15. Over current unit setting range :
  - a) Inverse time :
  - b) High set list unit :
- 16. Characteristic angle for

Directional Relay. :

J. EARTH FAULT RELAYS NON-DIRECTIONAL:

1. Manufacturer's Name & Address :
2. Type and Designation :
3. Conforming Standard :
4. Rated Current :
5. Rated DC voltage :
6. Operating Principle :
7. Solid State or Electro mechanical :
8. Thermal Withstand Rating :
9. Number of Contact :
  - a) Normally open :
  - b) Normally closed :
10. Contacts- Self reset :
11. Burden at highest and lowest tap :
12. Operation indicator provided :
13. Contact Ratings:
  - a) Make and carry continuously
  - b) Make and carry for 0.5 sec.
  - c) Break:
    - I. Resistive Load :
    - II. Inductive Load  
(with  $L/R=40$ ) :
14. Operating characteristic at  
10 times current setting :
15. Over current unit setting range :
  - a) Inverse time :
  - b) High set inst. unit :
16. Characteristic angle for  
Directional Relay.

K. DEFINIT TIME EARTH FAULT RELAY:

1. Manufacturer's Name & Address :
2. Type and Designation :
3. Conforming Standard :
4. Rated Current :

5. Rated DC voltage :
6. Operating Principle :
7. Solid State or Electro mechanical :
8. Thermal Withstand Rating :
9. Number of Contact :
  - a) Normally open :
  - b) Normally closed :
10. Contacts- Self reset :
11. Burden at highest and lowest tap :
12. Operation indicator provided :
13. Contact Ratings:
  - a) Make and carry continuously
  - b) Make and carry for 0.5 sec.
  - c) Break:
    - I. Resistive Load :
    - II. Inductive Load  
(with L/R=40) :
14. Current setting range :
15. Time setting range :

L. TRIP CIRCUIT SUPERVISION RELAY:

1. Manufacturer's Name & Address :
2. Type and Designation :
3. Conforming Standard :
4. Rated DC voltage :
5. Operating Principle :
6. Electro mechanical :
7. Thermal Withstand Rating :
8. Number of Contact :
  - a) Normally open :
  - b) Normally closed :
9. Contacts- Self reset :
10. Burden :
11. Operation indicator provided? :
12. Contact Ratings:
  - a) Make and carry continuously
  - b) Make and carry for 0.5 sec.

- c) Break:
  - I. Resistive Load :
  - II. Inductive Load  
(with  $L/R=40$ ) :
- 13. Whether pre-closing & post :  
Closing supervision provided?
- 14. Time delay :
  
- M. LEADING VAR /PF SUPERVISION RELAY:
- 1. Manufacturer's Name & Address :
- 2. Type and Designation :
- 3. Conforming Standard :
- 4. Rated DC voltage :
- 5. Operating Principle :
- 6. Electro mechanical :
- 7. Thermal Withstand Rating :
- 8. Number of Contact :
  - a) Normally open :
  - b) Normally closed :
- 9. Contacts- Self reset :
- 10. Burden :
- 11. Operation indicator provided? :
- 12. Contact Ratings:
  - a) Make and carry continuously
  - b) Make and carry for 0.5 sec.
  - c) Break:
    - I. Resistive Load :
    - II. Inductive Load  
(with  $L/R=40$ ) :
- 13. Whether pre-closing & post :  
Closing supervision provided?
- 14. Time delay :

G. GUARANATEED TECHNICAL PARTICULARS OF CAPACITORS

(To be filled in and signed by the Bidder)

1.		Manufacture's Name	:	
2.		Maker's Type Designation	:	
3.		Standard followed	:	
4.		Purpose	:	
5.		Location	:	
6.		System Specification:	:	
		Voltage	:	
		Frequency.	:	
7.		Ambient Temperature:	:	
		Maximum Temperature	:	
		Minimum Temperature	:	
8.		Capacitor Bank	:	
	8.1	Rated output (Installed) KV KVA <sub>r</sub>	:	
	8.2	Rated output (Effective) KV KVA <sub>r</sub>	:	
	8.3	No. of Phase.	:	
	8.4	Type of connection	:	
	8.5	No. of units per bank	:	
	8.6	Power frequency withstand and voltage, KV (RMS)	:	
	8.7	Impulse withstand voltage KV (PEAK)	:	
	8.8	Type of mounting.	:	
	8.9	Terminal Arrangement: (a) Incoming (b) Outgoing	:	

9.		Capacitor Unit	:	
	9.1	Rated Output (KVAr)	:	
	9.2	Rated Voltage (KV)	:	
	9.3	Rated Current (A)	:	
	9.4	No. of Bushings	:	
	9.5	Unit Protection	:	
	9.6	Losses (Watts / kVAr)	:	
	9.7	Di-electric type	:	
	9.8	Insulation Level	:	
		(a) Power Frequency withstand voltage KV (RMS)	:	
		(b) Impulse withstand voltage KV(PEAK)	:	
	9.9	Permissible load:	:	
		(a) Voltage	:	
		(b) Current	:	
		(c) Output	:	
	9.10	Discharge device to discharge capacitor to 50V or less in 3000 secs after disconnection from supply.	:	
		(a) Directly connected internal discharge	:	
		(b) External DPRT/RVT provided	:	
		(c) Other discharge device	:	
10.		Creepage distance (mm/ kv)	:	
11.		Annual failure rate	:	
12.		Clearance:	:	
		From Phase to Phase	:	
		From Phase to Phase	:	



## H. GUARANATEED TECHNICAL PARTICULARS OF REACTOR

(To be filled in and signed by the Bidder)

1.		Reference Standard	:	
2.		System Specification:	:	
		Voltage (kV)	:	
		Frequency. (Hz)	:	
3.		Ambient Temperature:	:	
		Maximum Temperature	:	
		Minimum Temperature	:	
4.		Type of Reactor:	:	
	4.1	Purpose	:	
	4.2	Location	:	
	4.3	Mounting	:	
	4.4	Core	:	
	4.5	Shielding	:	
	4.6	No. of Phase	:	
	4.7	Connection	:	
5.		Reactor Rating:	:	
	5.1	Fundamental current of the reactor (Amps.)	:	
	5.2	Minimum Rated rms current including all harmonic current (Amps.)	:	
	5.3	Harmonic current through the reactor	:	
	5.4	Reactance/Phase (Ohms)	:	
	5.5	Maximum permissible continuous current (Amps.)	:	
	5.6	Short time current A for 5 Sec.)	:	
		a) for winding and outgoing terminal	:	
		b) for incoming terminal	:	
	5.7	Linearity (in case of iron core reactors)	:	
	5.8	Q-value of Reactor	:	

	5.9	Losses in Watt / Coil	:	
6.		Class of Insulation	:	
7.		Tolerance in Inductance	:	
8.		Insulation level.	:	
		a) Power frequency withstand voltage KV (rms)	:	
		b) Impulse withstand voltage KV (Peak)		
9.		Terminal Arrangement		
	a)	Incoming	:	
	b)	Outgoing	:	
10.		Winding material	:	
11.		Clearance :	:	
		From Phase to Phase	:	
		From Phase to Earth	:	
		Magnetic clearance		
12.		Creepage distance (mm/ kv)	:	
13.		Fittings (standard)	:	
		- Rating plate	:	
		- Earthing terminal	:	
		- Lifting arrangement	:	
		- base frame	:	
14.		Fittings (Optional) : To be housed in air tight Marshalling box with IP 55 Protection	:	

## (I) Guaranteed Technical Particulars of Conductor( ZEBRA )

<u>Sl. No.</u>	<u>Description</u>	<u>To be specified by Tenderers</u>
1.	Code Word	
2.	Maker's name address and Country. a) Aluminum rods b) Steel Wire/rods c) Complete conductor	
3.	Stranding and wire diameter a) Aluminum. b) Steel.	
4.	Standard nominal copper area in sq. mm	
5.	Calculated equivalent aluminum area in sq. mm	
6.	Actual aluminum area in sq. mm.	
7.	Standard area of cross section in sq. mm. a) Aluminum strand b) Steel strand c) Conductor	
8.	Diameter of complete conductor in mm.	

9. Minimum ultimate tensile stress of strand, in Kg/sq. mm.  
Before stranding and after stranding for

- a) Aluminum strand.
- b) Steel strand

10. Guaranteed ultimate tensile strength of conductor in Kg.

11. Minimum breaking load in Kg.  
Before stranding and after stranding for

- a) Aluminum strand.
- b) Steel strand.

12. Purity of aluminum rods.

13. Zinc coating of steel strand.

- a) Uniformity of coating number and/duration of dips.
- b) Minimum weight of coating gm/sq. mm.

14. Weight in Kg. per K.M.

- a) Aluminum.
- b) Steel.
- c) Conductor.

15. Resistance in ohms per Km. at 20° c.

16. Continuous maximum current rating of conductor in still air at 45° C ambient temperature,

considering temp. rise of 50° C.

17. Modulus of elasticity of :  
Conductor.

18. Co-efficient of linear expansion  
per degree centigrade of.

- a) Aluminum strand.
- b) Steel Strand.
- c) Conductor.

19. Percentage of carbon in  
steel wire.

20. Standard length of each  
peace in Km.

21. Initial and final sags and  
tension and stringing charts,  
whether furnished.

22. Tolerance, if any on standard length.

23. Number of standard length  
in one reel.

24. Dimensions of the reel in cms.

25. Weight of the Conductor  
in one reel in Kg.

26. Weight of the reel in Kg.

27. Gross weight of the reel  
including weight of the conductor.

28. Standard according to

which the conductor will  
be manufactured and tested.

29. Other particulars, if any.

## (J) GUARANTEED TECHNICAL PARTICULARS FOR INSULATORS

Sl. No.	Description.	Single suspension	Double suspension	Single Tension	Double Tension.
1.	2.	3.	4.	5.	6.
1.	Makers name and address and country.				
2.	Size and designation of Ball and socket and standard to which it will conform mm.				
3.	No. of insulator discs per string.				
4.	Outside dia of the disc. Mm				
5.	Spacing – mm				
6.	Creepage distance of the single disc –mm				
7.	Electro-mechanical strength of single disc. Kg.				
8.	Withstand voltage of single disc.				
8.1	Power frequency:				
	a) Dry-kV (rms)				
	b) Wet-kV (rms)				
8.2	Impulse voltage 1.2/50 micro second.				
	a) Positive-kV (peak)				
	b) Negative-kV (peak)				
9.	Withstand voltage for the complete string.				

- 9.1 Power frequency:
  - a) Dry-kV (rms)                      With and
  - without
  - b) Wet kV (rms)                        corona
  - ang.
- 9.2 Lighting impulse voltage 1.2/50 micro second.
  - do-
  - a) Positive kV(peak)
  - b) Negative Kv(Peak)
- 9.3 Switching surge voltage 250/2500 micro second (for 400KV only)
  - a) Dry-kV (rms)                        -do-
  - b) Wet kV (rms)
- 10. Flashover voltage for the disc.
- 10.1 Power frequency:
  - a) Dry-kV (rms)
  - b) Wet kV (rms)
- 10.2 Lighting impulse voltage 1.2/50 micro second.
  - a) Positive kV(peak)
  - b) Negative Kv(Peak)
- 11. Flashover voltage for the complete string.
- 11.1 Power frequency:



- |  |                               |
|--|-------------------------------|
| a) Dry-kV (rms)                                    | With and without corona ring. |
| b) Wet kV (rms)                                    |                               |
| 11.2 Lighting impulse voltage 1.2/50 micro second. |                               |
| a) Positive kV(peak)                               |                               |
| b) Negative Kv(Peak)                               |                               |

**(K) GUARANTEED TECHNICAL PARTICULARS OF THE  
GALVANIZED STEEL G.I. TO BE FURNISHED BY THE BIDDER**

- |     |   |   |   |
|-----|---|---|---|
| 1.  | Maker's name, address and country                         | : |   |
| 2.  | Percentage of carbon content of the steel wire.           | : |   |
| 3.  | Particular of steel strands                               |   |   |
|     | c) Number of strands.                                     |   |   |
|     | d) Diameter   | : | Mm                                      |
|     | e) Standard sectional area                                |   | Sq.mm                                   |
|     | f) Minimum ultimate tensile strength.                     |   | N/mm <sup>2</sup>                       |
|     | g) Minimum breaking land                                  |   |   |
|     | h) Final stress in steel wires                            |   | N/mm <sup>2</sup><br>KN/mm <sup>2</sup> |
| 4.  | (a) Uniformity of coating of number and duration of dips. | : | Minutes Number of dips.                 |
|     | 1.  |   |   |
|     | 2.  |   |   |
|     | b) Minimum weight of coating                              | : | GM/m <sup>2</sup>                       |
| 5.  | Standard overall diameter of ground wire.                 | : | Sq.mm                                   |
| 6.  | Area of cross section of ground wire.                     | : | Mm                                      |
| 7.  | Guaranteed ultimate tensile strength of ground wire.      | : | N/mm <sup>2</sup>                       |
| 8.  | Maximum working tension                                   | : | N/mm <sup>2</sup>                       |
| 9.  | Resistance in ohms per KM at 20 <sup>0</sup> C.           | : |   |
| 10. | Standard length of ground wire.                           | : | Km.                                     |
| 11. | Modulus of elasticity of ground wire.                     | : | Kg / cm <sup>2</sup> Final Initial      |
| 12. | Co-efficient of linear expansion.                         | : |   |
| 13. | Zinc coating :-   |   |   |
|     | a) Number of one minute dip                               | : |   |
|     | b) Number of half minute dip.                             |   |   |
|     | c) Quality of zinc  | : |   |
| 14. | Weight of coating on wire                                 | : |   |
| 15. | Process of galvanising                                    | : |   |

Signature of the Bidder  
with Seal

# PRICE SCHEDULE FOR CAPACITOR BANK

\*\* REMARKS: 1) BIDDER SHOULD FURNISH AN UNPRICED SCHEDULE ALONG WITH COMMERCIAL BID(FIRST PART BID) INDICATING "QUOTED" /"NOT QUOTED"/"NOT APPLICABLE" AS THE CASE MAY BE IN EACH COLUMN. IF ANY PRICE IS INDICATED IN PART-I (UN PRICED PART) OF THE BID,SUCH BIDS SHALL BE LIABLE FOR REJECTION.

2) BIDDER SHOULD FILLUP THE ANNEXURES CAREFULLY CONSIDERING SUB-STATION/PACKAGE WISE.

3)

THE PRICE SHEDULE FOR EACH SUB-STATION SHOULD HAVE A) ANNEXURE-I(FOR SUPPLY);B) ANNEXURE-II(FOR ERECTION,CIVIL &TEST) C) ANNEXURE- III(AMC MATERIALS/EQUIPMENT SUPPLY & LABOUR);

4) (a) PART -I: Techno-

commercial/un-priced Bid (to be submitted on one original + 2 copies marked"original" and "copy") (b) PART-II: Price Bid in hard copies (in one original +2 copy marked "original" & "copy") in a separate sealed cover along with soft copy CD. In case of any discrepancies in "original" and "copy"/soft copy the prices quoted in "Original" copy shall prevail.

Signature of Bidder with seal

**ANNEXURE IV: CONSOLIDATED FINAL PRICE SCHEDULE**

SL. NO.	ANNEXU RE NO.	DESCRIPTION	TOTAL CONSOLIDATED PRICE – IN Rs (INCLUSIVE OF ALL TAXES & DUTIES AND F&I)																						
			PACKAGE I					PACKAGE II					PACKAGE III				PACKAGE IV								
			BALASORE	BHADRAKH	JAJPUR TOWN	JALESWAR	POLASHPANGA	BALUGAON	BERHAMPUR	KHURDHA	NIMAPARA	PURI	BOINDA	RAIRAKHOL	SONEPUR	SUNABEDA	DUBURI(OLD)	CUTTACK	JAGATSINGHPUR	KENDRAPARA	PATTAMUNDAI	RANASINGHPUR			
1	I	SUPPLY OF MAIN EQUIPMENT FOR CAPACITOR BANK(ANNEXURE-I)																							
2	II	ERECTION, TESTING & COMMISSIONING INCLUDING CIVIL WORKS (ANNEXURE-II)																							
3	III	SUPPLY OF AMC SPARES & LABOUR CHARGES FOR AMC FOR 10 YEARS (ANNEXURE-III)																							
4		TOTAL AMOUNT																							

		<b>GRAND TOTAL PACKAGE WISE</b>								
5										

**Signature of Bidder with Seal Name:-**

**Designation:-**

**Place:-**

**Date:-**

The position of the Bidder shall be decided on package wise and are bound to quote for (1) Supply,(2) Erection & (3) AMC for 10 Years for each Sub-station.

**DETAILS OF THE PACKAGE INCLUDING CAPACITOR BANK CAPACITY**

<b>PACKAGE-I: NAME OF THE SUB-STATION:</b>	<b>PACKAGE-III: NAME OF THE SUB-STATION:</b>																	
220/132/33KVSUB-STATION BALASORE (15MVAR-1 SET).	1. 132/33 KV SUB-STATION BOINDA:(10 MVAR-1SET).																	
220/132/33 KV SUB-STATION BHADRAKH (15MVAR-1 SET).	2. 132/33 KV SUB-STATION RAIKAKHOL:(10 MVAR-1SET).																	
132/33 KV SUB-STATION JAJPUR TOWN (20 MVAR-1 SET)	3. 132/33 KV SUB-STATIONSONEPUR:(10 MVAR-1SET).																	
132/33 KV SUB-STATION JALESWAR (10MVAR-1 SET)	4. 220/132/33 KV SUB-STATION, DUBURI(OLD):(10 MVAR-1 SET).																	
132/33 KV SUB-STATION POLASHPANGA(10MVAR-1 SET)	5. 132/33 KV SUB-STATION SUNABEDA:(15 MVAR-1SET).																	
(TOTAL 70 MVAR)	(TOTAL 55 MVAR)																	
<b>PACKAGE-II: NAME OF THE SUB-STATION:</b>	<b>PACKAGE-IV: NAME OF THE SUB-STATION:</b>																	
1.132/33KV SUB-STATION BALUGAON (10 MVAR-1SET).	1. 132/33 KV SUB-STATION PATTAMUNDAI:(15 MVAR-1SET).																	

2. 132/33 KV SUB-STATION, BERHAMPUR (10 MVAR-1 SET).	2. 132/33 KV SUB-STATION, KENDRAPARA:(20 MVAR-1 SET).																		
3. 132/33 KV SUB-STATION KHURDHA (20 MVAR-1SET).	3. 132/33 KV SUB-STATION RANASINGHPUR:(20 MVAR-1SET).																		
4. 132/33 KV SUB-STATION NIMAPARA (10 MVAR-1 SET).	4. 132/33 KV SUB-STATION, CUTTACK:(10 MVAR-1 SET).																		
5. 132/33 KV SUB-STATION PURI (20 MVAR-1 SET).	5. 132/33 KV SUB-STATION, JAGATSINGHPUR:(15 MVAR-1 SET).																		
(TOTAL 70 MVAR)	(TOTAL 80 MVAR)																		



**PRICE SCHEDULE**

**ANNEXURE-I**

**TO BE SUBMITTED BY THE TENDERER ALONG WITH QUOTATION (IN TRIPLICATE)**

**TENDER No.**

**DUE ON DATED.**

SL No.	DESCRIPTION OF MATERIALS FOR 20 MVAR CAPACITOR BANK BAY(33 KV SIDE)	UNIT	Tendere d Quantity (Nos/Set s)	Quantit y offered	Unit Ex- Works Price (Rs.)	Total Ex works Price in Rs.	Mode of Transa ction  Direct or Bought out item	Total taxes & Duties applicable for transaction between Bidder & OPTCL & not included in the price at Column 7 (for bought out items,taxes & duties excluding Octroi & Entry tax are invariably included in the price Quoted at col 7			Unit freight & Insuran ce charges (Rs)	Total Freight & Insuranc e charges (Rs)	Total cost in Rs.
								Excise Duty	VAT/ CST as applica ble	Other Taxes if any			
1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	Shunt capacitor Bank	No	1										
1.1	G.I Structure with Nuts and Bolts,washers of 1 (Capacitor Bank)+ 4(NCT)	Set	1										
2	Series Reactor(copper)	Nos	6										
2.1	G.I Structure with Nuts and Bolts,washers of 2 (Reactor)	Sets	6										
3	36 KV, 400-200/1-1 A, 2 Core Current Transformer	Nos	3										
3.1	G.I Structure with Nuts and Bolts,washers of 3 (C.T)	Sets	3										



1	2	3	4	5	6	7	8	9	10	11	12	13	14
4	33 KV Neutral Current Transformer, 2 Core	No.	1										
5	33KV Class III,10 KA,Heavy duty station class Surge Arrester	Nos	3										
5.1	G.I Structure with Nuts and Bolts,washers of 5 (S.A)	Sets	3										
6	33 KV, 3 Ph,800 Amp, Double Break Isolator with manual Earth Switch.	No	1										
6.1	G.I Structure with Nuts and Bolts,washers of 6 (Isolator with E/S)	Set	1										
7	33 KV, 3 Ph,800 Amp, Double Break Isolator without Earth Switch.	No	1										
7.1	G.I Structure with Nuts and Bolts,washers of 7 (Isolator without E/S)	Set	1										
8	36 KV, 1250 Amp, Vacuum Circuit Breaker including structure	No	1										
9	Control and relay panel for controlling & protection of Capacitor Bank of 33 KV Class.	No	1										
10	Control Cable( stranded copper unarmoured)												
10.1	4C X 2.5 Sq. mm	Lot	1										
10.2	5C X 2.5 Sq. mm	Lot	1										

1	2	3	4	5	6	7	8	9	10	11	12	13	14
10.3	7C X 2.5 Sq. mm	Lot	1										
10.4	10C X2.5 Sq. mm	Lot	1										
10.5	Galvanised cable tray Rack,Trays for laying cables	Lot	1										
11	36 KV Bus Post Insulator	Lot	1										
11.1	Structure of 11 (36 KV Bus Post Insulator)	Lot	1										
12	ACSR conductor (zebra) & Aluminium flat for the interconnection of the above equipment & extension of 33 KV Bus.	Lot	1										
13	Supply of all types of Hard ware fittings (Suspension and Tension),160 KN Disc insulators,Clamps and Connectors for all equipment etc.	Lot	1										
14	Supply of G.I flats (75X10)mm for earth mat and 50X6 mm for risers	MT	1										
<b>15</b>	<b>Hot Dip Galavnised Switchyard Structures with Nuts and bolts,Foundation Bolts with Nuts and washers</b>												
15.1	33 KV Column Type "T8"Height 10.5 Mtrs- 02 Nos.	MT	1.8										
15.2	33 KV Beam Type "G6",Length:7.25 Mtrs: 01 No.	MT	1										

1	2	3	4	5	6	7	8	9	10	11	12	13	14
	Total Amount in Rs.												
	Rupees.....												
<b>SIGNATURE OF BIDDER WITH SEAL</b>													

**PRICE SCHEDULE (FOR ERECTION, TESTING, COMMISSIONING)**

**ANNEXURE-II**

**TO BE SUBMITTED BY THE TENDERER ALONG WITH QUOTATION (IN TRIPLICATE)**

**TENDER No.**

**DUE ON DATED.**

<b>SL No.</b>	<b>DESCRIPTION OF MATERIALS FOR 20 MVAR CAPACITOR BANK BAY (33 KV SIDE)</b>	<b>Tendered Quantity (Nos / Sets)</b>	<b>Quantity offered</b>	<b>Unit cost in (Rs.)</b>	<b>Total Amount in (Rs.)</b>
<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>
1	Shunt capacitor Bank	1			
1.1	Structure of 1 (Capacitor Bank)+ 4 (NCT)	1			
2	Series Reactor(copper)	1			
2.1	Structure of 2 (Reactor)	6			
3	36 KV, 400-200/1-1 A, 2 Core Current Transformer	3			
3.1	Structure of 3 (C.T)	3			
4	33 KV Neutral Current Transformer, 2 Core	1			
5	33KV Class III, 10 KA, Heavy duty station class Surge Arrester	3			
5.1	Structure of 5 (S.A)	3			
6	33 KV, 3 Ph, 800 Amp, Double Break Isolator with manual Earth Switch.	1			
6.1	Structure of 6 (Isolator with E/S)	1			
7	33 KV, 3 Ph, 800 Amp, Double Break, Isolator without Earth Switch.	1			
7.1	Structure of 7 (Isolator without E/S)	1			
8	36 KV, 1250 Amp, Vacuum Circuit Breaker including structure	1			
9	Control and relay panel for controlling & protection of Capacitor Bank of 33 KV Class.	1			
10	Control Cable( stranded copper unarmoured)				
10.1	4C X 2.5 Sq. mm	1			
10.2	5C X 2.5 Sq. mm	1			
10.3	7C X 2.5 Sq. mm	1			
10.4	10C X 2.5 Sq. mm	1			
11	36 KV Bus Post Insulator	1			

1	2	3	4	5	6
11.1	Structure of 11 (36 KV Bus Post Insulator)	1			
12	CIVIL WORKS				
12.1	Excavation for foundation & Back filling of equipments, cable trench etc, including supply of all labour,T&P,materials and leveling of the area,disposing of the excess materials as per direction of Engineer in Charge				
12.1.1	Soft/Loose soil	25			
12.1.2	Hard/Dense soil	70			
12.1.3	Rock not required blasting	20			
12.2	Supply of all materials including 20mm nominal crusher broken HG chips, all types of fine and coarse aggregates,M.S Rods(Fe452),Cement for concreting for the foundation of equipment, cable trenches,cable trench covers etc as per the instruction of Engineer in Charge.				
12.2(a)	1:2:4 Ratio as per IS:4156 with cost of cement & steel including cost of taxes & royalties,lead and lift.	50			
12.2(b)	1:3:6 Ratio as per IS:4156 with cost of cement including cost of taxes & royalties,lead and lift.	6			
13	Site surfacing as per TS(levelling,spreding of sand and metal)	1			
14	Supply and Fixing of cable tray (GI) and racks (GI) including all associated materials in cable trench.	1			
15	Earth mat laying(75X10mm GI Flat) at depth of 700mm below the leveled soil in both the way, its welding and treatment of welding portion as per standard,earth riser to the equipment structure and tower structure,equipment and structure earthing by using 50X6 mm GI flat ,which include supply of all materials and as per the instruction of Engineer In Charge.	1			
16	Stringing/ fixing of ACSR conductor (zebra)/Aluminium flat for the interconnection of the above equipment, Erection of all types of Hard ware fittings(Suspension and Tension),160 KN Disc insulators,clamps and Connectors for all equipment etc. including other materials if required for	1			
17	Provision of treated earth pit as per standard practice, this include supply of all materials and as per the instruction of Engineer In Charge.Earting GI pipe as per specification	10			

1	2	3	4	5	6	
18	<b>Hot Dip Galavnised Switcyard Structures with Nuts and bolts,Foundation Bolts with Nuts and washers</b>					
18.1	33 KV Column Type "T8"Height 10.5 Mtrs- 02 Nos.	1.8				
18.2	33 KV Beam Type"G6",Length:7.25 Mtrs: 01 No.	1				
19	Obtaining Project License from competent authority( sub-station wise)					
Rupees.....						
SIGNATURE OF BIDDER WITH SEAL						

PRICE SCHEDULE (FOR SUPPLY OF MATERIALS/EQUIPMENT FOR AMC INCLUDING SUPPLY OF LABOUR FOR AMC FOR 20 MVAR)						
ANNEXURE-III						
TO BE SUBMITTED BY THE TENDERER ALONG WITH QUOTATION (IN TRIPLICATE)						
TENDER No.			DUE ON DATED.			
SL No.	DESCRIPTION	TOTAL YEARS	UNIT RATE/YEAR IN Rs.	TOTAL AMOUNT IN Rs.	Total Amount in (Rs.)	
1	2	3	4	5	6	
1	SUPPLY OF MATERIALS/EQUIPMENT FOR ANNUAL MAINTENANCE INCLUDING SUPPLY OF LABOUR FOR AMC WORKS FOR 10 YEARS	10 YEARS				
Rupees.....						
SIGNATURE OF BIDDER WITH SEAL						
NB: BIDDERS ARE INFORMED TO QUOTE PACKAGE WISE AS INDICATED ELSE WHERE.						





**PRICE SCHEDULE**

**ANNEXURE-I**

**TO BE SUBMITTED BY THE TENDERER ALONG WITH QUOTATION (IN TRIPLICATE)**

**TENDER No.**

**DUE ON DATED.**

SL No.	DESCRIPTION OF MATERIALS FOR 15 MVAR CAPACITOR BANK BAY(33 KV SIDE)	UNIT	Tendere d Quantity (Nos/Set s)	Quantit y offered	Unit Ex- Works Price (Rs.)	Total Ex works Price in Rs.	Mode of Transa ction  Direct or Bought out item	Total taxes & Duties applicable for transaction between Bidder & OPTCL & not included in the price at Column 7 (for bought out items,taxes & duties excluding Octroi & Entry tax are invariably included in the price Quoted at col 7			Unit freight & Insuran ce charges (Rs)	Total Freight & Insuranc e charges (Rs)	Total cost in Rs.
								Excise Duty	VAT/ CST as applica ble	Other Taxes if any			
1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	Shunt capacitor Bank	No	1										
1.1	G.I Structure with Nuts and Bolts,washers of 1 (Capacitor Bank)+ 4(NCT)	Set	1										
2	Series Reactor(copper)	Nos	6										
2.1	G.I Structure with Nuts and Bolts,washers of 2 (Reactor)	Sets	6										
3	36 KV, 400-200/1-1 A, 2 Core Current Transformer	Nos	3										
3.1	G.I Structure with Nuts and Bolts,washers of 3 (C.T)	Sets	3										

1	2	3	4	5	6	7	8	9	10	11	12	13	14
4	33 KV Neutral Current Transformer, 2 Core	No.	1										
5	33KV Class III,10 KA,Heavy duty station class Surge Arrester	Nos	3										
5.1	G.I Structure with Nuts and Bolts,washers of 5 (S.A)	Sets	3										
6	33 KV, 3 Ph,800 Amp, Double Break Isolator with manual Earth Switch.	No	1										
6.1	G.I Structure with Nuts and Bolts,washers of 6 (Isolator with E/S)	Set	1										
7	33 KV, 3 Ph,800 Amp, Double Break Isolator without Earth Switch.	No	1										
7.1	G.I Structure with Nuts and Bolts,washers of 7 (Isolator without E/S)	Set	1										
8	36 KV, 1250 Amp, Vacuum Circuit Breaker including structure	No	1										
9	Control and relay panel for controlling & protection of Capacitor Bank of 33 KV Class.	No	1										
10	Control Cable( stranded copper unarmoured)												
10.1	4C X 2.5 Sq. mm	Lot	1										
10.2	5C X 2.5 Sq. mm	Lot	1										

1	2	3	4	5	6	7	8	9	10	11	12	13	14
10.3	7C X 2.5 Sq. mm	Lot	1										
10.4	10C X2.5 Sq. mm	Lot	1										
10.5	Galvanised cable tray Rack,Trays for laying cables	Lot	1										
11	36 KV Bus Post Insulator	Lot	1										
11.1	Structure of 11 (36 KV Bus Post Insulator)	Lot	1										
12	ACSR conductor (zebra) & Aluminium flat for the interconnection of the above equipment & extension of 33 KV Bus.	Lot	1										
13	Supply of all types of Hard ware fittings (Suspension and Tension),160 KN Disc insulators,Clamps and Connectors for all equipment etc.	Lot	1										
14	Supply of G.I flats (75X10)mm for earth mat and 50X6 mm for risers	MT	1										
<b>15</b>	<b>Hot Dip Galavnised Switchyard Structures with Nuts and bolts,Foundation Bolts with Nuts and washers</b>												
15.1	33 KV Column Type "T8"Height 10.5 Mtrs- 02 Nos.	MT	1.8										
15.2	33 KV Beam Type "G6",Length:7.25 Mtrs: 01 No.	MT	1										

1	2	3	4	5	6	7	8	9	10	11	12	13	14
	Total Amount in Rs.												
	Rupees.....												
<b>SIGNATURE OF BIDDER WITH SEAL</b>													

**PRICE SCHEDULE (FOR ERECTION, TESTING, COMMISSIONING)**

**ANNEXURE-II**

**TO BE SUBMITTED BY THE TENDERER ALONG WITH QUOTATION (IN TRIPLICATE)**

**TENDER No.**

**DUE ON DATED.**

<b>SL No.</b>	<b>DESCRIPTION OF MATERIALS FOR 15 MVAR CAPACITOR BANK BAY (33 KV SIDE)</b>	<b>Tendered Quantity (Nos / Sets)</b>	<b>Quantity offered</b>	<b>Unit cost in (Rs.)</b>	<b>Total Amount in (Rs.)</b>
<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>
1	Shunt capacitor Bank	1			
1.1	Structure of 1 (Capacitor Bank)+ 4 (NCT)	1			
2	Series Reactor(copper)	1			
2.1	Structure of 2 (Reactor)	6			
3	36 KV, 400-200/1-1 A, 2 Core Current Transformer	3			
3.1	Structure of 3 (C.T)	3			
4	33 KV Neutral Current Transformer, 2 Core	1			
5	33KV Class III, 10 KA, Heavy duty station class Surge Arrester	3			
5.1	Structure of 5 (S.A)	3			
6	33 KV, 3 Ph, 800 Amp, Double Break Isolator with manual Earth Switch.	1			
6.1	Structure of 6 (Isolator with E/S)	1			
7	33 KV, 3 Ph, 800 Amp, Double Break, Isolator without Earth Switch.	1			
7.1	Structure of 7 (Isolator without E/S)	1			
8	36 KV, 1250 Amp, Vacuum Circuit Breaker including structure	1			
9	Control and relay panel for controlling & protection of Capacitor Bank of 33 KV Class.	1			
10	Control Cable( stranded copper unarmoured)				
10.1	4C X 2.5 Sq. mm	1			
10.2	5C X 2.5 Sq. mm	1			
10.3	7C X 2.5 Sq. mm	1			
10.4	10C X 2.5 Sq. mm	1			
11	36 KV Bus Post Insulator	1			

1	2	3	4	5	6
11.1	Structure of 11 (36 KV Bus Post Insulator)	1			
12	CIVIL WORKS				
12.1	Excavation for foundation & Back filling of equipments, cable trench etc, including supply of all labour,T&P,materials and leveling of the area,disposing of the excess materials as per direction of Engineer in Charge				
12.1.1	Soft/Loose soil	25			
12.1.2	Hard/Dense soil	70			
12.1.3	Rock not required blasting	20			
12.2	Supply of all materials including 20mm nominal crusher broken HG chips, all types of fine and coarse aggregates,M.S Rods(Fe452),Cement for concreting for the foundation of equipment, cable trenches,cable trench covers etc as per the instruction of Engineer in Charge.				
12.2(a)	1:2:4 Ratio as per IS:4156 with cost of cement & steel including cost of taxes & royalties,lead and lift.	50			
12.2(b)	1:3:6 Ratio as per IS:4156 with cost of cement including cost of taxes & royalties,lead and lift.	6			
13	Site surfacing as per TS(levelling,spreding of sand and metal)	1			
14	Supply and Fixing of cable tray (GI) and racks (GI) including all associated materials in cable trench.	1			
15	Earth mat laying(75X10mm GI Flat) at depth of 700mm below the leveled soil in both the way, its welding and treatment of welding portion as per standard,earth riser to the equipment structure and tower structure,equipment and structure earthing by using 50X6 mm GI flat ,which include supply of all materials and as per the instruction of Engineer In Charge.	1			
16	Stringing/ fixing of ACSR conductor (zebra)/Aluminium flat for the interconnection of the above equipment, Erection of all types of Hard ware fittings(Suspension and Tension),160 KN Disc insulators,clamps and Connectors for all equipment etc. including other materials if required for	1			
17	Provision of treated earth pit as per standard practice, this include supply of all materials and as per the instruction of Engineer In Charge.Earting GI pipe as per specification	10			

1	2	3	4	5	6	
18	<b>Hot Dip Galavnised Switcyard Structures with Nuts and bolts,Foundation Bolts with Nuts and washers</b>					
18.1	33 KV Column Type "T8"Height 10.5 Mtrs- 02 Nos.	1.8				
18.2	33 KV Beam Type"G6",Length:7.25 Mtrs: 01 No.	1				
19	Obtaining Project License from competent authority( sub-station wise)					
Rupees.....						
SIGNATURE OF BIDDER WITH SEAL						







**PRICE SCHEDULE**

**ANNEXURE-I**

**TO BE SUBMITTED BY THE TENDERER ALONG WITH QUOTATION (IN TRIPLICATE)**

**TENDER No.**

**DUE ON DATED.**

SL No.	DESCRIPTION OF MATERIALS FOR 10 MVAR CAPACITOR BANK BAY(33 KV SIDE)	UNIT	Tendere d Quantity (Nos/Set s)	Quantit y offered	Unit Ex- Works Price (Rs.)	Total Ex works Price in Rs.	Mode of Transa ction  Direct or Bought out item	Total taxes & Duties applicable for transaction between Bidder & OPTCL & not included in the price at Column 7 (for bought out items,taxes & duties excluding Octroi & Entry tax are invariably included in the price Quoted at col 7			Unit freight & Insuran ce charges (Rs)	Total Freight & Insuranc e charges (Rs)	Total cost in Rs.
								Excise Duty	VAT/ CST as applica ble	Other Taxes if any			
1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	Shunt capacitor Bank	No	1										
1.1	G.I Structure with Nuts and Bolts,washers of 1 (Capacitor Bank)+ 4(NCT)	Set	1										
2	Series Reactor(copper)	Nos	6										
2.1	G.I Structure with Nuts and Bolts,washers of 2 (Reactor)	Sets	6										
3	36 KV, 400-200/1-1 A, 2 Core Current Transformer	Nos	3										
3.1	G.I Structure with Nuts and Bolts,washers of 3 (C.T)	Sets	3										

1	2	3	4	5	6	7	8	9	10	11	12	13	14
4	33 KV Neutral Current Transformer, 2 Core	No.	1										
5	33KV Class III,10 KA,Heavy duty station class Surge Arrester	Nos	3										
5.1	G.I Structure with Nuts and Bolts,washers of 5 (S.A)	Sets	3										
6	33 KV, 3 Ph,800 Amp, Double Break Isolator with manual Earth Switch.	No	1										
6.1	G.I Structure with Nuts and Bolts,washers of 6 (Isolator with E/S)	Set	1										
7	33 KV, 3 Ph,800 Amp, Double Break Isolator without Earth Switch.	No	1										
7.1	G.I Structure with Nuts and Bolts,washers of 7 (Isolator without E/S)	Set	1										
8	36 KV, 1250 Amp, Vacuum Circuit Breaker including structure	No	1										
9	Control and relay panel for controlling & protection of Capacitor Bank of 33 KV Class.	No	1										
10	Control Cable( stranded copper unarmoured)												
10.1	4C X 2.5 Sq. mm	Lot	1										
10.2	5C X 2.5 Sq. mm	Lot	1										

1	2	3	4	5	6	7	8	9	10	11	12	13	14
10.3	7C X 2.5 Sq. mm	Lot	1										
10.4	10C X2.5 Sq. mm	Lot	1										
10.5	Galvanised cable tray Rack,Trays for laying cables	Lot	1										
11	36 KV Bus Post Insulator	Lot	1										
11.1	Structure of 11 (36 KV Bus Post Insulator)	Lot	1										
12	ACSR conductor (zebra) & Aluminium flat for the interconnection of the above equipment & extension of 33 KV Bus.	Lot	1										
13	Supply of all types of Hard ware fittings (Suspension and Tension),160 KN Disc insulators,Clamps and Connectors for all equipment etc.	Lot	1										
14	Supply of G.I flats (75X10)mm for earth mat and 50X6 mm for risers	MT	1										
<b>15</b>	<b>Hot Dip Galavnised Switchyard Structures with Nuts and bolts,Foundation Bolts with Nuts and washers</b>												
15.1	33 KV Column Type "T8"Height 10.5 Mtrs- 02 Nos.	MT	1.8										
15.2	33 KV Beam Type "G6",Length:7.25 Mtrs: 01 No.	MT	1										

1	2	3	4	5	6	7	8	9	10	11	12	13	14
	Total Amount in Rs.												
	Rupees.....												
<b>SIGNATURE OF BIDDER WITH SEAL</b>													

**PRICE SCHEDULE (FOR ERECTION, TESTING, COMMISSIONING)**

**ANNEXURE-II**

**TO BE SUBMITTED BY THE TENDERER ALONG WITH QUOTATION (IN TRIPLICATE)**

**TENDER No.**

**DUE ON DATED.**

<b>SL No.</b>	<b>DESCRIPTION OF MATERIALS FOR 10 MVAR CAPACITOR BANK BAY (33 KV SIDE)</b>	<b>Tendered Quantity (Nos / Sets)</b>	<b>Quantity offered</b>	<b>Unit cost in (Rs.)</b>	<b>Total Amount in (Rs.)</b>
<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>
1	Shunt capacitor Bank	1			
1.1	Structure of 1 (Capacitor Bank)+ 4 (NCT)	1			
2	Series Reactor(copper)	1			
2.1	Structure of 2 (Reactor)	6			
3	36 KV, 400-200/1-1 A, 2 Core Current Transformer	3			
3.1	Structure of 3 (C.T)	3			
4	33 KV Neutral Current Transformer, 2 Core	1			
5	33KV Class III, 10 KA, Heavy duty station class Surge Arrester	3			
5.1	Structure of 5 (S.A)	3			
6	33 KV, 3 Ph, 800 Amp, Double Break Isolator with manual Earth Switch.	1			
6.1	Structure of 6 (Isolator with E/S)	1			
7	33 KV, 3 Ph, 800 Amp, Double Break, Isolator without Earth Switch.	1			
7.1	Structure of 7 (Isolator without E/S)	1			
8	36 KV, 1250 Amp, Vacuum Circuit Breaker including structure	1			
9	Control and relay panel for controlling & protection of Capacitor Bank of 33 KV Class.	1			
10	Control Cable( stranded copper unarmoured)				
10.1	4C X 2.5 Sq. mm	1			
10.2	5C X 2.5 Sq. mm	1			
10.3	7C X 2.5 Sq. mm	1			
10.4	10C X 2.5 Sq. mm	1			
11	36 KV Bus Post Insulator	1			

1	2	3	4	5	6
11.1	Structure of 11 (36 KV Bus Post Insulator)	1			
12	CIVIL WORKS				
12.1	Excavation for foundation & Back filling of equipments, cable trench etc, including supply of all labour,T&P,materials and leveling of the area,disposing of the excess materials as per direction of Engineer in Charge				
12.1.1	Soft/Loose soil	25			
12.1.2	Hard/Dense soil	70			
12.1.3	Rock not required blasting	20			
12.2	Supply of all materials including 20mm nominal crusher broken HG chips, all types of fine and coarse aggregates,M.S Rods(Fe452),Cement for concreting for the foundation of equipment, cable trenches,cable trench covers etc as per the instruction of Engineer in Charge.				
12.2(a)	1:2:4 Ratio as per IS:4156 with cost of cement & steel including cost of taxes & royalties,lead and lift.	50			
12.2(b)	1:3:6 Ratio as per IS:4156 with cost of cement including cost of taxes & royalties,lead and lift.	6			
13	Site surfacing as per TS(levelling,spreding of sand and metal)	1			
14	Supply and Fixing of cable tray (GI) and racks (GI) including all associated materials in cable trench.	1			
15	Earth mat laying(75X10mm GI Flat) at depth of 700mm below the leveled soil in both the way, its welding and treatment of welding portion as per standard,earth riser to the equipment structure and tower structure,equipment and structure earthing by using 50X6 mm GI flat ,which include supply of all materials and as per the instruction of Engineer In Charge.	1			
16	Stringing/ fixing of ACSR conductor (zebra)/Aluminium flat for the interconnection of the above equipment, Erection of all types of Hard ware fittings(Suspension and Tension),160 KN Disc insulators,clamps and Connectors for all equipment etc. including other materials if required for	1			
17	Provision of treated earth pit as per standard practice, this include supply of all materials and as per the instruction of Engineer In Charge.Earting GI pipe as per specification	10			

1	2	3	4	5	6	
18	<b>Hot Dip Galavnised Switcyard Structures with Nuts and bolts,Foundation Bolts with Nuts and washers</b>					
18.1	33 KV Column Type "T8"Height 10.5 Mtrs- 02 Nos.	1.8				
18.2	33 KV Beam Type"G6",Length:7.25 Mtrs: 01 No.	1				
19	Obtaining Project License from competent authority( sub-station wise)					
Rupees.....						
SIGNATURE OF BIDDER WITH SEAL						



PRICE SCHEDULE (FOR SUPPLY OF MATERIALS/EQUIPMENT FOR AMC INCLUDING SUPPLY OF LABOUR FOR AMC FOR 10 MVAR)											
ANNEXURE-III											
TO BE SUBMITTED BY THE TENDERER ALONG WITH QUOTATION (IN TRIPLICATE)											
TENDER No.					DUE ON DATED.						
SL No.	DESCRIPTION				TOTAL YEARS	UNIT RATE/YEAR IN Rs.	TOTAL AMOUNT IN Rs.	Total Amount in (Rs.)			
1	2				3	4	5	6			
1	SUPPLY OF MATERIALS/EQUIPMENT FOR ANNUAL MAINTENANCE INCLUDING SUPPLY OF LABOUR FOR AMC WORKS FOR 10 YEARS				10 YEARS						
Rupees.....											
<b>SIGNATURE OF BIDDER WITH SEAL</b>											
NB: BIDDERS ARE INFORMED TO QUOTE PACKAGE WISE AS INDICATED ELSE WHERE.											