

MAHARASHTRA INDUSTRIAL TOWNSHIP LIMITED
(CIN No. U74999MH2014SGC260132)



Tender No. – MITL/SBIA/2026-27/T-01

Work of LILO on 220KV Chitegaon - Chitepimpalgaon line at MSETCL Bus including Supply, erection, and commissioning of required Lattice Towers for Power Supply arrangement to JSW Mobility Ltd at Bidkin Industrial Area, Dist.Chh.Sambhajinagar.

BOOK I

**INVITATION FOR BID,
QUALIFYING REQUIREMENTS
ALONG WITH
TECHNICAL BID EVALUATION FORM & SCHEDULES, GENERAL TERMS AND
CONDITIONS
&
INSTRUCTIONS TO BIDDERS**

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PREAMBLE

This specification covers the turnkey Work of LILO on 220KV Chitegaon - Chitepimpalgaon line at MSETCL Bus including Supply, erection, and commissioning of required Lattice Towers for Power Supply arrangement to JSW Mobility Ltd at Bidkin Industrial Area, Dist. Chh. Sambhajinagar.

The scope of work also includes supply of specified materials, as well as execution of required works which broadly includes EHV tower/monopoles foundations, EHV tower/monopoles erection & stringing and commissioning.

- 1.1. For ease of handling this specification is divided into three parts: Book- I, Book- II, & Book-III. The IFB, QR along with technical bid evaluation form & schedules, General terms and conditions and Instructions to Bidders are covered in Book-I, whereas the technical specifications in respect of Line works along with approved vendor list are covered in Book-II, the Price Schedules along with abstract are covered in Book- III.
- 1.2. Commercial terms and conditions covered in Book I generally applicable for works, including supply of materials against contract.
- 1.3. The quantities of items for supply and erection are tentative and based on estimate as per preliminary survey. While awarding the contract the quantities of supply as well as erection shall be worked out as per actual. The contract value shall be decided on the basis of total offered price against Supply portion + Erection portion (including all taxes & duties).
- 1.4. Bidders can submit the offers, subject to their meeting the qualifying requirements. The offer shall be submitted with only essential particulars which are in line with the requirement of these specifications.
- 1.5. Bidder (Agency) should carryout the Joint inspection of the site with MSETCL & MITL representative before submitting/uploading the Bid.

It is mandatory to submit Joint inspection report signed by MSETCL & MITL representative along with the Bid.

INVITATION FOR BID (IFB)
(LOCAL COMPETITIVE BIDDING)

1.0 Maharashtra Industrial Township Limited., hereinafter referred to as the 'Owner' (MITL) invites offers through E-Tendering in TWO bid system (Techno- commercial bid and price bid) from the eligible registered bidders for the following scope on turnkey basis as detailed below.

Tender No. – MITL/SBIA/2026-27/T-01

Sr. No.	Description of Work	Completion period
1.0	Work of LILO on 220KV Chitegaon - Chitepimpalgaon line at MSETCL Bus including Supply, erection, and commissioning of required Lattice Towers for Power Supply arrangement to JSW Mobility Ltd at Bidkin Industrial Area, Dist.Chh.Sambhajinagar.	06 months from date of order (including monsoon)

Sr. No.	Particulars	Date & Amount
1	Date and time for sale of bid documents	Dt. 09.05.2026
	Date and time of pre- bid	Date 13-05-2026, 15:00 Hrs.
	Last date and time for sale/purchase of bid document	Date 01-06-2026
2	Last date and time for submission of bids	On or before Dt.01.06.2026, 15:00 Hrs
3	Date and time for opening of techno-commercial bid	Dt. 01.06.2026 at 16.00 Hrs. (Tentatively)
4	Date and time for opening of Price Bids	Dt. 04.06.2026 at 15.00 Hrs. (Tentatively)
5	Price of bid document (E-Tender Fees - Non refundable)	Rs. 35,400/- (Including GST)
6	Earnest Money Deposit (EMD)	Rs.6,25,000/-

Bidders are requested to note the dates for purchase, submission and opening of the bids which are as above.

In case the due date for opening of bids happens to be a holiday, the next working day shall be the corresponding due date.

The prices to be quoted against this IFB shall be in Indian rupees only.

The tender is invited on percentage basis for Supply + ETC.

For Evaluation of the Tender, the total price of Supply + ETC works including GST & Duties shall be considered.

It should be noted by the Bidders that, Labour welfare cess at the rate of 1% of total amount of contract (Supply+ETC) will be deducted from the bills.

The LOA/work order will be placed on final accepted price for (Supply + ETC) works including GST & Duties.

Price Variation i.e. PV on Taxes & duties if any will not be applicable in this tender,

For extra quantities if any, rate shall be as per approved MITL/MSETCL SOR for the year 2025-26 or as reasonable.

Bidder should submit all applicable Schedules B1 to B12 duly signed and filled with relevant information alongwith Bid submission.

2.0 The brief scope of the work will be as under :

- a) Supply of required equipments & other allied materials as per standard specification mentioned and as per the approved vendor list as mentioned in supply schedule.
- b) Casting of required EHV tower/monopoles foundations & other allied works.
- c) Erection of EHV towers/monopoles along with fixing tower accessories & tack welding
- d) Stringing of conductor & earth wire
- e) Dismantelling of existing EHV tower lines (to be diverted) and associated materials including conductors and crediting the same with MSETCL store at CSN.
- f) Co-ordination and arranging required permissions/approvals of MITL/MSETCL and PWD (Electrical) departments for SITC of the project.

The work shall be carried under the supervision of authorized engineers from MITL/MSETCL
The scope of work given above is only indicative and detailed scope is described elsewhere in the bid documents

Technical Qualifying Requirements

Sr.No.	Qualifying Requirements for Bidder
1	STATUTORY QUALIFYING CRITERIA (Statutory Licences/Registration)
1.1	The bidder or his associate should have a valid Govt. Electrical Contractor's License.
1.2	The lead bidder should be registered under GST (Goods & Service Tax) under GOI as well as for other various taxes in force.
1.3	The lead bidder should be registered under P.F. Act
Note	The original coloured scan copy should be uploaded as bid documents in support of Statutory Qualifying Criteria i.e. Statutory Licenses / Registration. The Attested/Notarized photo copies of the same will not be entertained.
2	TECHNICAL QUALIFYING CRITERIA
2.1 (a)	The bidder should have, in last 5 years (FY 2021-22 to 2025-26) executed the work on turnkey basis including supply of material, erection, testing & commissioning as mentioned at 2.1(i) and 2.1(ii) below.
(i)	The bidder should be an approved vendor of MSETCL and have installed tower material manufacturing capacity of at least 10000 MT per year and should have fabricated and supplied at least 1000 MT of EHV transmission line towers cumulatively in last three years of voltage class at least one step below (132/110/100 kV) than the voltage class as mentioned in scope of tender. OR The bidder not satisfying above condition shall furnish a legally enforceable Joint Deed of Undertaking duly notarized (Format Enclosed) from the Tower manufacturer who satisfies such condition fully, to guarantee for quality & timely supply of tower material.
(ii)	Similar Work: The bidder should have constructed (including tower foundation, tower erection and stringing) at least D/C Tr. Line of route length of at least 1 KM in single order and of voltage class at least one step below (132/110/100 kV) than the voltage class as mentioned in scope of tender.
2.1 (b)	The bidder should submit the user's certificate in support of tower material supplies executed in last three years and end user's certificate for completed works issued by the concerned ordering authority indicating therein name of the line constructed, its voltage class, route length, configuration of conductor, date of completion and period taken for completion etc.
2.2	The owner reserves the right to accept/reject the bid
Note	The original coloured scan copy should be uploaded as bid documents in support to Technical Qualifying Criteria. The Attested/Notarized photocopies of the same will not be entertained. Detailed communication address, e-mail ID & contact numbers of end users should be furnished for cross verification
3	FINANCIAL QUALIFYING CRITERIA
3.1	The annual turnover of the bidder during last three financial years (2022-2023,2023-24,2024-25) should be not below than (Rs.3.10 Cr.) duly certified by Chartered Accountant.–
3.2	The bidder should have positive networth in last 3 previous Financial years (2022-

	2023,2023-24,2024-25). The bidder should submit the statement of Net Worth duly certified by Chartered Accountant for Last 3 Financial Years.
3.3	<p>Minimum Value of Work: The applicant should have:</p> <ol style="list-style-type: none"> 1. a) One Similar completed work costing not less than Rs.2.50 Crs. Or 2. b) Two similar completed works costing not less than Rs. 1.60 Crs. Or 3. c) Three similar completed works costing not less than Rs.1.25 Crs. <p>Definition of 'similar work' has been already clearly defined as per clause 2.1 (a) (ii)</p>
Note	<ol style="list-style-type: none"> 1.The original colored scan copy should be uploaded as bid document in support of Financial Qualifying Criteria, The Attested/Notarized photocopies of the same will not be entertained 2. The duly audited, verified & certified figures from Chartered Accountant will be considered for Annual Turnover & Net worth. The provisional certificates (if any) will not be entertained.
4	IN CASE OF CONSORTIUM/JV (Not Applicable)
4.1	<p>The principal (lead) bidder who desire to bid against this specification may submit the offer jointly with erection contractor /equipment manufacturer by entering into a legally valid agreement subject to fulfilment of following requirements.</p> <p>The bid, and in case of a successful bid, the Contract Agreement shall be signed so as to be legally binding on both partners.</p> <p>Both partners of the consortium shall be jointly and severally liable for execution of the contract in accordance with the Contract terms.</p>
4.2	One of the consortium partners should satisfy 100% technical qualifying criteria at (2) and subject to fulfilment of remaining qualifying criteria jointly by both the partners.
4.3	The number of partners in a consortium should not be more than two, including the lead partner.
4.4	The lead partner shall be authorized to be in charge and this authorization shall be evidenced by submitting a duly registered/ notarised power of attorney signed jointly by legally authorized signatories of both partners.
4.5	A copy of agreement entered into by the consortium partners as specified in Schedule 'shall be submitted with the bid.
4.6	The bid document should have been purchased and submitted by the Lead Partner only.
5	OTHER MANDATORY DOCUMENTS FOR VALID BID
5.1	Original colour scan copy of duly signed/sealed schedules in book I GTC
5.2	Earnest Security Deposit for an amount equal to 1% (1 percent) of the estimated cost of tender in the form of Bank Guarantee from Scheduled/Nationalized Bank in the prescribed format annexed in the tender specification as schedule , along with the offer. The validity of Bank Guarantee should at be for six (6) months from the originally scheduled date of techno-commercial bid opening.
5.3	Deadline for Submission of Bids
5.3.1	Technical and Financial Bid comprising of the document listed shall be submitted online through e-procurement portal on or before Bid Due Date.
5.3.2	Original Bid Security and Original Power of Attorney Documents shall be physically submitted on or before the Bid Due Date, at the MITL Mumbai address, mandatorily

	in the manner and form as detailed in Book I.
5.3.3	The bid submission would be considered to be complete only upon successful completion of both the online submission of the Technical and Financial Bid and physical copy submission of Enclosure of the Bid ('Original Bid Security and Original Power of Attorney Documents') before the Bid Due Date and Time indicated in IFB, failing which the bid will not be considered.
5.3.4	The Employer may, at its discretion, extend the deadline for submission of bids by issuing corrigendum in accordance, in which case all rights and obligations of the Employer and the bidders previously subject to the original deadline will thereafter be subject to the deadline as extended.
5.4	Late Bids
	Bids/ Enclosures of the Bid ('Original Bid Security and Original Power of Attorney Documents') received physically by the Employer after the specified time on the BID Due Date shall not be eligible for consideration and shall be summarily rejected and will be returned unopened to the bidder.

- a) **Networth, Turnover, Balance Sheet etc. certificates signed by Chartered Accountants which are submitted with Repsonse to this tender must have Unique Identification Number on certificates as per guideline issued by Institute of Chartered Accountants, so as to verify online.**

For detailed information please log on to <https://aitl.eproc.in>, www.auric.city. Interested bidders may obtain further information, if needed, from the Office of the Managing Director, Maharashtra Industrial Township Limited Udyog Sarathi, MIDC Office, Marol Industrial Area, Andheri (East) Mumbai – 400 093.

For Site : G.M. Electrical (Projects), Auric Hall Building, Shendra Industrial Area, Chh.Sambhajinagar.

SECTION II

GENERAL TERMS AND CONDITIONS OF THE CONTRACT (GTC)

1.0	<u>DEFINITION OF TERMS</u>
	In constituting these general terms and conditions and the annexed specifications, the following words shall have the meanings herein assigned to them.
1.1	‘Owner’ or ‘Purchaser’ or ‘Company’ shall mean Maharashtra Industrial Township Limited., Mumbai and shall include their legal representatives, successors and permitted assignees.
1.2	‘Contractor’ shall mean the Bidder whose Bid has been accepted by the Owner for the award of the Contract and shall include such successful Bidder’s legal representatives, successors and permitted assignees.
1.3	‘SUB-CONTRACTOR’ shall mean any person (other than the Contractor) named in the Contract for any part of the work or any person to whom any part of the Contract has been sublet by the Contractor with the consent in writing of the Owner/Engineer and will include the legal representatives, successors and permitted assignees of such person.
1.4	‘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.
1.5	‘Engineer’s Representative’ shall mean any assistant of the Engineer appointed from time to time to exercise the powers, directions, functions, and other authorities vested in the Engineer.
1.6	The terms ‘Equipment’, ‘Materials’, ‘Stores’ shall mean and include plant ‘Stores’ and ‘Materials’ to be provided by the Contractor under the Contract.
1.7	‘Works’ shall mean the design, engineering, manufacture (whenever applicable), supply of equipment, material erection, testing, and commissioning of various equipment as detailed in the bidding documents.
1.8	‘Specification’ shall mean the Tender specification forming a part of the Contract and such other Schedules and drawings as may be mutually agreed upon.
1.9	‘Site’ shall mean the whole of the premises, buildings and grounds in or upon which the work or works is or are to be provided, executed, erected, done or carried out.
1.10	‘Manufacturer’s works’ or ‘Contractor’s works’ shall mean the place of work used by the Manufacturer, the Contractor, or sub-Contractor for the performance of the works.
1.11	‘Notice of Award of Contract/letter of indent, shall mean the official notice issued by the Owner notifying the Contractor that his bid has been accepted.
1.12	The ‘Contract’ shall mean the agreement, if any, to be entered into by the Owner with the Contractor and shall include the conditions of Contract, specification, schedules, tender guarantees, drawings, and any further conditions which may be specifically agreed to between the parties as forming a part of the Contract.
1.13	‘Contract Price’ shall mean the sum named in the Contract agreement if any or the work order by the Owner, subject to such additions thereto or deductions there from as may be made under the provisions herein after contained.
1.14	‘Contract value’ shall mean that part of Contract price which is properly apportionable to the work in question having regard to the amount of work done and all other relevant circumstances and disregarding any changes that may have occurred since the date of Contract in the cost of executing the works.

1.15	‘Manufacturer’s Supervisory Personnel’ shall mean the supervisory personnel deputed by the Contractor or any other manufacturer who has supplied materials or under whose supervision the installation of equipment is to be carried out.
1.16	‘Date of Contract’ shall mean the date on which L.O.A. is issued and/or acceptance of bid is intimated to Contractor as the case may be.
1.17	‘Guarantee Tests’ shall mean such tests as prescribed in the Contract or as instructed by the Engineer to be performed by the Contractor before the works are finally accepted by the Owner ready for commercial use complete with all items to the satisfaction of site Engineer.
1.18	‘Delivery period’ shall mean the time period required from issue of LOI/Telegraphic intimation of acceptance of bid to the stage the works are ready for trial operation and inclusive of performance test.
1.19	‘Commissioning’ shall mean the first successful operation of the equipment after all initial adjustments, trials etc. cleaning and reassembly required at site if any have been completed and the equipment is made ready for commercial use.
1.20	The term ‘Final Acceptance’ shall mean the Owner’s written acceptance of the works performed under the Contract after successful testing and commissioning of the equipments offered under this Contract.
1.21	‘Guarantee period’ shall mean the period during which the Contractor shall remain liable for repair, replacement of any defective part of the works performed under the Contract.
1.22	‘Month’ shall mean the calendar month. DAY or DAYS unless herein otherwise expressly defined shall mean calendar day or days of 24 hours each.
1.23	‘Writing’ shall include any manuscript, under or over signature and/or seal as the case may be.
1.24	When the words ‘Approved’, ‘Subject to approval’, ‘As directed’, ‘Accepted’ etc. or words or phrases of like are used, the approval, direction, judgement etc. is understood to be a function of the Owner/Engineer.
1.25	<p>‘Drawings’ ‘Plans’ shall mean all:-</p> <ol style="list-style-type: none"> a) Drawings furnished by the Owner as a basic for proposal b) Supplementary drawings, if any, furnished by the Owner to clarify and to define in greater detail the intent of the Contract. c) Drawings submitted by the Contractor with his proposal, provided such drawings are acceptable to the Owner. d) Drawings furnished by the Contractor/Manufacturer to the Owner during the progress of the work.
1.26	<p>‘Codes’ shall mean the following but not limited to the following including the latest amendments and/or replacements, if any,</p> <ol style="list-style-type: none"> i. Indian Electricity Act, 1910 / 2003 and Rules and Regulations made thereunder. ii. Indian Factory Act, 1948 and Rules and Regulations applicable for relevant materials supplied. iii. A.S.M.E. Test Codes. iv. A.I.R.E. Test codes. v. Standards of the Indian Standards Institutions applicable for relevant materials supplied. vi. Other Internationally approved standards and/or Rules and Regulations touching the subject matter of Contract.

2.0	INTERPRETATION
2.1	Words imparting the “singular only” shall also include the plural and vice-versa where the context so requires.
2.2	Words imparting “Persons” shall include firms, companies, corporations and associations or bodies of individuals, whether incorporated or not.
2.3	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 (1987).
3.0	SCOPE OF CONTRACT
3.1	Work of LILO on 220KV Chitegaon - Chitepimpalgaon line at MSETCL Bus for Power arrangement to JSW Mobility Ltd at Bidkin Industrial Area, Dist.Chh.Sambhajinagar.
4.0	ENGINEER’S SUPERVISIONS
4.1	ENGINEER’S INSTRUCTIONS:
	All instructions and orders to the Contractor shall, except as herein otherwise provided, be given by the Engineer.
4.2	ENGINEER’S REPRESENTATIVE
	The Engineers may, from time to time, delegate to Engineer’s Representative any of the powers, discretions, functions and authorities vested in him and may at any time revoke any such delegation. Any such delegation or revocation shall be in writing signed by the Engineer; and in case of delegation, shall specify the powers, discretions, functions and authorities thereby delegated and the person or persons to whom the same are delegated. No such delegation shall have effect until a copy thereof has been delivered to the Contractor. Any person to whom any delegation is made shall be entitled to exercise the powers, discretions, functions and authorities so delegated to him as aforesaid.
4.3	RESIDENT ENGINEERS
4.3.1	Resident Engineer/Engineers shall mean the Engineer/Engineers to be appointed by the Owner to execute the works at the site. The Contractor shall afford him every reasonable facility for so doing but the Engineer/s shall not be authorized to relieve the Contractor in any way of his duties or obligation under the Contract. Any written notice from the Engineer/s pointing out the defects in materials or workmanship shall have the effect of a similar notice given by the Engineer under clause entitled remedy of defects except that the Contractor may appeal to the Engineer for his decision in the matter.
4.3.2	The Engineer shall during the progress of the work, have following powers to order, in writing, from time to time.

	<p>a) The removal from the site within such time or times as may be specified in the order, any materials, which in the opinion of the Engineer are not in accordance with the Contract.</p> <p>b) The substitution by proper and suitable material</p> <p>c) The removal and proper re-execution (notwithstanding any previous test thereof or interim payment there for) of any work, which in respect of materials or workmanship is not, in the opinion of the Engineer, in accordance with the Contract.</p> <p>d) Removal of materials obstructing the operation of existing station/equipments.</p> <p>In case of default on the part of the Contractor in carrying out such order, the Owner shall be entitled to employ and pay other persons to carry out the same and all expenses consequent thereon or incidental thereto shall be recoverable from the contractor by the Owner or may be deducted by the Owner from any amount/money due or which may become due to the Contractor. The engineer shall stipulate reasonable time for the Contractor to carry out the order aforesaid.</p>
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.
	<p>A) Bidding document of the Owner, covering the Instructions to Bidders, general terms and conditions of Contract, special terms and conditions, technical specifications, annexures, schedules, amendments etc.</p> <p>B) Contractor’s bid proposal including the letters of clarifications exchanged there to between the Contractor and the Owner prior to the Award of Contract.</p> <p>C) All the data/information of any sort given by the Contractor along with his bid, subject to the approval of the Owner/engineer.</p> <p>D) Any mutually agreed variations to the conditions of the documents, specifications terms and conditions of Contract, if any.</p>
6.0	ASSIGNMENT AND SUBLETTING OF CONTRACT
6.1	The Contractor shall not assign the Contract or any part thereof or any benefit or interest therein or thereunder without the prior written consent of the Owner.
6.2	The Contractor shall not sublet any part of the works without prior written consent of the engineer/Owner.
6.3	Such consent, if given, shall not relieve the Contractor from any liability or obligation under the Contract and he shall be responsible for the acts, defaults and neglects of any subcontractor, his agents, servants or workman as fully as if those were the acts, defaults, neglects of the Contractor, his agents, servants or workmen.
6.4	The engineer shall have the right to obtain from the Contractor any agreement in writing entered into by the Contractor with any of his sub-Contractors or any purchase orders placed for supplies and services in respect of the works included in the Contract provided that the Contractor shall not be bound to disclose the sub Contract value. The Contractor shall supply the engineer with full technical and commercial details of orders placed on his sub-Contractors. The technical specification of all the items ordered on sub-Contractor shall be subject to the approval of engineer.
7.0	CONTRACTOR TO INFORM HIMSELF FULLY

7.1	It is mandatory for the bidding contractor to conduct joint site inspection with Authorized representative of MSETCL and MITL and to have fixed his price taking into account all such relevant conditions and also the risks, contingencies and other circumstances which may influence or affect the execution of the work as specified in the Contract. The contractor shall submit such joint inspection report signed by all the representatives along with the Bid.
7.2	The Contractor shall be responsible for any misunderstanding or incorrect information, however obtained, on which the Contract price has been based except the written information furnished by the Owner.
7.3	The Contractor shall be deemed to have carefully examined all Contract documents to his entire satisfaction. If he shall have any doubt as to the meaning of any portion of the Contract documents, he shall, within one month of issue of Letter of Award or before signing the Contract as the case may be, set forth the particulars thereof, and submit them to the Owner in writing, in triplicate, in order that such doubt may be removed. The Owner shall provide such clarification as may be necessary, in writing to the Contractor. Any information otherwise obtained from the Owner or the engineer shall not in any way relieve the Contractor of his responsibility to fulfil his obligations under the Contract.
7.4	<u>SUPERVISION OF CONTRACTOR</u>
	The Contractor, upon award of the Contract shall, in addition to a Project Co-ordinator, nominate another responsible officer as his representative at site suitably designated for the purpose of overall responsibility and coordination of the works to be performed at site. Such persons shall function from site office of the Contractor during the pendency of Contract. Any written order or instruction of the engineer or his duly authorized representative shall be communicated to the said authorized resident representative of Contractor and the same shall be deemed to have been communicated to the Contractor.
8.0	<u>PERFORMANCE GUARANTEE IN LIEU OF SECURITY DEPOSIT</u>
8.1	The Performance Bank Guarantee for the proper fulfillment of the Contract shall be furnished by the Contractor in the prescribed form within Fifteen (15) days of Notice of Award of Contract/Letter of Award and before release of any payments due including the advance payment, if any. The performance Guarantee shall be as per proforma attached to the Bid Document. This guarantee shall be for an amount equal to 5% (Five percent) of the Contract price and MITL guideline time to time.
8.2	The performance guarantee shall cover additionally the following guarantee to the Owner:-
	The Contractor guarantees that the equipment installed by him shall be free from all defects in materials/workmanship and shall, upon written notice from the Owner, fully remedy free of expenses to the Owner such defects that are attributable to the Contractor within the period of guarantee specified in the relevant clause of the Contract.
8.3	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 stipulated in other clauses of the Contract.
8.4	The Performance Guarantee shall be returned to the Contractor 90 days after the end of the claim period. The Owner is not liable to pay any interest or compensation to the Contractor for retaining the performance Guarantee after the end of the claim period.

8.5	The termination of the Contract under the clause 25.0 ‘Contractor’s default’ of this section shall not entitle the Contractor to reduce the value of the performance guarantee nor the time thereof. The performance guarantee shall be valid for the full value and for the full period of Contract including 90 days after the end of guarantee period.
8.6	In the case of increase in contract value, the contractor shall within 30 days from the date of amendment letter, indicating increase in contract value, submit the Performance Bank Guarantee equivalent to 5% of the value of increase in contract value, valid for period as indicated in sub clause 8.5
8.7	After issue of the Notice of Award /Letter of Award of contract, if the contractor have not submitted the Performance Bank Guarantees within 30 days, the action of cancellation of Notice of Award/ Letter of Award will be initiated against the contractor and EMD will be forfeited.
9.0	CONTRACT DRAWINGS
	These should be as per Technical specification. The drawings are to be prepared and submitted and got approved from MSETCL.
10.0	MISTAKES IN DRAWINGS
	The Contractor shall be responsible for any discrepancies, errors or omissions in the drawings or other particulars supplied by him and shall pay all the costs of the alterations in the work necessitated thereby notwithstanding the fact that such drawing or particulars have been approved by the engineer provided that such discrepancies, errors or omission are not due to inaccurate information or particulars furnished to the Contractor in writing by the engineer. The Owner shall be responsible for drawings and information supplied by the engineer.
10.1	If any dimensions/figures upon a drawing or a plan differ from those obtained by scaling the drawings or plan, the dimensions as figured upon the drawings or plan shall be taken as correct.
11.0	EFFECT AND JURISDICTION OF CONTRACT
11.1	The Contract shall be considered as having come into force from the date of the issue of Letter of Award, by the Owner.
11.2	The laws applicable to this Contract shall be the laws in force in India. The Courts of Mumbai shall have exclusive jurisdiction in all matters arising under this Contract.
12.0	LANGUAGE AND MEASURES
	All documents pertaining to the Contract including specification, schedules, notices, correspondence, operating and maintenance instructions, drawings or any other writing shall be written in English language only. The metric system of measurement shall be used exclusively in the Contract.

13.0	PATENT RIGHTS & ROYALTIES
13.1	Royalties and fees for patents covering materials, articles, apparatus, devices, equipments 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, at his own cost and expenses, defend all suits or proceedings that may be instituted for 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 expenses of the Contractor who shall also satisfy/comply the decree, order or award made against the Owner. Final payment to the Contractor by the Owner will not be made while any such suit or claim remains unsettled. In the event any apparatus or 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 use of said apparatus, equipment or part thereof, replace it with non-infringing apparatus or equipment or modify it, so that it becomes non-infringing.
13.2	The Contractor shall be responsible for the observance by his sub-Contractors of the foregoing.
14.0	WORKMANSHIP & MATERIALS
14.1	The plant and/or the work shall be manufactured, constructed, provided, put in possession, carried out and maintained in all respect with workmanship and material of the best and most substantial and approved qualities to the entire satisfaction of the Engineer, who may reject any plant, apparatus, material or workmanship which shall in his opinion be defective in quality and such rejection shall be final and binding on the Contractor. The Contractor shall at his own expense provide all materials, labour, haulage, tools, tackles apparatus and all things necessary to execute and complete the work and plant in manner aforesaid.
14.2	All materials used in the manufacture shall be high graded, free from defects and imperfection, recent manufacture & unused. Materials shall, conform to the latest specifications of BIS, where applicable.
14.3	All work shall be performed and completed in accordance with the best shop practice. Manufacture, of high grade equipment castings shall be free from blow-holes, flaws, cracks or other defects and shall be smooth, close-grained and of free form and dimensions. All materials, supplies, parts, supplied under this Contract shall be tested.
15.0	PACKING, FORWARDING AND ETC.
15.1	The Contractor shall be fully responsible for packing, forwarding, by railways or any other authorized mode of transport, clearance of equipment and further at site to place of works/storage yards etc, in respect of material in his scope.
15.2	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/road or any other authorized mode of transport. The Contractor shall be held responsible for all damages/losses due to improper packing.
15.3	The Contractor shall notify the Owner of date of each shipment from his/manufacture's works and the expected date of arrival at the site for the information of Owner. 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.

16.0	INSPECTION, TESTING & INSPECTION CERTIFICATE:
	Necessary inspection as per technical specifications for the materials & equipments will be carried out by MITL/MSETCL and after the approval the same shall be used. The successful bidder shall inform to MITL/MSETCL accordingly in advance.
17.0	TIME THE ESSENCE OF CONTRACT
17.1	The time stipulated in the Contract for the completion of works shall be deemed to be the essence of the Contract. The Contractor shall so organise his resources and perform his work as to complete it not later than the date agreed to.
17.2	The Contractor shall submit a detailed PERT net work/Bar chart within the time frame agreed consisting of adequate number of activities covering various key phases of work also clearly indicating the completion period for various groups of activities. 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 which may be in the form as submitted or in revised form in line with the outcome of discussions shall form part of the Contract. 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.
17.3	The above PERT network shall be reviewed and periodic review reports shall be submitted by the Contractor as directed by the engineer.
18.0	DEMURRAGE AND WHARFAGE ETC.
18.1	When the materials are dispatched to the site stores with the name of consignee as that of the Owner, demurrage and wharfage and other expenses incurred due to delayed clearance of the material, dispatch documents, Railway/Lorry Receipt, or any other reason shall be to the account of the Contractor. It shall be the responsibility of the Contractor to obtain clear railway receipt/lorry receipt and allied documents in order to avoid any difficulty while clearing/taking delivery of the materials.
19.0	PROGRESS REPORT
19.1	The Contractor shall submit monthly reports to the engineer showing the progress of manufacture and delivery of the equipment/materials and the erection work executed by the Contractor. The Contractor shall also furnish to the engineer such other information as the engineer may require to satisfy himself about the timely manufacture and delivery of the equipments/materials and the various stages of execution of the works to suit the accepted commissioning programme. The Contractor shall be responsible for the proper dispatch, receipt and storage at the site of all equipment/materials delivered for the purpose of the Contract and also for notifying the engineer of the details of the deliveries and delay thereto. Should any plant and equipment be lost or damaged due to improper packing, transport, handling of cost to the Owner, the Contractor shall make best efforts to ensure that the replacement is arranged expeditiously so that commissioning schedule is not affected.

20.0	EXTENSION OF TIME LIMIT FOR COMPLETION
20.1	If by reasons of extra or additional work or any natural phenomenon or any cause beyond the control of the Contractor or the Owner as defined in the clause entitled “force majeure”, the Contract shall have been delayed or impeded in the completion of the works, whether such delay or impediment occurs before or after the time or extended time fixed for completion, provided that the Contractor shall without delay have given to the Engineer a notice in writing of his claim for an extension of time, the Engineer shall on receipt of such notice grant the Contractor either prospectively or retrospectively such extension of time fixed by the Contract for the completion of work as may be justified. The Contractor shall have no other claim against the Owner in respect of delay and disorganization of the work arising from occurrences here in above mentioned.
21.0	CONTRACT PRICE, TAXES & DUTIES
21.1	The lump sum prices quoted by the Contractor in his bid with additions and deletions as may be agreed for the entire scope of the works viz. Design, engineering, inspection at manufacturer’s factory site, supply, , receipt and storage at site, erection, testing and commissioning of the works covered under these specifications and documents shall be treated as the Contract price. The cost towards inspection at factory includes cost of travel including that of by Air, Hotel accommodation, etc. for at least 2 Engineers from MITL/MSETCL
21.2.1	The contract price shall include all taxes and duties, whatsoever applicable and the owner shall not be liable for payment of any such taxes or duties. The cost shall also include the cost of charges for obtaining any permit licenses etc. The inspection fee (If any) payable to the office of the Electrical inspector (PWD) GoM, towards inspection of the installation before energizing will be borne by the owner for the first (one) time. In case re-inspection becomes necessary due to any error/omissions on the part of the contractor, the charges payable towards such re-inspection(s) shall be borne by the contractor.
21.2.2	The contract price shall also include the custom duty on any imported components required for incorporation into the works. The responsibility for obtaining the import license shall rest with the Contractor.
21.4	The Contract price shall include any cost or charges for obtaining any permits, approval or license etc. wherever applicable.
21.5	The Contract is to be treated as a divisible Contract. The Contract shall include all applicable taxes, duties, etc. as indicated above. The bidder shall note this point while quoting the prices against this invitation to bid.
22.0	PRICE VARIATION DUE TO VARIATION IN TAXES
22.1.1	Variation in Taxes & duties if any will not be payable.
23.0	DEDUCTION FROM CONTRACT PRICE
23.1	All cost, damages or expenses which the Owner may have paid for which under the Contract the 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 fifteen (15) 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 amount due or becoming due by him to the Contractor under the Contract or Bank Guarantee issued by the Contractor or may be recovered by actions of law or otherwise, if the Contractor fails to satisfy the Owner of such claims.

24.0	TERMS OF PAYMENT
24.1	The payment to the contractor for the performance of the works under the contract shall be made by the owner as per guidelines and conditions specified herein. All payments made during the contract shall be on account payee or any other online banking methods. The final payment shall be made on completion of the whole work as per the contract and on fulfilment by the contractor of all his liabilities under the contract.
24.2	The owner shall make progressive payments as and when those are due as per the payment schedule. Payment shall become due and payable by the owner within 45 days from the date of receipt of contractor's bills/invoices (except final bill) by the Owner, provided the documents submitted with the invoices are complete in all respects.
24.3	Verification for completeness of bills/invoices shall be completed within seven days of receipt of the same from the contractor. In case any discrepancy is noticed, the bills/invoices shall be returned to the Contractor for revision within seven days of receipt of the same from Contractor.
24.4	Delete.
24.5	The payment will be made after fulfillment of dependency clause indicated in Activity Schedule enclosed.
24.5	PAYMENT SCHEDULE
	<p>a) For Supply of materials/ equipment</p> <p>(i) No advance.</p> <p>(ii) 80% of the cost for supplied materials/equipment shall be payable within 60 days against the material receipt (MRC) at site.</p> <p>(iii) 10% of the cost of supplied materials/equipment shall be payable within 60 days after successful erection / stringing.</p> <p>(iv) The balance 10% of the cost of supplied materials/equipment shall be paid within 60 days after successful commissioning.</p> <p>Note : The 60 days period mentioned for payments shall be reckoned from the date of successful clearance of verification of documents by MITL.</p>
	<p>b) For Services (Erection ,Testing and commissioning)</p> <p>i) 90% of the Charges towards erection portion completed shall be paid within 60 days from the date of completion, on those works.</p> <p>ii) Balance 10% of Erection charges (for the completed works) shall be paid within 60 days after successful commissioning of the works.</p> <p>Note : The 60 days period mentioned for payments shall be reckoned from the date of successful clearance of verification of documents by MITL</p>

	<p>C) For Civil Works</p> <p>i) 90% of the cost of civil works completed shall be paid within 60 days from the date of completion, on pro-rata basis.</p> <p>ii) Balance 10% shall be paid within 60 days from the date of successful commissioning of the works</p> <p>Note: The 60 days period mentioned for payments shall be reckoned from the date of successful clearance of verification of documents or due date whichever is later.</p>
24.5.1	Price Variation: Not Applicable
24.5.2	All the above payment periods shall commence on successful clearance of verification of documents after the submission of the bills duly certified by Engineer in charge and accompanied with relevant documents complete in all respects, supporting the claim(s) made.
24.6	MODE OF PAYMENT
24.6.1	All payment due to the Contractor shall be paid only by RTGS mode.
24.6.2	The Contractor shall present every month his invoice for the supply/works done in the preceding month. The invoice/bill for supply/works should be separately submitted. After verification of such invoice by Owner, all items having financial value shall be entered and certified in Owner's Measurement Book by the "Engineer Incharge" and these certified invoices along with relevant supporting documents complete in all respect shall be presented for payment.
24.6.3	Work is to be measured as per standard procedure. The measurement shall be taken jointly by persons duly authorized on the part of Owner and by the Contractor.
24.6.4	If, at any time due to any reason whatsoever, it becomes necessary to remeasure the work done in full or in part, the expense towards such remeasurement shall be borne by the Contractor.
24.6.5	The Contractor shall bear the expenditure involved, if any, in making the measurement. The Contractor shall, without extra charges, provide all the assistance with appliances and other things necessary for measurement.
24.6.6	The measurement entered in the measurement books and the bills prepared shall be signed and dated by both the Contracting parties.
24.6.7	The Contractor will be intimated in writing by the engineer the proposed date of measurement. If the Contractor does not turn at the appointed time, the Engineer shall have the powers to proceed by himself to take measurement in which case the measurement shall be accepted by the Contractor as final.
24.6.8	Passing of measurement as per bills does not amount to acceptance or the completion of the work mentioned. Any left out work has to be completed if pointed out at a later date by Engineer.
24.6.9	The Contractor shall be directly responsible for payment of wages to his workmen. A payroll sheet giving all the payments given to the workers and duly signed by the Contractor's representative should be furnished to Engineer for record purpose every month.
24.6.10	The payment for the works shall be made direct to the Contractor by the Owner / through funding agency.

25.0	CONTRACTOR'S DEFAULT
25.1	If the Contractor shall neglect to execute the works with due diligence and expedition or shall refuse or neglect to comply with any reasonable orders 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. Should the Contractor fail to comply with the notice within thirty(30) days from the date of service thereof then and in any 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, it shall be lawful for him, without prejudice to any other right he may have under the Contract, to take the works wholly or in part of the Contractor's hand 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 Contractor's all 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 money which may otherwise be due on the Contractor thereof as may be necessary, to the payment of the cost of executing the said part of the works or completing the works, as the case may be. If the cost of completing the works or executing a part thereof as aforesaid shall exceed the balance due to the Contractor, the Contractor shall pay such excess. The Owner shall have the right to terminate the Contract in case of Contractor's default.
25.2	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 Contract.
25.3	The termination of the Contract under this clause if effected by the Owner shall not entitle the Contractor to reduce the value of the performance guarantee nor the time thereof. The performance guarantee, shall be valid for the full value and for the full period of the Contract including 90 days after the end of guarantee period.
25.4	If any Part works/ half done work partial activity completion are delayed by contractor beyond the stipulated time even after the instructions are issued by nodal officer in writing, the nodal officer shall have the right to execute the same through any other Agency to avoid the delay in completion of the project. If the clause is exercised, the cost at such works shall be recovered through the Agency's payments upto the actual cost of the work executed with administrative cost i.e.10.75%. Further penalties at the rate of 10% of the above cost shall be levied to the Agency.
25.5	Such incidences, execution of clause no. 25.4 if exercised three (3) times for the project, the contractor shall be blacklisted from the participation in the future tenders of MITL/MSETCL for further three year.
26.0	TERMINATION OF CONTRACT
26.1	The Owner may upon written notice of default by the Contractor, terminate the Contract in the circumstances detailed hereunder: a) If, in the opinion of the Owner the Contractor fails to make delivery of equipment/ completion of work within the time specified in the Contract agreement or within the extended period of delivery granted by the Owner. b) If in the opinion of the Owner, the Contractor fails to comply with any of the other provisions of the Contract including technical requirements, statutory provisions etc.

26.2	In the event the Owner terminates the Contract in whole or in part as provided above, the Owner reserves the right to purchase the materials/equipments and get work executed as deemed by the Owner to be similar to the one contracted for, upon such terms and in such manner as the Owner may deem proper and the Contractor shall be liable to the Owner for any additional cost for purchase of such similar materials/equipments or works.
26.3	If the Contract is terminated under the provisions of this clause, the Owner, in addition to any other rights that he may have in terms of the Contract, may require the Contractor to transfer title and deliver to the Owner and in the manner as directed by the Owner, a) any completed equipment/works. b) Such partially completed equipments, works, drawing, information and Contract rights as the Contractor has specifically produced or acquired for the performance of such parts of this Contract which has been terminated.
26.4	The Owner shall pay to the Contractor the Contract price for the completed equipment delivered to and accepted at the rates as provided for in the Contract or where no rates are provided for in the Contract, at the rates deemed reasonable by the Owner after deduction by the Owner for the additional expenses incurred by him in getting the balance equipment from agencies other than the Contractor.
26.5	In all such cases where the Contract has been terminated due to Contractor's defaults, the decision of the Owner regarding the reasonability of the price for the parts completed and accepted and for which no rates are available in the Contract shall be final and binding on the Contractor.
27.0	REJECTION
27.1	In the event any of the equipment supplied/work done by the Contractor is found to be defective in material or workmanship or otherwise not in conformity with the requirements of the Contract even after rectification by the Contractor during the guarantee period, the Owner shall have the right to reject part or the whole of the material/work and call upon the Contractor to replace the material/work by a new one at his own expenses. If the Contractor fails to do so the Owner may either replace or rectify such defective equipment/work and charge to the Contractor the excess cost incurred by the Owner for replacement with a 15% overhead expenditure to cover the Owner's cost or terminate the Contract for Contractor's default as provided for in the Contract.
27.2	In the event the Contractor is unable to replace the rejected material within a reasonable time, the Owner reserves the right to acquire the said material/work at a reduced price considered equitable under the circumstances and the decision of the Owner as regards such reduced price shall be binding on the Contractor.
28.0	DELAYS BY OWNER OR HIS AUTHORISED REPRESENTATIVES
28.1	In case the Contractor's performance is delayed due to any act of omission on part of the Owner or his authorized representatives, 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 his work.
28.2	The Contractor desirous of extension of time for completion of work on this ground shall apply in writing to the engineer at least 30 days (Thirty days) before the expiry of the stipulated period of completion. Regarding reasonableness or otherwise of the extension of time, the decision of the Engineer shall be final.

29.0	MODIFICATION & RECTIFICATION
29.1	The modification, rectification, rework, revamping (in brief, any work done to change the existing state to the desired state) and also fabrication all or any, as are needed due to any change in or deviation from the drawing and design of equipment, operation/maintenance requirement, mismatching, transit damages and other allied works which are not very specifically indicated in the drawings, but are found essential for satisfactory completion of the work, if are required to be done, no extra charges shall be paid to the Contractor.
29.2	For the above work, any material and consumables required will also have to be arranged by the Contractor at his cost.
29.3	All the above, type of work shall preferably be carried out by separate personnel. Diversion of regular working personnel for such work shall not be permissible and no delay or slow progress should be caused due to executing such works. The Contractor shall not be liable for extension in Contract period for carrying out such works.
30.0	COMPLETION OF CONTRACT
30.1	Unless otherwise terminated under the provision of any other relevant clause, this Contract shall be deemed to have been completed at the expiration of the guarantee period as provided for under the clause entitled 'Guarantee' and upon release of last payment to the Contractor by the 'Owner', whichever is later.
31.0	CO-ORDINATION MEETINGS
31.1	Co-ordination meetings between the Engineer and the Contractor shall be held from time to time at the discretion of the Engineer, to monitor the works.
31.2	The Contractor will also be called upon to attend to design co-ordination meetings with the Engineer, other Contractors and consultants of the Owner during the period of Contract. The Contractor shall attend all such meetings at his own cost as and when required and fully co-operate with the Engineer/Owner and other agency involved during these discussions.
32.0	FORCE MAJEURE
32.1	The following clauses which substantially affect the performance of the Contract shall only be considered as force majeure conditions. 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, quarantines, embargoes. Provided the party affected by the 'Force Majeure' shall within fifteen (15) days from the occurrence of such a clause, notify the other party in writing of such cause with sufficient documentary proof.
32.2	Notwithstanding any provision under clause 32.1, the Owner shall not in any way be liable for non-performance either in whole or in part of any Contract or for any delay in performance thereof in consequence of strikes, shortages of labour or workmen or lockout, breakdown or accident to machinery or accidents of whatever nature, failure on the part of the railways to supply, sufficient wagons to carry essential raw materials etc. and finished products from the stores etc. These causes shall not be treated as 'Force Majeure' but subject to the provision and stipulation made in clause of liquidated damages for late delivery.
32.3	The Contractor or the Owner shall not be liable for delays in performing their respective obligations resulting from any force majeure causes as defined above. The date of completion will be extended by a reasonable time by mutual agreement.
32.4	In case of damage or destruction of any property or equipments belonging to the Contractor due to force majeure causes, the Owner shall not be liable for the same.

32.5	The Owner shall have the right to inform the Contractor not to ship any part of the equipment due to weather or any other reasonable cause and in all such cases, the Contractor shall withhold shipment of such parts without any extra charge for storage for a reasonable time.
33.0	ARBITRATION
33.1	The matters to be determined by the GM, Electrical (PRA)-
33.2	All disputes and differences of any kind whatsoever arising out of or in connection with the contract, whether during the progress of the work or after its completion and whether before or after the determination of the contract, shall be referred by the contractor to GM, Electrical (PRA) and the GM, Electrical (PRA) shall (within 120 days after receipt of the contractor's representation make and notify decisions of all matters to by the contractor in writing.
33.3	Demand for arbitration:- In the event of any dispute or difference between the parties hereto as to the construction or operation of this contract are the respective rights and liabilities of the parties on any matters in question, the dispute or difference on any account or as to the withholding by MITL of any certificate to which the contractor may claim to be entitled to, or if the GM, Electrical (PRA) fails to make a decision (within 120 days) then and in any such case, the contractor (after 120 days) but within (180 days) of his presenting his final claim on disputed matter, shall demand in writing that the dispute or difference to be referred to arbitration.
33.4	The demand for arbitration shall specify the matters which are in question are subject of the dispute are difference as also the amount of claim item-wise. Only such dispute (s) or difference (s) in respect of which the demand has been made, together with counter claims are set off, shall be referred to arbitration and other matters shall not be included in the reference. a) The arbitration proceedings shall be assumed to have commenced from the day, a written and valid demand for arbitration is received by the MITL. b) The claimant shall submit his claim stating the facts supporting the claims along with all relevant documents and the relief or remedy sought against each claim within a period of 30 days from the date of appointment of the Arbitration Tribunal. c) The MITL shall submit its defence statement and counter claim (s), if any, within a period of 60 days of receipt of copy of claims from the Tribunal thereafter unless otherwise extension has been granted by the Tribunal.
33.5	No new claim shall be added during the proceedings by either party. However, a party may amend or supplement the original claim or defence thereof during the course of arbitration proceedings subject to acceptance by tribunal having due regard to the delay in making it.
33.6.	If the contractor(s) does/do not prefer his/their specific and final claims in writing within a period of 90 days of receiving the intimation from the MITL, that the final bill is ready for payment, he/they will be deemed to have waived his /their claims and the MITL shall be discharged and released of all liabilities under contract in respect of these claims.
33.7	Obligation during pendency of Arbitration :

33.7.1	<p>Work under the contract shall unless otherwise directed by the Engineer, continue during the arbitration proceedings and no payments due or payable the MITL shall be with held on account of such proceedings, provided, however it shall be open for arbitral tribunal to consider and decide whether or not such works should be continued during arbitration proceedings.</p> <p>a) In cases where cases where the total value of all claims in question added together does not exceed Rs.1,00,00,000/- (one crore) the arbitral tribunal shall consist of a sole arbitrator who shall be either the C.E. of the MITL/MSETCL or serving or retired officer of the MITL/MSETCL / Government not below the grade of C.E. or equivalent nominated by the Managing Director of the MITL/MSETCL in that behalf. The Sole Arbitrator shall be appointed within 60 days from the day when a written and valid demand for arbitration is received by the MITL/MSETCL.</p> <p>b) In cases the value of the claim exceeds Rs.1,00,00,000/- (Rupees one crore) as above, the Arbitral Tribunal shall consist of panel of three serving or retired officers of MITL/MSETCL/ Government not below the grade of C.E./ C.A.O. as arbitrators. For this purpose the MITL/MSETCL will send a panel of more than three names arbitrators of one or more department of the MITL/MSETCL /Government to the Contractor who will be asked to suggest to the Managing Director at least two names for appointments as Contractor's nominee. The Managing Director shall appoint at least one of them as the Contractor's nominee and will also appoint the balance number of Arbitrators either from the panel or from outside the panel, duly indicating the presiding Arbitrator from amongst the three Arbitrators so appointed. While nominating Arbitrators, it will be necessary to ensure that one of them is or has worked in Accounts department.</p> <p>c) If one or more arbitrators appointed as above refuses to act as arbitrator, withdraws from his office as arbitrator or vacates his/their office/offices or is/are unable or unwilling to perform his functions as arbitrator for any reason whatsoever or dies or in the opinion of the Managing Director fails to act without undue delay, the Managing Director shall appoint new arbitrator/s to act in his/their place in the same manner in which the earlier arbitrator/s had been appointed. Such reconstituted Tribunal, may, at its discretion proceed with the reference from the stage at which it was left by the previous arbitrator(s).</p> <p>d) The Tribunal shall have powers to call for such evidence by way of affidavits or otherwise as the Arbitral Tribunal shall think proper, and it shall be the duty of the parties hereto to do or cause to be done all such things as may be necessary to enable the Arbitral Tribunal to make the award without any delay.</p> <p>e) While appointing arbitrator(s) as above, due care shall be taken that he/they is/are not the one/those who had an opportunity to deal with the matters to which the contract relates or who in the course of his / their duties as MITL/MSETCL's servant(s) expressed views on all or any of the matters under dispute or differences. The proceedings of the Arbitral Tribunal or the award made by such Tribunal will, however, not be invalid merely for the reason that one or more arbitrator had, in the course of his service, opportunity to deal with the matters to which the contract relates or who in the course of his/their duties expressed views on all or any of the matters under dispute.</p>
	f) Arbitral award shall state item wise, the sum and reasons upon which it is based.

	<p>g) A party may apply for corrections of any computational errors, any typographical or clerical errors or any other error of similar nature occurring in the award and interpretation of specific point of award to tribunal within 30 days of receipt of the award.</p> <p>h) A party may apply to Tribunal within 30 days of receipt of award to make an additional award as to claims presented in the arbitral proceedings, but omitted from the arbitral award.</p> <p>i) In case of the Tribunal comprising of three members any ruling or award shall be made by a majority of members of Tribunal. In the absence of such a majority, the views of the Presiding Arbitrator shall prevail.</p>
	<p>j) Where the arbitral award is for payment of money, no interest shall be payable on whole or any part of the money for any period till the date on which the award is made. The arbitrator shall have full power to review and/or revise any decision, opinion, directions, certification or valuation of the Engineer in connection 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.</p>
	<p>k) The cost of the arbitration shall be borne equally by the respective parties. The cost shall inter-alia include fees of the arbitrators as per the rates fixed by the MITL/MSETCL from time to time. Provided that the fees payable per arbitrator for claims up to Rs.One Crore, shall not exceed Rs.2000/- per sitting subject to a maximum of Rs.25,000/- and the fees payable per arbitrator for claims over Rs.One Crore, shall not exceed Rs.2000/- per sitting subject to a maximum of Rs.50,000/-. Provided further that the arbitrators who are in service of Govt./MSEB shall draw fees at half of the rates mentioned above.</p>
	<p>l) MITL/MSETCL shall maintain a list of arbitrators. The Managing Director shall have full powers to delete or add the name of the Arbitrators in the list or to make amendments to the said list as per his discretion.</p>
	<p>m) The arbitral proceedings should be completed and the award be finalized within one year from the date of appointment of arbitrators.</p>
	<p>n) Subject to the provisions as aforesaid, Arbitration & conciliation Act, 1996 and the rules there under, and any statutory notification thereof shall apply to the arbitration proceedings under this clause.</p>
34.0	SUSPENSION OF WORK
	<p>The contractor shall, on the written order of the Engineer, suspend the progress of works or any part thereof for such time or times and in such manner as the Engineer may consider necessary and shall, during such suspension, properly protect and secure the work so far as is necessary in the opinion of the Engineer. If such suspension is not due to any default on the part of the Contractor the time for completion of the works shall be extended for a period of corresponding to the duration of the suspension of works.</p>
35.0	TERMINATION OF CONTRACT ON OWNER'S INITIATIVE
35.1	<p>The owner reserves the right to terminate the contract either in part or in full for reasons other than those under clause '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.</p>

35.2	The Contractor upon receipt of such notice, shall discontinue the work on the date and time 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 upon terms satisfactory to the Owner, stop all further sub-Contracting or purchasing activity related to the work terminated and assist the Owner in maintenance, protection and disposition of the works acquired under the Contract by the Owner.
35.3	In the event of such a termination, the Contractor shall be paid reasonable compensation dictated by the circumstances prevalent at the time of termination.
36.0	POWER TO VARY OR OMIT WORK
36.1	No alterations, amendments, omissions, suspensions or variations (hereinafter referred to as "Variation") of the works 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 hereinafter 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 variation 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, 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.
36.2	In the event of the Engineer requiring any variation, such reasonable and proper notice shall be given to the Contractor to enable him to make his arrangement accordingly, and in cases where any work done requires to be altered, a reasonable and agreed sum in respect thereof shall be paid to the Contractor.
36.3	In any case in which the Contractor has received instructions from the Engineer as to the requirements of carrying out the altered or additional substituted work which either then or later on will, in the opinion of the Contractor, involve a claim or 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 the payment of any charges in respect of any such variations, unless the instructions for the performance of the same are confirmed in writing by the Engineer.
36.4	If any variation in the works results in reduction of Contract price, the parties shall agree in writing as to the extent of any change in the price.
36.5	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.
36.6	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. The Contractor shall carry out such variations and be bound by the same conditions, as though the said variations occurred in the Contract Documents.
37.0	ENFORCEMENT OF TERMS

37.1	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 herein 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.
38.0	ACCESS TO SITE AND WORKS ON SITE
38.1	The works shall be carried out at such time as the Owner may approve and the Owner shall give the Contractor facilities as brought out in the Contract for carrying out the works.
38.2	In the execution of the works, no persons other than the Contractor or his duly appointed representative, sub-Contractor and workmen, shall be allowed to do work on the site, except with the special permission, in writing, of the Engineer or his representative.
39.0	LINES AND GRADES
39.1	All the works shall be performed to the lines, grades and elevations indicated on the drawings. The Contractor shall be responsible to locate and layout the work. Basic horizontal and vertical control points will be established and marked by the Engineer at site at suitable points. These points shall be used as datum for the works under the Contract. The Contractor shall inform the Engineer well in advance of the times and places at which he wishes to do work in the area allotted to him, so that suitable datum points may be established and checked by the Engineer to enable the Contractor to proceed with his work. Any work done without being properly located may be removed and/or dismantled by the Engineer at Contractor's expense.
39.2	If any time during the progress of works any error shall appear or arise in the position, levels, dimension or alignment of any part of the work, the Contractor on being required to do so by the Engineer or Engineer's representative shall at his expense, rectify such error.
39.3	The Contractor shall carefully protect and preserve all bench marks, reference points, pegs and other things used in setting out, locating and layout of the works.
40.0	CONTRACTOR'S MATERIAL BROUGHT TO SITE
40.1	The Ownership of Contractor's all goods, tools and plants shall, from the time of their being brought to site, vest in the Owner, and these may be used for the purpose of the works and shall not on any account be removed or taken away by the Contractor from the site without the written permission of the Engineer. The Contractor shall nevertheless be solely liable and responsible for any loss or destruction thereof and damage thereto.
40.2	The Owner shall have a lien on such goods for any sum or sums which may at any time be due or owing to him by the Contractor, under in respect of or by reasons of the Contract. After giving a fifteen (15) days notice in writing of his intention to do so, the Owner shall be at liberty to sell and dispose of any such goods, in such manner as he shall think fit including public auction or private treaty and to apply the proceeds in or towards the satisfaction of such sum or sums due as aforesaid.
40.3	After the completion of the works, the Contractor shall remove from the site under the direction of the engineer the materials such as construction equipment, erection tools and tackles, etc. with the written permission of the Engineer. If the Contractor fails to remove such materials within fifteen (15) days of issue of a notice by the Engineer to do so, then the Engineer shall have the liberty to dispose of such materials as detailed above and credit the proceeds thereto to the account of the Contractor after deducting reasonable expenses incurred by the Engineer for such disposal.

41.0	CO-OPERATION WITH OTHER CONTRACTORS AND OWNER
41.1	The Contractor shall co-operate with all other Contractors or tradesmen of the Owner, who may be performing other works on behalf of the Owner and the workmen who may be employed by the Owner in the vicinity of the works under the Contract. The Contractor shall also so arrange to perform his work as to minimize, to the maximum extent possible, interference with the work of other Contractors and his workmen. Any injury or damage that may be sustained by the employees of the other Contractors and the Owner, due to the Contractor's work shall promptly be made good at his own expense. The Engineer shall determine the resolution for any difference or conflict that may arise between the Contractor and other Contractors or between the Contractor and the workmen of the Owner in regard to their work. If the works of Contractor are delayed because of any acts/omissions on the part of another Contractor, the Contractor shall have no claim against the Owner other than an extension of time for completing his works.
41.2	The Engineer shall be notified promptly by the Contractor of any defects in other Contractor's works that could affect the Contractor's works. The Engineer shall determine the corrective measures, if any, required to rectify this situation after inspection of the works and such decisions by the Engineer shall be binding on the Contractor.
42.0	WORK TO BE OPEN TO INSPECTION AND CONTRACTOR OR RESPONSIBLE AGENT TO BE PRESENT
	All works under or in course of execution or executed in pursuance of the Contract shall at all times be open to the inspection and supervision of the Engineer and the Contractor shall at all times during the usual working hours and at all other times at which reasonable notice of the intention of the Engineer to visit the works shall have been given to the Contractor, either himself be present to receive orders and instructions or have a responsible agent duly accredited in writing, present for that purpose. Orders given to the Contractor's duly authorized agent shall be considered to have the same force and effect as if those had been given to the Contractor himself.
43.0	NOTICE TO BE GIVEN BEFORE WORK IS COVERED UP
	The Contractor shall give not less than seven days notice in writing to the Engineer before covering up or otherwise placing beyond the reach of measurement any work in order that the same may be measured and correct dimensions thereof taken. In case the Contractor covers up the work without such notice, the Engineer reserves the right to get the same uncovered at the risk and expense of the Contractor.
44.0	REMEDY OF DEFECTS
	If at any time before the works are finally taken over by the Owner, the engineer shall:- a) decide that any work done or plant supplied or materials used by the Contractor or any sub-Contractor is/are defective or not in accordance with the Contract or that the works or any portion thereof are defective or do not fulfill the requirements of the Contract (all such matters being hereinafter in this clause called 'defects') and b) as soon as reasonably practicable give to the Contractor notice in writing of the said decision specifying particulars of the defects alleged and/or where the same are alleged to exist or to have occurred and c) so far as may be necessary, place the works at the Contractor's disposal.

	then the Contractor shall with all speed and at his own expense make good the defects so specified. In case the Contractor shall fail to do so, the Owner may take, at the cost of the Contractor such steps as may in all circumstances be reasonable to make good such defects. All plant provided by the Contractor to replace defective plant shall comply with the Contract. The Contractor shall be entitled to remove and retain all plant that the Owner may have replaced at the Contractor's cost. In case of failure of the Contractor to remove the replaced parts within a reasonable time, the Owner, reserves the right to take further, action for its disposal in any manner deemed fit. Such action shall in no way limit the liability and responsibility of the Contractor for removal of such parts. However, the Owner shall give reasonable time to the Contractor before such action is taken.
45.0	EMPLOYMENT OF LABOUR
45.1	The Contractor will be expected to employ on the work only his regular skilled employees with experience of this particular work. No person below the age of eighteen years shall be employed.
45.2	All travelling expenses including provisions of all necessary transport to and from site, lodging allowances and other payments to the Contractor's employees shall be the sole responsibility of the Contractor. The Contractor shall arrange, at his own cost, the accommodation for his labour and other supervisory staff.
45.3	The Contractor's employees shall wear identification badges while on work at site.
45.4	In case the Owner becomes liable to pay any wages or dues to the labour or to any Government agency under any of the provisions of the Minimum Wages Act, Workmen Compensation Act, Contract Labour Regulation Abolition Act or any other law due to act or omission of the Contractor, the Owner may make such payments and shall recover the same from the Contractor's bill.
45.5	As far as possible, unskilled workers shall be engaged from the local area in which the work is being executed.
45.6	The Contractor shall at all times during the continuance of this Contract, in all his dealings with local labour for the time being employed on or in connection with the work, have due regard to all local festivals and religions and other customs. The Contractor will fully comply with all the provisions of labour, civil and other state and central laws, statutory rules, regulations etc. In case of his non-compliance with any provision under the laws, the Contractor will indemnify the Owner from and against all liabilities, damages, penalties, demand etc.
45.7	The Contractor, in the event of his engaging 20 or more workmen at the Project, shall obtain independent licence under the Contract Labour (Regulation and Abolition) Act, from the concerned State Labour Authorities.
45.8	No idle labour charges will be admissible in the event of any stoppage caused in the work resulting in Contractor's labour being rendered idle due to any cause at any time.
45.9	The Contractor shall fulfill all his obligations in respect of accommodation including proper medical facilities for the personnel employed by him.
45.10	The Contractor shall submit to the Engineer, on the first day or every month, a man-hour schedule for the month indicating the number of manpower, skilled or otherwise proposed to be employed by him for the works. Should the Engineer be of the opinion that the list needs modification to ensure completion of the scheduled work in time and in a professional manner, the Contractor shall, at his own expense, rearrange the manpower to be employed at site.

46.0	DISCIPLINE OF WORKMEN
	The Contractor shall adhere to the disciplinary procedure set by the Engineer in respect of his employees and workmen at site. The Engineer shall be at liberty to object to the presence of any representative or employee of the Contractor who in the opinion of the Engineer has misconducted himself or is incompetent or negligent or otherwise undesirable. The Contractor shall forthwith remove such a person from site and provide in his place a competent replacement.
47.0	DISORDERLY CONDUCT, ETC.
	The Contractor shall at all time take all reasonable precautions to prevent any unlawful, riotous or disorderly conduct by or amongst his employees and for the preservation of peace and protection of persons and property in the neighbourhood of the works.
48.0	CLEANLINES
48.1	The Contractor shall be responsible for keeping the entire area allotted to him clean and free from rubbish, debris etc. during the period of Contract. The Contractor shall employ enough number of special personnel to thoroughly clean his work area at least once in a day. All such rubbish and scrap material shall be stacked or disposed of in a place to be identified by the Engineer. Materials and stores shall be so arranged to permit easy cleaning of the area. In areas where equipment might drip oil and cause damage to the floor surface, a suitable protective cover of a flame resistant, oil proof sheet shall be provided to protect the floor from such damage.
48.2	Similarly, the labour colony, the offices and the residential area of the Contractor's employees and workmen shall be kept clean and best to the entire satisfaction of the Engineer. Proper sanitary arrangements shall be provided by the Contractor, in the work areas, office and residential areas of the Contractor.
48.3	On the completion of the works, the Contractor shall clear away and remove from the site all Contractor's equipments, surplus materials, rubbish and temporary works of every kind and leave the whole of the site and works clean and in a workman like condition to the satisfaction of the Engineer.
49.0	FIRST AID
	The Contractor shall provide necessary first aid facilities for all his employees, representatives and workmen working at the site. Enough number of Contractor's personnel shall be trained in administering first aid.
50.0	SECURITY
	The Contractor shall have total responsibility for all equipments and materials in his custody stored, loose, semi-assembled and/or erected by him at site. The Contractor shall make suitable security arrangements to ensure the protection of all materials, equipment and works from theft, fire, pilferage and any other damages and loss. All materials of the Contractor shall enter and leave the work site only with the written permission of the Engineer in the prescribed manner. It shall be the responsibility of the Contractor to arrange for security till the works are finally taken over by the Engineer.
51.0	UNFAVOURABLE WORKING CONDITIONS

	The Contractor shall confine all his field operations to those works which can be performed without subjecting the equipment and materials to adverse effects, during inclement weather conditions like monsoon, storms, etc. and during other unfavourable construction conditions. No field activities shall be performed by the Contractor under conditions which might adversely affect the quality and efficiency thereof, unless special precautions or measures are taken by the Contractor in a proper and satisfactory manner in the performance of such works and with the concurrence of the engineer. Such unfavourable construction conditions will in no way relieve the Contractor of his responsibility to perform the works as per the Schedule.
52.0	WORKS & SAFETY REGULATIONS
52.1	The Contractor shall ensure the safety of all the workmen, materials and equipment either belonging to him or to others working at site.
52.2	The Contractor will notify the engineer of his intention to bring on to site any equipment or any container, with liquid or gaseous fuel or other substance which may create hazard. The Engineer shall have the right to prescribe the conditions under which such equipment or container may be handled and used during the performance of the works and the Contractor shall strictly adhere to such instructions. The Engineer shall have the right to inspect any construction plant and to forbid its use, if in his opinion it is unsafe. No claim due to such prohibition shall be entertained by the Owner.
52.3	The Contractor shall be responsible for provision of all safety notices and safety equipments required both by the relevant legislations and the Engineer as he may deem necessary.
52.4	All safety rules and codes applied by the Owner at site shall be observed by the Contractor without exception. The Contractor shall be responsible for the safety of the equipment/material and work to be performed by him. The Contractor shall also take such additional precautions as may be indicated from time to time by the engineer with a view to prevent pilferage, accidents, fire hazards and due precautions shall be taken against fire hazards and atmospheric conditions. Suitable number of clerical staff, watch & ward, store keepers to take care of equipment, materials and construction tools and tackles shall be posted at site by the Contractor till the completion of the work under this Contract.
52.5	The Contractor shall arrange for such safety devices as are necessary for such type of work and carry out the requisite tests of handling equipment, lifting tools, tackles, etc. as per prescribed standards and practices.
53.0	ELECTRICAL SAFETY REGULATIONS
53.1	No work shall be carried out on any live equipment. The equipment must be made safe by the Engineer and a permit to work issued before any work is carried out.
53.2	The Contractor shall employ the necessary number of qualified, full-time electricians to maintain his temporary electrical installation, wherever necessary.
54.0	INSURANCE

54.1	<p>The Contractor at his cost shall arrange, secure and maintain comprehensive insurance as may be necessary and for all such amounts to protect his interests and the interest of the Owner, against all risks. Any loss or damage to the equipment, during supply, handling, transporting, storage and erection, till such time the plant is taken over by the Owner shall be to the account of the Contractor. The Contractor shall be responsible for lodging of all claims and make good for the damage or loss by way of repairs and/or replacement of the portion of the works damaged or lost. The transfer of title shall not in any way relieve the Contractor of the above responsibilities during the period of the Contract.</p> <p>All the insurance cover shall be procured by the contractor from Director of Insurance, Govt. Insurance Fund, Govt. of Maharashtra, MHADA Bhavan, 264, First Floor, Bandra (East), Mumbai- 400 051 under direct method.</p> <p>The contractor shall approach to Nodal Officer and the Nodal Officer, MITL/MSETCL should ensure that all the insurance policies are obtained as above and copy of it is submitted to him accordingly. As per the directives of Govt. of Maharashtra letter no. NMP1009/sankra 39/NV 26, dtd. 16.03.2009, it is to be noted that in case the aforesaid directives are not followed by the contractor, the concerned authority of MITL/MSETCL shall recover 1% of contract value and deposit same with Director of Insurance, Govt. of Maharashtra, Mumbai by cheque/DD with complete details of contract.</p>						
	<p>As per this GR, Government Resolution (GR) No. Sankirn-2018/pr.kr.47/CR-174/Vima Prashasan dtd: 13.07.2022 issued by Government of Maharashtra Finance section. it is mandatory for the contractor to take insurance from Directorate of Insurance only and follow the instruction given in said GR.</p>						
55.0	<p>INDEMNIFICATION OF OWNER</p>						
	<p>The Contractor shall insure all his personnel, tools and plants, etc. and shall also take a third party liability cover to indemnify the Owner of all liabilities which may come up due to any act or omission on the part of Contractor and cause harm/damage to other Contractor/representatives of Owner or all or anybody rendering service to the Owner or is connected with Owner's work in any manner whatsoever.</p>						
	<p>The Contractor shall necessarily indemnify the Owner in all these respects and the indemnification and insurance policy shall be to the approval of Engineer.</p>						
	<p>The recommended value for the third party insurance policy to be taken by the Contractor are as follows:</p> <table border="0"> <tr> <td>a) Maximum liability for injury to any person</td> <td>... Rs.1,00,000/-</td> </tr> <tr> <td>b) Maximum liability for any one accident</td> <td>... Rs.2,00,000/-</td> </tr> <tr> <td>d) Maximum liability for total number of accidents during the Contract period</td> <td>... Rs.10,00,000/-</td> </tr> </table>	a) Maximum liability for injury to any person	... Rs.1,00,000/-	b) Maximum liability for any one accident	... Rs.2,00,000/-	d) Maximum liability for total number of accidents during the Contract period	... Rs.10,00,000/-
a) Maximum liability for injury to any person	... Rs.1,00,000/-						
b) Maximum liability for any one accident	... Rs.2,00,000/-						
d) Maximum liability for total number of accidents during the Contract period	... Rs.10,00,000/-						
	<p>If the total liability exceeds Rs.10/- lakhs prior to completion of the work then the Contractor shall arrange to renew the policy for the same amount to cover the balance completion period. However, irrespective of the value of the policy, the Contractor shall indemnify the Owner for all liabilities.</p>						

56.0	WORKMEN'S COMPENSATION INSURANCE
	This insurance shall protect the Contractor against all claims applicable under the Workmen's compensation Act 1948 or any amendment thereof. This policy shall also cover the Contractor against claims for injury, disability, disease or death of his or his sub-Contractor's employees, which for any reason are not covered under the Workmen's compensation Act 1948. The liabilities shall not be less than Workmen's Compensation as per statutory provisions.
57.0	COMPREHENSIVE AUTOMOBILE INSURANCE
	This insurance shall in such a form to protect the Contractor against all claims for injuries, disabilities, disease and death to members of public including the Owner's men and damage to the property of others arising from the use of motor vehicle during, on or off the site operations, irrespective o the Ownership of such vehicles.
58.0	COMPREHENSIVE GENERAL LIABILITY INSURANCE
58.1	This insurance shall protect the Contractor against all claims arising from injuries, disabilities, disease or death of members of public or damage to property of others, due to any act or omission on the part of the Contractor, his agents, his employees, his representatives and sub-Contractors or from riots, strikes and civil commotion. This insurance shall also cover all the liabilities of the Contractor arising out of the clause entitled "Defence of Suits".
58.2	The hazards to be covered will pertain to all the works which and areas the Contractor, his sub-Contractors, his agents and his employees have to perform work pursuant to the Contract.
58.3	The above are only illustrative list of insurance covers normally required and it will be the responsibility of the Contractor to maintain all necessary insurance coverage to the extent both in time and amount to take care of all his liabilities either direct or indirect.
59.0	GUARANTEE/WARRANTY
59.1	The Contractor shall warranty that the equipments/materials will be new and in accordance with the Contract documents and will be free from defects in material and workmanship for a period of one years (Twelve Months) from the date of final acceptance of the works by the Owner. Any defect developed due to defective materials and/or workmanship during testing and commissioning of the equipments or during the guarantee period of one years from the date of final acceptance of work by the Owner, shall be rectified or made good by the Contractor at his own cost. The Contractor's liability shall be limited to repair/replacement of any defective part in the equipment of his own manufacture or those of his sub-Contractor and arising from faulty, design, materials and/or workmanship. All costs for the repair and/or replacement of defective parts such as dismantling, re-erection, supply, , etc. shall be to the account of the Contractor.

59.2	No repairs or replacement shall normally be carried out by the Engineer when the plant is under supervision of Contractor's supervisory engineers. In the event of emergency, where in the judgement of the Engineer, delay would cause serious loss or damage, 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 the cost of such action is taken by the engineer, the Contractor will be notified promptly and he shall assist wherever possible in making the necessary corrections. This shall not relieve the Contractor's liability under the terms and conditions of the Contract.
59.3	If it becomes necessary for the Contractor to replace or renew any defective portion of the plant under this clause, the provision of this clause shall apply to the portion of the plant so replaced or renewed until the expiry of two year from the date of such replacement or renewal.
59.4	The acceptance of the works by the engineer shall in no way relieve the Contractor of his obligation under this clause.
59.5	If at any time during the guarantee period, it shall appear to the engineer that any work has been executed with unsound, imperfect or unskillful workmanship or with materials of inferior quality or that any materials or articles provided by him for the execution of the work unsound or of a quality inferior to that Contracted for or are otherwise not in accordance with the Contract, it shall be lawful for engineer, notwithstanding the fact that the work or materials or articles complained of may have been inadvertently passed, certified and paid for the Contractor shall be found forthwith to rectify, to remove and reconstruct the work so specified in whole or in part, as the case may require or, if so required, to remove the materials or articles so specified and provide other proper and suitable materials or articles at his own charge and cost.
59.6	In the event of the Contractor failing to remove the defect within the time specified by the engineer, the Owner may proceed to undertake the removal of such defect at the Contractor's risk and expense, without prejudice to any other rights and recover the same from performance bank guarantee/other dues
59.7	The Contractor shall promptly provide adequate staff at site during the guarantee period to attend to defects, if any.
60.0	BANKRUPTCY
	If the Contractor shall become bankrupt or insolvent, or have a receiving order made against him, or compound with his creditors, or being a company or corporation commence to the wound up, not being a member's voluntary winding up for the purpose of amalgamation or reconstruction, or carry on its business under a receiver for the benefit of its creditors or any of them, the Owner shall be at liberty (a) to terminate the Contract forthwith by notice in writing to the Contractor or to the receiver or liquidator or to any person the option of carrying out the Contract subject to his providing a guarantee for the due and faithful performance of the Contract up to an amount to be agreed.
61.0	NOTICES

61.1	Any notice to be given to the Contractor under the terms of the Contract shall be served by sending the same by registered post or leaving the same at the Contractor's principal place of business (or in the event of the Contractor being a company to or at its registered office).
61.2	Any notice to be given to the Owner under the terms of the Contract shall be served by sending the same by registered post at the owner's address.
62.0	DETAILS CONFIDENTIAL
	The Contractor shall treat the Contract and everything contained therein as private and confidential. In particular the Contractor shall not publish any information, drawing or photograph concerning the works and shall not use the sites for the purpose of advertising except with the written consent of the Engineer and subject to such conditions as he may prescribe.
63.0	EARNEST MONEY DEPOSIT (EMD)
63.1	<p>The Bidder shall pay the Earnest Money deposit.</p> <p>The Bidders will have to provide BID Security (EMD) in the form of a bank guarantee, payable at Mumbai, issued by any Nationalised / Scheduled Bank, approved by RBI, located in India, in favour of:</p> <p>Managing Director, Maharashtra Industrial Township Limited Udyog Sarathi, MIDC Office, Marol Industrial Area, Andheri (East) Mumbai – 400 093</p> <p>Bank Details of Employer required for Bid Security (EMD) Bank Guarantee: Beneficiary Name: Maharashtra Industrial Township Limited Address: Udyog Sarathi, MIDC Office, Andheri (E), Mumbai – 93 Name of the Bank: Bank of India Branch address: Chakala Branch, Andheri (E) Type of Account: Current Account Account No: 006720110000968 IFSC Code: BKID0000067</p> <p>EMD submitted by the Bidder's shall be refundable after submission of Performance Security by the successful bidder.</p>

63.2	<p>The EMD as above shall also be submitted by those bidders who are public Sector Undertaking or belong to Small Scale Industries. No exemption on these grounds can be considered and all undertakings of the State Govt., Govt. of India or local bodies including those classified as Small Scale Industries shall furnish EMD as specified.</p> <p>The micro and small enterprised (only Manufacturing and service enterprises) as defined in MSMED Act, 2006 are exempted from paying EMD and tender fees. The Udyog Aadhar Memorandum and Udyog Aadhar Registration certificate submitted by said enterprises should indicate the same Material/service as required against the tender floated.</p> <p>The Bidder has to pay EMD and tender fees in following cases:</p> <p>a. If the micro/Small Enterprises Registration Certificate does not indicate the relevant classification code covering Material/Service as required against the tender floated.</p> <p>b. If the investment in plant and machinery or Equipment exceeds the threshold limit indicated in the MSMED Act 2006(at present the Threshold prescribed limit being for Micro upto Rs. 25 Lakh, Small Rs 25 Lakh to Rs 5 crs. As investment in plant and machinery and for Micro upto Rs. 10 Lakh, Small Rs. 10 lakhs to Rs. 2crs. As investment in Equipment).</p> <p>In case of works contract, if the micro and small enterprises submits that the enterprises shall supply all the materials of intended works contract, manufactured from its own unit, then it shall be eligible for exemption of payment of EMD & Tender fee To MITL/MSETCL. However, an undertaking duly notarized from Micro and Small Enterprises to this effect is to be submitted along with bid.</p> <p>The works contractor except as stated above and traders are excluded from the benefits of EMD and Tender Fees, hence shall be required to pay EMD or tender fees while participating for e-tender process at MITL/MSETCL</p> <p>The Registration certificate as submitted by micro and small enterprise should be valid on the date of submission of bid and the validity of the same should be certified by the Chartered Accountant in practice.</p> <p>Note: In case, the micro and small enterprise (Who have been exempted from payment of EMD/Tender Fees) does not accept the Tender being L1, then such micro and small enterprises shall be debarred from the bidding process for all tenders at MITL/MSETCL for next 2 years from the date of non-acceptance of L1 bid and this is to be clearly mentioned in all tenders.</p>
63.3	The EMD will be valid for a period of 6 months from the date of opening of Techno-Commercial bid.
64.0	<u>PRICE VARIATION : Not Applicable for this tender and hence DELETED.</u>
64.1	Bids for the contract will be on variable price basis i.e. Price Variation will be applicable with frozen indices. Or may vary as per MITL/MSETCL guideline time to time
64.2	-

64.3	<p>For the purpose of calculation of price adjustment for lines & substation:</p> <ul style="list-style-type: none"> ▪ The indices for various materials shall be considered as published by IEEMA. The indices published by IEEMA on the 1st working day of the calendar month, one month prior to the date of opening of techno-commercial bid will be the base indices for calculation of PV. ▪ DELETED. <p>The formula for calculation of price variation will be as per IEEMA. For supply of materials (as specified under clause 65.5 below) and civil services (Erection) latest revision of IEEMA. P.V. formula will be applicable.</p>
64.4	The Owner shall not be liable for any additional cost incurred by Contractor on account of price variation beyond the time stipulated in the Contract for completion of works on account of default by Contractor.
64.5	<p>Components for which PV is applicable:</p> <ul style="list-style-type: none"> (i) Structural Steel, ACSR conductor For all other materials/equipments PV not applicable (ii) Erection works
64.6	If interest free advance is paid for supply of material, P.V. on amount equivalent to value of advance payment will not be considered on applicable items for supply. The price variation will be evaluated as per recent PV formula specified by IEEMA.
64.7	The PV formula for calculation of price variation for the items to which PV is applicable are enclosed separately.
64.8	In case of non completion of activities related to Supply & ETC works within the scheduled date, if the price adjustment calculated for the period beyond the scheduled date is positive, no payment against the same shall be allowed, while if the figure is negative, the price adjustment will be applicable.
65.0	LIQUIDATED DAMAGES
65.1	If the Contractor fails to complete all the works within the time frame stipulated as completion period or within any extension of time granted by the Owner, the Owner shall levy liquidated damages for breach of Contract without prejudice to any other rights and/or remedies provided for the Contract.
65.2	The liquidated damages shall be levied at ½% (half percent) of the total Contract price per week of delay subject to maximum of 10% (Ten percent) of the Contract price for the entire scope of work delay. The Contract may be terminated by the Owner and the balance work shall be completed by the Owner at the risk and cost of the Contractor in case the progress is not to the satisfaction of the owner.
65.3	In the event the contract being divided into sections such as Supply of materials & equipments, Civil and Erection, Testing & Commissioning, the provision for liquidated damages shall be applicable for the total project irrespective of the divisible contract.
65.4	GST on LD will be applicable as per rule.
66.0	VALIDITY OF THE OFFER
66.1	Validity of the offer should be for a period of 6 months from the due date of submission of Techno-commercial Bid.
67.0	-
68.0	The offers not conforming to our clauses regarding EMD, Performance, Terms of payment, liquidated damages, Force majeure and validity are liable to be rejected.

69.0	POLICY FOR BIDS UNDER CONSIDERATION
69.1	The bids shall be deemed to be under consideration immediately after those 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 bid under consideration. The Owner if necessary, shall obtain clarifications on the bid by requesting for such information from any or all the bidders in writing as may be necessary.
70.0	ACCEPTANCE OF BIDS
	The Owner does not bind himself to accept the lowest or any bid neither will any reason be assigned for the rejection of any bid or part of the bid. It is also not binding on the Owner to disclose any analysis report on bids.
71.0	WITHDRAWAL OF INVITATION TO BID
	While the Owner has floated this public tender and has requested bidders to submit their proposals, the Owner shall always be at liberty to withdraw this invitation to bid at any time before its acceptance.
72.0	REPRESENTATIVE/AGENT OF BIDDER
72.1	All the bidders are requested to mention the name of their authorized representative/agent, if any, with full address in the offer.
72.2	In case the representative/agent is changed during the course of execution of the Contract, such changes shall be notified by the Contractor, failing which, the Owner shall not accept any responsibility.
73.0	AGREEMENT BOND
73.1	The successful Bidder will have to execute the Agreement with the MITL on the stamp paper as per LOA / Work order value as below. a) where the LOA/Work order value does not exceed Rs.10 Lakhs : The stamp duty payable is Rs.500/- (i.e.Stamp paper of Rs.500/-) b) where the LOA/Work order value exceed Rs.10 Lakhs : The stamp duty payable is Rs.500/- plus 0.1% of the amount above Rs.10 Lakhs, subject to a maximum of Rs.25 Lakhs.
74.	BIDDERS FROM A COUNTRY SHARING A LAND BORDER WITH INDIA IN ORDER TO BE ELIGIBLE TO BID
74.1	All registered vendors of MITL/MSETCL whose registration on e-tendering is valid on the date of submission of bid can participate in the subject tender. The bidder shall invariably declare the name of the manufacturer of the equipment offered and shall also indicate its country of origin (mandatory in case of imported items).
74.2	For bidders from a country that share land border with India the following restrictions shall be applicable (As per order Public Procurement no. 1 dt. 23.7.2020 from MoF, GOI with subsequent clarifications):
i)	Any bidder from a country which shares a land border with India will be eligible to bid in this tender only if the bidder is registered with the competent authority as indicated in Annexure-I (Competent Authority and Procedure for registration) of order Public Procurement no. 1 dt. 23.7.2020 from Ministry of Finance, Government of India.

ii)	<p>The term “Bidder from a country which shares a land border with India” means:</p> <ul style="list-style-type: none"> a) An entity incorporated, established or registered in such a country; or b) A subsidiary of an entity incorporated, established or registered in such a country; or c) An entity substantially controlled through entities incorporated, established or registered in such a country; or d) An entity whose beneficial owner is situated in such a country; or e) An Indian (or other) agent of such an entity; or f) A natural person who is a citizen of such a country; or g) A consortium or joint venture where any member of the consortium or joint venture falls under any of the above.
iii)	<p>The registration of the bidder from Competent Authority should be valid at the time of submission of bids and at the time of acceptance of bids. If the bidder was validly registered at the time of acceptance / placement of order, registration shall not be a relevant consideration during contract execution.</p>
iv)	<p>The bidder who shares a land border with India shall furnish documentary evidence of valid registration obtained from the issuing competent authority and submit the following undertaking on their letterhead, duly sealed and signed, along with their offer:</p> <p>“I the undersigned have read the clause regarding restrictions on procurement from a bidder of a country which shares a land border with India; I certify that _____ (name of bidder) incorporated on _____ with its registered office at _____, participating in the subject tender, is from such a country and has been registered with the competent authority. I hereby enclose the valid registration certificate issued by the competent authority and certify that _____ (name of bidder) fulfils all requirements in this regard and is eligible to be considered.”</p>
v)	<p>The bidder who does not share a land border with India shall submit the following undertaking on their letterhead, duly sealed and signed, along with their offer:</p> <p>“I the undersigned have read the clause regarding restrictions on procurement from a bidder of a country which shares a land border with India; I certify that _____ (name of bidder) incorporated on _____ with its registered office at _____, participating in the subject tender, is not from such a country. I hereby certify that _____ (name of bidder) fulfils all requirements in this regard and is eligible to be considered.”</p>

vi)	<p>For Works involving possibility of sub-contracting, the bidder shall additionally submit the following undertaking on their letterhead, duly sealed and signed, along with their offer:</p> <p>I have read the clause regarding restrictions on procurement from a bidder of a country which shares a land border with India and on sub-contracting to contractors from such countries; I certify that _____ (name of bidder) is not from such a country or, if from such a country, has been registered with the Competent Authority and will not sub-contract any work to a contractor from such countries unless such contractor is registered with the Competent Authority. I hereby certify that _____ (name of bidder) fulfils all requirements in this regard and is eligible to be considered. [Where applicable evidence of valid registration by the Competent Authority shall be attached]”</p>
vii)	<p>Offer received without the prescribed undertaking (as per Sr. No. iv, v, vi above as applicable) shall be liable for rejection. Further, if the certificate / undertaking submitted by the bidder is found to be false, it would be a ground for rejection of offer / immediate termination and further legal action in accordance with law.</p>

SCHEDULE – ‘B1’

Tender No. : MITL/SBIA/2026-27/T-01

Name of Project: Work of LILO on 220KV Chitegaon - Chitepimpalgaon line at MSETCL Bus including Supply, erection, and commissioning of required Lattice Towers for Power Supply arrangement to JSW Mobility Ltd at Bidkin Industrial Area, Dist. Chh. Sambhajinagar.
Name of Bidder & Address:

DETAILS OF FULFILLMENT OF FOLLOWING CONDITIONS.

Sr. No.	Particulars of registration	Registration No.	Period of Validity From – To
1	Valid Govt. Electrical Contractor's license		
2	GST (Goods & Service Tax) Code		
3	P.F. Act		

Signature of the Bidder: _____

Name : _____

Designation : _____

Date : _____

Authorized Common
Rubber Stamp/Seal of the Bidder:

SCHEDULE 'B2'

Tender No. : **MITL/SBIA/2026-27/T-01**

Name of Project: Work of LILO on 220KV Chitegaon - Chitepimpalgaon line at MSETCL Bus including Supply, erection, and commissioning of required Lattice Towers for Power Supply arrangement to JSW Mobility Ltd at Bidkin Industrial Area, Dist. Chh. Sambhajinagar.

Name of Bidder & Address:

DETAILS OF TOOLS-PLANTS AND INFRASTRUCTURE AVAILABLE

Sr. No	Particulars of Tools, Plants, Machinery Available	Capacity Rating, if any	Quantity Available	Make

Signature of the Bidder: _____

Name : _____

Designation : _____

Date : _____

Authorized Common
Rubber Stamp/Seal of
The Bidder : _____

SCHEDULE 'B3'

Tender No. : MITL/SBIA/2026-27/T-01

Name of Project: Work of LILO on 220KV Chitegaon - Chitepimpalgaon line at MSETCL Bus including Supply, erection, and commissioning of required Lattice Towers for Power Supply arrangement to JSW Mobility Ltd at Bidkin Industrial Area, Dist. Chh. Sambhajinagar. Name of Bidder & Address:

DETAILS OF EXPERIENCED STAFF EMPLOYED BY THE BIDDER

Sr. No.	Name of person with designation	Educational Qualification	Date of joining the organization	Details of project executed with voltage class
1				
2				
3				
4				
5				

Signature of the Bidder: _____

Name : _____

Designation : _____

Date : _____

Authorized Common
Rubber Stamp/Seal of
The Bidder : _____

SCHEDULE 'B4'

Tender No. : MITL/SBIA/2026-27/T-01

Name of Project : Work of LILO on 220KV Chitegaon - Chitepimpalgaon line at MSETCL Bus including Supply,erection,and commissioning of required Lattice Towers for Power Supply arrangement to JSW Mobility Ltd at Bidkin Industrial Area, Dist.Chh.Sambhajinagar.Name of Bidder & Address :

DETAILS OF WORKS EXECUTED

The following is the list of orders executed by us, the details of which are furnished in support of Qualifying Requirement.

Sr. No.:	Customer :	Order ref. : and date :	Order Value : (Rs. Lakhs) :	Name of Line with Voltage :	Date of Starting Work : rating :	Date of Comp- : letion :	Date of Commi- : ssoning :	Re- : mar- : ks :

NOTE : 1) Copies of User's certificate to be enclosed in support of above details.

Signature of the Bidder: _____

Name : _____

Designation : _____

Date : _____

Authorized Common
Rubber Stamp/Seal of
The Bidder : _____

SCHEDULE 'B5'

Tender No. : MITL/SBIA/2026-27/T-01

Name of Project: Work of LILO on 220KV Chitegaon - Chitepimpalgaon line at MSETCL Bus including Supply, erection, and commissioning of required Lattice Towers for Power Supply arrangement to JSW Mobility Ltd at Bidkin Industrial Area, Dist. Chh. Sambhajinagar.

Name of Bidder & Address:

FINANCIAL CAPACITY QUALIFICATION INFORMATION-

Annual turnover

S. No.	Financial Years	Turnover from Similar Work	Turnover from Other Business	Total Annual turnover	Net worth	Profit
1	2020-2021					
2	2021-2022					
3	2022-2023					
4	2023-2024					
5	2024-2025					

Certificate from the Chartered Accountant.

This is to certify that _____ full name of company] [registered address] has received the payments shown above against the respective years and also not applied for Corporate Debt Restructuring (CDR) as on date of bid submission.

Name of Authorized Signatory:

Designation:

Name of firm:

Signature of Authorized Signatory:

Seal of CA / Audit firm:

UDIN

Note:

The Contractor shall provide the certificate from its Chartered Accountant.

SCHEDULE 'B6'

Not Applicable

Tender No. _____ : **MITL/SBIA/2026-27/T-01**

~~Name of Project: Work of LILO on 220KV Chitegaon—Chitepimpalgaon line at MSETCL Bus including Supply, erection, and commissioning of required Lattice Towers for Power Supply arrangement to JSW Mobility Ltd at Bidkin Industrial Area, Dist. Chh. Sambhajinagar.
Name of Bidder & Address:~~

DETAILS OF NET WORTH

Sr. No.	Financial Year	Equity Capital *	Reserves *	Revaluation Reserve s *	Intangible assets *	Misc. Exp. to the extent not written off & carry forward losses *	Net Worth *
1							
2							
3							
4							
5							

_____ (* All the figures are in Rs. lakhs.)

NOTE: 1) The above details should be duly certified by the Chartered Accountant with UIDN.

Signature of the Bidder: _____

Name : _____

Designation : _____

Date : _____

Authorized Common
Rubber Stamp/Seal of
The Bidder : _____

SCHEDULE 'B7'

DEVIATION FROM SPECIFICATION

Tender No. : **MITL/SBIA/2026-27/T-01**

All the deviations from this specification shall be set out by the tendered, clause by clause in this schedule. Unless specifically mentioned in this schedule the tender shall be deemed to conform to the specification.

Sr. No.	: Part/Section	: Details of	: Justification/
	: Clause No.	: deviation	: Reasons

Signature of the Bidder: _____

Name : _____

Designation : _____

Date : _____

Authorized Common
Rubber Stamp/Seal of
The Bidder : _____

SCHEDULE-‘B8’

Undertaking by bidder to supply the equipments /materials conforming to GTP / Specification given in tender document and from the approved manufacturers /vendors of MSETCL

Tender No. : **MITL/SBIA/2026-27/T-01**

I, the undersigned hereby confirm that the equipments /materials offered against the above Tender shall conform to specification/ GTPs given in Tender Specification and shall be procured from the approved manufacturers /vendors mentioned in Technical Specification of above Tender document.

The drawings /GTPs/Type test reports will be submitted for approval within 30 days from date of LOA.

The undersigned has been authorized to sign the above undertaking on behalf of Company and necessary Power of Attorney /Authorization letter is enclosed with our bid offer.

Date:

Signature of authorized

Place:

Representative Name _____

Designation_____

Name of Bidder Firm_____

Common Seal of Company_____

SCHEDULE – ‘B9’

SUPPLY OF MATERIALS AND CONSTRUCTION OF -----

AGAINST Tender No. : MITL/SBIA/2026-27/T-01

UNDERTAKING BY THE BIDDERS REGARDING TYPE TESTING OF THE EQUIPMENT

(This schedule is applicable when the already conducted type tests are more than five years old)

I/ We hereby confirm that the type tests for the below listed equipment have already been carried out. However, since these tests are more than 5 Years old, I/ We undertake to carryout the relevant type tests on these equipment free of cost to the Purchaser and shall submit the reports after completing type tests successfully, but positively before commencement of the supply, in the event of award of contract to me/us.

Sr. No.	Description of equipment	Model No./ Type designation	Date of previous (successful) type tests

Name of the firm :
Signature of the Tenderer :
Name :
Designation :
Date :
Seal of the company :

SCHEDULE 'B10'

Bid validity Letter

To,

The Managing Director,
MITL, Udyog Sarathi, DMIC Cell,
Mahakali Caves Road, Andheri East,
Mumbai- 400 093

Turnkey project for :

Under Tender No. : **MITL/SBIA/2026-27/T-01**

Sir,

We hereby confirmed that, the validity of our bid is for 06 months from the date of opening of Techno-commercial bid as required.

Signature of the Bidder_____

Name _____

Designation_____

Date_____

Authorised common
Rubber Stamp /Seal of
The Bidder_____

SCHEDULE 'B11'

Undertaking to be Submitted by the Bidder declaring that Bidder is not Debarred / Blacklisted by Government / Semi-Government / Other Power Utilities

To,

The Managing Director,
MITL, Udyog Sarathi, DMIC Cell,
Mahakali Caves Road, Andheri East,
Mumbai- 400 093

Sub: Undertaking to be Submitted by the Bidder declaring that Bidder is not Debarred / Blacklisted by Government / Semi-Government / Other Power Utilities

Ref: Tender No. : **MITL/SBIA/2026-27/T-01**

Sir, I / We hereby declare that I / We is / are participating in MITL Tender No. : **MITL/SBIA/2026-27/T-01**

As on date of submission of this tender, I / We hereby declare that My Firm / We is / are Not Debarred / Blacklisted by Any Government / Semi-Government / Other Power Utilities, anywhere.

The above declaration is true to the best of My / Our knowledge and belief. .

I / We hereby agree that in case My Firm / We are Debarred / Blacklisted by Any Government / Semi-Government / Other Power Utilities, anywhere, My / Our Offer is liable for Rejection at any stage of Tendering process as per the Tender Conditions.

Further, I / We hereby understand and agree that in case My Firm / We are Debarred / Blacklisted by Any Government / Semi-Government / Other Power Utilities, anywhere, My / Our Order is liable for Termination at any stage of Order execution process and My Firm / We shall be solely responsible for the consequences arising out of it. Authorized Signatory Seal of Firm

Signature of the Bidder _____
Name _____
Designation _____
Date _____
Authorized common
Rubber Stamp /Seal of The Bidder _____

Schedule B-12

< On OEM letter head >

MANUFACTURER'S AUTHORIZATION FORM (MAF/Joint Deed-Undertaking)

To,
The Managing Director,
MITL, Udyog Sarathi, DMIC Cell, Mahakali Caves Road, Andheri East, Mumbai- 400 093
Subject: Manufacturer's / OEM Authorization Form

Ref.: Tender No. MITL/SBIA/2026-27/T-01: Work of LILO on 220KV Chitegaon - Chitepimpalgaon line at MSETCL Bus including Supply,erection,and commissioning of required Lattice Towers for Power Supply arrangement to JSW Mobility Ltd at Bidkin Industrial Area, Dist.Chh.Sambhajinagar.

Dear Sir,

This is with reference to above referenced tender & subject. We, OEM, certify that M/s. _____, having their registered office at _____ is our authorized exclusive partner to bid against your tender.

As OEM, we assure to provide support & services to _____ for following quoted products till the contract completion period. We also hereby confirm that we would be responsible for the satisfactory working of all equipment purchased by us and the spares for the equipment shall be available for at least 5 years (warranty period) from the date of supply of equipment. So, we, OEM, hereby undertake that all the components/parts/software used in our products shall be original & new and no refurbished / duplicate / second hand components / parts / software are being used or shall be used in future.

Details of quoted products:

We, further confirm that our system will provide 5 years of warranty against manufacturing defect and will be repaired by our authorized repair center which is located in _____.

Yours faithfully,
(Authorized Signatory)
Name:
Signature & Seal/Stamp of the OEM Place:
Date:

SCHEDULE 'E'

FORM OF PERFORMANCE SECURITY (BANK GUARANTEE IN LIEU OF SECURITY DEPOSIT)

To:

Managing Director,
Maharashtra Industrial Township Limited,
Udyog Sarathi, MIDC Office,
Marol Industrial Area, Andheri (East),
Mumbai, Maharashtra State, India – 400093

WHEREAS _____ [name and address of Contractor] (hereinafter called "the Contractor") has undertaken, in pursuance of Contract No. _____ dated _____ to execute **"Work of LILO on 220KV Chitegaon - Chitepimpalgaon line at MSETCL Bus including Supply, erection, and commissioning of required Lattice Towers for Power Supply arrangement to JSW Mobility Ltd at Bidkin Industrial Area, Dist. Chh. Sambhajinagar."** (hereinafter called "the Contract").

AND WHEREAS it has been stipulated by you in the said Contract that the Contractor shall furnish you with a Bank Guarantee by a recognized Nationalised/Scheduled bank for the sum specified therein as security for compliance with its obligations in accordance with the Contract.

AND WHEREAS we have agreed to give the contractor such a Bank Guarantee;

NOW THEREFORE we agree unconditionally and irrevocably to guarantee as primary obligator and not as Surety merely, on behalf of the contractor, a total of up to _____ [amount of Guarantee] _____ [in words], such sum being payable in the types and proportion of currencies in which the Contract Price is payable, and we undertake to pay you, upon first written demand and without cavil or argument, any sum or sums within the limits of _____ [amount of Guarantee] as aforesaid without your needing to prove or to show grounds or reasons for your demand for the sum specified therein.

We hereby waive the necessity of your demanding the said debt from the Contractor before presenting us with the demand.

We further agree that no change or addition to or other modification of the terms of the Contract or of the Works to be performed there under or of any of the Contract documents which may be made between you and the Contractor shall in any way release us from any liability under this guarantee, and we hereby waive notice of any such change, addition or modification.

This guarantee shall be valid until the date of issue of the Performance Certificate. We are liable to pay up to the guarantee amount upon receipt of written claim or demand from you of

(Name of Bank with Branch Address in Mumbai) not later than (60 Days) i.e. inclusive of further 60 Days from the date of expiry.

Notwithstanding anything to the contrary contained herein –

- i. Our liability under this Guarantee shall not exceed **Rs.**
- ii. This Guarantee shall be valid up to (Being the date of expiry date of the Guarantee)
- iii. The beneficiary's right as well the Bank's liability under this Guarantee shall stand extinguished unless a written claim or demand is made under this Guarantee on or before completion of one year from expiry date i.e.
- iv. This Guarantee shall be encashable at Mumbai Branch of which address is given below:

Name of Bank _____

Address _____

Date:

Signature & Seal of the Guarantor

SCHEDULE 'F'
Not Applicable

~~PROFORMA OF INDEMNITY BOND TO BE EXECUTED BY THE CONTRACTOR FOR THE MATERIALS HANDED OVER IN INSTALMENTS BY MITL/MSETCL FOR PERFORMANCE OF ITS CONTRACT~~

~~(On non-Judicial stamp paper of appropriate value) Not Applicable~~

INDEMNITY BOND

— THIS INDEMNITY BOND is made on this..... day of 20.....by
a company registered under the law, having its Registered Office at (hereinafter called a 'Contractor' or 'Obligor' which expression shall include its successors and permitted assigns) in favor of Maharashtra State Electricity Transmission Co. Ltd; constituted under the Electricity (Supply) act 1948 having its Registered Office at Mumbai and its project inMaharashtra State. (hereinafter called the MITL/MSETCL which expression shall include its successors and assigns):

— WHEREAS MITL/MSETCL has awarded to the Contractor a Contract for.....
vide its Award letter/Contract No..... and Amendment No.....(applicable when amendments have been issued) (hereinafter called "Contract") in terms of which the MITL/MSETCL is required to hand over materials to the Contractor for execution of the Contract.

— AND WHEREAS by virtue of Clause No..... of the said Contract, the Contractor is required to execute an Indemnity Bond in favor of the MITL/MSETCL for the materials handed over to it by the MITL/MSETCL for the purpose of performance of the Contract/Erection portion of the Contract. (hereinafter called the "Material").

— NOW THEREFORE, this indemnity Bond witnessed as follows:

1. That in consideration of various materials as mentioned in the Contract valued at Rs..... (Rupees.....) handed over to the Contractor in installments from time to time for the purpose of performance of the Contract, the Contractor hereby undertakes to indemnify and shall keep the MITL/MSETCL indemnified, for the full value of the Material. The Contractor hereby acknowledges receipt of initial installments of the Materials as per details in the Schedule appended hereto. Further the Contractor agrees to acknowledge receipt of the subsequent installments of the Material as required by the MITL/MSETCL in the form of schedules consecutively numbered which shall be attached to this Indemnity Bond so as to form integral part of this Bond. It is expressly understood by the Contractor that handing over of the Dispatch title documents in respect of the said Material duly endorsed by the MITL/MSETCL in favor of the Contractor shall be construed as handing over of the Material purported to be covered by such title documents and the Contractor shall hold such materials in trust as a Trustee for and on behalf of the MITL/MSETCL.

2. That the Contractor is obliged and shall remain absolutely responsible for the safe transit/protection and custody of the Material at the said project sites against all risks whatsoever till the Material are duly used/ erected in accordance with the terms of the Contract

and the Plant/Package duly erected and commissioned in accordance with the terms of the Contract, is taken over by the owner. The Contractor undertakes to keep the owner harmless against any loss or damage that may be caused to the Materials.

3. The Contractor undertakes that the Materials shall be used exclusively for the Performance/execution of the Contract strictly in accordance with its terms and conditions and no part of the material shall be utilized for any other work or purpose whatsoever. It is clearly understood by the Contractor that non-observance of the obligations under this Indemnity Bond by the Contractor shall inter alia constitute a criminal breach or trust on the part of the Contractor for all intents and purposes including legal/penal consequences.

4. The MITL/MSETCL is and shall remain the exclusive Owner of the Materials free from all encumbrances, charges or liens of any kind, whatsoever. The materials shall at all times be open to inspection and checking by Engineer in Charge /Engineer or other employees / agents authorized by him in this regard. Further, the MITL/MSETCL shall always be free at all times to take possession of the materials in whatever form the Materials may be, if in its opinion, the Materials are likely to be endangered, mis-utilized or converted to uses other than those specified in the Contract, by and acts of omission or commission on the part of the Contractor or any other person or on account of any reason whatsoever and the contractor binds itself and undertakes to comply with the directions of demand of the MITL/MSETCL to return the Materials without any demur or reservation.

5. That this Indemnity Bond is irrevocable. If at any time any loss or damage occurs to the materials or the same or any part thereof is mis-utilized in any manner whatsoever, then the Contractor hereby agrees that the decision of the Engineer in charge/Engineer of the Owner shall be binding on the Contractor. The Contractor binds itself and undertakes to replace the lots and any demur, reservation or protest. This is without prejudice to any other right or remedy that may be available to the MITL/MSETCL against the Contractor under the Contract and under this Indemnity Bond.

6. NOW THE CONDITION of this bond is that if the Contractor shall duly and punctually comply with the terms and conditions of this Bond to the satisfaction of MITL/MSETCL. Then, the above bond shall be void, but otherwise, it shall remain in full force and virtue.

IN WITNESS WHEREOF, the Contractor has hereunto set its and through its authorized representative under the common seal of the Company, the day, month and year first above mentioned

Particulars of the material handed over	Qty.	Particulars of Dispatch Title Document	Value of the Material receipt.	Signature of Attorney in token of

RR/LR/ Carrier				
No., date of bill/				
Date of loading.				

(Please Number subsequent Schedules)

For and on behalf of

M/s. _____

WITNESS:

I) 1. Signature _____ (Signature) _____

2. Name _____ (Name) _____

3. Address _____ (Designation) _____

II) 1. Signature _____ (Common Seal)

2. Name _____ (In case of Company)

3. Address _____

Indemnity Bonds are to be executed by the authorised persons and

_____ (i) in case of contracting Company under common seal of the Company of (ii) having the power of attorney issued under common seal of the Company with authority to execute Indemnity Bonds, (iii) In case of (ii), the original Power of Attorney if it is specifically for this Contract or a photo state copy of the Power of Attorney if it is General Power of Attorney and such documents should be attached to Indemnity Bond.

SCHEDULE 'F'

BID SECURITY FORM

BANK GUARANTEE IN LIEU OF BID SECURITY (EMD)

(To be Stamped in accordance with Stamp Act)

WHEREAS, _____ [Name of Bidder] (hereinafter called "the Bidder") has submitted his bid dated _____, 2026, [Date] for the "**Work of LILO on 220KV Chitegaon - Chitepimpalgaon line at MSETCL Bus including Supply, erection, and commissioning of required Lattice Towers for Power Supply arrangement to JSW Mobility Ltd at Bidkin Industrial Area, Dist.Chh.Sambhajinagar.**", under Tender No. _____ (hereinafter called "the Bid").

KNOW ALL PEOPLE by these presents that We _____ [Name of Bank] of [Name of Country] _____ having our registered office at _____ (hereinafter called "the Bank") are bound unto the Managing Director, Maharashtra Industrial Township Limited, Udyog Sarathi, MIDC Office, Marol Industrial Area, Andheri (East), Mumbai, Maharashtra State, India – 400093, India, (hereinafter called "the Employer") in the sum of _____ for which payment will and truly to be made to the said Employer the Bank binds himself, its successors and assigns by these presents.

AND WHEREAS it has been stipulated by you in the said Tender that the Bidder shall furnish you with a Bank Guarantee by a recognized Nationalised/Scheduled bank for the sum specified therein as security for compliance with its obligations in accordance with the Tender.

AND WHEREAS we have agreed to give the Bidder such a Bank Guarantee;

SEALED with the Common Seal of the said Bank this _____ day of _____ 2026.

THE CONDITIONS of this obligation are:

1. if the Bidder withdraws or amends his Bid during the period of Bid validity specified in the Form of Bid; or
2. if the Bidder does not accept the correction of arithmetical errors of his bid price in accordance with the Instructions to Bidders in his Bid; or
3. if the Bidder, having been notified of the acceptance of his Bid by the Employer during the period of Bid validity:
 - a) fails or refuses to execute the Form of Contract Agreement in accordance with the Instructions to Bidders, if required; or
 - b) fails or refuses to furnish the Performance Security, in accordance with the Instructions to Bidders;
4. if the bidder is determined, at any time prior to the award of contract, to have engaged in corrupt or fraudulent practices in competing for the Contract; or
5. if it comes to notice that the information/documents furnished in its Proposal is incorrect, false, misleading or forged or
6. in giving effect to any other provisions given in the Instructions to Bidders.

We undertake to pay to the Employer up to the above amount upon receipt of its first written demand, without the Employer having to substantiate his demand, provided that in its demand the Employer will note that the amount claimed by him is due to him owing to the occurrence of one or all of the above conditions, specifying the occurred condition or conditions.

This Guarantee will remain in force up to and including the date occurring 180 days after the deadline for submission of bids as such deadline is stated in the Instructions to Bidders or as it may be extended by the Employer, notice of which extension(s) to the Bank is hereby waived. Any demand in respect of this Guarantee should reach the Bank **(Name of Bank with Branch Address in Mumbai)** not later than the above date.

Notwithstanding anything to the contrary contained herein

i. Our liability under this Guarantee shall not exceed Rs.

ii. This Guarantee shall be valid up to

(Being the date of expiry of the Guarantee, i.e., 180 days after the bid submission deadline or as extended).

iii. The beneficiary's right as well the Bank's liability under this Guarantee shall stand extinguished unless a written claim or demand is made under this Guarantee on or before completion of one year from expiry date i.e.

iv. This Guarantee shall be encashable at Mumbai Branch of which address is given below:

Address _____

Date:

Signature & Seal of the Guarantor

Section III

General Points: - General Instruction to Bidders

1. Owner invites bids in respect of work to be done as set forth in the accompanying specifications. All bids are required to be prepared and submitted in accordance with the instructions, set forth hereinafter.
2. owner reserves the right to accept any bid or reject any or all bids or cancel/ withdraw invitation to Bid without assigning any reason for such decision. Such decision of the Owner shall not be subject to question by any bidder and Owner shall bear no liability whatsoever for such a decision.
3. **Cost Of Bidding**
 - 3.1 All the costs and expenses incidental to preparation of the bid, pre-award discussions, technical and other presentations including any demonstrations, etc. shall be to the account of the Bidder and Owner shall bear no liability whatsoever towards such costs and expenses regardless of the conduct or outcome of the bidding process.
 - 3.2 Understanding of Bid Documents: The bidder is expected to examine all instructions, terms and conditions, forms and specifications in the Bid Document and fully inform himself as to all the conditions and matters which may in any way affect the works or the cost thereof.
 - 3.3 Further, failure to furnish all information required by the Bid Document 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 his bid.
4. **AMENDMENT OF BIDDING DOCUMENTS**
 - 4.1 At any time prior to the deadline for submission of bids, the Owner may, for any reason, whether at his own initiative or in response to a clarification requested by a prospective Bidder, modify the Bidding documents by amendment.
 - 4.2 The amendment will be notified in writing by telex, fax or cable to all prospective Bidders who have purchased the Bidding Documents and it will be binding on them.
 - 4.3 In order to allow prospective bidders reasonable time in which to take the amendment into account in preparing their bids, the Owner may, at his discretion, extend the deadline for the submission of bids.
5. **SIGNING OF BIDS**
 - 5.1 The Bid must contain the name 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. All pages of bid drawings and other documents shall be initialed at the lower right hand corner with ink only and signed where required by the bidder.
 - 5.2 Bid by a partnership firm must be furnished with full names of all partners and be signed with the partnership name, followed by the signature and designation(s) of the authorized partner(s) or other authorized representative(s).

5.3 Bid(s) by corporation/Company must be signed with the legal name of the Corporation/Company and by the President, Managing Director, Secretary or other person or persons authorized to bid on behalf of such Corporation/Company in the matter

5.4 A bid by a person who affixes to his signature the word ‘President’, ‘Managing Director’, ‘Secretary’, ‘Agent’ or other designation without disclosing the details concerning the principal on whose authority he is signing the bid, will be rejected

5.5 Satisfactory evidence of authority of the person(s) signing on behalf of the Bidder shall invariably be furnished with the bid.

5.6 The Bidder’s name stated on the proposal shall be the exact legal name of the firm.

5.7 Erasures or other changes in the Bid including the proposal documents shall be initialed by the person(s) signing the bid.

6 INFORMATION REQUIRED WITH THE BID:

6.1 Bidder shall submit complete information as required under the relevant schedules of the accompanying bid forms and price schedules.

6.2 In case the information contained in the bid is in contradiction with the requirements of the specification, the specification requirements will govern, unless otherwise brought out clearly in the schedule of deviations

6.3 If the bidder deliberately gives wrong information in his bid to create circumstances for the acceptance of his bid, the Owner reserves the right to reject such bid and/or cancel the order if placed.

6.4 Bid submitted shall be for the complete scope of work as envisaged in the owner’s specification. Bid submitted for partial scope of work will not be acceptable.

7 SUBMISSION OF BIDS:

7.1 The Contractor shall submit (upload) the Bid ONLINE on <https://aitl.eproc.in>. Being a Two Bid system, the Contractor shall upload the Technical offer as per the Qualifying requirements in Technical Bid and the Commercial offer in Commercial Bid.

7.2 The Owner reserves the right to reject any bid which is not submitted in accordance with the instructions stipulated above.

7.3 The Owner may, at his discretion, extend the dead line for submission of bids by amending bidding documents in which case all rights and obligations of the Owner and bidders subject to the previous dead line will thereafter be subjected to the dead line as extended.

7.4 Any bid received by the Owner after the deadline for submission of bids prescribed by the Owner in clause 2.5 of Section – I of this specification will be rejected and/or returned unopened to the Bidder

7.5 The Bidder may modify or withdraw his bids 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.

7.6 No bid may be modified subsequent to the deadline for submission of bids.

7.7 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 proforma Bank Guarantee for Bid Security. Withdrawal of a bid during this interval may result in the Bidder's forfeiture of its bid guarantee.

7.8 The contract shall be awarded to the successful bidder, including Material Supply, Services (Erection, Testing and commissioning) & Civil works. The contract will be divisible as mentioned in GTC Condition No. 21.5

8 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 contact as may be necessary. Bidders will not be permitted to change the substance of the bids after the bids have been opened

9 OTHER MANDATORY DOCUMENTS FOR VALID BID

9.1 The bidder has to note that no deviation in tender conditions will be allowed after bid submission.

9.2 Submission of Bid validity period - 6 months from the date of opening of techno-Commercial bid.

9.3 Original colour scan copy of duly signed/sealed schedules .

9.4 The owner reserves the right to accept/reject the bid

10 The prices to be quoted against this IFB shall be in Indian Rupees only.

11 A complete set of documents can be downloaded by the bidder from MITL <https://aitl.eproc.in>, www.auric.city. The cost of bidding documents should be paid online before the date of bid submission and the screen shot of successful payment transaction shall be uploaded with bid documents being submitted by the bidder.

12 The bidder shall be required to furnish Earnest Money Deposit (EMD) for an amount equal to 0.5% (0.5 percent) of the estimated cost of tender only.

13 The tender is invited as In-divisible composite work contract on item Rate Basis. Bidders are requested to submit their offers item-wise for all portions, including Supply, ETC (Erection, Testing, and Commissioning), and Civil.

14 Additional Instructions for Price Bid Submission

Bidders are requested to submit their for all portions, including Supply, ETC (Erection, Testing, and Commissioning), and Civil works following instructions below-

- 15 It may please be noted that the taxes / duties will be paid / reimbursed as per actual OR as stated in Price break up in bidding whichever is lower on submission of valid documentary proof.
- 16 The competent Authority reserves the right to relax any of the above conditions without assigning any reason thereof. All the above original documents should be brought for scrutiny at the time of opening if present or as and when requested.
- 17 All the Statutory charges / fees for obtaining NOCs from various government department, forest clearances, police protection & TILR charges etc. will be reimbursed to the contractor by owner on valid documentary proof.
- 18 In case of any variation in statutory taxes / duties / levy or any new existing tax / duty / levy is revoked by the Government, the same shall be passed through either side. In certain cases production of valid documentary proof may be brought for.
- 19 The bidders are requested to submit the financial documents (Turnover & Net Worth certificate) duly audited, verified & certified figures from Chartered Accountant and same should be generated with UDIN number. So, same can be verified on <http://udin.icai.org>.
- 20 Bidders are requested to submit the all the Formats/Schedules with the Bid.
 - 20.1 The new bidders are requested to complete the contractor registrations for e-Tendering with MITL as per the procedure prior to the date of submission of the tender documents. The bids of only registered main / lead bidders will be entertained.
 - 20.2 Kindly note that, the queries received after last date of submission of queries will not be entertained. The queries if any shall be submitted well within time as mentioned in the tender document.
 - 20.3 A complete set of document can be downloaded by the bidder from MITL e-Tendering website <https://aitl.eproc.in> The cost of document should be paid online before the date of bid submission and the screen shot of successful payment transaction shall be uploaded with bid documents being submitted by the bidder.
 - 20.4 The bidder should ensure to submit the bid well in advance. Request for extension in submission will not be entertained on ground of any problem related to link, internet banking etc at last moment.
 - 20.5 Registration of bidders from a country sharing a land border with India in order to be eligible to bid as per order (Public Procurement No. 1) dt. 23.07.2020 from Ministry of Finance, GOI is required.
 - 20.6 For detailed information please log on to <https://aitl.eproc.in>, www.auric.city. Interested bidders may obtain further information, if needed, from the Office of the Managing Director, Maharashtra Industrial Township Limited Udyog Sarathi, MIDC Office, Marol Industrial Area, Andheri (East) Mumbai – 400 093.
For Site : G.M. Electrical (Projects), Auric Hall Building, Shendra Industrial Area, Chh.Sambhajinagar.

MAHARASHTRA INDUSTRIAL TOWNSHIP LIMITED
(CIN No. U74999MH2014SGC260132)



Tender No. MITL/SBIA/2026-27/T-01

Work of LILO on 220KV Chitegaon - Chitepimpalgaon line at MSETCL Bus including Supply,erection,and commissioning of required Lattice Towers for Power Supply arrangement to JSW Mobility Ltd at Bidkin Industrial Area, Dist.Chh.Sambhajinagar.

BOOK II

TECHNICAL SPECIFICATIONS

NOTE: - Technical Specification are provided for the Tender are attached herewith. The Circular MSETCL/CO/Design/G2/Standardization/6116 Dt 23.08.2022 will prevail the provisions in detailed specifications for type test.

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SECTION I

TECHNICAL SPECIFICATION FOR TRANSMISSION LINE

1.0 General

This Section details about the specifications for construction of EHV Transmission Lines.

2.0 Scope of work for EHV lines

2.1 The scope of work for the EHV Line will be as under:

- a) Preliminary Survey, Detailed survey and Check survey of line.
- b) Fabrication and supply of towers as per owner supplied tower designs with required extensions, design of special towers, (If required) modification/strengthening of tower extensions, (if required) supply of Bolts & Nuts, Conductors, Earth-wires, zindulstors, Insulator hardwares, accessories for conductor & ground wire and tower accessories including earthing sets, number plates, circuit plates, bird guards, anti climbing devices and all other material required for completion of the line.
- b) Clearing of site, casting of tower foundations, with supply of required sand cement, steel, metal, water etc stub setting, erection of complete towers with extensions and providing all accessories, hoisting of insulators, stringing of conductor and earthwire, fitting of line hardwares, tower accessories etc. and all other material required for completion of line along with tree cutting as per requirement. The cost of cutting the trees, stacking of cut trees, clearing debris and transportation of cut trees (if required) shall be borne by the contractor.
- c) Construction, Testing and commissioning of the line.
- d) Design of Foundations for special towers (If required) and also for normal towers, if necessary.

3.0 Material to be supplied by the Contractor

All materials required to complete the line works in all respects shall be arranged by the contractor at his cost. The material to be supplied shall meet the following requirements:

3.1 Tower

Technical details for 220KV, 132KV and Special towers are given in **Annexure - I**.

3.2 Insulator hardware and conductor accessories

- 3.2.1 The insulator hardwares shall be suitable for 0.2 ACSR Panther/0.4 ACSR Zebra conductor and disc insulators of EMS ratings 70 KN for suspension location and 120 KN for tension location and shall be in line with the parameters listed in **Annexure II** and generally as per the drawings enclosed and relevant standards listed in this specification.

3.2.2 The conductor accessories shall be suitable for 0.2 ACSR Panther/0.4 ACSR zebra conductor and earthwire accessories shall be suitable for 7/3.15 mm size G.S. earthwire and shall be in line with the parameters listed in **Annexure-III** as well as standards listed elsewhere in this specification.

3.3 **Insulators**

The 70 KN & 120 KN normal / antifog porcelain disc insulators or porcelain long rod insulators shall be in line with the parameters listed in Annexure –VII and as per relevant standards listed elsewhere in the specification.

3.4 **Conductor and Earth-wire**

Size of conductor required for the line:

0.2 ACSR Panther(for 132 KV) / 0.4 ACSR zebra conductor (for 220 kV) line.

Size of earthwire required for the line:

7/3.15 mm G.S. wire

Aluminium strands of ACSR shall be manufactured from electrolytic grade aluminium rods suitably hard-drawn on wire drawing machines.

Re-inforcing steel wire (galvanized) of ACSR shall be drawn from high carbon steel rods produced by any of the following processes.

- a) Acidic or open heat process.
- b) Electric furnace process or basic oxygen process.

No joints shall be permitted in the Aluminium wires in the outermost layer of ACSR. Similarly, no joints shall be permitted in the galvanized steel wire except those in the base rod or wire before final drawings.

The ACSR Conductor and G.S. earthwire shall conform to technical specification contained in ANNEXURE - VIII and IX respectively.

3.5.1 All the material in the contractor's scope of supply shall be procured from reputed manufacturers having at least Five (5) years experience of supplying similar equipment for 220/132 KV lines. The list of approved vendors is given in **Annexure-IV**.

3.5.2 Detailed dimensioned drawings of all material to be supplied by contractor shall be got approved by the contractor from owner before type testing of the same.

3.5.3 All material covered under contractor's scope of supply shall be satisfactorily type tested as per relevant standards in presence of owner's representatives before commencement of mass manufacturing.

Conductor, Insulators and Earthwire as per technical details given in **Annexure-I**, shall also be procured by the contractor.

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- 4.0 Quantity for Tower, Conductor, Earth Wire, Insulators, Hardwares, Conductor & Earth Wire Accessories.
- 4.1 The contractor shall assess the requirement of line materials after completion of detailed / check survey and work out the final tower quantities. Accordingly, the contractor shall intimate the owner regarding quantities of material for procurement and seek the approval from owner. The contractor shall consider the permitted extra consumption furnished below.
- 4.2 The procedure to be used for calculation of length of conductor and earthwire shall be as follows:
- a) **Quantity of Conductor** = Route length x No. of Circuits x No. of phases (3)
 - b) **Quantity of Earthwire** = Route length.
 - c) One percent extra quantity on length as calculated above shall be allowed.
- 4.3 In case of conductor/ Earth wire, the permitted extra quantity of one percent is inclusive of sag, jumpering, damage, losses and wastages etc.
- 4.4 The insulators shall be supplied as per technical details given in Annexure-VII. The unit rate and quantity of insulators considered in the Price schedule are of disc insulators. The quantity of long rod insulator shall be number of Disc insulators divided by number of discs in one 132 KV string as specified in Clause No. 4.1 of Annexure-VII and the unit rate for long rod insulator string shall be equal to the number of Disc insulators in a 132 KV string as specified in Clause No. 4.1 of Annexure-VII multiplied by unit rate of Disc insulator.

5.0 Construction

- 5.1 The transmission lines shall be constructed with the best industry practice generally as per details given in **Annexure-V** and **Annexure-VI** keeping in view the various statutory clearances required en-route.

5.2 Statutory clearances and way leave

The statutory clearances/NOCs such as forest, aviation, PTCC, Railway, National highway/state highway, maritime board etc. which may be required for construction of the line shall be arranged by the contractor. The respective proposal shall be prepared and arranged by the contractor without any financial implication to the owner. All statutory fees required for obtaining the clearances/NOC will be reimbursed to contractor by owner on submission of documentary evidence.

Any way leave problem; obstructions etc. shall be cleared by the contractor. The owner, if required shall extend necessary information in resolving the issues. However, the entire responsibility of clearances including any payments such as expenditure required for collection of land documents from revenue department, charges for police protection (if required) etc. shall rest with the contractor. The contractor shall act proactively to achieve the goals.

- 5.3 Felling of trees, tree cutting, crop compensation would be organized and paid by the contractor. The owner shall render necessary help for fixing compensation through

horticulture Dept. or any other appropriate authorities. The compensation so paid by the contractor shall be reimbursed by the owner. However expenses on account of stacking of cut trees, clearing debris and transportation of cut trees (if required) shall be borne by contractor.

6.0 Line profile

Data on the route alignment and ground profile will be supplied by the owner after issuance of letter of Intent (LOA).

7.0 Completion period

7.1 The EHV line covered in this tender shall be completed within the period as mentioned in Book - I (including monsoon season) from the date of LOA.

7.2 Time is essence

The time stipulated in the contract for the completion of works shall be deemed to be an essence of the contract. The contractor shall so organize his resources and perform his work so as to complete it not later than the date agreed to.

7.2.1 The contractor shall submit a detailed activity schedule/bar chart within the time frame agreed consisting of adequate number of activities covering various key phases of work, also clearly indicating the completion period for various groups of activities. This network/chart, activity schedule shall also indicate the infrastructure facilities to be provided by the owner and the dates by which such facilities activity schedule are needed. The contractor shall discuss the activity schedule and network/bar chart, activity schedule so submitted with the owner and the agreed network/bar chart which may be in the form as submitted or in revised form in line with the outcome of discussions, before signing of contract, shall form part of the contract. 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 as per scheduled date of completion.

7.2.2 The above activity schedule/bar chart shall be reviewed and periodic review reports shall be submitted by the contractor as directed by engineer.

7.3 Bar chart indicating detailed programmed of project implementation shall be furnished by the bidder in his offer. The bar chart shall include but not be limited to following items with dates of commencement and completion shown against each.

1. Check survey
2. Supply of Stub setting Template and foundation for towers
3. Supply of 75% Suspension and 25% Angle Tower
4. Supply of tower
5. Erection of towers

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6. Supply of insulator hardwares & accessories for tower, Conductor and earthwire
 7. Stringing of conductor & ground wire along with hoisting of insulators with hardwares & installation of accessories and tree cutting with clearing of site
 8. Testing and commissioning.

Note: The above activities are inter-related and shall commence as the status of allied activities. However, contractor may take-up certain activities in advance with no financial implication on owner.

8.0 Price Schedule

- 8.1 The bidder shall quote Price on lump sum, % (Percentage) above/below basis, in **price Schedule-B** enclosed in Book-II.
- 8.2 The unit prices and total costs shall be applicable for erection, casting of foundation (including soil investigation if necessary), for all types of towers in various soils as indicated in the price schedule enclosed separately. Quantity wise break up of probable types of soils and different types of towers is given in enclosed **price schedule** and **Annexure-A** in Book-II for the assessment purpose only. Type of earthings and foundation to be cast for any location will have to be got approved from the concerned engineer incharge at site. The unit price and cost of benching and protection to tower foundation near nallas, river beds, creek banks hilly/undulated terrain etc. required at few locations shall be as per the **price schedule-H**. The quantities of benching and tower footing protection in m³ and stringing of conductors for three phases in route KM are to be indicated in the price schedule for bid evaluation purpose. Tentative quantities of insulator hardwares and conductor and earthwire accessories to be supplied by the contractor are indicated in price schedule enclosed separately. Unit price and total cost of stringing shall include the installation of these items. However, the owner reserves the right to increase/decrease or totally delete these quantities. Any variation in quantities (within the limit of contract value) duly justified by contractor and certified by engineer incharge at site shall be paid at the unit rates indicated by the contractor against item rates in **price Schedule-H**.

ANNEXURE-I

GENERAL TECHNICAL REQUIREMENTS

1.0 SYSTEM PARAMETERS

Following are the salient parameters of the electrical and environmental systems :

a.	Nominal System Voltage	: 220/132 KV
b.	Frequency	: 50 Hz
c.	System highest voltage	: 245/145 KV
d.	Maximum ambient temperature	: 50 °C
e.	Minimum ambient temperature	: 0 °C
f.	Maximum daily average temperature	: 32 °C
g.	Maximum relative humidity (in %)	: 90
h.	Maximum annual rain fall (in mm)	: 1500 to 3800
i.	Number of rainy days/year	: 90
j.	Average number of thunder storm (days per annum)	: 50
k.	Pollution level category	: Moderately polluted as per IEC: 71-2

2.0 LINE DATA

132 KV line 220 kV line

a.	Conductor Code Name & type	: 0.2 inch ² : ACSR Panther	: 0.4 inch ² : ACSR Zebra
b.	Number of Conductors Per phase	: One	: One
c.	No. of Earth wires Type and size	: One : 7/3.15 mm 110 KGF Qty.	: One : 7/3.15 mm 110 KGF Qty.
d.	Phase Configuration	: Vertical	: Vertical
e.	Max. Wind pressure on wires	: 43 Kg/m ² : 45 Kg/m ²	: 43 Kg/m ² : 45 Kg/m ²

f. Ruling design span : 320 meters : 350 meters

Note : The details applicable for the tender only be considered

3.0 Material to be supplied by the contractor

3.1 Insulator String Hardware inclusive of but not limited to

- a) Anchor shackle
- b) Ball eye
- c) Line and tower side yoke plates
- d) Ball clevis
- e) Arcing horns
- f) Socket clevis
- g) Clevis Eye
- h) External link
- i) U/Y-clevis
- j) Free centre type suspension clamp
- k) Compression type dead end clamp

3.2 Accessories for Conductor and Earthwire

- a) Mid span compression joints.
- b) Repair sleeves.
- c) Copper Earth Bond.
- d) Vibration Damper (For conductor only).
- e) Suspension Clamp for Earthwire
- f) Tension Clamp for Earthwire
- g) P. A. Rods

3.3 Towers

3.3.1 Standard 220/132 KV D/C, Horizontal and Special towers are to be fabricated as per the approved structural drawings provided by the owner. The structural drawings would be spared to the successful bidder only. The manufacturer shall fabricate proto type towers (in case the proto assembly inspection has not been conducted by MSETCL before) and offer them for inspection by the representative of MSETCL before taking up mass production of towers.

3.3.2 Erection Mark

These shall be marked with a 16 mm die distinctly on each member of the tower. The notation shall be as follows:

A - BB - CC - DDD

Where A = Owner's code - Alphabet.(in this case 'M').

BB = Contractor's Mark - Numerical.

CC = Tower Type - Alphabet.

DDD = Mark Number - Numerical.

The details in respect of 'CC' are given in Statements III and V. Other details are to be furnished by the bidder.

For tower members having length more than three (3) mtrs the markings shall be provided at both the ends.

- a) The details of fabrication of towers shall be in conformity with IS:802 (Part-II):1978 except to the extent modified herein.
- b) Butt splices shall be used and the inside angle and outside plate shall be so as to transmit the load and the inside cleat angle shall not be less than half the thickness of heavier member connected plus 2mm. Lap splice may be used for connecting members of unequal size. The inside angle of lap splice shall be rounded at the heel to fit the fillet of the outside angle. All splices shall develop full stress in the members connected through bolts. Butt as well as lap splice shall be made as close to the main panel point as possible.
- c) Joints shall be so arranged as to avoid eccentricity as far as possible. The use of gusset plates for joining tower members shall be avoided as far as possible. However, where the connections are such that the elimination of the gusset plates would result in eccentric joints or where more than three members are joining at a particular point, gusset plates and spacer plates may be used in conformity with modern practices. The thickness of the gusset plates, required to transmit stress, shall not be less than that of members connected.

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-
- d) The use of filler in connection shall be avoided as far as possible. The diagonal web members in tension may be connected entirely to the gusset plate where necessary to avoid the use of filler and it shall be connected at the point of inter-section by one or more bolts.
 - e) The tower structures shall be accurately fabricated to bolt together easily at site without any undue strain on the bolts.
 - f) No angle member shall have the two leg flanges brought together by closing the angle.
 - g) The structure shall be such that all parts shall be accessible for inspection and cleaning. Drain holes shall be provided at all points where pockets of depressions are likely to hold water.
 - h) All similar parts shall be made strictly interchangeable. All steel sections before any work is done on them, shall be carefully levelled, straightened and made true to detailed drawings, by methods which will not injure the materials so that when assembled the adjacent matching surfaces are in close contact throughout. No rough edges shall be permitted in the entire structure.

3.3.3 DRILLING AND PUNCHING

- a) Before any cutting work is started, all steel sections shall be carefully straightened and trued by pressure and not by hammering. They shall again be trued after being punched and drilled.
- b) Holes for bolts shall be drilled or punched with a jig but drilled holes shall be preferred. The following maximum tolerance of accuracy of punched holes is permissible.
 - i) Holes must be perfectly circular and no tolerance in this respect is permissible.
 - ii) The maximum allowable difference in diameter of the holes on the two sides of plates or angle is 0.8mm i.e. the allowable taper in a punched holes should not exceed 0.8mm on diameter.
- c) All burrs left by drills or punch shall be removed completely. When the tower members are in positions the holes shall be truly opposite to each other. Drilling or reaming to enlarge defective holes shall not be permitted.
- d) The strain plate holes shall be chamfered properly and sharp edges removed.

3.3.4 GALVANISING

Fully galvanised towers and stubs shall be used for the lines. Galvanising of the member of the towers shall conform to IS:2629-1966 and IS:4759-1968. All galvanised members shall withstand tests as per IS:2633-1972. For fasteners, the galvanising shall be done after all fabrication work is completed, except that the nuts may be tapped or re-run after galvanising. Spring washers shall be electro- galvanised as per Grade 4 of IS:1573-1070.

3.3.5 FASTENERS : BOLTS, NUTS and WASHERS

- a) All bolts and nuts shall conform to IS:6639-1972 or IS.12427 - 1988 as applicable and shall be of approved makes only. All bolts and nuts shall be Hot Dip galvanised and shall have hexagonal heads and nuts. The heads shall be forged out of the solid, truly concentric, and square with the shank, which must be perfectly straight. The material shall be as per makes approved by M.S.E.T.C.L., the list of which is available on the website. However, if the bidders desires to procure bolts & nuts from any other vendor the same can be approved by the owner and the owner finds the same to be acceptable for use on transmission lines.
- b) Fully threaded bolts shall not be used. The length of bolts shall be such that the threaded portion will not extend into the place of contact of the members. All bolts shall be threaded to take the full depth of the nut and threaded enough to permit firm gripping of the members, but not further. It shall be ensured that the threaded portion of each bolt protrudes not less than 3 mm and not more than 8 mm when fully tightened. All nuts shall fit hand tight to the bolt. Threads of bolts and nuts shall have a neat fit and shall be such that they can be turned with finger throughout the length of the threads of bolts and they shall be capable of developing full strength of the bolts.
- c) Flat and tapered washers shall be provided where necessary. Spring washers shall be provided for insertion under all nuts. These washers shall be of steel electro-galvanised, positive lock type and 3.5 mm thick for 16mm dia. bolt and 4.5mm thick for 24mm dia. bolt.
- d) The contractor shall furnish bolt schedules giving thickness of members connected, the nut and the washer, the length of shank, the threaded portion of bolts and sizes of holes and any other detail of this nature.
- e) The bolts shall be of class 5.6 and nuts shall be of property class 5. For normal towers 16mm dia. bolts of required length shall be used. For special towers 24 mm dia. bolts may also be used. The ultimate shear stress on bolts shall be 3160 Kg/cm^2 and ultimate bearing stress shall be 5500 Kg/cm^2 In case of connection with MS angles and plate the ultimate bearing stress shall be 4440 Kg/cm^2 .
- f) To obviate bending stress in bolts or to reduce it to minimum, no bolt shall connect aggregate thickness of more than three (3) times its diameter.
- g) Bolts at the joints shall be so staggered that nuts may be tightened with spanners without fouling.
- h) The minimum bolt spacing and rolled edge distance and sheared edge distances of sections from the centers of bolt holes to be maintained are given in following Table:

Diameter of bolts	Hole diameter	Min. Bolt spacing	Min. rolled distance	Min. sheared edge distance
(mm)	(mm)	(mm)	(mm)	(mm)
16	17.5	40	20	23

3.3.6 STEP BOLTS/LADDER AND TOWER ACCESSORIES

a) **Step Bolts & Ladders**

Each tower shall be provided with step bolts of not less than 16mm diameter and 175 mm long, spaced not more than 450 mm apart and extending from about 3.5 metres above the ground level to the top of the tower. The step bolts shall be provided with two nuts on one end to fasten the bolt securely to the tower and button head at the other end to prevent the foot from slipping away. The step bolts shall be capable of withstanding a vertical load not less than 1.5 KN. For towers, where the height of the super structure exceeds 50 metres, ladders alongwith protection rings as per the Owner approved design shall be provided in continuation of the step bolts on the longitudinal face of the tower from 30 metres above ground level to the top of the super structure. From 3.5m to 30m height of superstructure step bolts shall be provided. Suitable platform using 6mm thick checkered plates alongwith suitable railing for access from step bolts to the ladder and from the ladder to each cross-arm and the groundwire support shall also be provided on tower above 50 mtrs.

b) **Anticlimbing Device**

Provision for inserting fully galvanised barbed wire type anticlimbing device as per drawing enclosed shall be made for all towers. This shall be provided at 3.5m above ground level on the tower. The galvanised barbed wire and accessories shall be supplied by the Contractor.

c) **Danger, Number & Phase Plates**

i) The provision for fixing Danger, Number and Phase Plates shall be made on transverse face of the tower during development of the structural drawing. The arrangement for fixing these accessories shall not be more than 4.5m above the ground level and shall be provided above anti-climbing device.

ii) The letters, figures and the conventional skull and bones mark of danger plate shall conform to IS : 2551-1963 and shall be in a signal red colour on the front of the plate.

iii) Typical drawings of Number plate, phase plate, danger board are enclosed.

3.4 **Conductor Earthwire and insulators**

ACSR conductor, G.S earthwire and Insulators are also to be supplied by the contractor as per relevant Specifications.

4.0 Stub Setting Templates

Stub templates shall be arranged by the Contractor at his own cost for all types of towers with or without extensions for the line in the scope. Stub templates for standard towers and tower with extensions shall be of adjustable type. The stub templates shall be galvanized or painted. One set of each type of stub setting template will be retained by the owner on completion of the project, supply of which shall be included in the scope of the Contractor at no extra cost to the owner.

5.0 Aviation Requirements

The river crossing towers and the crossing span shall be painted and provided with markers respectively to caution the low flying air-craft as given below:

5.1 Span marker of size 600mm x 600mm shall be provided on the earthwire. Each face of the marker shall be divided into two triangles by drawing a line along one of the diagonals of the markers, one of the triangles thus formed shall be painted in orange or red and other in white. These markers shall be suspended from earthwire at intervals of 36m. The design of the markers and their fixing arrangement should be such that they can withstand the wind pressure.

5.2 The full length of the towers shall be painted over the galvanized surface in contrasting bands of orange or red and white. The bands should be horizontal and not less than 1.5m and not more than 3m in height. The bands on the extremities should be orange or red in color.

a) Surface Preparation

The etching of galvanized surface of erected tower members with suitable etching or wash primer is to be done as per IS:1477-1971 to enhance the adhesion of subsequently applied paint coating. After etching of galvanized surface of tower one coat of zinc primer is to be applied.

b) Painting of Towers

Two coats of international orange or red and white paint at alternate interval (bands) as explained above are to be applied. The painting of towers shall generally conform to relevant provisions in IS: 1477-1977 parts II & I. The paints to be used for painting shall be in accordance with IS: 2074-1962.

5.3 Obstruction lights

Fixed lights, red in color, having intensity sufficient to ensure conspicuity considering the intensity of the adjacent lights and the general level of illumination against which they would normally be viewed shall be provided on the river crossing towers. In no case the intensity of the light shall be less than 107.6 Lox of red lights. If the height of the towers are more than 45m above the level of surrounding ground, additional lights shall

be provided at intermediate levels. The numbers and arrangement of lights at each level to be marked shall be such that the towers are visible from all sides.

5.4 The lighting fixture, paint and L.T. power supply for the aviation light requirements shall be arranged by the owner.

6.0 SPECIAL TOWERS

- a) Special towers shall be used for major river crossing, for very long spans and railway track or line crossings. The special towers shall be offered in such a way that after suitable truncation the same tower can be used for crossing the spans of 700 M, 800 M, 900 M or 1000M. These towers including their foundations, soil testing, tower erections and stringing shall form part of the scope. The Contractor shall submit the most economical design for the towers and foundations.
- b) All the requirements for standard towers shall be applicable for special towers. Wind pressure on towers for height beyond 45 metres shall be as per following Table.

Unit (Kgf/m ²)	Height of support						
	45m	50m	60m	70m	80m	100m	120m
Light	140	145	150	154	159	165	172
Medium	210	217	224	230	238	249	258

6.1 Angle of Deviation for special tower

The angle of deviation to be considered for special tower is minimum 2° and all the live material clearance to be computed considering double 'X' suspension string.

6.2 Factor of safety for special tower

The minimum factor of safety for special tower shall be as follows:

- a) 2.5 under normal conditions
- b) 2.0 under broken wire conditions

6.3 Maximum tension for conductor and earth wire

The minimum factor of safety for conductor and earthwire shall be 2.5 for the maximum tension corresponding to 2/3 full wind pressure at 0 °C or full wind pressure at 32 °C such that the initial unloaded tensions at 32 °C do not exceed 30 % of their ultimate strength and the final unloaded tension at 32 °C do not exceed 20 % of the ultimate strength of conductor and Earthwire.

6.4 Wind Loads

- a) The procedure for wind load calculation on tower, conductor and earthwire shall be the same as adopted for normal structure.

- b) The wind pressure acting at an angle of 45° to the tower body and 90° to the conductor acting simultaneously shall also be considered for designing the structure.
- 6.5 Under normal condition, unbalanced longitudinal pull due to difference in tension in ruling span for river crossing towers on one side and span of the line on the other side shall also be considered for the design of anchor towers on case to case basis.
- 6.6 During designing and detailing for the river crossing tower, provision for ladders, platform etc. shall be made.
- 6.7 The rates for special towers shall be quoted on the basis of per ton. However the payment shall be released as per the approved BOM weight.

7.0 STANDARDS

The manufacturing, fabrication, galvanizing, and materials used for manufacture of towers shall conform to the following Indian Standards (IS) Codes and Rules which shall mean latest revisions, with amendments/changes adopted and published, unless specifically stated otherwise in the specification. In the event of supply of equipment conforming to standards other than IS, the features of comparison of the relevant standard and IS shall be brought out and furnished.

Sr. No.	Indian Standards	Title
1.	IS:209-1966	Specification for zinc
2.	IS:2062-1992	Structural steel(Standard quality)
3.	IS:8500	High Tensile Steel
4.	IS:800-1962	Code of practice for use of structural steel in general Building construction.
5.	IS:802 Part I 1978 IS:802 (Part-II)1978	Code of practice for use of structural steel in overhead transmission line. Part I: Load and permissible stresses. Code of practice for use of structural steel in overhead transmission line. Part II : Fabrication, Galvanizing, inspection and packing.
	IS:802 (Part-III) 1978	Code of practice for use of structural steel in overhead transmission line towers. Part III : Testing
6.	IS:1367-1992	Technical supply conditions for threaded fasteners (First Revision).
7.	IS:2016-1992	Plain Washers
8.	IS:2551-1992	Danger Notice Plates.

9. IS:2629-1992	Recommended practice for hot dip galvanizing of iron and steel.	
Sr. No.	Indian Standards	Title
10. IS:2633-1994		Method of testing uniformity of coating of zinc coated articles.
11. IS:3063-1994		Single Coil Rectangular Section spring washers for bolts, nuts, screws.
12. IS:5358-1969		Hot dip galvanized coatings on fasteners.
13. IS:6610-1991		Specification for heavy washers for steel structures.
14. IS:6639-1990		Hexagonal bolts for ISO/R 272-1968 steel Structures.
15. IS:6745-1972		Methods for determination of weight of zinc coating for zinc coated iron and steel articles.
16. IS:5613-1993		Code of practice for design, installation and maintenance of overhead power lines Section-1 Designs Section-2 Installation Maintenance
17.	CEA (Measures relating to Safety and Electric Supply) Regulations, 2010	
18.	Publication No. 87/Elect/112/1 Regulation for Electrical Crossing of Railway Tracks amended update	
19. IS-961		H.T.Steel
20. IS-12427-1988		Specification for Transmission Tower Bolts.
21.	Indian Electricity Act - 2003 and amended update	

ANNEXURE-II

TECHNICAL PARTICULARS FOR INSULATOR HARDWARES

1.0 TECHNICAL DESCRIPTION

1.1 GENERAL

This section details the technical particulars of the Hardware fittings for 132/220 KV Line. The insulator hardware shall be suitable for 0.2 ACSR Panther conductor (for 132 KV line) and 0.4 ACSR Zebra conductor (for 220 KV line).

1.1.1 DETAILS OF HARDWARE FITTINGS

The hardware fittings shall generally be as per drawings enclosed with this specification & suitable for hot line maintenance.

1.2 DIMENSIONS OF INSULATOR STRING ALONG WITH HARDWARE FITTING

The various limiting dimensions of the various suspension and tension strings along with hardware fittings shall be as per the drawings attached with this specification. The hardware shall be suitable for use with 'Normal' and 'Antifog' type insulators.

1.3 INTERCHANGEABILITY

The hardware together with ball and socket fittings shall be of standard design so that these hardware are interchangeable with each other.

1.4 BALL AND SOCKET DESIGNATION

The dimensions of the ball and socket shall be of 16 mm for 70 KN and 20 mm for 120 KN disc insulators in accordance with the standard dimensions stated in IS:2486 (Part-II) - 1974.

1.5 SECURITY CLIPS AND SPLIT PINS

Security clips for use with ball and socket coupling shall be R-shaped, hump type which provides positive locking of the coupling as per IS:2486 (Part-III) 1974. There shall be no risk of the locking device being displaced accidentally or being rotated when in position. Under no circumstances shall the locking device allow separation of fittings.

1.6 ARCING HORN

The arcing horn shall be provided on line side of the hardware fittings. The same shall be either ball ended rod type for 132 KV and tubular type for 220 KV.

1.7 FREE CENTRE TYPE SUSPENSION CLAMP

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-
- a) The suspension clamp shall have a slip strength between 12.5% to 20% of breaking load of conductor.
 - b) The suspension assembly shall be designed, manufactured and finished so as to avoid any possibility of hammering between suspension assembly and conductor due to vibration. The suspension assembly shall be smooth so that it shall not damage the conductor.

1.8 **DEAD END ASSEMBLY**

- a) The dead end assembly shall be of compression type with provision for compressing jumper terminal at one end. The angle of jumper terminal to be mounted, should be 30° with respect to the vertical line.
- b) The assembly shall not permit slipping off, damage to or failure of the complete conductor or any part thereof at a load less than 95% of the ultimate tensile strength of the conductor.
- c) The steel sleeve of dead end assembly shall be made by drop forging method and shall not involve any welded joints.

1.9 **FASTENERS**

All fasteners shall conform to IS: 6639-1972. All fasteners shall be hot dip galvanised.

1.10 **WORKMANSHIP**

- a) All the equipment shall be of the latest design and conform to the best modern practices adopted in the Extra High Voltage field.
- b) The design, manufacturing process and quality control of all the materials shall be such as to give maximum possible working load, highest mobility, elimination of sharp edges and corners to limit corona and radio interference, best resistance to corrosion and a good finish.
- c) After award of contract, the contractor shall submit to the Owner, within one month, 2 copies of Quality assurance plan for approval.
- d) Minimum weight of zinc coating shall be 300 gm/m² for fasteners and 610 gm/m² for all other hot dip galvanised articles.

1.11 **BID DRAWINGS**

The proposal shall include fully dimensioned assembly and component drawings for all items quoted. All drawings shall be neatly arranged, and all drafting and lettering shall be standard and legible. The minimum size of lettering shall be one eighth of an inch. Dimensions shall be in the customary units. The drawings shall give following information:

- a) The bill of material indicating quantity, nature, grade and reference standard of the material used for various parts. The thickness of plain/spring washers, size and length of bolts shall also be indicated.
- b) Technical details like ball and socket designation, method of manufacture, Hardness, Proof Load, slip strength, UTS, installation torque, make of Nuts, bolts, plain/spring washers, security clip and identification mark of the manufacturer.
- c) After award of contract the contractor shall submit to the Owner, within one month, 2 copies of drawings for approval. The Owner shall accord approval for the drawings in reasonable period provided the same are as per specification. The Contractor shall endeavor to furnish all the clarification required by the Owner for approving the drawings promptly.
- d) Once the drawings have been approved, no alteration or modification should be carried out without prior approval of the Owner.

1.12 TESTS

A) TYPE TESTS

The bidder shall offer the hardwares and accessories which are already type tested within the last five (5) years and manufactured by the reputed manufactures approved by MSETCL

In case the items are not type tested within 5 years as on the date of LOA, fresh type tests as per relevant IS standards and MSETCL specification shall be carried out, in presence of purchasers representative, before supply of material.

The list of type tests to be conducted is as follows:

Sr. No.	Particulars of test	Reference standard	
I) Suspension hardwares:			
1)	Visual examination	}	
2)	Verification of Dimensions		
3)	Mechanical strength test on clamp and components	}	
4)	Slip strength test on clamp		
5)	Magnetic power loss test on suspension clamp assembly		
6)	Galvanising/Electroplating test	}	
II) Tension hardwares:			
1)	Visual examination		}
2)	Verification of Dimensions		
3)	Mechanical strength test		

	on components	}	
4)	Mechanical/slip strength test on dead end assembly	}	IS:2486(I)/MSETCL specification
5)	Heating cycle test	}	
6)	Electrical resistance test (Before and after heat cycle test)	}	
7)	Galvanising/Electroplating test	}	
III) Tests on locking devices(Security clip):			
1)	Verification of resistance to bending	}	
2)	Hardness test	}	IS:2486(IV)
3)	Operation test	}	

B) ACCEPTANCE TESTS:

This shall mean those tests which are to be carried out on samples taken at random from a lot for acceptance of the lot.

The item wise list of acceptance tests to be conducted is as follows:

Sr. No.	Particulars of test	Reference standard
I) Suspension hardwares:		
1)	Visual examination	}
2)	Verification of Dimensions	}
3)	Mechanical strength test on clamp and components	}
4)	Galvanising/Electroplating test	}
		IS:2486(I)
II) Tension hardwares:		
1)	Visual examination	}
2)	Verification of Dimensions	}
3)	Mechanical strength test on components	}
4)	Mechanical/slip strength test on dead end assembly	}
5)	Galvanising/Electroplating test	}
		IS:2486(I)
III) Tests on locking devices(Security clip):		
1)	Verification of resistance to bending	}
2)	Hardness test	}
3)	Operation test	}
		IS:2486(IV)

C) **ROUTINE TESTS:**

This shall mean those tests, which are to be carried out on each item to check the requirements which are likely to vary during production.

The list of routine tests to be conducted is as follows:

Sr. No.	Particulars of test	Reference standard
I)	Insulator String fittings:	
1)	Visual Inspection	} IS:2486(I)
2)	Mechanical routine test	
II)	Tension Clamp:	
1)	Visual Inspection	} IS:2486(I)

D) **TESTS DURING MANUFACTURING:**

Stage tests during manufacture shall mean those tests which are to be carried out during the process of manufacturing to ensure quality control such that the end product is of the designed quality conforming to the intent of this specification.

The list of tests to be conducted during manufacturing is as follows:

Sr. No.	Particulars of test	Reference standard
1)	Visual inspection, Chemical analysis, tensile strength, Hardness, inclusion rating, Grain size, Forgeability, proof load and magnetic particle examination tests for ferrous forgings.	} } } } As per relevant } IS Standards } }
2)	Visual inspection, Dimensional check, Chemical analysis, tensile strength and hardness test for steel fabricated components.	} } } - do - } }
3)	Chemical analysis test for aluminum alloy ingots.	} } - do -
4)	Visual inspection, Dimensional check and chemical analysis	} } - do -

	test for aluminum, aluminum } alloy tubes and flats. }	
6)	Chemical analysis of zinc for } galvanising. }	- do -
Sr. No.	Particulars of test	Reference standard
7)	Visual inspection, Dimensional } check, chemical analysis and } hardness test for Stainless } steel bolts, U-bolts, Nuts } and washers. }	- do -
8)	Visual inspection, Dimensional } check, Resistance to bending, } Operation, Hardness and } Resistance to internal corrosion } tests on security clip. }	- do -
9)	Visual inspection, Dimensional } check and mechanical strength } tests on M.S bolts, nuts and } plain washers. }	- do -
10)	Visual inspection, Dimensional } check, Twist, Permanent load } and hardness tests on spring } washers. }	- do -

E) **ADDITIONAL TESTS**

The Owner reserves the right of having at his own expenses any other test(s) of reasonable nature carried out at manufacturer's premises, at site, or in any other laboratory in addition to the aforesaid type, acceptance and routine tests to satisfy himself that the material complies with the specification. The owner also reserves the right to repeat the full series or a particular type test at any time during the pendency of contract.

1.13 **GUARANTEED TECHNICAL PARTICULARS**

The Guaranteed Technical Particulars for insulator hardwares enclosed with this Annexure shall be duly filled in and submitted along with the offer.

1.14 **IDENTIFICATION MARK**

All components of hardwares made by forging/casting shall invariably be marked by embossing with identification mark of the manufacturer. The identifying letters and

numbers shall be raised 1 mm and shall be at least 5 mm high. They shall be die stamped or cast on one or both sides of the assembly. The characters shall be distinct, durable, and conspicuous after galvanising.

1.15 STANDARDS APPLICABLE

Except as modified in this specification, the materials to be supplied shall conform to the latest version, with amendments thereof, of the following Bureau of Indian Standards and other International Standards.

Sr. No.	Bureau of Indian Standard No.	Title
1)	IS 2486-1993 Part-I	Metal fittings of insulators for overhead power lines with a nominal voltage greater than 1000 V - General requirements and tests
2)	IS 2486-1989 Part-II	Insulator fittings for overhead power lines with a nominal voltage greater than 1000 V – Dimensional requirements
3)	IS 2486-1974 Part-III	Insulator fittings for overhead power lines with a nominal voltage greater than 1000 V – Locking devices
4)	IS 2486-1981 Part-IV	Insulator fittings for overhead power lines with a nominal voltage greater than 1000 V – Tests for Locking devices
5)	IS:2121-1981 Part I	Conductor and Earthwire accessories for overhead power Lines – P.A.Rod
6)	IS:2121-1981 Part II	Conductor and Earthwire accessories for overhead power Lines – MSCJ & Repair Sleeves
7)	IS 9708-1993	Stockbridge vibration dampers for Overhead power lines
8)	IS 2004-1991	Carbon steel forgings for general Engineering Purposes
9)	IS 2062-1992	Steel for general structural Purposes.
10)	IS 5082-1981	Wrought aluminum and aluminum sections for electrical purposes
11)	ASTM A 276-96	Standard specification for stainless steel Bars and Shapes
12)	IS 6603-1972	Stainless steel bars and flats
13)	IS 4759-1984	Hot dip zinc coatings on structural steel and other allied products
14)	IS 2633-1986	Method of testing uniformity of coatings on zinc coated articles

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- 15) IS 3063-1994 Single coil rectangular section spring washers for bolts, nuts & screws
 - 16) IS 6639-1972 Hexagonal bolts for steel structures
 - 17) IS 2016-1967 Specification for plain washers
 - 18) IS 5358 Specification for hot dip galvanize coatings on fasteners.
 - 19) IS 1573-1986 Electroplated coatings of zinc on iron and steel
 - 20) IS 1363-1984 Black hexagonal bolts, nuts and lock nuts and hexagonal screws.
 - 21) IS 1367-1991 Part-I Technical supply conditions for threaded steel fasteners – Introduction and general information
 - 22) IS 1367-1979 Part-III Technical supply conditions for threaded steel fasteners – Mechanical properties and test methods for Bolts, screws & Studs with full loadability
 - 23) IS 1367-1980 Part-VI Technical supply conditions for threaded steel fasteners – Mechanical properties and test Methods for nuts with specified proof loads
 - 24) IS 1367-1979 Part-IX Technical supply conditions for threaded steel fasteners – Surface discontinuities on Bolts, screws & studs
 - 25) IS 1367-1979 Part-X Technical supply conditions for threaded steel fasteners – Surface discontinuities on nuts
 - 26) IS 1367-1979 Part-XIII Technical supply conditions for threaded steel fasteners – Hot dip Galvanized coatings on threaded fasteners
 - 27) IS 9997-1991 Aluminum alloy redrawn rods for Electrical purposes
 - 28) IS 3703 Code of practice for Magnetic Power flaw detection
-

**2.0 GUARANTEED TECHNICAL PARTICULARS FOR INSULATOR HARDWARE
SUITABLE FOR ACSR Panther/Zebra**

Manufacturer's name and address •
Identification mark on forged & cast components •

Sr. No.	Item	Material	Grade
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A) Single Suspension hardware

- 1) Horn holder ball hook •
- 2) Tower side arcing horn •
- 3) Horn holder Socket eye •
- 4) Line side arcing horn •
- 5) Anchor/Twisted Shackle •

B) Double Suspension hardware

- 1) Tower side Twisted Shackle •
- 2) Tower side yoke plate •
- 3) Tower side arcing horn •
- 4) Ball clevis •
- 5) Socket clevis •
- 6) Line side yoke plate •
- 7) Line side arcing horn •
- 8) Clevis eye •
- 9) Line side Twisted/ Anchor Shackle •

C) FCT Clamp assembly

(Common for suspension hardwares)

- 1) Saddle and link strap •
- 2) Keeper piece •
- 3) Suspension clamp •

D) Single tension hardware

- 1) Anchor Shackle •
- 2) Horn holder ball link •
- 3) Tower side arcing horn •
- 4) Horn holder Socket eye •
- 5) Line side arcing horn •

E) Double tension hardware

- 1) Anchor Shackle •
- 2) Chain link •
- 3) Tower side yoke plate •
- 4) Tower side arcing horn •
- 5) Ball clevis •
- 6) Socket clevis •
- 7) Line side yoke plate •
- 8) Line side arcing horn •
- 9) Clevis eye •

F) Clamp assembly

(Common for tension hardwares)

- 1) Steel sleeve •
- 2) Compression tube and jumper •
 - 1) Minimum failing load of
 - a) Single suspension hardware •
 - b) Double suspension hardware •
 - c) Single tension hardware •

-
- d) Double tension hardware •
 - 2) Length of suspension clamp •
 - 3) Slip strength of suspension clamp •
 - 4) Magnetic power loss in watts for suspension clamp at 800 Amps. •
 - 5) Slip strength of tension clamp •
 - 6) Electrical resistance of tension joint after compression •
 - 7) Standard specification to which galvanising confirm •
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ANNEXURE-III

TECHNICAL PARTICULARS OF CONDUCTOR & EARTHWIRE ACCESSORIES

1.0 Accessories suitable for 0.2 ACSR Panther conductor(for 132 kV line), 0.4 ACSR Zebra Conductor (for 220 kV line) and 7/3.15 mm earth wire shall be offered.

2.0 MID SPAN COMPRESSION JOINT (CONDUCTOR)

Mid Span Compression Joint shall be used for joining two lengths of conductor. The electrical resistance of joint shall be less than 75% of measured resistance of equivalent length of conductor. The joint shall not permit slipping off, damage to, or failure of the complete conductor or any part thereof at a load less than 90% of the ultimate tensile strength of the conductor. The joint shall be made of aluminium alloy.

3.0 REPAIR SLEEVE (CONDUCTOR)

Repair Sleeve of compression type shall be used to repair conductor with not more than two strands broken in the outer layer. The sleeve shall be manufactured from aluminium alloy. The repair sleeve shall comprise of two pieces with a provision of seat for sliding of the keeper piece. The edges of the seat as well as the keeper piece shall be so rounded that the conductor strands are not damaged during installation.

4.0 PRE-FORMED ARMOUR RODS

P. A. Rods shall be used for wrapping on the conductor before installation of suspension clamp on line. The rods shall be made of aluminum alloy grade 6201 having tensile strength not less than 35 Kg/mm². The electrical conductivity of each rod shall not be less than 40% of IACS(International Annealed Copper Specification). The shape of ends of each rod shall be Parrot bill. The center point of each rod shall be marked with indelible black paint.

5.0 VIBRATION DAMPER

Vibration damper of 4R-stock bridge type with four different resonant frequencies spread within the specified aeolian frequency band-width shall be used for suspension and tension points on each conductor in each span to damp out aeolian vibrations. Two dampers on each side shall be used at tension points and one damper on each side at suspension points, for normal spans. The Bidder shall furnish damper placement charts along with the bid for spans ranging from 100 m to 600 m.

The clamp of the vibration damper shall be made of aluminium alloy. The clamp shall be capable of supporting the damper during installation and prevent damage or chafing of the conductor during erection or continued operation.

The messenger cable shall be made of high tensile strength steel wire with a minimum strength of 135 kg/mm². The damper mass shall be made of cast iron, hot dip galvanized or a permanent mould cast zinc alloy.

The vibration analysis of the system, with and without damper, dynamic characteristic of the damper shall be submitted by the Bidder along with his bid.

6.0 SUSPENSION CLAMP (EARTH WIRE)

At all suspension towers suitable envelop type suspension clamp shall be used to hold earthwire. The suspension clamp shall be provided with an eye hook suitable for M16 size bolt, for attaching it to the hanger plate. The design of the assembly shall be such that the direction of run of the earthwire through the clamp shall be same as that of the earthwire.

The suspension clamp shall be provided with M12 size U&J bolts, nuts and plain washers of Mild steel and spring washers of spring steel for connecting earth bond to the tower body.

The suspension clamp shall have a slip strength between 12.5% to 20% of ultimate tensile strength of the earthwire. The breaking load of suspension clamp shall not be less than 50 KN.

7.0 TENSION CLAMP (EARTH WIRE)

At all tension towers suitable compression type tension clamps shall be used to hold earthwire. 16 mm diameter anchor shackle shall be supplied which shall be suitable for attaching the tension clamp to strain plate. The tension clamp shall be provided with jumper plate, for attaching jumper terminal to it. The same shall be attached with 2xM12 size bolts, nuts and plain washers of mild steel and spring washer of spring steel. The length of one of the bolts shall be more than the other for connecting earth bond to the tower body.

The electrical resistance of the clamp when compressed on the earthwire shall be less than 75% of measured resistance of equivalent length of earthwire. The slip strength of the assembly shall not be less than 90% of the ultimate tensile strength of the earthwire. The angle of jumper terminal shall be 30° with respect to the vertical line.

The clamp shall be complete with all the components including anchor shackle, bolt, nuts, washers, split pin, jumper arrangement etc.

8.0 MID SPAN COMPRESSION JOINT (EARTH WIRE)

Mid Span Compression Joint shall be used for joining two lengths of earthwire. The joint shall be made of Mild Steel. The joint shall not permit slipping off, at a load less than 90% of the ultimate tensile strength of the earthwire. The electrical resistance of joint shall be less than 75% of measured resistance of equivalent length of earthwire.

9.0 EARTH BOND_

The earth bond shall be made of E.C. grade (% of Copper > 99.5%) tinned flexible copper cable of size 37/7/0.417 mm and copper area equivalent of 35 mm². The length of earth bond shall not be less than 750 mm. Two tinned copper lugs having suitable holes for 12 mm & 16 mm diameter bolts shall be press jointed at either ends of the copper cable. One 45 mm long galvanised Mild Steel bolt with nut and plain, spring washer shall also be provided. This shall be suitable for providing proper bondage between earthwire hardware and tower body. The pull off load shall not be less than 300 kg.

10.0 WORKMANSHIP

- a) All the equipment shall be of the latest design and conform to the best modern practices adopted in the Extra High Voltage field.
- b) The design, manufacturing process and quality control of all the materials shall be such as to give maximum possible working load, highest mobility, elimination of sharp edges and corners to limit corona and radio interference, best resistance to corrosion and a good finish.
- c) Minimum weight of zinc coating shall be 300 gm/m² for fasteners and 610 gm/m² for all other hot dip galvanised articles.

11.0 BID DRAWINGS

The proposal shall include fully dimensioned assembly and component drawings for all items quoted. All drawings shall be neatly arranged, and all drafting and lettering shall be standard and legible. The minimum size of lettering shall be one eighth of an inch. Dimensions shall be in the customary units. The drawings shall give following information:

- a) The bill of material indicating quantity, nature, grade and reference standard of the material used for various parts. The thickness of plain/spring washers, size and length of bolts shall also be indicated.
- b) After award of contract the contractor shall submit to the Owner, 2 copies of drawings for approval within one month. The Owner shall accord approval for the drawings in reasonable period provided the same are as per specification. The Contractor shall endeavor to furnish all the clarification required by the Owner for approving the drawings promptly.
- c) Once the drawings have been approved, no alteration or modification should be carried out without prior approval of the Owner.

12.0 TESTS

A) TYPE TESTS

The contractor shall offer the accessories which are already type tested within the last five (5) years and manufactured by the reputed manufactures approved by the Board.

In case the items are not type tested within 5 years as on the date of LOA, fresh type tests as per relevant IS standards shall be carried out, in presence of purchasers representative, before supply of material.

The list of type tests to be conducted is as follows:

Sr. No.	Particulars of test	Reference standard
D)	Conductor accessories:	
A)	MSCJ	
1)	Visual examination	IS:2121
2)	Verification of Dimensions	
3)	Mechanical/slip strength test	
4)	Heat cycle test	
5)	Electrical resistance test (Before and after heat cycle test)}	
B)	Repair Sleeves	
1)	Visual examination	IS:2121
2)	Verification of Dimensions	
3)	Mechanical/slip strength test	
4)	Electrical resistance test	
C)	P.A.Rod	
1)	Visual examination	IS:2121
2)	Verification of Dimensions	
3)	Slip strength test	
4)	Tensile Strength test	
5)	Bend test	
6)	Resilience test	
7)	Electrical resistance test	
D)	Vibration Damper	
1)	Visual examination	IS:9708
2)	Verification of Dimensions	
3)	Mass pull off test	
4)	Magnetic power loss test	
5)	Clamp slip test (Before & after fatigue test)	
6)	Clamp bolt torque test	
7)	Resonance frequency test	
8)	Fatigue test	
9)	Galvanising/Electroplating test	
10)	Dynamic characteristics test (Before & after fatigue test)	
11)	Vibration analysis/ Damper Efficiency test	

Sr. No.	Particulars of test	Reference standard
II)	Earthwire accessories:	
A)	Suspension clamp	
1)	Visual examination }	
2)	Verification of Dimensions }	
3)	Mechanical strength test }	IS:2486
4)	Clamp slip test }	
5)	Galvanising/Electroplating test }	
B)	Tension clamp	
1)	Visual examination }	
2)	Verification of Dimensions }	
3)	Mechanical/Slip strength test }	IS:2486
4)	Electrical resistance test }	
5)	Galvanising/Electroplating test }	
C)	MSCJ	
1)	Visual examination }	
2)	Verification of Dimensions }	
3)	Mechanical/slip strength test }	IS:2121
4)	Electrical resistance test }	
5)	Galvanising test }	
D)	Earth Bond	
1)	Visual examination }	
2)	Verification of Dimensions }	IS:2121
3)	Slip strength test }	

B) ACCEPTANCE TESTS:

This shall mean those tests which are to be carried out on samples taken at random from a lot for acceptance of the lot.

The item wise list of acceptance tests to be conducted is as follows:

Sr. No.	Particulars of test	Reference standard
I)	Conductor accessories:	
A)	MSCJ	
1)	Visual examination }	
2)	Verification of Dimensions }	IS:2121
3)	Mechanical/slip strength test }	

B)	Repair Sleeves	
1)	Visual examination	}
2)	Verification of Dimensions	}
3)	Mechanical/slip strength test	}
		IS:2121
Sr. No.	Particulars of test	Reference standard
C)	P.A. Rod	
1)	Visual examination	}
2)	Verification of Dimensions	}
3)	Tensile Strength test	}
4)	Resilience test	}
5)	Electrical resistance test	}
		IS:2121
D)	Vibration Damper	
1)	Visual examination	}
2)	Verification of Dimensions	}
3)	Mass pulloff test	}
4)	Fatigue test	}
5)	Clamp slip test after fatigue test	}
6)	Resonance frequency test	}
7)	Galvanising/Electroplating test	}
		IS:9708
II)	Earthwire accessories:	
A)	Suspension clamp	
1)	Visual examination	}
2)	Verification of Dimensions	}
3)	Mechanical strength test	}
4)	Galvanising/Electroplating test	}
		IS:2486
B)	Tension clamp	
1)	Visual examination	}
2)	Verification of Dimensions	}
3)	Mechanical strength test	}
	on clamp & components	}
4)	Galvanising/Electroplating test	}
		IS:2486
C)	MSCJ	
1)	Visual examination	}
2)	Verification of Dimensions	}
3)	Mechanical/slip strength test	}
4)	Galvanising test	}
		IS:2121
D)	Earth Bond	
1)	Visual examination	}
2)	Verification of Dimensions	}
3)	Slip strength test	}
		IS:2121

C) **ROUTINE TESTS:**

This shall mean those tests, which are to be carried out on each item to check the requirements which are likely to vary during production.

The list of routine tests to be conducted is as follows:

Sr. No.	Particulars of test	Reference standard
I)	Conductor accessories:	
A)	<u>P.A. Rod</u>	
1)	Visual Inspection }	
2)	Verification of Dimensions }	IS:2121
B)	<u>MSCJ & Repair Sleeves</u>	
1)	Visual Inspection }	
2)	Verification of Dimensions }	IS:2121
C)	<u>Vibration Damper</u>	
1)	Visual Inspection }	IS:9708
II)	Earthwire fittings:	
A)	<u>Suspension clamp</u>	
1)	Visual Inspection }	IS:2486
2)	Mechanical routine test }	
B)	<u>Tension Clamp</u>	
1)	Visual Inspection }	IS:2486
C)	<u>MSCJ</u>	
1)	Visual Inspection }	
2)	Verification of Dimensions }	IS:2121
D)	<u>Earth Bond</u>	
1)	Visual Inspection }	IS:2121

D) TESTS DURING MANUFACTURING:

Stage tests during manufacture shall mean those tests which are to be carried out during the process of manufacturing to ensure quality control such that the end product is of the designed quality conforming to the intent of this specification.

The list of tests to be conducted during manufacturing is as follows:

Sr. No.	Particulars of test	Reference standard
1)	Visual inspection, Dimensional check, Chemical analysis and }	As per relevant }

	mechanical strength tests for malleable Cast Iron castings.	}	IS standards
2)	Dimensional check and chemical analysis test for Copper wire/ bars.	}	- do -
Sr. No.	Particulars of test		Reference standard
3)	Chemical analysis of zinc for galvanising.	}	- do -

E) **ADDITIONAL TESTS**

The Owner reserves the right of having at his own expenses any other test(s) of reasonable nature carried out at manufacturer's premises, at site, or in any other laboratory in addition to the aforesaid type, acceptance and routine tests to satisfy himself that the material complies with the specification. The owner also reserves the right to repeat the full series or a particular type test at any time during the pendency of contract.

13.0 GUARANTEED TECHNICAL PARTICULARS

The Guaranteed Technical Particulars for conductor and earthwire accessories enclosed with this Annexure shall be duly filled in and submitted along with the offer.

14.0 IDENTIFICATION MARK

All components made by forging/casting shall invariably be marked by embossing with identification mark of the manufacturer. The identifying letters and numbers shall be raised 1 mm and shall be at least 5 mm high. They shall be die stamped or cast on one or both sides of the assembly. The characters shall be distinct, durable, and conspicuous after galvanising.

GUARANTEED TECHNICAL PARTICULARS FOR MSCJ FOR 0.2 sq.in. ACSR Panther/0.4 ACSR zebra

Manufacturer's name and address

Sr. No.	Particulars	Guaranteed Value
1)	Material	•
2)	Before Compression dimensions	
i)	Aluminium Sleeve	
a)	Outer Diameter	•
b)	Inner Diameter	•

-
- ii) Steel Sleeve
 - a) Outer Diameter •
 - b) Inner Diameter •
 - 3) After Compression dimensions
 - a) Corner to Corner •
 - b) Flat to Flat •
 - 4) Length before Compression •
 - 5) Slip strength •
 - 6) Electrical resistance of Joint after Compression •
-

**GUARANTEED TECHNICAL PARTICULARS FOR REPAIR SLEEVES
FOR 0.2 sq. in. ACSR Panther/ 0.4 ACSR Zebra**

Manufacturer's name and address •

Sr. No.	Particulars	Guaranteed Value
1)	Material	•
2)	Before Compression dimensions	
a)	Outer Diameter	•
b)	Inner Diameter	•
3)	After Compression dimensions	
a)	Corner to Corner	•
b)	Flat to Flat	•
4)	Length before Compression	•
5)	Slip strength	•
6)	Electrical resistance of Joint after Compression	•

GUARANTEED TECHNICAL PARTICULARS FOR P.A. ROD FOR 0.2 sq.in.
ACSR Panther/0.4 ACSR Zebra

Manufacturer's name and
address

•

Sr. No.	Particulars	Guaranteed Value
1)	Material	•
2)	Dimensions	•
a)	Length of each rod (in mm)	•
b)	Diameter of each rod (in mm)	•
c)	No. of rods per set	•
d)	Tolerance on length of each rod	•
3)	Conductivity	•
4)	Direction of lay	•
5)	Shape of end	•
6)	Tensile strength	•

**GUARANTEED TECHNICAL PARTICULARS FOR VIBRATION DAMPER
FOR 0.2 sq.in. ACSR Panther/0.4 ACSR Zebra**

Manufacturer's name and address •

Identification mark •

Sr. No.	Particulars	Guaranteed Value
1)	Type	•
2)	Material, Grade and	
3)	Standard of	•
a)	Clamp	•
b)	Messenger cable	•
c)	Weights (Damper mass)	•
4)	Weight of damper mass	
5)	Total weight of damper	
6)	Slip strength of clamp	
a)	Before fatigue	•
b)	After fatigue	•
7)	Maximum possible Dynamic strain on the conductor with damper	•
8)	Resonance frequency	
9)	Mass pull off load	•
10)	Magnetic power loss at 800 Amps.	•
10)	Standard specification to which galvanizing confirm	•

GUARANTEED TECHNICAL PARTICULARS FOR SUSPENSION CLAMP FOR EARTHWIRE

Manufacturer's name and address •

Identification mark •

Sr. No.	Particulars	Guaranteed Value
1)	Type	•
2)	Material, Grade & Standard for	
a)	Clamp body	•
b)	Keeper piece	•
c)	U&J bolt and nut	•
d)	Eye hook	•
3)	Breaking load of clamp	•
4)	Slip strength	•
5)	Length of clamp	•

GUARANTEED TECHNICAL PARTICULARS FOR COPPER BOND

Sr.No.	Particulars	Guaranteed value
1)	Material, Grade and Standard for	
a)	Connecting lugs	•
b)	Flexible bond	•
2)	Stranding	•
3)	Length	•
4)	Pull off load	•

GUARANTEED TECHNICAL PARTICULARS FOR TENSION CLAMP FOR EARTHWIRE

Manufacturer's name and address •

Identification mark •

Sr. No.	Particulars	Guaranteed Value
1)	Material, Grade & Standard for	
a)	Clamp body	•
b)	Jumper	•
2)	Before compression dimensions	
a)	Outer Diameter	•
b)	Inner Diameter	•
3)	After compression dimensions	
a)	Corner to Corner	•
b)	Flat to flat	•
4)	Slip strength	•
5)	Length before compression	•
6)	Electrical resistance of Joint after compression	•
7)	Standard specification to which galvanizing confirm	•

GUARANTEED TECHNICAL PARTICULARS FOR MSCJ FOR EARTHWIRE

Manufacturer's name and address •

Sr. No.	Particulars	Guaranteed Value
1)	Material, Grade & Standard for sleeve	•
2)	Before compression dimensions	
a)	Outer Diameter	•
b)	Inner Diameter	•
3)	After compression dimensions	
a)	Corner to Corner	•
b)	Flat to flat	•
4)	Length before compression	•
5)	Slip strength	•
6)	Electrical resistance of joint after compression	•
7)	Standard specification to which galvanizing confirm	•

ANNEXURE IV
LIST OF APPROVED VENDORS

Please refer MSETCL website www.mahatransco.in for list of approved vendors for all items.

ANNEXURE-V

GENERAL TECHNICAL REQUIREMENTS OF FOUNDATION, STUB SETTING AND EARTHING

1.0 GENERAL

Cement concrete/Reinforced concrete footings shall be used for all types of Towers in conformity with the present day practice followed in the country and the specifications laid herein.

Foundation works shall include all items of work related to supply and installation of foundations such as form installation work, excavation, concreting, curing, backfilling, stub setting, providing reinforcement etc. Supply of materials such as cement, sand, coarse aggregate and reinforcement steel is included in the scope of the contractor.

The foundation designs and drawings for a few types of soil for 220/132 KV towers are available and shall be spared to the successful Bidder. The foundation designs required for any other type of soil shall be developed by the Bidder as per the details given and shall be submitted to the owner for approval.

2.0 CLASSIFICATION OF SOIL AND FOUNDATIONS

2.1 CLASSIFICATION OF SOILS

The soil shall be classified for the excavation asked upon the type of soil, subsoil water level and the presence of surface water as under:

a) **Normal Soil**

Soil for which removal by means of an ordinary pick, axe, spade and shovel is possible.

b) **Wet Soil**

Where the sub-soil water table is encountered within the range of foundation depth or/ and where pumping or bailing out of water is required due to presence of surface water.

c) **Rocky Soil**

i) **Fissured Rock**

Lime stone, laterite, hard conglomerate or other soft or fissured rock which can be quarried or split with crow bars, wedges or pickaxes shall be classified as Fissured Rock. However, if required, light blasting may be resorted to for loosening the material, but this will not in any way entitle the material to be classified as hard rock.

ii) **Hard Rock**

Soil other than specified under fissured rock above for which blasting, drilling, chiseling are required, for excavation.

iii) **Black Cotton Soil**

Where soil is clayey type loose not necessarily black in colour, which shrinks when dry & swells when wet resulting in differential movement extending to a maximum depth of about 3.5 meters below ground level, the foundation shall be classify as black cotton.

3.0 Classification of Foundations

The foundation design shall depend upon the type of soil, sub-soil water level and the presence of surface water which have been classified as follows:

3.1 Normal dry

Where cohesive or non-cohesive soils or soft murrum are met in dry conditions, the foundations shall be classified as normal dry.

3.2 Wet

Where sub-soil water is met at 1.5 meters or more below the ground level or where surface water is present for long periods with water penetration not exceeding one meter below the ground level e.g. the paddy fields, the foundation shall be classified as wet.

3.3 Partially submerged

Where sub-soil water table is met between 0.75 meter to 1.5 meter below the ground level, the foundation shall be classified as partially submerged.

3.4 Fissured Rock

Where decomposed or fissured rock, Soft Rock, hard gravel, kankar, limestone, laterite or any other soil of similar nature is met, the foundations shall be classified as Fissured Rock and Undercut type foundation is to be used for these types of locations.

3.5 Hard Rock

Where hard rock is encountered at 1.5 mtr. or less below ground level and excavation by Chiseling, drilling and blasting is required

3.6 Black cotton soil

Where soil is clayey type loose not necessarily black in colour, which shrinks when dry & swells when wet resulting in differential movement extending to a maximum depth of about 3.5 meters below ground level, the foundation shall be classify as black cotton.

4.0 Properties of soil

Properties of soil encountered in general in the state of Maharashtra are given in following table:

PROPERTIES OF EARTH

Sr. No.	Particulars	Unit	Value
1)	Weight of earth		
a)	Dry	KN/m ³	14.12
b)	In presence of surface water	KN/m ³	14.12
c)	In presence of subsoil water	KN/m ³	9.22
2)	Normal Dry		
a)	Ultimate bearing capacity	KN/m ²	490
b)	Weight of earth	KN/m ³	14.40
c)	Angle of repose	Degrees	30 ⁰ degree
3)	Soft Rock/Fissured Rock		
a)	Ultimate Bearing Capacity	KN/m ²	612.19
b)	Weight of earth	KN/m ³	14.12
c)	Angle of Repose	Degrees	20 ⁰
4)	Wet Fissured Rock		
a)	Ultimate bearing capacity	KN/m ²	612.19
b)	Weight of Earth	KN/m ³	9.22
c)	Angle of Repose	Degrees	10 ⁰
5)	Hard Rock		
a)	Ultimate Bearing Capacity	KN/m ²	1250.0
b)	Ultimate bond between steel and concrete	KN/m ²	0.147

Sr. No.	Particulars	Unit	Value
6)	Black Cotton Soil (On Dry portion)		
a)	Ultimate Bearing Capacity	KN/m ²	122.58
b)	Weight of Earth	KN/m ³	14.22
c)	Angle of Repose	Degrees	0°
7)	Black Cotton Soil (On Wet portion)		
a)	Ultimate Bearing Capacity	KN/m ²	122.58
b)	Weight of Earth	KN/m ³	9.22
c)	Angle of Repose	Degrees	9.0°

5.0 DESIGN OF FOUNDATIONS

All the four footings of the tower and its extension shall be similar, irrespective of down thrust an up-lift.

- 5.1 The total depths of foundations below the ground level shall not be less than 1.5 meters and more than 3.5 meters. To maintain the interchangeability of stubs for all types of foundations, for each type of tower, the same depths of stub below ground level shall be used for different types of foundations. Common foundation design shall be suitable for normal tower and tower with 3M/ 6M extension.

For designing foundations at locations involving black cotton soil the soil is to be considered as fully submerged in nature.

In case of fissured rock locations where water table is met at 1.5 meter or more below ground level wet type fissured rock foundations shall be adopted. If after soil investigation, water level is encountered less than 1.5m below ground level, a separate foundation design for partially submerged condition as applicable shall be developed by the Contractor for execution.

- 5.2 The foundation shall be designed to withstand the specific loads of the super-structure and for the full footing reactions obtained from the structure stress analysis in conformity with the relevant safety factors.
- 5.3 The reactions on the footings shall be composed of the following type of loads for which they shall be required to be checked.

(a) Maximum tension or uplift along the leg slope.

(b) Maximum compression or down thrust along the leg slope.

(c) Maximum horizontal shear on side thrust.

- 5.4 The additional weight of concrete in the footing below ground level over the earth weight and the full weight of concrete above the ground level in the footing and embedded steel parts will also be taken into account adding to the down thrust.
- 5.5 Foundations in B.C. soil shall be designed with zero degree angle of repose and also for fully submerged condition.
- 5.6 16 mm dia. deformed bars and 6 mm dia. stirrups shall be used for reinforcement.
- 5.7 Reinforcement bars shall be provided in the chimney portion in all types of soil.

6.0 FACTOR OF SAFETY

- 6.1 The factor of safety of 2.2 and 1.65 shall be adopted in normal condition and broken wire conditions respectively. The working loads on normal tower or extensions whichever is critical, shall be multiplied by appropriate factor of safety to arrive at the ultimate foundation loads.

7.0 STABILITY ANALYSIS

- 7.1 In addition to the strength design, stability analysis of the foundation shall be done to check the possibility of failure by over-turning, uprooting, sliding and tilting of the foundation.
- 7.2 The following primary types of soil resistance shall be assumed to act in resisting the loads imposed on the footing in earth:
- a) Resistance against uplift:

The uplift loads will be assumed to be resisted by the weight of earth in an inverted frustum of a conical pyramid of earth as per formula detailed in drawing enclosed of this specification on the footing pad whose sides make an angle equal to the angle of repose of the earth with the vertical, in average soil.

The weight of concrete embedded in earth and that above the ground will also be considered for resisting the uplift. In case where the frustum of earth pyramids of two adjoining legs superimpose each other, the earth frustum will be assumed truncated by a vertical plane passing through the centerline of the tower base. The self-weight of tower shall not be considered with FOS while calculating uplift.

- b) Resistance against down-thrust:

The down-thrust loads combined with the additional weight of concrete above earth will be resisted by bearing strength of the soil assumed to be acting on the total area of the bottom of the footing.

- c) Resistance against side-thrust:

The contractor has to check the foundation against side thrust force as detailed in drawing enclosed. If uplift and down thrust are computed in vertical direction for foundation design, full resultant horizontal shear shall be taken at footing tip for design of the footing to resist side thrust.

8.0 PROPERTIES OF CONCRETE

- 8.1 The cement concrete used for the foundations shall be grade M-150 corresponding to 1:2:4 nominal mix ratio or M-20 corresponding to 1:1.5:3 nominal mix ratio with 20mm coarse aggregate for chimney portion and 40mm coarse aggregate for pyramid or slab portion depending on foundation design and relevant foundation drawing.

All the properties of concrete regarding its strength under compression, tension, shear, punching and bend etc. as well as workmanship will conform to IS:456-1978.

- 8.2 The weight of concrete to be considered for design of foundation is given in following Table:

WEIGHT OF CONCRETE		
Type of Concrete	Weight in dry region KN/M ³ (Kg/M ³)	Weight in presence of subsoil water KN/M ³ (Kg/M ³)
Concrete	21.96 (2240)	12.16(1240)
Reinforced Concrete	23.54 (2400)	13.73(1400)

9.0 DETAILING OF FOUNDATIONS

- 9.1 The thickness of concrete in the chimney portion of the tower footing would be such that it provides minimum cover of not less than 100mm from any part of the stub angle to the nearest outer surface of the concrete in respect of all dry locations limiting the minimum section of chimney to 300 mm x 300 mm. In respect of all wet location, the chimney should have all round clearance of 150mm from any part of stub angle considering the minimum chimney size of 450 mm x 450 mm.
- 9.2 The chimney top or muffing must be at least 225mm above ground level and also the coping shall be extended up to the lower most joint level between the bottom lattices and the main corner legs of the tower.
- 9.3 The spread of concrete pyramid or slabs shall be limiting to 45⁰, with respect to the vertical. However, bidders can design foundation with reinforced concrete pyramid/slab, in which case the limitation of 45⁰ is not applicable. Mild steel bars shall not be used for reinforcement steel.
- 5.2 At least 50mm thick pad of size equal to the base of pyramid with its sides vertical will be provided below the pyramid to account for the unevenness of soils impurities likely

to be mixed in concrete due to direct contact of wet concrete with earth and also for allowing stone aggregate reaching up to corner edges. This pad will also be provided in cases where pyramids are provided over concrete slabs.

- 9.5 In case of partially submerged and fully submerged type foundation, at least one base slab of not less than 200mm thick shall be provided. In case of reinforced concrete slab, the slab thickness should not be less than 300mm.
- 9.6 The minimum distance between the lowest edge of the stub angle and the bottom surface of concrete footing shall not be less than 75 mm or more than 100mm in case of dry locations and not less than 100mm or more than 150mm in case of wet locations.
- 9.7 In case of foundations having steel reinforcement in pyramid or slab and for all wet, partially submerged locations at least 50mm thick pad of lean concrete corresponding to 1:3:6 shall be provided prior to pad/slab mentioned in clauses 9.4 and 9.5 to avoid the possibility of reinforcement rods being exposed to unevenness of the bottom excavated pit and to avoid direct contact of concrete slab with water.
- 9.8 The portion of the stub in the pyramid (or slab) shall be designed to take full down-thrust or uplift loads by the cleats combined with the bond between stub angles and pyramid concrete. The Contractor shall furnish the calculation for uprooting of stub along with the foundation design.

10.0 MARKING OF TOWER LOCATION

The check survey shall be carried out and pit markings of foundation as per approved excavation chart shall be made on the ground.

11.0 EXCAVATION

- 11.1 Except as specifically otherwise provided, all excavation for footing shall be made to the lines and grades of the foundation. The excavation wall shall be vertical and the pit dimensions shall be such as to allow a clearance on all sides from the foundation pad. The Contractor should ensure that clearance is maintained as advised by Engineer incharge of owner from the foundation pad is maintained as per advice of engineer incharge for quality work. All excavation shall be protected so as to maintain a clean sub grade, until the footing is placed, using timbering, shoring etc., if necessary. Any sand, mud, silt or other undesirable materials which may accumulate in the excavated pit shall be removed by the Contractor before placing concrete.
- 11.2 No extra charge shall be admissible for the removal of the fallen earth in the pit, when once excavated. Shoring shutting and timbering as approved by authorized representative of the Owner shall be provided by the Contractor when the soil condition is so bad that there is likelihood of the falling of earth.
- 11.3 Where rock is encountered, the holes for tower footings, shall preferably be drilled, but where blasting is to be resorted to as an economy measure it shall be done with utmost care to minimize the use of concrete for filling the blasted areas. All necessary precautions for handling and use of blasting materials shall be taken. In case where drilling is done, the stubs may be shortened suitably with the approval of the Owner or

his authorized representatives. Further it may be noted that the contractor may be required to do controlled blasting if the site conditions so warrant.

11.3.1 When intermediate soil strata is encountered the owner will modify the foundation drawings as per requirement with under cut position of reinforcement The Contractor shall supply requisite blasting material and be responsible for storage and use of this material.

11.4 The Contractor shall record the types of soil encountered during excavation of pits for different strata and soil.

12.0 SETTING OF STUBS

12.1.1 The stubs shall be set correctly in accordance with approved method at the exact location and alignment and precisely at correct levels with the help of stub-setting templates and leveling instrument. Stubs shall be set in the presence of Owner's representative available at site where required and for which adequate advance intimation shall be given to the Owner by the Contractor. No extra charges shall be payable while cutting/cleaning of earth required for setting of stub setting template.

12.2 Setting of stub at each location shall be approved by the Owner's representative.

13.0 RAISED FOUNDATIONS

Wherever normal towers and extensions are to be spotted at locations which fall under highest flood level of adjacent rivers, the chimney shall be suitably raised above HFL. The stub length for such locations shall be suitably increased and provided through out the chimney and frustum.

14.0 BASE PLATES AND ANCHOR BOLTS

At some special locations/normal locations, it may be necessary to provide Anchor bolts and Base plates instead of stubs. These shall be designed and submitted by the Contractor for the approval of the Owner. The Contractor shall supply the anchor bolts, base plates, tower footing and template for setting of anchor bolts.

15.0 CEMENT, AGGREGATES & REINFORCEMENT STEEL

15.1 The cement shall be arranged by the contractor. Also cement should be stacked in an approved manner and only fresh cement not more than three months old from the date of manufacture should be used for foundations. Empty cement bags shall be retained by the Contractor.

15.2 a) The Portland cement used in concrete shall conform to IS:269-1967.

b) The Puzzolena cement if used in concrete shall conform to IS:1489-1976. The curing time of Puzzolena cement will be decided at the time of execution of the Contract.

c) The minimum cement content for the various grades of concrete shall be as follows:

M 20 (1:1.5:3)	400 kg/m ³
M 15 (1:2:4)	330 kg/m ³
Lean concrete M 10 (1:3:6)	260 kg/m ³
M7.5 (1:4:8)	180 Kg/m ³
1:5 Cement & sand mortar	105 kg/m ³

d) The bidder shall use the cement of following brands:

- i) L & T
- ii) KESORAM
- iii) ACC
- iv) Ambuja

- 15.3 Concrete aggregates shall conform to IS:383-1970. It may be noted that the metal to be used shall be black trap metal machine-crushed and it should be without skin-material.
- 15.4 The water used for mixing concrete shall be fresh, clean and free from oil, acids and alkalis, organic materials or other deleterious substances. Potable water is generally satisfactory.
- 15.5 Reinforcement shall conform to IS:432-1966 for M.S. bars and hard drawn steel wires and to IS:1139-1966 and IS:1786 for deformed and cold twisted bars respectively. All reinforcement shall be clean and free from loose mill scales, dust, loose rust, and coats of paint, oil or other coatings, which may destroy or reduce bond. Contractor shall supply, fabricate and place reinforcement with fusion bonded epoxy coating to shapes and dimensions as indicated or as required to carry out the intent of drawings and specifications.

16.0 MIXING, PLACING AND COMPACTING OF CONCRETE

- 16.1 The concrete shall be mixed in the mechanical mixer. However, in case of difficult terrain hand mixing may be permitted at the discretion of Owner's site Engineer. The water for mixing concrete shall be fresh, clean and free from oil, acids and alkalies. Saltish or brakish water shall not be used.
- 16.2 Mixing shall be continued until there is uniform distribution of material and the mix is uniform in colour and consistency, but in no case the mixing be done for less than two minutes. Normally mixing shall be done close to the foundation, but in case it is not possible, the concrete may be mixed at the nearest convenient place. The concrete shall be transported from the place of mixing to the place of final deposit as rapidly as practicable by methods which shall prevent the segregation or loss of any ingredient. The concrete shall be placed and compacted before setting commences.

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- 16.3 Form boxes shall be used for casting all types of foundation. The concrete shall be laid down in 150mm layers and consolidated well, so that the cement cream works up to the top and no honey-combing is left in the concrete. The mechanical vibrator shall be employed for compaction of the concrete. However, in case of difficult terrain, manual compaction may be permitted at the discretion of site engineer. After concreting the chimney portion to the required height, the top surface should be finished smoothly with a slight slope towards the outer edge, to drain off any rain water falling on the coping.
- 16.4 In wet locations, the site must be kept completely dewatered, both during placing of the concrete and for 24 hours thereafter. There should be no disturbance of concrete by water during this period. No extra charges shall be paid for dewatering.
- 16.5 After the form work has been removed if the concrete surface is found to be defective, the damage shall be repaired with rich cement and sand mortar to the satisfaction of the Owner's representative before the foundation pits are backfilled.

17.0 BACK-FILLING AND REMOVAL OF STUB TEMPLATES

- 17.1 After opening of form work and removal of shoring and timbering if any, backfilling shall be started, after repairs, if any, to the foundation concrete. Backfilling shall normally be done with the excavated soil, unless it consists of large boulders/stones, in which case the boulders shall be broken to a maximum size of 80mm. At such locations where borrowed earth is required for backfilling, this shall be done by the Contractor at his own cost, irrespective of lead.
- 17.2 The backfilling materials should be clean and free from organic or other foreign materials. The earth shall be deposited in maximum 200mm layers, leveled and wetted and tempered properly before another layer is deposited. Care shall be taken that the backfilling is started from the foundation ends of the pits, towards the outer ends. After the pits have been backfilled to full depth, the stub template may be removed.
- 17.3 The backfilling and grading shall be carried to an elevation of about 75mm above the finished ground level drain out water. After backfilling 50mm high earthen embankment (bandh) will be made along the sides of excavation pits and sufficient water will be poured in the backfilling earth for at least 24 hours.

18.0 CURING

The concrete after setting for 24 hours shall be cured by keeping the concrete wet continuously for a period of 21 days after laying. The pit may be back filled with selected earth sprinkled with necessary amount of water and well consolidated in layers not exceeding 200mm of consolidated thickness after a minimum period of 24 hours and thereafter both the backfilled earth and exposed chimney top shall be kept wet for the remainder of the prescribed time of 10 days. The uncovered concrete chimney above the backfilled earth shall be kept wet by providing empty cement bags dipped in water fully wrapped around the concrete chimney for curing and ensuring that the bags are kept wet by the frequent pouring of water on them.

19.0 SPECIAL FOUNDATIONS

The Owner may desire to construct a few special foundations in marshy locations, loose soil etc. if necessary.

19.1 FACTOR OF SAFETY FOR SPECIAL FOUNDATIONS

The factor of safety of 2.75 and 2.2 shall be adopted in normal condition and broken wire conditions respectively. The working loads on normal tower or extensions whichever is critical, shall be multiplied by appropriate factor of safety to arrive at the ultimate foundation loads.

19.2 EARTHING

The footing resistance of all towers shall be measured by the Contractor in dry weather after tower erection and before the stringing of earth-wire. All the towers are to be earthed, however, in no case tower footing resistance shall exceed 10 ohms. Pipe type earthing and counterpoise type earthing wherever required shall be done in accordance with the stipulations made in IS:3043-1987 and IS:5613 (Part-II/Section-2) 1985. The details for pipe and counterpoise type earthing are given in drawing enclosed.

20.0 Benching

When the line route passes through hilly/undulated terrain, for a few tower locations it may be required to level the ground for casting of tower footings on same elevation. All the activities related to make the required area of ground in same elevation for casting of foundation, shall be termed as benching work. Benching work shall include cutting of excess earth and removing the same to a suitable point of disposal as required by the Owner. The excavated earth should be used for filling the slopping area for leveling the ground. Benching shall be resorted to only after getting specific approval from the Owner. Volume of the earth to be cut shall be measured before cutting and got approved from the Owner. This volume of earth shall be considered for the purpose of payment against the head of benching work. It may be noted that the activity related to making the area of ground to same elevation for level difference less than one meter shall not be considered as benching. No payment shall be made for benching works excavation up to the level of 1 meter from top. For level difference more than 3.0 mtr. between legs, the bidder shall provide the towers with unequal legs. The required unequal legs with bracings shall be designed by the bidder.

21.0 PROTECTION OF TOWER FOOTING

21.1 The work shall include all necessary stone pitching and concreting after earth filling above ground level and the clearance with stacking, of all surplus excavated soil at site for providing revetment. Special measures for protection of foundation close to or in nallas, river beds, hilly undulated terrain, etc. shall be arranged by providing suitable revetment with stone pitching and galvanized wire netting and meshing packed with boulders. The top seal cover of the stone revetment shall be done with M-15 concrete (1:2:4 mix). The Contractor shall furnish recommendations for providing protection at these locations wherever required.

21.2 Retaining Wall

In case level difference between tower footing is more, the retaining wall of suitable height at the low lying part shall be provided with Rubble stone, masonry in 1:5 mix mortar with necessary excavation, lean concrete, rubble stone masonry & provision of 100 mm thick M-15 concrete at top of wall. The tower footing will be leveled by back

filling with excavated soil or borrowed soil inside the retaining wall. The height of retaining wall, its length and width shall be got approved by the contractor before taking up the work from engineer in-charge not below the rank of Executive Engineer.

- 21.3 The quantity of excavated earth obtained from a particular location shall generally be utilised in back filling work in protection of tower footing of same location, unless it is unsuitable for such purposes. In the latter case, the back-filling shall be done with excavated soil is not sufficient to achieve the leveled filling borrowed earth of suitable quality irrespective of lead, as per the rate provided in the letter of award. The consolidation of earth shall however, be done after backfilling free of cost.

22.0 STANDARDS

- 22.1 The erection procedure and materials used for design and construction of foundations shall conform to the following Indian Standards (IS) which shall mean latest revisions, with amendments/changes adopted and published, unless specifically stated otherwise in the specification.
- 22.2 The material and services covered under these specifications shall be performed as per requirements of the relevant standards/codes referred hereinafter against each set of equipment and services. Other internationally acceptable standards which ensure equal or higher performance than those specified shall also be accepted.

Sr. No.	Indian Standards	Title
1.	IS:269-1967	Ordinary rapid hardening and low heat Portland Cement
2.	IS:388-1970	Coarse and fine aggregates from natural sources for concrete
3.	IS:432-1966 (Part I & II)	Mild steel and medium tensile bars and hard drawn steel wire for concrete reinforcement
4.	IS:456-1978	Code of practice for plan and reinforced concrete
5.	IS:800-1962	Code of practice for use of structural steel in general Building construction.
6.	IS:1139-1966	Hot rolled mild steel medium high yield strength steel deformed bars for concrete reinforcements.
7.	IS:1489-1976	Portland Pozzolena Cement
8.	IS:1786-1966	Cold twisted steel bars for concrete reinforcements
9.	IS:1893-1965	Criteria of Earth- quake resistant design of structures
10.	IS:3043-1972	Code of practice for earthing(with amendments No.1 & 2)
11.	IS:4091-1967	Code of practice for design and construction of foundation for transmission line towers and poles

ANNEXURE-VI

GENERAL TECHNICAL REQUIREMENTS OF ERECTION WORKS

1.0 General

- 1.1 The scope of erection work shall include the labour, all tools and plants and all other incidental works in connection with the setting up of site stores, unloading at the destination the various materials, transportation to stores, storage, safe custody, movement to work site, erection, stringing, and testing and commissioning of the line.
- 1.2 Contractor shall set up required number of stores along the line and the exact location of such stores shall be discussed and agreed to between the Contractor and the Owner.

The insulators packed in wooden crates should be stacked properly so as to cause no damages. The insulators should be taken to site in packed crates and not in loose condition so that there are no breakages during transit. It will be the responsibility of the contractor to see that damaged insulators are not used.

- 1.3 All galvanised members shall be thoroughly inspected. If any defects are found in case of hot-dip galvanised members, the members if acceptable to Owner shall be repaired by applying zinc rich protection paint.

1.4 Treatment of Joints

Before starting assembly, the surfaces at joints shall be cleaned and applied with a coat of Zinc-rich paint, if required. However for the lines in coastal or highly polluted areas, the above painting shall necessarily be carried out.

1.5 Assembly

The method followed for the erection of towers, shall ensure the points mentioned below:

- a) Straining of the members shall not be permitted for bringing them into position. It may, however, be necessary to match hole positions at joints and to facilitate this, tummy bars not more than 450mm long may be used.
- b) Before starting erection of an upper section, the lower section shall be completely braced and all bolts provided and tightened adequately in accordance with approved drawings to prevent any mishap during tower erection.
- c) All plan diagonals relevant to a section of tower shall be placed in position before assembly of upper section is taken up.
- d) The bolt positions in assembled towers shall be as per IS:5613 (Part-II/Section-2)-1976.
- e) Tower shall be fitted with number plate, danger plate, pole plates, circuit plate and ant climbing device as described.

2.0 Tightening and Punching of Bolts and Nuts

- 2.1 All nuts shall be tightened properly using correct size spanners and torque wrench. Before tightening, it will be seen that filler washers and plates are placed in relevant gaps between members, bolts of proper size and length are inserted, and one spring washer is inserted under each nut. In case of step bolts, spring washers shall be placed under the outer nuts. The tightening shall progressively be carried out from the top downwards, care being taken that all bolts at every level are tightened simultaneously. The threads of bolts projecting outside the nuts shall be punched at their position on the diameter to ensure that the nuts are not loosened in course of time. If during tightening a nut is found to be slipping or running over the bolt threads, the bolt together with the nut shall be replaced.
- 2.2 The threads of all the bolts projected outside the nuts shall be welded at two diametrically opposite places. The circular length of each welding shall be at least be 10mm. The welding shall be provided from ground level to first panel or six meters height whichever is higher. After welding, cold galvanized paint having at least 90% zinc content shall be applied to the welded portion. At least two coats of the paint shall be applied. The cost of welding and paint including application of paint shall be deemed to be included in the tower erection price.
- 2.3 Instead of tack welding of nuts with bolts, as described above, the Contractor can also propose some alternative arrangements, like use of epoxy resin adhesive which can serve the purpose of locking the nut permanently with the bolt and thus preventing pilferage of the tower members.

In case the contractor offers some alternative to tack welding, as stated above, he shall have to furnish all the technical parameters of the same, to facilitate the owner to technically evaluate its acceptability.

3.0 Insulator Hoisting

- 3.1 Suspension insulator strings shall be used on suspension towers and tension insulator strings on angle and dead end towers. These shall be fixed on all the towers just prior to the stringing. Damaged insulators and fittings, if any, shall not be employed in the assemblies. Before hoisting all insulators shall be cleaned in a manner that will not spoil, injure or scratch the surface of the insulator, but in no case shall any oil be used for the purpose. Corona control rings shall be fitted in an approved manner. The yoke arrangements shall be horizontal for tensions and longitudinal for suspension strings. Torque wrench shall be used for fixing different line materials and their components like suspension clamp for conductor and earthwire, etc. wherever recommended by the manufacturer of the same.

4.0 Handling of conductor and earthwire

- 4.1 The Contractor shall be entirely responsible for any damage to the towers, conductors and earthwire during stringing. While running out the conductors, and earthwire, care shall be taken that these do not touch and rub against the ground or objects which could cause scratches or damages to the strands. The conductors shall be

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- run out of the drums from the top in order to avoid damage due to chafing. Immediately after running out, the conductor shall be raised at the supports to the levels of the clamp and placed into the running blocks. The groove of the running blocks shall be of such a design that the seat is semicircular and larger than the diameter of the conductor/earthwire and it does not slip over or rub against the sides. The grooves shall be lined with hard rubber or neoprene to avoid damage to conductor and shall be mounted on properly lubricated bearings.
- 4.2 The running blocks shall be suspended in a manner to suit the design of the cross-arm. All running blocks especially those at the tensioning end, will be fitted on the cross arms with jute cloth wrapped over the steel work and under the slings to avoid damage to the slings as well as to the protective surface finish of the steel work. In case tension or section towers are used even for temporary terminations, if this be unavoidable, they shall be well guyed and steps shall be taken by the Contractor to avoid damage. Guying proposal along with necessary calculations shall be submitted by the Contractor to Engineer-in-Charge for the approval. Proper T&P shall also be made available to the Owner by the Contractor for checking the tensions in the guy wires. The drums shall be provided with a suitable braking device to avoid damages, loose running out and kinking of the conductor. The conductor shall be continuously observed for loose or broken strands or any other damage. When approaching end of a drum length at least three coils shall be left when the stringing operations are to be stopped. These coils are to be removed carefully, and if another length is required to be run out, a joint shall be made as per the recommendations of the accessories manufacturers.
- 4.3 Repairs to conductors, if necessary, shall be carried out during the running out operations, with repair sleeves. Repairing of conductor surface shall be done only in case of minor damage, scuff marks etc. keeping in view both electrical and mechanical safe requirements. The final conductor surface shall be clean, smooth without any projections, sharp points, cuts, abrasions etc.
- 4.4 Conductor splices shall be so made that they do not crack or get damaged in the stringing operation. The Contractor shall use only such equipment/methods during conductor stringing which ensure complete compliance in this regard.
- 4.5 Derricks shall be used where roads, rivers, channels, telecommunication or overhead power lines, railway lines, fences or walls have to be crossed during stringing operations. It shall be ensured that normal services are not interrupted or damage caused to property. Shut down shall be obtained when working at crossing of overhead power lines. The Contractor shall be entirely responsible for the proper handling of the conductor, earthwire and accessories in the field.
- 4.6 The sequence of running out shall be from top to downwards, i.e. the earthwire shall be run out first, followed by the conductors in succession. Unbalances of loads on towers shall be avoided as far as possible.
- 4.7 The proposed transmission line may run parallel for certain distance with the existing 400 KV, 220 kV, 132 KV lines which may remain energized during the stringing period. As a result there is a possibility of dangerous voltage build up due to electromagnetic and electrostatic coupling in the pulling wire of conductors and earth wires which although comparatively small during normal operation can be severe during

switching. It shall be the Contractor's responsibility to take adequate safety precautions to protect his employees and others from this potential danger.

- 4.8 B, C and D angle type of towers are not designed for one side stringing. Therefore proper guying arrangements shall be made for 'B', C and D type of towers during stringing on one section while the other section is not strung. The Contractor has to submit the detailed proposal along with the calculation for guying which shall be approved by Engineer-in-Charge. Proper T&P shall be made available to the Owner by the Contractor for checking the tension in the guy wires. All the expenditure on account of the above work is deemed to be included in the bid price and no extra payment shall be made for the same.

5.0 Stringing of earthwire and conductor

The sequence of stringing shall be first earthwire, then phase conductor.

- 5.1 An allowance of 500 mm should be given to compensate the conductor creep.
- 5.2 The contractor shall give complete details of the stringing methods which he proposes to follow. Before the commencement of stringing, the Contractor shall submit the stringing charts for the conductor and earthwire showing the initial and final sags and tension for various temperatures and spans, along with equivalent spans in the lines for the approval of the Owner. The stringing chart shall be prepared for actual spans based on tower schedule and shall cover the entire line details.

6.0 Jointing

- 6.1 All the joints on the conductor and earthwire shall be of compression type, in accordance with the recommendations of the manufacturer for which all necessary tools and equipment like motorized compressors, dies processes etc. shall have to be arranged by the contractor. Each part of the joint shall be cleaned by wire brush to make it free of rust or dirt etc. all be properly greased with anti-corrosive compound, if required and as recommended by the supplier before the final compression is done with the compressors.
- 6.2 All the joints or splices shall be made at least 30 meters away from the structures. No joints or splices shall be made in the spans crossing over main roads, railways, small rivers with tension spans. Not more than one Joint per sub-conductors shall be allowed in one span. The compression type fittings used shall be self centering type or care shall be taken to mark the conductors to indicate when the fitting is centered properly. During compression or splicing operation the conductor shall be handled in such a manner as to prevent lateral or vertical bearing against the dies. After pressing the joint the aluminum sleeve shall have all corners rounded, burrs and sharp edges removed and smoothed.
- 6.3 During stringing of conductor to avoid any damage to the joint the Contractor shall use a suitable protector with mid span compression joints in case joints are to be passed over pulley blocks/aerial rollers. The size of the groove of the pulley shall be such that the joint along with projection can be passed over it smoothly.

7.0 Sagging-in-Operation

- 7.1 The conductors, and earth wire shall be pulled unto the desired sag and left in running block for at least one hour after which the sag shall be re-checked and adjusted, if necessary, before transferring the conductors from the running blocks to the suspension clamps. The conductors shall be clamped within 36 hours of sagging in.
- 7.2 The sag will be checked in the first and the last span of the section in case of sections up to eight spans and in one intermediate span also for sections with more than eight spans. The sag shall also be checked when the conductors have been drawn up and transferred from running blocks to the insulator clamps.
- 7.3 The running blocks, when suspended from the transmission structure for sagging shall be so adjusted that the conductors on running blocks will be at the same height as the suspension clamp to which it is to be secured.
- 7.4 At sharp vertical angles, the sags and tensions shall be checked on both sides of the angle, the conductor and earthwire shall be checked on the running block for equality of tension on both sides. The suspension insulator assemblies will normally assume vertical positions when the conductor is clamped.
- 7.5 Tensioning and sagging operations shall be carried out in calm weather when rapid changes in temperatures are not likely to occur.
- 7.6 Tensioning and Sagging of Conductors and Earth wire shall be done accordance with the approved stringing charts before the conductors and earthwire are finally attached to the towers through the clamps for the earthwire and insulator strings for the conductor. The 'Initial' stringing chart shall be used for the conductor and 'final' stringing chart for earthwire should be employed for this purpose. Dynamometers shall be employed for measuring tension in the conductor and earthwire. The dynamometers employed shall be periodically checked and calibrated with a standard dynamometer.

8.0 Clipping in

- 8.1 Clipping of the conductors in position shall be done in accordance with the recommendations of the manufacturer. Conductor shall be fitted with the Armour rods where it is made to pass through suspension clamps.
- 8.2 The jumpers at the section and angle towers shall be formed to parabolic shape to ensure maximum clearance requirements. Pilot suspension insulator string shall be used, if found necessary, to restrict the jumper swings to the design values.
- 8.3 Fasteners in all fittings and accessories shall be secured in position. The security clip shall be properly opened and sprung into position.

9.0 Fixing of Conductor/Earthwire Accessories

Vibration dampers for conductor and other conductor and earthwire accessories to be supplied by the Contractor shall be installed by the Contractor as per the design requirements and respective manufacturer's instructions within 24 hours of the conductor/earthwire clamping. While installing the conductor and earthwire accessories proper

care shall be taken to ensure that the surfaces are clean and smooth and no damage shall occur to any part of the accessories.

10.0 Replacement

If any replacements are to be effected after stringing and tensioning or during maintenance, leg members and bracings shall not be removed without reducing the tension on the tower with proper guying or releasing the conductor. If the replacement of cross arms becomes necessary after stringing, the conductor shall be suitably tied to the tower at tension points or transferred to suitable roller pulleys at suspension points.

11.0 Returnables

The Contractor shall not be required to return to the owner, empty wooden drums of conductor and earthwire and shall dispose off the same at his cost.

12.0 Final checking, testing and commissioning

After completion of the works, final checking of the line shall be done by the Contractor to ensure that all the foundation works, tower erection and stringing have been done strictly according to the specifications and as approved by the Owner. All the works shall be thoroughly inspected keeping in view the following main points:

- a) Sufficient backfilled earth is lying over each foundation pit and it is adequately compacted.
- b) Concrete chimney and their copings are in good finely shaped conditions.
- c) All the tower members are correctly used, strictly according to final approved drawing and are free of any defect or damage, whatsoever.
- d) All bolts are properly tightened and punched/tack welded.
- e) The stringing of the conductors and earthwire has been done as per the approved sag and tension charts and desired clearances are clearly available.
- f) All conductor and earthwire accessories are properly installed.
- g) All other requirements to complete the work like fixing of danger-plate, phase plate, number plate, anticlimbing device, aviation signal(wherever required) etc. are properly installed.
- h) Wherever required it should be ensured that revetment is provided.
- i) The original tracings of profile, route alignment and tower designs, structural drawings, bill material, shop drawings of all towers other than the towers designed by the Owner are submitted to the owner for reference and record.
- j) The line insulation is tested by the Contractor by providing his own equipment, labour etc. to the satisfaction of the owner.
- k) All towers are to be properly earthed.
- l) The line is tested satisfactorily for commissioning purpose.

ANNEXURE – VII

TECHNICAL SPECIFICATION FOR PORCELAIN DISC / LONGROD INSULATORS

1.0 GENERAL

This section details the technical particulars of Porcelain disc / Longrod insulators for 132KV / 220 KV / 400 KV Transmission Lines. The Insulators shall conform in all respects to high standards of Engineering, design, workmanship and latest revisions of relevant standards

Contractor may quote for disc insulator or porcelain longrod insulator made of electro-porcelain.

2.0 STANDARDS APPLICABLE:

2.1 Except as modified in this specification, the insulators to be supplied shall conform to the latest version, with amendments thereof, of the following Bureau of Indian Standards and equivalent International Standards.

Sr. 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 nominal voltage greater than 1000V	BS 137(I&II) IEC:274
4.	IS: 2071 Part (I to III)	Method of High Voltage Testing	
5.	IS: 2486	Specification for Insulator fittings for overhead power lines with a nominal voltage greater than 1000V	
	Part I	General Requirements and Tests	BS: 3288
	Part II	Dimensional Requirements	IEC: 120
	Part III	Locking Devices	IEC: 372
	Part IV	Tests for Locking Devices	IEC: 372
6.	IS: 2629	Recommended practice for Hot Dip Galvanization for iron and steel	
7.	IS: 2633	Testing for Uniformity of Coating of Zinc coated articles	
8.	IS: 3188	Dimensions for Disc Insulators	IEC: 305

Sr. Indian No. Standard	Title	International Standard
9. IS: 6745	Determination of Weight of Zinc coating on Zinc coated iron and steel articles	
10. IS: 8263	Methods of RIV Test of HV Insulators 107/1964 CISPR	IEC: 437, NEMA Publication No.
11. IS: 8269	Methods for Switching impulse test on HV insulators	IEC: 506
12.	Thermal Mechanical performance test and mechanical performance test on string insulator units	IEC: 575
13.	Tests on insulators of Ceramic material or glass or glass for overhead lines with a nominal voltage greater than 1000V	IEC: 60383

2.2 Insulators conforming to any other International standards are also acceptable provided always that such standard are equivalent to or better than the corresponding standards specified in 2.1 above. However, in such an event the salient points of comparison between the standards adopted and the standards quoted herein shall be detailed in the offer. One copy of authentic English version of such standards shall be submitted (in physical form) alongwith the offer.

3.0 GENERAL REQUIREMENTS:

- a) All raw materials to be used in the manufacture of 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.
- b) The design, manufacturing, process and material control at various stages shall 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.
- c) 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.
- d) The cap and pin 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 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.

- e) Insulator units after assembly shall be concentric and coaxial within limits as permitted by Indian/International standards.
- f) The insulator design shall be such that when units are coupled together to form a string, there shall be no contact between the shell of one unit and metal of the adjacent unit.
- g) 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 microscopically visible cracks, inclusions and voids.
- h) Cap, Pin shall not be manufactured by joining, welding, shrink fitting or by any other process from more than one piece of metal.
- i) The insulator design shall be such that the insulating medium shall not directly engage with hard metal. The surface of porcelain shall be coated with resilient paint to offset the effect of difference in thermal expansion of these materials.
- j) The porcelain longrod insulators shall have sheds of 'open aerodynamic profile' with good self cleaning properties. Insulator shed profile, spacing, projection etc. shall be strictly in accordance with the recommendations of IEC:60815.
- k) For 400 KV and 220 KV strings, the porcelain longrod insulators shall be supplied with intermediate ball pins.

4.0 DETAILS OF INSULATORS:

4.1 DISC INSULATORS:

- a) The insulator strings shall consist of standard discs for a three phase 50 Hz, effectively earthed 400 KV/220 KV/132 KV transmission system in a moderately polluted atmosphere. The discs shall be cap and pin, ball and socket type.
- b) The size of disc insulator, minimum creepage distance, the number to be used in different type of strings, their electromechanical strength; and mechanical strength of insulator string alongwith hardware fitting shall be as follows:

Type of	Size of disc	Minimum	No. of	Mechanical strength
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String fitting		insulator (mm)	creepage distance disc (mm)	standard discs of each	of Insulator string with H/W (Nos.) (KN)
<u>400 KV</u>					
Single Suspension 'I' string/pilot string	(N)	255x145	320	23	120
	(AF)	280x145	430	23	120
Double Suspension 'I' string	(N)	255x145	320	2x23	240
	(AF)	280x145	430	2x23	240
Single Suspension 'V' string	(N)	280x170	320	2x23	210
	(AF)	280/305x170	430	2x23	210
Double Suspension 'V' string	(N)	280x170	320	2x2x23	420
	(AF)	280/305x170	430	2x2x23	420
Double Tension string	(N)	280x170	320	2x24	320
	(AF)	280/305x170	430	2x24	320
Quadruple Tension String	(N)	280x170	320	2x2x24	640
	(AF)	280/305x170	430	2x2x24	640
<u>220 KV</u>					
Single Suspension	(N)	255x145	320	14	70
	(AF)	280x145	430	14	70
Double Suspension	(N)	255x145	320	2x14	2x70
	(AF)	280x145	430	2X14	2X70
Single tension	(N)	255x145	320	15	120
	(AF)	280x145	430	15	120
Double tension	(N)	255x145	320	2x15	2x120
	(AF)	280x145	430	2x15	2x120
<u>132 KV</u>					
Single Suspension	(N)	255x145	320	9	70
	(AF)	280x145	430	9	70
Double Suspension	(N)	255x145	320	2x9	2x70
	(AF)	280x145	430	2X9	2X70
Single tension	(N)	255x145	320	10	120
	(AF)	280x145	430	10	120
Double tension	(N)	255x145	320	2x10	2x120
	(AF)	280x145	430	2x10	2x120

NOTE: Details applicable for strings required only be considered.

4.2 **LONGROD INSULATORS:**

- a) The insulator strings shall consist of standard longrod insulators for a three phase 50 Hz, effectively earthed 400 KV/220 KV/132 KV transmission system in a moderately polluted atmosphere. The insulators shall be cap and pin, ball and socket type.
- b) The length of longrod insulator, minimum creepage distance, the number to be used in different type of strings and mechanical strength of insulator string alongwith hardware fitting shall be as follows:

Type of String	Length of longrod insulator (mm)	Minimum creepage distance of each string (mm)	No. of units per string (Nos.)	Mechanical strength of insulator string with H/W fitting (KN)
<u>400 KV</u>				
Single Suspension 'I' string	(N) 3335	7360	1x3	120
	(AF) 3335	9890	1x3	120
Double Suspension 'I' string	(N) 3335	7360	2x3	240
	(AF) 3335	9890	2x3	240
Single Suspension 'V' string	(N) 4075	7680	2x3	210
	(AF) 4075	10320	2x3	210
Double Suspension 'V' string	(N) 4075	7680	2x2x3	420
	(AF) 4075	10320	2x2x3	420
Double Tension string	(N) 4075	7680	2x3	320
	(AF) 4075	10320	2x3	320
Quadruple Tension string	(N) 4075	7680	2x2x3	640
	(AF) 4075	10320	2x2x3	640
<u>220 KV</u>				
Single Suspension	(N) 2030	4480	2	70
	(AF) 2030	6020	2	70
Double Suspension	(N) 2030	4480	2x2	140
	(AF) 2030	6020	2x2	140
Single tension	(N) 2175	4800	2	120
	(AF) 2175	6450	2	120
Double	(N) 2175	4800	2x2	240

tension	(AF)	2175	6450	2x2	240
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132 KV

Single Susp- ension	(N)	1305	2880	1	70
	(AF)	1305	3870	1	70
Double Susp- ension	(N)	1305	2880	1x2	70
	(AF)	1305	3870	1x2	70
Single tension	(N)	1450	3200	1	120
	(AF)	1450	4300	1	120
Double tension	(N)	1450	3200	1x2	240
	(AF)	1450	4300	1x2	240

NOTE: Details applicable for strings required only be considered.

- c) The electro-mechanical strength of individual disc/longrod in strings mentioned above are as follows:

Sr. No.	Type of String	Electro-Mechanical strength of individual disc/longrod insulator
A) <u>400 KV</u>		
1)	Single/Double Suspension 'I' string	120 KN
2)	Single Suspension 'Pilot' string	120 KN
3)	Single/Double Suspension 'V' string	160 KN
4)	Double Tension string	160 KN
5)	Quadruple Tension string	160 KN
B) <u>220/132 KV</u>		
1)	Single/Double Suspension string	70 KN
2)	Single/Double Tension string	120 KN

NOTE: Details applicable for strings required only be considered.

5.0 DRAWINGS:

5.1 The bidder shall furnish outline drawings of disc insulator unit/longrod indicating all dimensions for scrutiny and approval. All drawings shall be neatly arranged, and all drafting and lettering shall be standard and legible. Dimensions shall be in SI units. The drawings shall give following information:

- 1) The bill of material indicating quantity and nature of material used for various parts.
- 2) Details like Ball and Socket designation, Maximum Axial & Radial Runout, Minimum & Protected Creepage distance, Colour of Glaze, Electro-mechanical strength, Identification mark and weight of insulator.
- 3) Electrical characteristics like One minute power frequency withstand and flashover voltage under dry and wet conditions, Lightning impulse withstand and flashover voltage, Switching surge impulse withstand voltage, Visible discharge and Radio Interference Voltage.

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- 4) After award of contract, the bidder shall submit 3 sets of drawings to C.E.(D, C&M), giving details as mentioned above, for scrutiny and approval. Once the drawings have been approved, no alteration or modification will be carried out without prior approval of the Purchaser.

6.0 SPECIFIC TECHNICAL REQUIREMENTS:

I) NON-METALLIC PARTS (PORCELAIN)

a) 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, 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, zinc or dust. The manufacturing shall be by the wet process and impervious character obtained by thorough vitrification.

b) PORCELAIN GLAZE

Surfaces to come in contact with cement shall be made rough by sand 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 glaze shall be uniform throughout and the colour of glaze shall be brown. The glaze shall have a visible luster, shall be 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.

c) FILLER MATERIAL

Cement to be used, as a filler material shall 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.

II) METALLIC PARTS

a) BALL PINS / TWIN BALL PINS

These shall be made of forged steel of grade EN-8D(BS:970)/CL-IV(IS:2004) or equivalent, by drop forging method and normalised. They shall not be manufactured by joining, welding, shrink fitting or by any other process from more than one piece of metal. The ball pins shall be free from forging defects. The bidder shall specify the grade, composition and mechanical properties of steel used in manufacture of ball pin, in Quality Assurance Plan.

b) **METAL CAP**

The caps shall be cast from black heart malleable cast iron of grade BM 320 (IS: 14329) or equivalent and annealed. The caps shall be made in single piece and shall be free from casting defects like misrun, cold shut etc.

The bidder shall specify the grade, composition and mechanical properties of steel used in manufacture of caps, in Quality Assurance Plan.

c) **INTERMEDIATE ARCING HORN**

For 220KV and 400 KV longrod insulators besides arcing horn on tower side of the hardware fittings, intermediate arcing horns alongwith fixtures and fasteners may be provided by the insulator manufacturer. The arcing horn shall be of mild steel tube.

d) **SECURITY CLIPS**

- i) These shall be made of Stainless Steel grade AISI 304/316 (ASTM A276) or Phosphor Bronze.
- ii) 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). 'W' type security clips are also acceptable. 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.
- iii) 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.
- iv) The force required for pulling the R-clip into its unlocked position shall not be less than 50 N (5 Kgs) or more than 500 N (50 Kgs).
- v) The force required for pulling the W-clip into its unlocked position shall not be less than 25 N (2.5 Kgs) or more than 250 N (25 Kgs).

7.0 GALVANISING:

- a) All ferrous parts shall be hot dip galvanized in accordance with IS: 2629 and IS: 2633. Before galvanization, the steel section shall be thoroughly cleaned of any paint, grease, rust, scale, acid/alkali or such other foreign matters as are likely to interfere with the galvanizing process or with the quality and durability of the zinc coating. Pickling shall be very carefully done and shall be proper.
- b) Before ball fittings are galvanized, all die flashing on the shank and on bearing surface of the ball shall be carefully removed without reducing the designed dimensional requirements.

- c) The zinc used for galvanizing shall be of grade Zn 98 (% of zinc \geq 99.95%) as per IS: 209. The mass of zinc coating shall not be less than 610 gm/m² (86 microns).
- d) The galvanized surface shall consist of continuous and uniformly thick coating of zinc, firmly adhering to the surface of steel. The finished surface shall be clean and smooth and shall be free from defects like discolored patches, bare spots, unevenness of coating, spelter which is loosely attached to the steel, globules, spiky deposits, blistered surface, flaking or peeling off etc. The presence of any of these defects noticed on visual or microscopic inspection shall render the material liable to rejection.
- e) There shall be no flaking or loosening when struck squarely with a chisel faced hammer. The galvanized components shall withstand minimum four one minute dips in standard copper sulphate solution as per IS: 2633.
- f) Defect in any component indicating presence of impurities in the galvanizing bath in quantities larger than that permitted by the specifications, or lack of quality control in any manner in the galvanizing plant, shall render the entire production in the relevant shift liable to rejection.

8.0 BALL AND SOCKET DESIGNATION:

The dimensions of ball and socket for 120 KN and 160 KN discs shall be 20 mm in accordance with the standard dimensions stated in IS: 2486 (Part II)/IEC:120.

9.0 INTERMEDIATE BALL PIN DESIGNATION:

The dimensions of intermediate ball pin shall be in accordance with standard dimensions stated in IEC:471.

10 .0 DIMENSIONAL TOLERANCES:

a) DISC INSULATORS

The dimensions of the disc insulators shall be within the limits specified below:

	Standard	Maximum	Minimum
<u>Diameter of Disc</u> (in mm)			
120 KN (N)	255	266	244
120 KN (AF)	280	293	267
160 KN (N)	280	293	267
160 KN (AF)	280/305	293/318	267/292
<u>Ball to Ball Spacing between Discs</u> (in mm)			
120 KN (N, AF)	145	149	141
160 KN (N, AF)	170	175	165

b) LONGROD INSULATORS

The tolerance on all dimensions e.g. diameter, length and creepage distance shall be as follows:

$\pm (0.04d + 1.5)$ mm when $d < 300$ mm
 $\pm (0.025d + 6)$ mm when $d > 300$ mm

where d stands for dimensions in millimeters for diameter, length or creepage distance as the case may be.

However, for creepage distance no negative tolerance shall be applicable.

11.0 INTERCHANGEABILITY:

The insulators inclusive of ball and socket fittings shall be of standard design suitable for use with hardware fittings of any make conforming to relevant Indian Standards.

12.0 CORONA AND RIV PERFORMANCE:

All surfaces shall be even, smooth, without cuts, abrasions or projections. No part shall be subjected to excessive localized pressure. The metal parts and porcelain shall not produce any noise-generating corona under all operating conditions. The insulators and metal parts shall be so designed and manufactured that it shall avoid local corona formation and not generate any radio interference beyond specified limit under operating conditions.

13.0 SUITABILITY FOR LIVE LINE MAINTENANCE:

- a) The insulators shall be compatible for use with hot line or live line maintenance techniques so that usual hot line operations can be carried out with ease, speed and safety.
- b) All insulators shall be designed to facilitate cleaning and insulators shall have minimum practical number of sheds and grooves. All grooves shall be so proportioned that any dust deposit can be removed without difficulty either by wiping with cloth or by remote washing under live line condition.

14.0 FREEDOM FROM DEFECTS:

Insulators shall have none of the following defects:

- a) Ball pin shake
- b) Cementing defects near the pin like small blowholes, hair cracks, lumps, etc.
- c) Sandfall defects on the surface of the insulator.

15.0 STRING CHARACTERISTICS:

The characteristic of the complete string shall be as follows:

Sr. No.	STRING TYPE ► PARTICULARS ▼		SUSPENSION			TENSION		
			400 KV	220 KV	132 KV	400 KV	220 KV	132 KV
1	Switching Surge Withstand Voltage (Dry & Wet) (KVp)	N	1050	--	--	1050	--	--
		AF	1050	--	--	1050	--	--
2	Dry Lightning Impulse Withstand Voltage (KVp)	N	1600	1050	650	1700	1050	675
		AF		1080	670		1110	690
3	50% Lightning Impulse flashover voltage (KVp)	N	1650	1100	680	1770	1100	710
		AF		1130	700		1125	720
4	Dry Power frequency withstand voltage (KV rms)	N	740	510	335	740	550	375
		AF		520	365		570	380
5	Wet Power frequency withstand voltage (KV rms)	N	690	460	300	690	500	350
		AF		480	330		520	360
6	Corona extinction Voltage (KV rms)	N	320	176	105	320	176	105
		AF	320	176	105	320	176	105
7	Maximum RIV for complete string Including corona Rings, arcing horns, clamps etc. at 1.1 times max. Line to Ground Voltage (μ V)	N	500	500	--	500	500	--
		AF	500	500	--	500	500	--
8	Maximum voltage across any disc	N	9%	13%	--	10%	13%	--
		AF	9%	13%	--	10%	13%	--

16.0 TESTS

16.1 TYPE TESTS:

- a) The bidder shall offer the Insulator that are already type tested within the last five years and manufactured by reputed manufacturer approved by MSETCL. In case the insulators are not type tested within last 5 (five) years as on the date of opening of bids, fresh type tests as specified hereunder shall be carried out in presence of purchaser's representative before supply of materials
- b) In case of manufacturers of foreign origin, reports for all the type tests specified under Clause No. 15.1.1 of this specification, conducted in internationally accredited laboratories (accreditation based on ISO/IEC vide 25/17025 or EN 45001 by the National accreditation body of the country where laboratory is located) or at the manufacturers works in presence of users representative can also be submitted alongwith the offer as

evidence to establish the fulfillment of above requirement. However, in such a case all type tests as specified under clause No. 15.1.1 of this specification shall be organised by the successful bidder, after award of contract, in presence of Purchaser's representative, at the cost of bidder. The arrangement of journey of purchaser's representative (2 nos.) from his headquarter to the place of testing shall be made by the bidder at his cost.

- c) In case, the test(s) on insulator have been conducted earlier than 5 years, the respective type test(s) shall be carried out by the successful bidder, after award of contract, in presence of purchaser's representative, free of cost.
- d) If there is any change in manufacturing process or insulator design since after earlier passing of the type tests, all the type tests as specified under Clause No. 15.1.1 shall be carried out by the successful bidder, after award of contract, in presence of purchaser's representative, free of cost.

16.1.1. LIST OF TYPE TESTS

The list of type tests to be conducted is as follows:

I) **On Disc/Long rod Insulator Unit:**

Sr. No.	Particulars of test	Reference Standard
a)	Visual examination	} IS:731
b)	Verification of dimensions test	} IS: 731
c)	Thermal-Mechanical performance test	} IEC: 575 and } Annexure- a of } this specification
d)	Power frequency voltage flashover test	
	i) Dry	} IEC:60383
	ii) Wet	}
e)	Lightning Impulse voltage withstand test (Dry)	} IEC: 60383 }
f)	50% Lightning Impulse voltage flashover test (Dry)	} IEC: 60383 }
g)	Visible Discharge test (Dry)	} IS:731
h)	Radio Interference Voltage test (Dry)	} IEC: 60437 & } Annex.- a of this } specification
i)	Residual strength test (On 160KN disc insulator only)	} As per Annex.- a } of this specification
j)	Steep wave front test (On 160KN disc insulator only)	} As per Annexure - a } of this specification

II) **On complete insulator string with hardware fittings:**

- a) The type tests on 132KV and 220KV strings specified hereunder, shall be conducted on Single Suspension (1x70 KN) and Double tension (2x120 KN) insulator strings alongwith hardware fittings except for mechanical strength test which shall be conducted on all strings mentioned.
- b) The type tests on 400KV strings specified hereunder, shall be conducted on Single ‘I’ Suspension (1x120 KN) and Double tension (2x160 KN) insulator strings alongwith hardware fittings.

Sr. No.	Particulars of test	Reference Standard
A)	<u>On 132KV String of 70KN & 120KN insulators</u>	
a)	Power frequency voltage withstand test	IEC:60383
	i) Dry	
	ii) Wet	
b)	Lightning Impulse voltage withstand test (Dry)	IEC:60383
c)	50% Lightning Impulse voltage flashover test (Dry)	IEC:60383
d)	Mechanical strength test on	As per Annexure-II of this specification
	i) Single suspension string	
	ii) Double suspension string	
	iii) Single Tension string	
	iv) Double Tension string	
B)	<u>On 220KV String of 70KN & 120KN insulators</u>	
a)	Power frequency voltage withstand test	IEC:60383
	i) Dry	
	ii) Wet	
b)	Lightning Impulse voltage withstand test (Dry)	IEC:60383
c)	50% Lightning Impulse voltage flashover test (Dry)	IEC:60383
d)	Voltage distribution test (For Disc insulator only)	IEC:60383
e)	RIV test under dry condition	As per Annexure-II of this specification
f)	Mechanical strength test on	As per Annexure-II of this specification
	i) Single suspension string	
	ii) Double suspension string	
	iii) Single Tension string	
	iv) Double Tension string	

Sr. No.	Particulars of test	Reference Standard
C)	<u>On 400KV String of 120KN & 160KN insulators</u>	
I)	On 1st sample	
a)	Power frequency voltage withstand test with corona control/grading rings and arcing horn i) Dry ii) Wet	} } } } }
		} IEC:60383 and Annexure-a of this specification
b)	Switching Surge voltage withstand test (Wet)	} } }
		} IEC:60383 and Annexure-a of this specification
c)	Lightning Impulse voltage withstand test (Dry)	} } }
		} IEC:60383 and Annexure-a of this specification
d)	50% Lightning Impulse voltage flashover test (Dry)	} } }
		} IEC: 60383 and Annexure-a of this specification
e)	Voltage distribution test	} } }
		} IEC: 383 and Annexure-a of this specification
f)	Corona and RIV test under dry condition	} }
		} As per Annexure - a of this specification
g)	Mechanical strength test i) Single 'I' suspension string ii) Double Tension string	} } }
		} As per Annexure-a of this specification
II)	On 2nd sample	
h)	Dynamic test (Vibration test)	} }
		} As per Annexure - a of this specification
III)	On 3rd sample	
i)	Time Load test	} }
		} As per Annexure - a of this specification

16.2 ACCEPTANCE TESTS:

This shall mean those tests, which are to be carried out on samples taken from each lot offered for predespatch inspection for the purpose of acceptance of the lot.

16.2.1 LIST OF ACCEPTANCE TESTS:

The following acceptance tests shall be conducted on 70KN, 120KN and 160KN disc / longrod insulators in presence of purchasers representative for the purpose of acceptance of a lot:

Sr. No.	Particulars of test	Reference Standard
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: 60575
f)	Test on locking device for ball and socket coupling	IS: 2486(IV)
g)	Eccentricity test (Axial & Radial Runout)	IEC:60383/60168
h)	Electro-mechanical strength test	IS: 731
i)	Puncture test (Only for Porcelain Disc insulators)	IS: 731
j)	Porosity test (Only for Disc insulators)	IS: 731
k)	Power frequency voltage withstand test (Dry) (Only on Disc insulator)	IEC: 60383
l)	Mechanical strength test (On longrod insulator only)	IEC:60383-1

16.3 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.

16.3.1 LIST OF ROUTINE TESTS:

The following routine tests shall be conducted on each insulator and results certified by the manufacturer:

Sr. No.	Particulars of test	Reference Standard
a)	Visual Inspection	IS: 731
b)	Mechanical routine test	IS: 731
c)	Electrical routine test (For disc insulator only)	IEC: 60383

16.4 TESTS DURING MANUFACTURING:

Stage tests during manufacturing shall mean those tests, which are to be carried out during the process of manufacturing to ensure quality control such that the end product is of the designed quality conforming to the intent of this specification.

16.4.1 LIST OF TESTS DURING MANUFACTURING:

The following tests, including but not limited to, shall be conducted on raw and in process material during the process of manufacturing:

Sr. No.	Particulars of test	Reference Standard
a)	Fineness, Raw appearance, Fired appearance, Free Magnetic Iron content, Grain size, Chemical Analysis, Free Moisture Content on raw materials like Quartz Powder, Feldspar Powder, China Clay, Ball Clay etc.	Relevant Indian /International/ Plant standard
b)	Raw appearance, Fired appearance, Chemical Analysis of Glaze material	Relevant Indian /International/ Plant standard
c)	Visual inspection, Grain size, Compressive Strength, Optimum water content, Initial and final setting time, Auto Clave Expansion of Cement	Relevant Indian /International/ Plant standard
d)	Hydraulic Pressure Proof load test, High Frequency test on Porcelain Shell	Relevant Indian /International/ Plant standard
e)	Visual inspection, Dimension/Guage Checking, Chemical Analysis, Tensile Strength, Hardness, Grain size, Inclusion rating, Heat treatment, Magnetic Particle Inspection on ball pins	As per Annexure - a of this specification
f)	Visual inspection, Dimension/ Guage Checking, Chemical Analysis, Tensile Strength, Hardness, Microstructure, Magnetic Particle Inspection on MCI caps	As per Annexure - a of this specification
g)	Visual inspection, Dimensional verification, Resistance to Bending, Operation test, Hardness test on Security Clip	As per Annexure - a of this specification
h)	Chemical analysis of Zinc used for galvanizing	As per Annexure - a of this specification

17.0 TEST VALUES:

For all type and acceptance tests, the acceptance values shall be the values guaranteed by the Bidder in the guaranteed technical particulars or the acceptance value specified in this specification or the relevant standard whichever is more stringent for that particular test.

18.0 TEST PROCEDURE AND SAMPLING NORMS:

- a) The test procedure and sampling norms for carrying out type tests; acceptance tests and routine tests shall be as per reference standards specified under clause No. 15.0 of this specification.
- b) The test procedure and sampling norms for carrying out tests during manufacturing shall be as per relevant Indian/ International Standard where applicable and plant standard for others. The sampling norm for conducting tests on bought out items shall be as outlined in Annexure-a of this specification.
- c) The bidder shall furnish details regarding sampling norm and reference standard followed, in Quality Assurance Plan.

19.0 ADDITIONAL TESTS:

The Purchaser reserves the right for carrying out any other test(s) of a reasonable nature at the works of the supplier 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 himself that the material complies with the intent of this specification.

20.0 IDENTIFICATION MARK:

- a) The shell of each disc/longrod insulator shall be legibly and indelibly marked with the trade mark/name of the manufacturer, the month and year of manufacture, country of manufacture, guaranteed electro-mechanical strength in Kilo-Newton's abbreviated by 'KN' to facilitate easy identification and proper use. The marking shall be printed and not impressed and the same shall be applied before firing.
- b) The metal cap of each disc/longrod insulator shall bear the name of manufacturer by embossing. The identifying letters shall be at least 5 mm high. The characters shall be distinct, durable, and conspicuous after galvanizing.

21.0 INSPECTION:

- a) The work and materials covered by this specification shall be subject to inspection by the authorised representative of the Purchaser at manufacturer's/ sub-vendors work.
- b) Inspector shall have free access at all times to all parts of the shop where raw material is stacked, and where material is being manufactured and shall be provided with all reasonable facilities for inspection and tests. Equipments and instruments required for carrying out the tests shall be furnished by the manufacturer. No material shall be dispatched without inspection unless such inspection is waived in writing by Purchaser.

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- c) Inspection by inspector or waiver of inspection shall neither relieve the manufacturer from the responsibility of supplying materials conforming to the requirements of this specification nor invalidate any claims which may be made because of defective or unsatisfactory material, workmanship, galvanizing etc.
 - d) The correct grade and quality of raw material shall be used by the manufacturer. To ascertain the grade of material, the Purchaser may at his discretion get the material tested at an approved laboratory of his choice.
 - e) The arrangement of journey (by air) of purchaser's representative (2 nos.) from his headquarter to the place of testing and boarding/lodging shall be made by the bidder at his cost.

22.0 PACKING & FORWARDING:

- a) All disc/longrod insulators shall be packed in strong seasoned wooden crates. The gross weight of the crates alongwith insulators shall not normally exceed 50 Kg for disc insulators and 65 Kg for longrod insulators to avoid handling problem.
- b) The packing shall be of sufficient strength to withstand rough handling during transit, storage at site and subsequent handling in the field.
- c) Suitable cushioning, protective padding, dunnage or spacers shall be provided to prevent damage or deformation during transit and handling.
- d) All packing cases shall be marked legibly and correctly so as to ensure safe arrival at their destination and avoid the possibility of goods being lost or wrongly despatched on account of faulty packing and faulty or illegible markings. Each wooden case/crate shall have all the markings stenciled on it in indelible ink.

23.0 GUARANTEED TECHNICAL PARTICULARS FOR INSULATORS:

The Guaranteed Technical Particulars for Insulators enclosed as SCHEDULE- "IIC" shall be duly filled in and submitted along with the offer.

SCHEDULE- IIC

A) GUARANTEED TECHNICAL PARTICULARS FOR UNIT DISC INSULATOR

Sr. No.	INSULATOR TYPE ► PARTICULARS ▼	70 KN (N)	70 KN (AF)	120 KN (N)	120 KN (AF)	160 KN (N)	120 KN (AF)
1)	Manufacturers name, address and country						
2)	Size and designation of Ball & Socket and standard to which it will conform (mm)						
3)	Outside diameter of disc (mm)						
4)	Spacing (mm)						
5)	Eccentricity of disc						
a)	Axial runout(mm)						
b)	Radial runout(mm)						
6)	Creepage distance of disc (mm)						
7)	Electro-mechanical strength of disc(KN)						
8)	Withstand voltage of disc						
8.1	Power frequency						
a)	Dry (kV rms)						
b)	Wet (kV rms)						
8.2	Impulse voltage (1.2/50 μsec)						
a)	+ve (kV peak)						
b)	-ve (kV peak)						

Sr. No.	INSULATOR TYPE ► PARTICULARS ▼	70 KN (N)	70 KN (AF)	120 KN (N)	120 KN (AF)	160 KN (N)	120 KN (AF)
9)	Flashover voltage of disc						
9.1	Power frequency						
a)	Dry (kV rms)						
b)	Wet (kV rms)						
9.2	50% Lightning impulse voltage (1.2/50 μsec)						
a)	+ve (kV peak)						
b)	-ve (kV peak)						
10)	Corona inception voltage (kV rms)						
11)	Corona extinction voltage (kV rms)						
12)	Max. RIV at 1 MHz and 10 KV AC (rms)						
13)	Weight of each disc (kgs)						

NOTE:1) Please furnish GTP, only for insulators mentioned in tender document.

Signature of the Bidder.....

Name.....

Designation.....

Date.....

Common authorized seal of the bidder.....

SCHEDULE- IIC

B) GUARANTEED TECHNICAL PARTICULARS FOR 132KV AND 220KV DISC / LONGROD INSULATOR STRING

Sr. No.	STRING TYPE ► PARTICULARS ▼	SINGLE SUSPENSION (70 KN)	DOUBLE SUSPENSION (2x70KN)	SINGLE TENSION (120KN)	DOUBLE TENSION (2x120 KN)
1)	No. of insulator discs per string				
2)	Withstand voltage of complete string				
2.1	Power frequency				
a)	Dry (kV rms)				
b)	Wet (kV rms)				
2.2	Impulse voltage (1.2/50 μ sec)				
a)	+ve (kV peak)				
b)	-ve (kV peak)				
3)	Flashover voltage of complete string				
3.1	Power frequency				
a)	Dry (kV rms)				
b)	Wet (kV rms)				
3.2	50% Lightning impulse voltage (1.2/50 μ sec)				
a)	+ve (kV peak)				
b)	-ve (kV peak)				
4)	Corona inception voltage (kV rms)				

Sr. No.	STRING TYPE ► PARTICULARS ▼	SINGLE SUSPENSION (70 KN)	DOUBLE SUSPENSION (2x70KN)	SINGLE TENSION (120KN)	DOUBLE TENSION (2x120 KN)
5)	Corona extinction voltage (kV rms)				
6)	Max. RIV for complete string including corona rings, arcing horns, clamps etc. at 1.1 times maximum line to ground voltage (in μ volts)				
7)	Max. voltage (%) across any disc in the string				
8)	Electromechanical strength of complete string (KN)				

- NOTE:** 1) Separate sheets to be filled in for each voltage class.
2) Please furnish GTP, only for insulators mentioned in tender document.

Signature of the Bidder.....

Name.....

Designation.....

Date.....

Common authorised seal of the bidder.....

SCHEDULE- IIC

C) GUARANTEED TECHNICAL PARTICULARS FOR 400 KV DISC / LONGROD INSULATOR STRING

Sr. No.	STRING TYPE ► PARTICULARS ▼	SINGLE"1" SUSPENSION (120 KN) N/AF	DOUBLE"1" SUSPENSIO N (120KN) N/AF	QUAD TENSION (160KN) N/AF
1)	No. of insulator discs per string			
2)	Withstand voltage of complete string			
2.1	Power frequency			
a)	Dry (kV rms)			
b)	Wet (kV rms)			
2.2	Impulse voltage (1.2/50 µsec)			
a)	+ve (kV peak)			
b)	-ve (kV peak)			
3)	Flashover voltage of complete string			
3.1	Power frequency			
a)	Dry (kV rms)			
b)	Wet (kV rms)			
3.2	50% Lightning impulse voltage (1.2/50 µsec)			
a)	+ve (kV peak)			
b)	-ve (kV peak)			
4)	Corona inception voltage (kV rms)			
5)	Corona extinction voltage (kV rms)			

6)	Max. RIV for complete string including corona rings, arcing horns, clamps etc. at 1.1 times maximum line to ground voltage (in μ volts)			
7)	Max. voltage (%) across any disc in the string			
8)	Electromechanical strength of complete string (KN)			

Signature of the Bidder.....

Name.....

Designation.....

Date.....

Common authorized seal of the bidder.....

ANNEXURE - a

TEST PROCEDURE

1.0 PROCEDURE FOR MOUNTING INDIVIDUAL DISC AND COMPLETE STRING FOR MEASUREMENT OF RIV, VOLTAGE DISTRIBUTION & VISIBLE DISCHARGE:

- a) The insulator unit or insulator string shall be suspended vertically by means of an earthed wire rope or other suitable means from a supporting structure. The distance between the upper most point of the insulator metal work and the supporting structure shall be not less than 1 meter. No other object shall be nearer to the insulator than 1 meter or 1.5 times the length of the insulator string, whichever is greater. A length of conductor in the form of a straight smooth metal rod or tube shall be attached to the lower integral fitting of the insulator unit or insulator string so that it lies in a horizontal plane and the distance from the lowest shed of porcelain part to the upper surface of the conductor shall be as short as possible but greater than 0.5 times the diameter of the lowest insulator.
- b) The diameter of the conductor shall be about 1.5% of the length of the insulator unit or insulator string with a minimum of 25 mm.
- c) The length of the conductor shall be at least 1.5 times that of the insulator unit or insulator string and it shall extend at least 1 meter on each side of the vertical axis.
- d) Precaution shall be taken to avoid flashover from the ends of the conductor.
- e) The test voltage shall be applied between the conductor and earth.

2.0 MOUNTING PROCEDURE FOR COMPLETE STRING FOR WET POWER FREQUENCY, WET SWITCHING SURGE AND DRY IMPULSE WITHSTAND TESTS:

- a) The insulator string shall be suspended vertically in an arrangement simulating a tower body and cross arm. The cross arm is simulated by a horizontal member, the insulator string being at one end and the vertical member simulating the tower body at the other. Both members and the link supporting the insulator string shall be earthed. The width of each member facing the insulator string shall be from 400 mm minimum to at least 20% of the length of the insulator string. The distance between the axis of the insulator string and the vertical member simulating the tower body shall be between 1.2 and 1.5 times the length of the insulator string. The distance between the upper most point of the insulator string and the lower part of the horizontal member simulating the cross arm shall be equal to about 300 mm. The member simulating the tower body shall extend to at least twice the length of the insulator string below the member simulating the tower cross arm.
- b) A bundle consisting of two/quad sub conductors in the form of straight smooth metal rods or tubes shall be attached to the lower integral fittings of the insulator string at right angles to the cross arm. The two/quad sub conductors of the bundle shall be maintained parallel by means of horizontal spacers, the sub conductor spacing shall be equal to about one tenth of the length of the insulator string. The bundle shall extend approximately for the length of the insulator string on each side of the axis of the insulator string and diameter of each sub conductor shall be between 0.75% and 1.25% of the length of insulator string. To avoid spark over from the two ends of the bundle, each end shall be protected by means of a suitable device (for instance by means of metal ring). The height of the conductor above ground shall be equal to about 1.5 times the length of the insulator string but not less than 6 meters.

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- c) The test voltage shall be applied between the conductor bundle and earth, the H.V. connection being made at one end of the conductor bundle.
 - d) During the test, no object other than those described in this clause shall be nearer to the live end of the insulator string than 1.5 times the length of string.
 - e) The insulator string shall be complete with those parts, which are considered necessarily associated with the string and are specified as such by the manufacturer.

3.0 TESTING PROCEDURE FOR DYNAMIC TEST (VIBRATION TEST):

Complete string is to be subjected to aeolian vibrations by suitable arrangement, while keeping the tension at every day stress (e.d.s). The string shall be vibrated at frequencies and double amplitude as already agreed between purchaser and supplier for 10 million cycles. After 5 million cycles, the string shall be rotated through 90 in horizontal plane. For 'V/I' suspension string & quad tension string, the e.d.s. will be 4600 kgs per conductor. All discs shall be thoroughly checked for any damage, cracks, loosening of pins/caps. Thereafter, all the discs will be subjected to electrical routine test, electro mechanical failing load test and porosity test. The string shall be deemed to have passed the dynamic test if it withstands all these tests.

4.0 TESTING PROCEDURE FOR WET POWER FREQUENCY WITHSTAND TEST :(As per IEC: 60383/IS: 731)

- a) The insulator string shall be mounted as per mounting arrangement given above in Clause 2.0.
- b) The characteristics of artificial rain shall be in accordance with Clause 3.3 of IS 2071 (Part-I).
- c) The test voltage to be applied to the insulator string shall be the wet power frequency withstands voltage adjusted for atmospheric conditions at the time of test.
- d) A voltage of about 75% of the test voltage so determined shall be applied and then increased gradually with a rate of rise of about 2% of this voltage per second. The test voltage at full value shall be maintained for one minute. No flashover or puncture shall occur during this period.

5.0 TESTING PROCEDURE FOR WET SWITCHING SURGE WITHSTAND TEST: (As per IEC: 60381/IS: 731)

- a) The insulator string shall be mounted as per mounting arrangement given above (Clause 2.0). The impulse generator shall be adjusted to produce a 250/2500 μ second impulse wave. Impulse waves of both positive and negative polarity shall be used. Wet tests shall be made under the conditions prescribed in specified standards.
- b) The withstand test shall be performed at a specified switching impulse voltage with application of corrections for atmospheric conditions. Fifteen impulses shall be applied to the insulator string under test. If the number of flashovers on the external insulation does not exceed two, the insulator string shall be deemed to have complied with this test requirement.
- c) The insulators shall not be damaged by the test but slight marks on the

surface of the insulating parts or chipping of the cement or other material used for assembly is permitted.

6.0 TESTING PROCEDURE FOR DRY LIGHTNING IMPULSE VOLTAGE WITHSTAND TEST: (As per IEC: 60383/IS: 731)

- a) The insulator string shall be arranged as per mounting arrangement given above (Clause 2.0). Impulse waves of both positive and negative polarity shall be used. However, when it is evident which polarity will give the lowest flashover voltage it will suffice to test with that polarity.
- b) The impulse generator shall be adjusted to produce a standard 1.2/50 μ second impulse wave of a value equal to the specified value of the impulse withstand voltage corrected for atmospheric conditions.
- c) Five such impulses shall be applied. If there is no flashover or puncture, the insulator shall be considered to have passed the test. If during the application of these five impulses, puncture occurs or if there is more than one flashover, the insulator shall be considered to have failed to comply with the test requirement. If only one flashover occurs, a new series of ten impulses shall be applied. The insulator will be considered to have passed the test only if during this new series of impulses there is no flashover or puncture.
- d) The insulators shall not be damaged by the test but slight marks on the surface of the insulating parts or chipping of the cement or other material used for assembly is permitted.

7.0 TESTING PROCEDURE FOR MECHANICAL STRENGTH TEST ON STRING:

- a) The complete disc/longrod insulator string consisting of number of units as stipulated alongwith its hardware fitting excluding arcing horn, corona control ring/grading ring and suspension/dead end assembly shall be mounted in the Tensile Testing Machine.
- b) The assembly shall then be subjected to a tensile load equal to 50% of the specified minimum ultimate tensile strength (UTS) which shall be increased at a steady rate to 67% of the minimum UTS specified. This load shall be maintained on the string for five minutes and then removed. After removal of the load the string shall be unloaded and dismantled with hand or small hand tools and the string components shall be inspected for visual deformation. Should any difficulty be experienced in dismantling and re-assembling the string with hand or small hand tool and/or if there is any visual deformation caused by the application of the above load, the string shall be deemed to have failed in this test.
- c) If the string can be re-assembled, it shall again be mounted in the tensile testing machine and loaded up to 50% of UTS and the load shall be further increased at a steady rate till the specified minimum UTS is reached and held there for one minute. No fracture should occur during this period. The applied load shall then be increased until the failing load is reached and the value recorded. The string shall be deemed to have passed the test if the breakage occurs at a load not lower than guaranteed E&M strength.

8.0 TESTING PROCEDURE FOR TIME LOAD TEST:

- a) The insulator string shall first be subjected to 5 minutes power frequency routine test. After successful completion of this test, the insulator string shall be mounted

vertically/horizontally and subjected to a load equal to 66% of the specified mechanical strength for duration of 24 hours.

- b) After the completion of above period if the string is found to be intact on visual examination, it shall again be subjected to 5 minutes power frequency routine test. The string shall be deemed to have passed the time load test if it successfully withstands 5 minutes power frequency routine test.

9.0 TESTING PROCEDURE FOR 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 so as to give a total of 100% distribution. The voltage across any disc shall not exceed the specified values.

10.0 TESTING PROCEDURE FOR 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 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.

11.0 TESTS ON INDIVIDUAL DISCS:

11.1 VISUAL EXAMINATION:

- a) Visual examination shall be made at random on the lot of insulators. The color of the insulator shall approximate to the color specified. Some variation of color shade is permitted and shall not justify rejection of the insulator. The insulator shall be free from physical distortion of shape within tolerance specified. Defects such as looseness of pins/caps, cracks etc. in the metal part shall be checked.
- b) The area specified as glazed on the drawing shall be covered by a smooth hard glaze, free from cracks and other defects prejudicial to satisfactory performance in service.
- c) Out of the areas specified as glazed on the drawing the total area not covered by glaze shall not exceed.

$$1 + \frac{DF}{2000} \text{ cm}^2$$

Also the area of any single glaze defect shall not exceed:

$$0.5 + \frac{DF}{20000} \text{ cm}^2$$

Where:

D is the greatest diameter of the insulator in cm.

F is the creepage distance of the insulator in cm.

11.2 VERIFICATION OF DIMENSIONS:

The dimension of the insulator shall be checked with the approved drawing. Unless otherwise specified, the tolerance in the diameter shall be:

$\pm (0.04D + 1.5)$ mm for D less than or equal to 300 mm and
 $\pm (0.03D + 6)$ mm for D more than 300 mm.

Where: **D** = Specified insulator diameter in mm.

The tolerance in spacing shall be $\pm (0.03S + 0.3)$ mm.

Where: **S** = Specified insulator spacing in mm.

11.3 **ECCENTRICITY TEST (AXIAL RUNOUT & RADIAL RUNOUT):**

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 petticoat. 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 the maximum and minimum position of the slider reached on the scale are found out. The difference between the above readings shall satisfy the guaranteed value for radial run out.

11.4 **DRY LIGHTNING IMPULSE VOLTAGE WITHSTAND TEST:**

Please refer to Clause No. 6.0 for Testing Procedure.

11.5 **WET POWER FREQUENCY WITHSTAND TEST:**

Please refer to Clause No. 4.0 for Testing procedure.

11.6 **RADIO INTERFERENCE VOLTAGE TEST :(As per IS 8263)**

- a) Insulator string or insulators shall be mounted as per mounting arrangement given above (Clause 1). As radio interference level may be affected by fibres or dust setting on the insulator, the insulators may be wiped with a clean cloth before taking a measurement. The atmospheric conditions during tests shall be recorded. It is not known what correction factors apply to radio interference testing, but it is known that test may be sensitive to high relative humidity exceeding 80%.
- b) The test circuits may be either NEMA-107 or as per Fig.1 of IS: 8263. The measuring set shall be tuned to 1MHz + 10% frequency and the results shall be expressed as dB above 1 μ volt across a resistance of 300 Ohm.
- c) A voltage of 10% higher than the specified test voltage shall be applied to the object under test and maintained for at least 5 minutes. The voltage shall then be decreased by steps down to 30% of the specified test voltage, raised again by steps to the initial value and finally decreased by steps to the 30% value. At each step, a radio interference level as recorded during third run v/s the applied voltage shall be plotted.

The curve so obtained is the radio interference characteristics of the insulator. Each voltage step shall be approximately 10% of the specified test voltage.

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- d) The insulator unit passes the radio interference test if the radio interference level at the specified test voltage, as read from the radio interference characteristic, does not exceed the specified radio interference level. Furthermore, no sudden increase shall be found on the radio interference characteristic between the specified test voltage and 1.1 times the specified test voltage. Because of high variability, it is preferable to make radio interference measurements on a number of insulators. The radio interference characteristic is the mean corona obtained after taking into account all measurements made on insulators of one type.

11.7 TEST PROCEDURE FOR THERMAL-MECHANICAL PERFORMANCE TEST (As per IEC 575)

The test shall be conducted on string of 5 or 10 or 15 units.

- a) This test has an initial stage of thermal cycles together with mechanical loading and unloading and a concluding stage of testing the insulator units to failure. Such a failing load test constitutes the basis of the thermal mechanical performance test in judging the test results.
- b) During the initial stage of test, the insulator units shall be subjected to four 24 hours cycles of cooling and heating and to a tensile load equal to 60% of the specified electro-mechanical failing load. The tensile load shall be applied to the insulator units at room temperature before starting the first thermal cycle.
- c) Each 24 hours cycle shall comprise a cooling to $-30 \pm 5^{\circ}\text{C}$ and a heating to $+40 \pm 5^{\circ}\text{C}$. The temperature limits for temporary range of 40°C may be suitably changed where the prevailing conditions so require. The temperature sequence shall be first cooling, then heating. The temperature equipment shall be such as to permit keeping of minimum and maximum temperatures each for at least four consecutive hours of the temperature cycle.
- d) The tensile load shall be completely removed and reapplied towards the end of each heating period, the last one excepted.
- e) On completion of the fourth 24 hours cycle and cooling to room temperature the tensile load shall be removed on the same day. After this load removal, the insulator units shall be subjected individually to an electromechanical strength test.
- f) The performance of insulator unit will be determined by comparison of the failing load values and the fracture pattern obtained during the electromechanical strength test.

11.8 RESIDUAL STRENGTH TEST

The test shall be conducted in accordance with clause No. 4.4 and 4.5 of IEC: 797 proceeded by temperature cycle test. The sample size shall be 25 and the evaluation of results and acceptance criteria shall be as per Clause No. 4.6 of IEC: 797.

11.9 POLARISED LIGHT INSPECTION (Only for Glass Disc Insulator)

The disc insulator shall be held over a polarised light source and the stress lines viewed thereon. There shall be no uneven stress distribution in the toughened glass insulators. This shall be carried out on 100% glass shells.

11.10 STEEP WAVE FRONT TEST (Only for Glass Disc Insulator)

Following test shall be performed on 10 insulator units in case of disc insulators selected at random from the lot offered for inspection.

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- a) Each insulator unit shall be subjected to five successive positive and negative impulse flashovers with a wave having minimum effective rate of rise of 2500 kV per microseconds.
 - b) Each unit shall then be subjected to three dry power frequency voltage flashovers.

Acceptance Criteria

An insulator shall be deemed to have met the requirement of this test if, having been successfully subjected to the ten impulse flashovers, the arithmetic mean of the three subsequent dry power frequency voltage flashover values equals or exceeds 95% of the rated dry power frequency flashover voltage.

An insulator shall be deemed to have failed to meet the requirement of above testing if,

- (a) It has not flash over when the oscillogram or peak voltage indicator shows a marked reduction in voltage.

or

- (b) Any one of the subsequent three dry power frequency voltage flashover value is less than 80% of the value specified.

In case of failure of any one unit either in the steep wave front or subsequent low frequency voltage test, above tests shall be conducted on double number of units.

11.11 MECHANICAL FAILING LOAD TEST

The test shall be performed in accordance with clause No. 18 and 19 of IEC 383 with the following acceptance criteria:

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

Where

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

R = Rated electro-mechanical / mechanical failing load.

S = Standard deviation.

- (ii) The minimum sample size shall be taken as 20 for disc insulators units and 5 for long rod units. However, for larger lot size, IEC 591 shall be applicable.
- (iii) The individual electro-mechanical/mechanical failing load shall be at least equal to the rated value. Also electrical puncture shall not occur before the ultimate fracture.

12.0 HYDRAULIC INTERNAL PRESSURE TEST ON SHELLS:

The test shall be carried out on 100% disc insulator shells before assembly. The insulator should withstand required pressure for the preset time of one second (min.) without breaking.

13.0 HIGH FREQUENCY TEST ON SHELLS:

The test shall be carried out on 100% disc insulator shells before assembly. The insulators should withstand applied High Frequency voltage for 5 minutes without puncture.

A) **TESTS ON BOUGHT-OUT ITEMS:**

1) **Forged Components (Ball Pins):**

- a) Visual inspection: All material (100% samples) shall be visually checked for forging defects and general appearance.
- b) Dimensional check: At random check of not less than 1 sample per lot. The acceptance norm shall be dimensions as per drawing.
- c) Guage Check: The test shall be conducted on 100% samples with 'GO' and 'NO GO' gauges. The acceptance norm shall be dimensions as per approved drawing/relevant IS.
- d) Normalising: Time temperature chart/Graph from output of recorder shall be verified. The same shall conform to required standard.
- e) Hardness test: The test shall be conducted on minimum of 2 samples per lot of 1000 nos. The acceptance norm shall be hardness as per IS:1500/175-210 BHN.
- f) Grain Size: The test shall be conducted on minimum of 2 samples per lot of 1000 nos. The acceptance norm shall be grain size of 6 microns and above (ASTM No. 6 and above).
- g) Inclusion rating: The test shall be conducted as per IS: 4163 on minimum of 1 sample per lot of 1000 nos. The acceptance norm shall be inclusion rating of ASTM 2 thick series or less.
- h) Chemical analysis: The test shall be conducted on minimum of 1 sample per lot per heat no. The acceptance norm shall be chemical composition as per BS: 970 for EN-8D steel or equivalent.
- i) Failing Load test: At random check of not less than 2 samples per lot of 1000 nos. The sample shall be subjected to proof load limit and held for one minute. The load shall be released and there shall not be any crack or permanent deformation. Thereafter, the sample shall be subjected to further loading up to its recommended breaking load and actual breaking load shall be noted.
- j) Magnetic Particle Examination: The test shall be conducted on 100% samples as per IS: 3703 for detection of longitudinal and transverse cracks. There shall not be any surface or sub-surface cracks.

2) **Malleable Cast Iron Cap:**

- a) Visual inspection: All material (100% samples) shall be visually checked for freedom from casting defects and identification mark. The surface shall be free from casting defects and shall be cleanly fettled. The cap shall bear identification mark of the manufacturer.
- b) Dimensional check: At random check of not less than 1 sample per lot of 1000 nos. The acceptance norm shall be dimensions as per drawing.
- c) Guage Check: The test shall be conducted on 100% samples with 'GO' and 'NO GO' gauges. The acceptance norm shall be dimensions as per approved drawing/relevant IS.
- d) Hardness test: The test shall be conducted on minimum of 2 samples per lot of 1000 nos. The acceptance norm shall be hardness as per IS:2108/150 BHN max.

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- e) Chemical analysis: The test shall be conducted on minimum of 1 sample per 5000 nos. The acceptance norm shall be chemical composition confirming to grade BM:320 or equivalent.
- f) Failing Load test: At random check of not less than 2 samples per lot of 1000 nos. The sample shall be subjected to proof load limit and held for one minute. The load shall be released and there shall not be any crack or permanent deformation. Thereafter, the sample shall be subjected to further loading upto its recommended breaking load and actual breaking load shall be noted.
- g) Magnetic Particle Examination: The test shall be conducted on 100% samples as per IS:3703 for detection of longitudinal and transverse cracks. There shall not be any surface or sub-surface cracks.
- 3) **Security clip:**
- a) Visual inspection: All material (100% samples) samples shall be inspected for corrosion and surface irregularities. The acceptance norm shall be as per IS:3063.
- b) Dimensional check: At random check of not less than 1% sample per lot. The acceptance norm shall be dimensions as per IEC: 372/ IS: 2486(IV).
- c) Resistance to bending: At random check of not less than 1 sample per lot. The acceptance norm shall be as per IEC: 372/IS: 2486(IV).
- d) Operation test: At random check of not less than 1 sample per lot. The acceptance norm shall be as per IEC: 372/IS: 2486(IV).
- e) Hardness test: At random check of not less than 2 samples per lot. The acceptance norm shall be hardness not less than 152 BHN for R-clip and 143 BHN for W-clip.
- f) Chemical analysis: At random check of not less than 1 sample per lot. The acceptance norm shall be chemical composition confirming to AISI: 304/316 grade as per ASTM A 276.
- B) **Hot Dip Galvanized components:**
- I) **Test on Raw material**
- 1) Chemical analysis of Zinc: At random check of not less than one sample per lot. The acceptance norm shall be grade Zn98 (% of zinc > 99.95%) as per IS: 209.
- II) **Galvanizing checking:**
- 1) Visual inspection: All material (100% samples) shall be visually checked as per IS: 2629. The finished surface shall be clean, smooth and shall be free from defects like discoloured patches, bare spots, unevenness of coating, spelter which is loosely attached to the steel, globules, spiky deposits, blistered surface, flaking or peeling off etc.
- 2) Uniformity of zinc coating: At random check of not less than 2 samples per lot. The test shall be conducted as per IS: 2633 and the samples shall withstand minimum 4 dips of 1 minute each in standard CuSO₄ solution without showing signs of red deposits of copper.
- 3) Thickness of zinc coating: At random check of not less than 1 sample per lot. The acceptance norm shall be thickness of coating not less than 610 gms/mm².
- 4) Adherence of zinc coating: At random check of not less than 2 samples per lot. There shall be no flaking or loosening when struck squarely with a chisel faced hammer.

ANNEXURE- VIII
TECHNICAL SPECIFICATION FOR 0.2 ACSR “PANTHER” AND 0.4 ACSR
“ZEBRA” CONDUCTOR FOR EHV TRANSMISSION SCHEMES

1.0 GENERAL

This section details on the ACSR aluminum conductors to be used for the 220 kV and 132 kV overhead transmission lines

- 1.1 This specification provides for design, manufacture, engineering, inspection and testing before dispatch, packing and delivery of ALUMINIUM CONDUCTOR STEEL REINFORSED (ACSR) for EHV overhead transmission purposes in Maharashtra State.

2.0.0 STANDARDS

- 2.1.0 Except as modified in this Specification, the conductor shall conform to the following Indian Standards, which shall mean latest revisions, amendments thereof. Equivalent International and Internationally recognized standard to which some of these standards generally correspond are also listed below:

Sr. No.	Indian Standards	Title	International Standards
1	IS:209	Specification for Zinc	BS:3436
2	IS:398 Part I to Part V as relevant	Specification for Aluminium conductors for overhead Transmission purpose.	IEC:209, BS:215(Part II).
3	IS:1778	Reels and Drums for Bare conductors.	BS:1559
4	IS:1521	Method of Tensile Testing of Steel wire.	ISO/R89
5	IS:2629	Recommended practice for Hot Dip Galvanising of Iron and Steel.	
6	IS:2633	Method of Testing of Uniformity of coating of Zinc Coated Articles	
7	IS:4826	Galvanised Coating on Round Steel Wire.	ASTM A-472 729.
8	IS:6745	Methods of Determination of weight of Zinc Coating of zinc coated Iron & Steel Articles.	Bs:443
9	IS:1841	EC grade Aluminium rod produced by rolling(Second Revision).	
10	IS:5484	EC grade Aluminium rod produced by continuous casting and rolling (First Revision).	
11	IS:7623	Specification for Lithium Soap Grease.	

3.0.0 PRINCIPAL PARAMETERS

3.1.0 The details of ACSR conductor are tabulated below:

Sr.No.	Particulars	Values For ACSR panther	Values For ACSR Zebra
(a)	Stranding and wire diameter	Aluminium: 30/3.00 mm., Steel: 7/3.00 mm.	Aluminium: 54/3.18 mm. , Steel: 7/3.18 mm.
(b)	Number of Strands		
	(i) Steel Centre	1	1
	(ii) Ist Steel Layer	6	6
	(iii) Ist Aluminium Layer	12	12
	(iv) 2nd Aluminium Layer	18	18
			24
(c)	Sectional area of Aluminium in Sq. mm.	212.1	428.9
(d)	Sectional area of Steel in Sq. mm.	49.4	55.6
(e)	Total sectional area in Sq.mm.	261.5	484.5
(f)	Overall Diameter in mm.	21.00	28.62
(g)	Approximate weight in Kg/Km.	974	1621
(h)	Calculated D.C. Resistance at 20 degree Celsius in Ohm/Km.	0.1400	0.06915
(i)	Minimum Breaking load in KN	89.67	130.32
(j)	Modulus of Elasticity in GN/Sq.metre.	80.00	69

3.2.0 The details of Aluminium Strands are as below:

Sr. No.	Particulars	Values For ACSR panther	Values For ACSR Zebra
(a)	Minimum Breaking Load of Strand before stranding in KN	1.17	1.29
(b)	Minimum Breaking Load of Strand after stranding in KN.	1.11	1.23
(c)	Maximum D.C. Resistance of Strand at 20 Degree Celsius in Ohm/Km.	4.107	3.651

3.3.0 The details of Steel Strands are as below:

Sr. No.	Particulars	Values For ACSR panther	Values For ACSR Zebra
(a)	Minimum Breaking Load of Strand before stranding in KN.	9.29	10.43
b)	Minimum Breaking Load of Strand after stranding in KN.	8.83	9.91
(c)	Minimum weight of Zinc Coating after stranding in Gm/Sq. Metre	260	260
4.0.0	(a) Maximum Ambient Air Temperature		50 Degree C.
	(b) Minimum Ambient Air Temperature		3.5 Degree C.
	(c) Average Daily Ambient Air Temperature		40 Degree C.
	(d) Relative Humidity		10-100%
	(e) Maximum Rainfall yearly		1450 mm.
	(f) Maximum Altitude above Mean Sea level.		1000 metres
	(g) Maximum Wind Pressure		45 Kg/Sq.m.
	(h) Isoceraunic level		50 days/year.

GENERAL TECHNICAL REQUIREMENTS

The conductor shall be suitable for satisfactory operation under the following tropical climatic conditions:

5.0.0 PHYSICAL CONSTANTS OF MATERIALS

5.1.0 Physical Constants of Hard Drawn Aluminium:

(a) Resistivity:

The resistivity of aluminium depends upon its purity and its physical condition. For the purpose of this specification the maximum value permitted is 0.02845 Ohm Sq.mm/mtr.at 20 Degree C and this value has been used for calculation of the maximum permissible value of resistance.

Note: It is not intended to check the resistivity from the measured values of resistance.

(b) Density:

At a temperature of 20 Degree C, the Density of hard drawn Aluminium has been taken as 2.703 gm/cubic cm.

(c) Constant-Mass Temperature Co-Efficient of Resistance:

At a temperature of 20 Degree C, the constant mass temperature co-efficient of hard drawn aluminium measures between two potential points rigidly fixed to the wire, the metal being allowed to expand freely, has been taken as 0.004 per Degree C.

(d) Co-Efficient of Linear Expansion:

The Co-Efficient of Linear Expansion of hard drawn aluminium at 0 Degree C has been taken as 23×10^{-6} per Degree C. This value holds good for all practical purposes over the range of temperature from 0 Degree C to highest safe operating temperature.

5.2.0 Physical Constants For Galvanised Steel Wires:

(a) Density:

At a temperature of 20 Degree C, the density of galvanised steel wire is to be taken 7.80 gm/cubic cm.

(b) Co-Efficient of Linear Expansion:

In order to obtain uniformity in calculations, a value of 11.5×10^{-6} per Degree C may be taken as the value for the co-efficient of Linear Expansion of galvanised steel wires used for the cores of steel re-in forced aluminium conductors.

5.3.0 MATERIALS

- (a) The conductors shall be manufactured from EC Grade aluminium rods suitably hard-drawn on wire drawing machines. The aluminium rods used shall comply with IS: 1841 and IS:5484. The mechanical and electrical properties of aluminium wire shall comply with the requirements given in relevant standard.
- (b) Galvanised steel wire shall be drawn from high carbon steel rods produced by either acidic or basic open hearth process, electric furnace process or basic oxygen process. The mechanical and electrical properties of wire shall comply with the requirements given in relevant standard. The chemical composition of high carbon steel wire is given below for guidance only:

Sr.No.	Element	Percentage Composition
1	Carbon	0.50 to 0.85
2	Manganese	0.50 to 1.10
3	Phosphorus	Not more than 0.035
4	Sulphur	Not more than 0.045
5	Silicon	0.10 to 0.35

-
- (c) The Zinc used for galvanising shall be electrolytic high grade Zinc not less than 99.95% purity. It shall conform to and satisfy all the requirements of IS: 209. Galvanising may be done by hot process. Neutral Grease may be applied to the core wire.

5.4.0 **FREEDOM FROM DEFECTS**

The wires shall be smooth and free from all imperfections such as spills, spilts, slag inclusion, die marks, scratches, fittings, blow-holes, projections, looseness, overlapping of strands, chipping of aluminium layers etc. and all such other defects which may hamper the mechanical and electrical properties of the conductor. Special care should be taken to keep away dirt, grit etc. during stranding.

5.5.0 **WIRE SIZE**

5.5.1 **NOMINAL SIZE**

The aluminium and galvanised steel wires for the stranded conductor covered by this standard shall have diameters specified in Clause 3.1.0. The diameter of the steel wires shall be measured over the zinc coating.

5.5.2 **TOLERANCE ON NORMAL SIZE**

- (i) ALUMINIUM WIRES: A tolerance of ± 1 % is permitted on the nominal diameter of “Panther”/ “Zebra” conductor
- (ii) GALVANISED STEEL WIRES: A tolerance of ± 2 % is permitted on the nominal diameter.

NOTE : In order to maintain the circularity of the wires, the tolerance allowed in Clause 5.5.2 shall apply to both the measurements at right angles taken at the same cross-section as per Clause 2.2 of IS:398 (Part-II, Second Revision with Amendments 1 to 30).

5.6.0 **JOINTS IN WIRES**

- (i) Aluminium Wires: No joints shall be permitted in the aluminium 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 metre apart in the complete stranded conductor. Such joints shall be made by cold pressure butt-welding.

NOTE: 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.

- (ii) Galvanised 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 re-inforced aluminium conductor.

NOTE: 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.

5.7.0 **STRANDING**

- (i) The wires used in the construction of galvanised steel reinforced aluminium conductor shall before stranding, satisfy all the relevant requirements of this specification.
- (ii) The lay-ratio of the different layers shall be within the limit given in the following table:

LAY-RATIO OF ALUMINIUM CONDUCTOR GALVANISED STEEL REINFORCED

Sr. No.	Particulars	For ACSR Panther	For ACSR Zebra
1	Number of Wire	Aluminium: 30 Steel: 7	Aluminium: 54 Steel: 7
2	Ratio of Diameter	1.0	1.0
3	Lay-Ratio for Steel Core (6 Wire Layer)	Minimum: 13 Maximum: 28	Minimum: 13 Maximum: 28
4	Lay-Ratio for Aluminium Wires		
(i)	Out side Layer	Minimum: 10 Maximum: 14	Minimum: 10 Maximum: 14
(ii)	Layer immediately beneath outside Layer	Minimum: 10 Maximum: 16	Minimum: 10 Maximum: 16
(iii)	Innermost layer of conductor with three All Wire layers	Minimum: 10	Maximum: 17

NOTE: For the purpose of calculation, the mean lay-ratio shall be taken as the arithmetic mean of the relevant minimum and maximum values given in the above table.

- (iii) While stranding, pre forming and post forming method should be used for stranded steel core in order to relieve the residual tension in core wire to avoid flaring of conductor.
- (iv) In all constructions, the successive layers shall have opposite directions of lay, the outermost layer being right-handed. The wires in each layer shall be evenly and closely stranded.
- (v) In conductors having multiple layers of aluminium wires, the lay-ratio of any aluminium layer shall not be greater than the lay-ratio of aluminium layer immediately beneath it.

5.8.0 **STANDARD LENGTH OF THE CONDUCTOR**

The standard length of the 'Panther' / 'Zebra' conductor shall be minimum 2000 / 2000 metres. Tolerance of $\pm 5\%$ in standard length offered by the bidders shall be permitted. All length outside this limit of tolerance shall be treated as random length.

5.9.0 **GUARANTEED TECHNICAL PARTICULARS**

The bidder shall furnish the guaranteed technical particulars of item offered in the form enclosed at SCHEDULE “A” of this specification.

6.0 TESTS

The conductor offered in the tender should have been successfully type tested in line with the standard and technical specification within the last five years from the date of opening of tender. The bidder shall submit copy of the type test reports specified hereunder along with the offer :

6.1.1 The type tests, acceptance tests, routine tests and tests during manufacture shall be carried out on the conductor. For the purpose of this clause:

- (a) Type tests shall mean those tests, which are to be carried out to prove the design, process of manufacture and general conformity of the material to this specification. These tests shall be carried out on sample prior to commencement of commercial production against the order. The bidder shall indicate his schedule for carrying out these tests in the offer.
- (b) Acceptance tests shall mean those tests, which are to be carried out on sample taken from each lot, offered for pre-despatch inspection, for the purposes of acceptance of that lot.
- (c) Routine tests shall mean those tests, which are to be carried out on each strand/spool/length of the conductor to check requirements which are likely to vary during production.
- (d) Tests during manufacture shall mean those tests, which are to be carried out during the process of manufacturing by the supplier, to ensure the desired quality of the end product to be supplied by him.

6.1.2 For all type tests and acceptance tests, the acceptance values shall be the values guaranteed by the bidder in the “Guaranteed Technical Particulars” of his proposal or the acceptance value specified in this specification, whichever is more stringent for that particular test.

6.2 DESCRIPTIONS OF TESTS

6.2.1 TYPE TESTS

The following Type Tests shall be conducted free of cost once on each sample/samples of conductor for every 500 Kms. or part thereof of production from each manufacturing facility.

(a) TEST FOR SURFACE CONDITION

A sample of the finished conductor having a minimum recommended length of 5 metres 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 subjected to a tension of 50 % of the ultimate breaking load of the conductor

The surface shall not depart from its cylindrical shape nor shall the strands move relative to each other so get out of place or disturb the longitudinal smoothness of the conductor. The measured diameter at any place shall not be less than the sum of the minimum specified diameters of the individual aluminium and steel strands.

(b) **ULTIMATE TENSILE STRENGTH TEST**

Circles perpendicular to the axis of the conductor shall be marked at two places on a sample conductor of minimum 5 metre length, suitably compressed with Tension Clamps at either end. Tensile load shall be applied to the sample and shall be increased at a steady rate up to 50 % of the Ultimate Tensile Strength of the conductor and held for one minute. The circles drawn, shall not be distorted due to relative movement of strands. The applied load shall then be increased at steady rate until the failing load is reached. This value shall not be less than the guaranteed breaking load of the conductor.

(c) **D.C.RESISTANCE TEST**

On a conductor sample of minimum 5 metres length, two contact clamps shall be fixed. The resistance shall be measured by a Ke;vin Double Bridge by placing the clamps initially zero metre and subsequently one metre apart. The test shall be repeated at least 5(five) times and the average value recorded. The value obtained shall be corrected to the value at 20 degree C as per IS: 398 (Part II). The resistance corrected at 20 °C shall conform to the requirements of this specification.

6.2.2 **ACCEPTANCE TESTS**

The following acceptance tests shall be conducted on the samples in presence of the purchaser's representative and the test values shall conform to IS:398-V.

(a) **VISUAL AND DIMENSIONAL CHECK ON DRUM**

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

(b) **CHECK FOR JOINTS, SCRATCHES ETC.**

Conductor drums shall be rewound in the presence of Purchaser's representative. The Purchaser's representative shall visually check for scratches, joints etc. and that the conductor generally conforms to the requirements of this specification.

(c) **DIMENSIONAL CHECK ON ALUMINIUM AND STEEL STRANDS**

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

(d) **LAY- RATIO TEST OF VARIOUS LAYERS**

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

(e) **ELONGATION AND TORSION TEST**

The test procedure shall be as specified in IS-398 (Part-V)-1992. The material shall conform to the requirements of this specification and Clause No,9.4 & 9.5 of IS:398 (Part-V).

(f) **BREAKING LOAD TEST ON INDIVIDUAL ALUMINIUM AND STEEL STRAND**

For the purpose of acceptance test, this test shall be made on both aluminium and steel. The tensile test shall apply to all wires of ACSR conductors. The tensile strength of any of the wires shall not be less than the values given in the technical particulars mentioned in this specification.

When an automatic tensile testing machine is used, the load shall be applied gradually and rate of separation of the jaws of the testing machine shall not be less than 25 mm/minute and not greater than 100 mm/minute.

(g) **RESISTANCE TEST**

As per Clause 13.8 of IS-398-V, the measurement of resistance shall be made on strands of ACSR conductor, and shall be carried out to an accuracy of at least one part in a thousand and conform to the specified values. Certificates as to the accuracy of the apparatus shall be provided.

(h) **UTS TEST ON WELDED JOINTS OF ALUMINIUM STRAND**

As per procedure mentioned in IS: 398 (Part I-V)

(i) **VERIFICATION OF LENGTH:** By rewinding method.

(j) **QUANTITY OF DRUMS TO BE VERIFIED FOR LENGTH:**

As per Clause No. 7.5.

(k) **GALVANISING TEST**

The test procedure shall as specified in IS: 4826. The material shall conform to the requirement of this specification.

NOTE: All the above tests except test mentioned at (h) shall be carried out on aluminium and steel strands after stranding only.

6.2.3 **ROUTINE TESTS**

- (a) Check to ensure that the joints are as per specification.
- (b) Check that there are no cuts etc. on the strands.

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- (c) Check that drums are as per specifications.
 - (d) All above routine tests shall be carried out on each coil and the record of the same shall be kept by the supplier and same shall be produced at the time of Inspection.

6.2.4 **TESTS DURING MANUFACTURE**

- (a) Chemical Analysis of Zinc Used for Galvanising:

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

- (b) Chemical Analysis of Aluminium used for making Aluminium Strands:

Chemical Analysis of Aluminium samples taken from the Aluminium ingots/coils/strands shall be chemically/spectrographically analyzed. The same shall be in conformity to the requirements stated in this specification.

- (c) Chemical Analysis of Steel used for making Steel Strands:

Chemical Analysis of Steel samples taken from the Steel ingots/coils/strands shall be chemically/spectrographically analyzed. The same shall be in conformity to the requirements stated in this specification.

6.3 **TESTING EXPENSES:**

- 6.3.1 The Purchaser may opt for repetition of Type Test at his own expenses prior to manufacture.
- 6.3.2 In case of failure in any type test, the bidder is either required to modify the design of the material or repeat the particular type test successfully, at his own expenses. The decision of the purchaser, in this regard shall be final and binding.
- 6.3.3 Bidder shall indicate the laboratories, in which he proposes to conduct the type test. He shall ensure that the tests can be completed in these laboratories, within the time schedule, guaranteed by him, in the appropriate schedule. (Name of Laboratories to be uploaded with the offer).
- 6.3.4 The entire cost of testing for the acceptance tests, routine tests and tests during manufacture, specified herein, shall be treated as included in the quoted unit price of conductor, except, for the expenses of the inspector/ purchaser's representative.

6.4 **ADDITIONAL TESTS:**

The purchaser reserves the right of having, at his own expenses, any other test(s) of reasonable nature carried out at supplier's premises, at site, or at any other place in addition to the aforesaid type, acceptance and routine tests to satisfy himself, that the materials complies with the specification.

6.5 SAMPLE BATCH FOR TYPE TESTING

- 6.5.1 The supplier shall offer at least five (5) drums for selection of samples required for conducting all the type tests.
- 6.5.2 The Supplier is required to carry out all the type tests & acceptance tests successfully in the presence of purchaser's representative before mass production & dispatch respectively. The bidder/manufacturer may carry out the type tests in absence of user's representative in Govt. testing laboratory to establish his eligibility for trial order. However on award of purchase order, the bidder will conduct type tests in presence of purchaser's representative.

6.6 TEST REPORTS

- 6.6.1 Two copies of type test reports shall be furnished to the Purchaser within one month of conducting the tests. One copy will be returned duly certified by the purchaser to the supplier within three weeks thereafter and on receipt of the same, supplier shall commence commercial production of the conductor.
- 6.6.2 Two copies of the acceptance test reports shall be furnished to the purchaser. One copy will be returned, duly certified by the purchaser and only thereafter, shall the conductor be dispatch.
- 6.6.3 All records of routine test reports shall be maintained by the supplier at his works for periodic inspection by the purchaser.
- 6.6.4 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.

6.7 TEST FACILITIES

- 6.7.1 The following additional test facilities shall be available at supplier's works:
- (i) The testing equipments with Valid Calibration certificate of various testing equipments including tensile testing machine, resistance measurements facilities, burette, thermometer, barometer etc.
 - (ii) Standard resistance for calibration of resistance bridges.
 - (iii) Finished conductor shall be checked for length verification and surface finish on separate rewinding machine at reduced speed (variable from 8 to 16 metres per minute). The rewinding facilities shall have appropriate clutch system and free of vibrations, jerks etc with transverse layering facilities.
 - (iv) Test for Zinc Coating by volumetric method or by weight methods.

6.8 RE-TEST AND REJECTION

6.8.1 Each drum or reel selected for testing, shall be tested for compliance with the requirements of IS-398(I-V). Should any selected drum or reel not fulfill any of the test requirements, that particular drum or reel shall be withdrawn. In respect of each failure, two test pieces shall be selected from two different drums in the lot and subjected to the test under which the failure occurred. If either of the two- re-test pieces fails to pass that test, the drum or reel concerned shall be rejected.

6.8.2 All rejected drums shall be marked and segregated.

6.9 The Purchaser reserves the right to have carried out any/all type tests mentioned under Clause No. 6.2.1 at his own expenses on samples of conductor selected from the lot supplied at site. The entire conductor shall be rejected if the test results are not satisfactory.

7.0 INSPECTION

7.1 The Purchaser's representative shall, at all time, be entitled to have access to the works and all places of the manufacturer, where the conductor shall be manufactured or prepared and the representative shall have full facilities for unrestricted inspection of Supplier's works, the raw materials, the manufacture of the conductor and for conducting necessary tests as detailed herein before.

7.2 The Supplier shall keep the Purchaser informed in advance of the time of starting and of the progress of manufacture of conductor in its various stages so that arrangements shall be made for Inspection.

7.3 No material shall be dispatched from its point of manufacture before it has been satisfactorily inspected and tested, unless the inspection, if waived off by the Purchaser in writing. In the later case also, the conductor shall be dispatched only after satisfactory testing for all tests specified herein has been completed.

7.4 The acceptance of any quantity of conductor shall in no way relieve the supplier of any of his responsibilities for meeting all requirements on the specification, and shall not prevent subsequent rejection if such conductor is later found to be defective.

7.5 At least 5 % of the total number of drums subject to minimum two in any lot put-up for inspection shall be selected at random to ascertain the length of conductor by following method:

“At the works of the manufacturer of the conductor, the conductor shall be transferred from one drum to another at the same time measuring its length with the help of a graduated pulley and Cyclometer. The difference in the average length thus obtained and as declared by the Supplier in the packing list shall be applied to all the drums if the conductor is found short during checking.”

8.0 QUALITY ASSURANCE PLAN

8.1 The Bidder shall invariably furnish following information along with his offer, failing which his 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 purchaser's representative, copies of test certificates.

- (ii) Information 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 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) List of testing equipments available with the Bidder for final testing of equipment specified and test plan 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 deviation from specified test requirements.

8.2 The supplier shall within 30 days of placement of order, submit Quality Assurance Plan to C.E.(D,C&M) for scrutiny and approval.

8.3 The supplier shall submit the routine test certificates of raw materials at the time of acceptance tests on the conductor.

9.0 PACKING & FORWARDING

9.1 The conductor shall be supplied in non-returnable strong wooden drums provided with lagging of adequate strength and displacement during transit, storage and subsequent handling and stringing operation in the field. The drums shall generally conform to IS:1778-1980, amendment No.1, June 1989, except otherwise specified hereinafter. A specimen wooden drum drawing No. EEPL/WM-II/PANTHER/235 Dt 25.03.1997 for 0.2 ACSR "Panther" Conductor and No. EEPL/WM-II/ZEBRA/234 Dt 25-031997 for 0.4 ACSR "Zebra" Conductor, is enclosed for ready reference.

9.2 The drums shall be suitable for wheel mounting and for jetting off the conductor under a minimum controlled tension of the order of 5 KN.

9.3 The Bidder should submit the proposed drum drawing along with the bid. However, the same shall be in line with the requirements as stated herein. After placement of the LOA, the supplier shall submit Three copies of full dimensioned drawing of the drum he wishes to supply, for Purchaser's approval before taking up manufacturing of Conductor.

9.4 All wooden components shall be manufactured out of seasoned soft wood, free from defects that may materially weaken the component parts of the drums. Preventive treatment for anti-termite/anti-fungus (Aldrime/Aldruse) shall be applied to the entire drum with preservatives of a quality which is not harmful to the conductor.

9.5 The flanges shall be of two/three ply construction with each ply at right angles to the other and nailed together. The nails shall be driven from the inside face flange, punched and then clenched on the outer face. The tolerance in the thickness of each ply shall be ± 3 mm only. There shall be at least 3 nails per plank for ply with maximum nail spacing of 75 mm. Where a slot is cut in the flange to receive the inner end of the conductor, the entrance shall be in the line with the periphery of the barrel.

9.6 The wooden battens used for making the barrel of the conductor shall be of segmental type. These shall be nailed to the barrel supports with at least two nails. The battens shall be closely butted and shall provide a round barrel with smooth external surface. The edges of the battens shall be rounded or chamfered to avoid damage to the conductor.

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- 9.7 Barrel studs shall be used for constructions of drums. The flanges shall be holed and the barrel supports slotted to receive them. The barrel studs shall be threaded over a length on either end, sufficient to accommodate washers, spindle plates and nuts for fixing flanges at the required spacing. Barrel studs should be tack welded with the nuts after tightening.
 - 9.8 Normally, the nuts on the studs shall stand round of the flanges. All the nails used on the inner surface of the flanges and the drum barrel shall be countersunk. The ends of barrel shall generally be flushed with the top of the nuts.
 - 9.9 The inner check of the flanges and drum barrel surface shall be painted with a bitumen based paint.
 - 9.10 Before reeling, card board or double corrugated or thick bitumenised waterproof bamboo paper shall be secured to the drum barrel and inside of flanges or the drum by means of a suitable commercial adhesive material. The paper should be dried before use. Medium grade craft paper shall be used in between the layers of the conductor. After reeling the conductor, the exposed surface of the outer layer conductor shall be wrapped with thin polythene sheet across the flanges to preserve the conductor from dirt, grit and damage during transportation and handling and also to prevent ingress of rain water during storage/transport.
 - 9.11 A minimum space of 75 mm shall be provided between the inner surface of the external protective layer and outer layer of the conductor.
 - 9.12 Each batten shall be securely nailed across grains as far as possible to the flange edges with at least 2 nails per end. The length of the nails shall not be less than twice the thickness of the battens. The nail shall not protrude above the general surface and shall not have exposed sharp edges or allow the battens to be released due to corrosion.
 - 9.13 Outside the protective layer, there shall be minimum of two binder consisting of hoop iron/galvanised steel wire. Each protective layer shall have two recess to accommodate the binders.
 - 9.14 The conductor ends shall be properly sealed and secured with the help of U- nails on one side of the flanges. The end securing shall be done by taking out at least 500 mm of steel core on either ends by U-nails. The composite conductor shall be binded by use of galvanised steel wire/aluminium wire at three locations at least 75 mm apart or more covered with PVC adhesive tape so as to avoid loosening of conductor layers in transit and handling.
 - 9.15 Only one length of conductor shall be wound on each drum.

10.0 MARKING

Each drum shall have the following information stenciled on it in indelible ink along with other essential data:

- (a) Contract/Award letter number :
- (b) Name and address of consignee :

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- (c) Manufacturer's name and address :
- (d) Drum Number :
- (e) Size of Conductor :
- (f) Length of Conductor in metres :
- (g) Gross weight of drum with Conductor:
- (h) Weight of empty drum with lagging :
- (i) Arrow marking for unwinding :
- (j) I.S.I. Marking :

Note: The conductor offered shall bear valid ISI Certification mark. The Bidder shall furnish copies of documentary proof to this effect along with his offer.

9.0 REQUIREMENT OF DOCUMENTS

9.1 Following information shall be furnished along with the offer in hard and **soft copy**

Certificate of accreditation of the testing laboratory where the type test are to be conducted.

SCHEDULE –‘a’

**GUARANTEED TECHNICAL PARTICULAR OF ACSR “PANTHER”/
“ZEBRA” CONDUCTOR**

(The form of information to be furnished by the bidder as per Clause No.5.9.0 of the specification.)

- (1) Code word of Conductor offered :
- (2) Maker’s, address and country of
 - (a) Aluminium wire :
 - (b) Steel wire :
 - (c) Complete Conductor :
- (3) Whether the Supplier has valid ISI Certification for the conductor offered?
(Please furnish copies of documentary proof) :
- (4) Details of quantities of conductor of same or higher number of strands supplied during the last five years (Please furnish copies of documentary proof). :
- (5) Average annual turn over during the last five :
years (Please furnish copies of documentary proof).
- (6) Details of type test conducted on similar :
conductor during last five years (Please furnish copies of documentary proof).
- (7) Stranding and wire diameter in mm.
 - (a) Aluminium :
 - (b) Steel :

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- (8) Tolerance on diameter of wires
- (a) Aluminium :
 - (b) Steel :
- (9) Cross Sectional area in Sq.mm. :
- (10) Overall Diameter of conductor in mm. :
- (11) Approximate weight of complete conductor :
- (12) Minimum breaking load in KN for
- (a) Aluminium :
 - (b) Steel :
- (13) Zinc coating of steel strand
- (a) Thickness of coating number and duration of dips (Precee Test) withstood :
 - (b) Minimum weight of coating in gms/sq.mm:
- (14) Type of grease applied to the core wires :
- (15) Maximum working tension at 0 degree C and 2/3 of wind pressure (Enclose sag tension chart)
- (16) Weight in Kg /Km
- (a) Aluminium :
 - (b) Steel :
 - (c) Complete Conductor :
- (17) Resistance in ohms/Km at 20 degree C
- (a) Aluminium Strand :
 - (b) Complete Conductor :
- (18) Continuous maximum current rating of conductor in still air at 40 degree C ambient temperature in Amps. :
- (19) Temperature rise for the above current in degree C. :

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- (20) Reactance/Km at 50 degree C per one metre spacing between conductors in ohms/Km, temperature rise for the above current in degree C. :
- (21) Lay Ratio (Maximum & Minimum)
- (a) Steel Core (i) 6 Wire layer :
- (b) Aluminium (i) 12 Wire layer :
- (ii) 18 Wire layer :
- (22) Whether the drum on which the conductor is wound is conforming to the specification. (The detailed dimensional drawing shall be submitted with the offer). :
- (23) Physical Constants of material/conductor
- (i) Modulus of elasticity of
- (a) Aluminium strand :
- (b) Steel strand :
- (c) Complete conductor :
- (ii) Co-efficient of linear expansion per degree C:
Of
- (a) Aluminium strand :
- (b) Steel strand :
- (c) Complete conductor :
- (iii) Resistivity of Aluminium :
- (iv) Chemical composition of Steel :
- (24) Standard length of each piece in Km :
- (25) Tolerance, if any, on standard length :
- (26) No. of standard lengths in one reel :
- (27) Whether bidder is ready to supply six numbers of 2500 metres long conductor, if required :
- (28) Diameter of the reel in cms. :

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- (29) Weight of the conductor in one reel in Kgs :
- (30) Weight of the reel in Kgs :
- (31) Gross weight of the reel including weight of the conductor. :
- (32) Standard according to which the conductor will be manufactured and tested. :
- (33) Whether the bidder has valid ISI mark for the conductor offered(Furnish documentary evidence). :
- (34) Whether the bidder has adequate facilities for performing, post forming and stranding the aluminium wire/core. :
- (35) List of facilities available for testing of conductor. :
- (36) Other particulars, if any. :

Signature of the Bidder: -----

Name : -----

Designation : -----

Date : -----

Authorized Common
Rubber Stamp/Seal of
The Bidder : -----

ANNEXURE - IX
TECHNICAL SPECIFICATION FOR 7/3.15MM
GALVANISED STEEL EARTH-WIRE

1.0 GENERAL

This section details about the Galvanised Steel (G.S.) earthwire, required for 220/132 KV EHV lines. The earthwire offered, shall conform to the technical requirements covered under this specification and latest Indian Standard Specifications.

2.0 SYSTEM PARTICULARS

(i) The 7/3.15mm size G.S. earthwire is required for shielding of EHV Transmission Lines.

(ii) (a)	System	:	AC, 3 Phase 50 Hz.	
(b)	Line Voltage	:		
	Normal	:	220 KV	132KV
	Maximum	:	245 KV	145KV
(c)	Tower Configuration	:		
i)	Single Circuit	:	Delta	Delta
ii)	Double Circuit	:	Vertical	Vertical
iii)	Bil (Impulse)	:	1050 KV (peak)	650 KV (peak)
iv)	Power Frequency withstand voltage (wet)	:	460 KV (4ms)	275KV (rms)
v)	Max. wind pressure on power conductors and groundwire in Kg/ sq.mtrs.	:	45	45
vi)	No. of conductors per phase	:	One	One
vii)	Earthing	:	Effectively earthed	Effectively earthed

3.0 TECHNICAL PARTICULARS OF EARTHWIRE SIZE 7/3.15mm

3.1 Physical properties

i)	Material	:	Heavily galvanized steel		
ii)	No. of steel wires in strand (Nos.)	:	Inner 1	Outer 6	Total 7
iii)	Normal diameter of galvanized strand wire (mm.)	:	Std. 3.15	Max. 3.25	Min. 3.07
iv)	Total sectional area (mm.sq.)	:	54.52		
v)	Approximate weight (kg/ Km)	:	426		
vi)	Minimum breaking load of strand (KN)	:	Std. 54.0	Max. 64.3	Min. 48.2
vii)	Elongation of strand after breakage shall not be less than	:	4%		
viii)	Co-efficient of linear expansion (per deg.C)	:	11.5×10^{-6}		
ix)	Modulus of elasticity (Kg/sq.mm.)	:	19×10^3		
x)	Permissible variation in diameter of individual zinc coated wires for a nominal diameter of 3.15mm (percent)	:	+/- 2%		
xi)	Overall diameter of earthwire (mm)	:	9.45		
xii)	Minimum weight of zinc coating (g/M sq.)	:	240 (should withstand one minute dips = 3 Nos, 1/2 minute dips =1 No.		
xiii)	Calculated D.C. resistance at 20	:	3.41		

deg. C (ohm/km)

- xiv) Strand lay and lay length (mm) : Minimum : 123
Maximum : 265
- xv) Direction of lay of outer layer : Right hand
- xvi) Density at 20 deg.C (g/cm³) : 7.8

3.2 **Detailed Technical Particulars**

3.2.1 Material

The basic metal shall be steel made by the open heart basic oxygen or electric furnace process and of such quality and purity that when drawn to size of wire specified and coated with zinc, the finished strand and individual wires shall be of uniform quality and have the properties and characteristics as prescribed in this specification. The steel shall have following composition as per IS-12776: 2002.

<u>Element</u>	<u>Composition</u>
Carbon	0.55 Max
Manganese	0.40 to 1.10
Phosphorous	0.05 Max
Sulphur	0.05 Max
Silicon	0.15 to 0.35

3.2.1 **Galvanised:**

The slab zinc, when used for zinc coating, shall be of any grade of zinc conforming to ASTM specification, B-6, for zinc metal (slab Zinc) process – Hot dip.

3.2.2 **Stranding**

All steel strands shall be smooth, uniform and free from all imperfections such as spills and split die marks, scratches, abrasions and kinks after drawing and also after stranding. The finished material shall have minimum brittleness. Unless otherwise specified, the strand shall right hand lay. All wires shall be stranded with uniform tension. Stranding shall be sufficiently close to ensure no appreciable reduction in diameter when stressed to 10% of the specified strength. The 7 wire strand shall consist of central wire with 6 wire layer concentrically twisted over it with a uniform pitch not more than 16 times the specified nominal diameter of the strand.

3.2.3 **Ductility of steel**

The zinc coated wire shall not fracture when wrapped at a rate not exceeding 15 turns per minute in a close helix of at least two turns around a cylindrical mandrel. The mandrel diameter for extra high strength strand shall be equal to three times the nominal diameter of the individual wire of the strand.

3.2.4 **Joints and splices**

There will be no joint/splice in any of the wires of the strand in the standard length of $2750 \pm 10\%$ metre. The tenders should explicitly mention in their offers that there will be no joint in any of the wires constituting the ground wire notwithstanding the provisions, otherwise, if any, in the IS.

3.2.5 **Weight of coating**

The weight of zinc coating gm/sq.mtre. of uncoated wire surface shall be not less than 240 gm/sq.mtr.

3.2.6 **Tests of coating**

The weight of the zinc coating shall be determined by stripping test in accordance with ASTM methods A90, test for weight of coating on zinc coated iron or steel articles.

3.2.7 **Adherence of coating**

The zinc coated wire shall be capable of being wrapped at a rate not exceeding 15 turns per minute in close helix of at least two turns round a cylindrical mantrel equal to three times the nominal diameter of the wire under test without cracking or flaking the zinc coating to such an extent that any zinc can be removed by rubbing with the bare fingers.

3.2.8 **Finish**

The zinc coated wire shall be free from imperfections not consistent with good commercial practice. The zinc coating shall be continuous and of reasonably uniform thickness.

3.3 **Tests**

All type tests and routine tests as per standard methods shall be carried out by the bidder. copies of the Type test certificate shall be submitted with the tender in hard and soft copies.

3.4 **Standards**

The Groundwire shall conform to the provisions of the latest edition of ASTM Designation A 475-72(a) pertaining to Standard Specification for Zinc coated steel wire strand or any other authoritative standard (as amended upto date) except where specified

otherwise, in the specification. The materials conforming to any international standard which ensure equal or better performance shall also be acceptable.

3.5 **Sag Tension Charts**

The supplier shall be required to submit six sets of stringing charts for earthwire, showing initial and final sags and tensions for various temperatures and spans. One set of chart shall be in ink on tracing cloth.

3.6 **Guaranteed Technical Particulars**

The bidder shall fill in the guaranteed technical particulars in this specification and submit the same with his tender.

4 **TESTS**

4.1 The earthwire offered in the tender should have been successfully type tested in line with the standard and technical specification within the last five years from the date of opening of tender.

4.2 The following type, acceptance and routine tests and tests during manufacture shall be carried out on the earthwire for the purpose of this clause.

4.2.1 Type tests shall mean those tests which are to be carried out to prove the process of manufacture and general conformity of the material to these specifications. These tests shall be carried out on samples prior to commencement of commercial production .

4.2.1 Acceptance tests shall mean those tests which are to be carried out on samples taken from each lot offered for pre-despatch inspection for the purpose of acceptance of that lot.

4.2.2 Routine tests shall mean those tests, which are to be carried out on each strand spool/length of the earthwire to check requirements, which are likely to vary during production.

4.2.3 Tests during manufacture shall mean those tests which are to be carried out during the process of manufacture and end inspection by the Contractor to ensure the desired quality of the end product to be supplied by him.

4.2.4 The norms and procedures of sampling for these tests will be as per the Quality Assurance Programme to be mutually agreed to, by the Contractor and Board or as per relevant IS/International Standard.

4.2.5 The standards and norms to which these tests will be carried out are listed against them. Where a particular tests is a specific requirement of this specification, the norms and procedures of these tests shall be as specified in Annexure-I or as mutually agreed by the Contractor and the Owner in the Quality Assurance Programme.

4.2.6 For all type and acceptance tests, the acceptance tests, the acceptance values shall be the values guaranteed by the bidder in the guaranteed technical particulars of this proposal or the acceptance value specified in these specifications, whichever is more stringent for that particular test.

4.3 **Type Tests**

The following tests shall be conducted once on a sample/samples of earthwire for every 500 kms of production from each manufacturing facility.

- | | | | |
|-----|------------------------|---|----------------------|
| (a) | UTS Tests |) | MSETCL Specification |
| (b) | DC Resistance Test |) | Annexure-a |
| (c) | Surface Condition Test |) | |

4.4 **Acceptance Tests**

- | | | | |
|----|--|---|------------------------------------|
| a) | Visual check for joints etc. | : | MSETCL Specification
Annexure-a |
| b) | Dimensional check on steel strands | : | - do - |
| c) | Check for Lay – Length of 6 wire Layer | : | - do - |
| d) | Wrap test on steel strands | : | - do - |
| e) | DC resistance test on steel strands | : | - do - |
| f) | Visual check on drum | : | - do - |
| g) | Breaking load test on steel strands | : | IS-12776:2002 |
| h) | Elongation test on steel strand | : | - do - |
| i) | Torsion Test | : | - do - |
| j) | Galvanising tests on steel strands | : | *IS-4826-1979 |
| k) | Length & Surface Verification
by rewinding method | | |

***Note:**

Although the tests will be as specified in IS:4826-1979, no allowance or relaxation will be given for galvanization tests done on steel wires after stranding for the purpose of acceptance of an material covered by these specifications.

4.5 **Routine Tests**

- (a) Check to ensure that there are no joints as per specification.
- (b) Check that there are no cuts, fins etc. on the strands.
- (c) Check for correctness of stranding.
- (d) Check that drums are as per specification.

4.6 **Test During Manufacture**

- | | | | |
|-----|---|---|----------------------|
| (a) | Chemical analysis of Zinc used for galvanizing |) | |
| | |) | |
| | |) | MSETCL Specification |
| (b) | Chemical analysis of steel for making steel strands |) | Annexure-a |
| | |) | |

4.7 **Testing Expenses**

- 4.7.1 The purchaser may opt for repetition of Type test at his own expenses, prior to manufacture.
- 4.7.2 In case of failure in any type test the bidder is either required to modify the design of the material or repeat the particular type test successfully at his own expense. The decision of the purchaser in this regard shall be final and binding.
- 4.7.3 Bidder shall indicate the laboratories in which he proposes to conduct the type tests. He shall ensure that the tests can be completed in these laboratories within the time schedule guaranteed by him in the appropriate schedule.
- 4.7.4 The entire cost of testing for the acceptance and routine tests and tests during manufacture specified herein shall be treated as included in the quoted unit price of conductor, except for the expenses of the inspector/purchaser's representative.

4.8 **Additional Tests**

The owner reserves the right of having at his own expenses any other test(s) of reasonable nature carried out at contractor's premises, at site, or any other place in addition to the aforesaid type, acceptance and routine tests to satisfy himself that the materials comply with the specification.

4.9 **Sample Batch for Type Testing**

- 4.9.1 The supplier shall offer at least five (5) drums for selection of samples required for conducting all the type tests.
- 4.9.2 The supplier is required to carry out all the acceptance tests successfully in the presence of purchaser's representative before dispatch.

5 **TEST REPORTS (DOCUMENTS IN PHYSICAL FORM).**

- 5.1 At least 3 (three) copies of type test reports should be furnished. One copy of type test reports will be returned duly certified by the Board. Only after receipt of this report, the commercial production of the said material should start.

-
-
- 5.2 At least 3 (three) copies of acceptance test reports shall be furnished. One copy will be returned duly certified by the owner, only after receipt of which, the materials should be dispatched.
- 5.3 Record of routine test reports should be maintained by the Contractor at his works for periodic inspection by the Company's representatives.

6 INSPECTION

- 6.1 The Company's representative shall at all times be entitled to have access to the works and all places of manufacture, where earthwire shall be made or prepared and the representatives shall have full facilities for unrestricted inspection of the Contractor's works, raw materials, manufacture of the earthwire and for conducting necessary tests detailed herein.
- 6.2 The contractor shall keep the Company informed in advance of the time of starting and of the progress of manufacture of earthwire in its various stages so that arrangements can be made for inspection.
- 6.3 No earthwire shall be dispatched from its point of manufacture before it has been satisfactorily inspected and tested, unless the inspection is waived off by the Company in writing. In the later case also, the earthwire shall be dispatched only after satisfactory testing for all tests specified herein have been completed.
- 6.4 The acceptance of any quantity of material shall in no way relieve the Contractor of any of his responsibilities for meeting all requirements of the specification and shall not prevent subsequent rejection, if such materials are later found to be defective.

7 PACKING

- 7.1 The earthwire shall be suitably packed before dispatch in strong, non-returnable wooden drums suitable for ocean/local rail and road transportation, rough handling and stringing and shall conform in all respects to the latest edition of IS 1778-1961 except as otherwise specified herein. The general construction of the drum shall be as shown in drawing enclosed.

7.2 Standard Length

The standard length of the galvanized steel earth strand shall be minimum 2750 metre. A tolerance of $\pm 10\%$ on the standard length shall be permitted.

7.3 **Random Length**

Random length will be accepted provided no length is less than 70% of standard length and total quantity of random lengths is not more than ten (10%) percent of the total quantity in each shipment.

7.4 Only one length of earthwire shall be wound on each drum.

7.5 Boiled linseed oil should be applied to earthwire to avoid white rust.

8 MARKING

8.1 Each drum shall have the following information stenciled on it in indelible ink alongwith other essential data.

- (a) Contract / LOI No.
- (b) Name and Address of Consignee
- (c) Manufacturer's Name and Address
- (d) Drum No. & Lot No.
- (e) Size of Earthwire
- (f) Length of Earthwire in mtrs.
- (g) Gross weight of the drum with earthwire.
- (h) Weight of empty drum with laggings.
- (i) Arrow marking for unwinding.
- (j) Position of the earthwire ends.
- (k) Number of lengths on the reel/or drum.
- (l) The product may be marked with the standard mark.

ANNEXURE – a

TESTS

1 UTS Test on Earthwire

A sample of earthwire of about 5m length will be subjected to the ultimate Tensile strength test. The earthwire shall not fail at a value less than 54 KN.

2 Surface Condition Test

A sample of earthwire of 5m length shall be subjected to a load of 50% of the UTS of the earthwire. Neither shall the surface depart from its cylindrical form nor the strands move relative to each other so as to get out of place or disturb the longitudinal smoothness of the earthwire.

3 D.C. Resistance Test

On strand of minimum 5m length, two contact clamps shall be fixed. The Resistance shall be measured by Kelvin bridge by placing the clamps initially from one end and subsequently one metre apart. The test shall be repeated at each metre length and the value recorded. The value obtained shall be corrected to the value at 20 deg.C.

4 Visual Check for joints/lengths

Two drums from each lot/50Km. whichever is less, shall be selected at random and rewound in the presence of the inspector and actual length of earthwire measured. The weight of the earthwire also will be measured by weighing empty drum and drum with earthwire. The inspector shall visually check for scratches, joints etc. and see that the earthwire generally conforms to the requirements of this specification. The expenditure for above measurements, if any, will be to the bidder's account. The firm should have separate facility for winding and unwinding for inspection purpose.

5 Visual Check on Drums

The drums shall be visually and dimensionally checked to ensure that they conform to these specifications.

6 Chemical analysis of Zinc used for galvanising

Samples taken from the zinc ingots shall be chemically/ spectrographically analysed as per IS-209. The purity of zinc shall not be less than 99.95%.

7 Wrapping Test

One specimen cut from each of the samples of galvanised steel wire shall be wrapped round a mandrel of diameter equal to 4 times the wire of diameter to form a close helix of 8 turns. Six turns shall be unwrapped and again closely wrapped in the same direction as before. The wire shall not break.

8 Lay Length Check

The lay length shall be checked to ensure that they confirm to the requirement of the specification.

ANNEXURE – b

DRAWING CHARTS & DESIGN DATA TO BE SUBMITTED IN PHYSICAL FORM

- (A) Bidder shall furnish full details of earthwire drum offered. The drawing shall indicate:
- i) Size & weight of drum
 - ii) Materials used.
 - iii) Identification marks.
 - iv) Any other information which may be useful to the user.
- (B) Successful bidder during the execution of contract, shall submit the sag tension charts of earthwire for approval.

(GUARANTEED TECHNICAL PARTICULARS)

Sr.No	<u>Description</u>	<u>Unit</u>	Specified values	Offered Values
1	2	3	4	5
1.	Maker's name, address and country			
2.	Percentage composition of steel wire element			
	i) Carbon	%	.55 (Max)	
	ii) Sulphur	%	.05 (Max)	
	iii) Phosphorus	%	.05 (Max)	
	iv) Manganese	%	0.4to 1.1	
	v) Silicon	%	0.15 to 0.35	
3.	Particulars of steel strand:			
	a) No. of strands	Nos.	7	
	b) Diameter of strand			
	Standard	mm	3.15	
	Maximum	mm	3.25	
	Minimum	mm	3.07	
	c) Sectional area of strand	sq.mm.		
4.	Zinc coating of steel strand:			
	a) Uniformity of coating (number and duration of dips withstood)			
	Minute duration of dips			
	i) One	No.	3	

	ii) Half	No.	1
	b) Minimum weight of coating	g/m.sq.	240
5.	Standard overall diameter of steel wire	mm	9.45
6.	Total area of cross section of steel wire.	sq.mm.	54.52
7.	Guaranteed ultimate tensile strength of steel wire	N/mm ²	1100
8.	D.C. resistance in ohms per km. At 20 deg.C		3.41
9.	Standard length of steel wire (minimum)	Km	2.75 ± 10 %
10.	Tolerance if any on standard length	%	+ 10 %
11.	Random length of steel wire	Km	
12.	Random lengths in No.	No.	
13.	Modulus of elasticity of steel wire	Kg/mm ²	19x10 ³
14.	Co-efficient of linear expansion	/deg.C	11.5x10 ⁻⁶
15.	1) Length of the lay of standard wire		
	a) Maximum	mm	265
	b) Standard	mm	
	c) Minimum	mm	123
	2) Direction of lay of outer layer	Right/ Left	Right
16.	Weight of steel wire	Kg/Km	426
17.	Standard length of steel wire in each drum	Metre	2750
18.	Standard weight of steel wire on the drum	Kg.	
19.	Weight of empty drum	Kg.	
20.	Gross weight of the drum	Kg.	
21.	Dimension of the drum in cms.	GWB	
22.	Initial and final sags and tension and stringing charts, whether furnished.	Yes/No	
23.	Standard according to which the steel wire will be manufactured	IS or equivale	

nt

24. Other particulars, if any
25. Separate winding & unwinding facilities for Yes/No
inspection purpose whether available.

Name of the Firm:

Signature of the Bidder:

Designation:

Date:

SECTION - II

1.0 SURVEY AND ALIGNMENT

1.1 Check Survey

1.1.1 The Contractor shall finalise and submit proposal for all obligatory points within One (1) Month from the date of commencement of work at site. These obligatory points shall include all the river crossings, railway crossings, Power Line crossings or any other important crossings encountered in the transmission line route. The following schedule shall be adhered to in respect of obligatory points.

1.1.2 Route Making:

1.2 Tower Location

1.2.1 Sag Template

Sag template curve drawing and tower spotting Data shall be supplied by the owner to the successful bidder on award of contract. Sag template prepared based on the supplied sag template curve drawing shall only be used for tower spotting on the profiles Two nos. of the approved template prepared on rigid transparent plastic sheet, shall be provided by the Contractor to the Owner for the purpose of checking tower spotting. The templates shall be on the same scale as that of the profile.

1.2.2 Tower Spotting

With the help of approved sag template and tower spotting data, tower locations shall be marked on the profiles While locating the towers on the profile sheet, the following shall be considered.

a) **Span**

The number of consecutive spans between the Section points shall not exceed 10.(A section point shall be taken to comprise of a tension point with angle tower).

b) **Extension**

An individual span shall be as near to the normal design span as possible. In case an individual span becomes too short with normal supports on account of undulations in ground profile, one or both the supports of the span may be extended by inserting standard body extension designed for the purpose according to technical specifications.

c) **Loading**

There shall not be any upward force on suspension towers under normal working conditions and the suspension towers shall support at least the minimum weight span as provided in the designs. In case uplift is unavoidable, it will be examined if the same can be overcome by adding standard body extensions to the towers failing which tension towers designed for purpose shall be employed at such positions.

d) **Road crossing**

At all important road crossings, the towers shall be fitted with single suspension or tension or double tension insulator strings depending on the type of towers and the importance of the road being crossed but the ground clearance at the roads under maximum temperature and in still air shall be such that even with conductor broken in adjacent span, the ground clearance of the conductor from the road surface will not be less than 8.0 meters. At all national highways tension towers with double tension string shall be used. The crossing span, however, will not exceed 200 meters in any case.

e) **Railway Crossing**

Railway Crossing shall be supported on 15⁰, 30⁰ or 60⁰ type towers on either side, depending on the merits of each case and shall be constructed in conformity with the specification laid down by the Railway Authorities. Necessary copies of tracings and prints of plan, profile etc. required for the approval of railway crossings shall be supplied by the Contractor.

f) **River Crossing**

In case of Major River Crossings, towers shall be of suspension type using double suspension strings and the anchor towers on either side of the main River crossing shall be 60⁰ type tower with double tension string. Clearance required by navigation authority shall be provided. For non navigable rivers clearance shall be reckoned with respect to highest flood level (HFL).

g) **Power Line Crossings**

Where this line is to cross over another line of the same voltage or lower voltage, 2⁰ type tower with suitable extensions shall be used. Provision to prevent the possibility of its coming into contact with other overhead lines shall be made in accordance with the CEA (Measures relating to Safety and Electric Supply) Regulations, 2010. In order to reduce the height of the crossing towers, it may be advantageous to remove the ground wire of the line to be crossed (if this is possible and permitted by the Owner of the line to be crossed). All the works related to the above proposal shall be deemed to be included in the scope of the contractor without any extra cost of the Owner.

h) **Telecommunication Line Crossing**

The angle of crossing shall be as near to 90 Deg. as possible. However, deviation to the extent of 30⁰ may be permitted under exceptionally different situations. When the angle of crossing has to be below 60⁰, the matter will be referred to the authority in-charge of the telecommunication system. On a request from the Contractor the permission of the telecommunication authority will be obtained by the Owner. Also, in the crossing span, power line supports will be as near the telecommunication line as possible, to obtain increased vertical clearance between the wires.

1.2.3 **Clearance from Ground Buildings, Trees etc.**

Clearance from ground, buildings, trees and telephone lines shall be provided in conformity with the CEA (Measures relating to Safety and Electric Supply) Regulations, 2010 as amended up to date.

1.2.4 **Preliminary Schedule**

The profile sheets, duly spotted, along with preliminary schedules indicating type of towers, type of foundations, wind span angle of deviation, river or road crossing and other details shall be submitted for the approval of the owner.

1.2.5 The detailed check survey shall be made along the alignment.

1.2.6 Preliminary line alignment and Soil resistivity measurement

During execution of the project, if due to some unavoidable reasons, the route is required to be diverted then the contractor shall have to submit the preliminary line alignment for the diverted portion to the owner for approval. The alignment shall be plotted on Survey of India maps to the scale of 1 cm=0.5 km.(1:50000). All the topographical details including all railway lines, P&T Lines, wires, canals, roads etc. up to 8 Kms. on either side of the route of the transmission line shall be drawn to the scale. After getting approval for the diverted alignment. Original tracing of the route alignment drawing shall be handed over to the Owner.

1.2.7 The soil resistivity, along the diverted line alignment, shall also be measured by the Contractor. It shall be measured by four electrodes method keeping inter-electrode spacing as 50 m. For calculating soil resistivity, the formula $R=2 ar$ (where $a = 50 \text{ m}$ & $r =$ Megger reading in OHMS) shall be adopted. The measurement shall be made at every 2 or 3 kms along the line route or wherever the soil characteristic changes.

1.2.8 All the expenditure on account of the above shall be deemed to be included in the bid price and no extra payment shall be made for the same.

1.3 **Check Survey of Tower Location**

1.3.1 The Check survey shall be conducted to make a check on detailed survey and to locate and peg mark the tower positions on ground conforming to the approved profile and tower schedule. In the process, it is necessary to have the pit centers marked according to the excavation marking charts. The levels, up or down of each pit center, with respect to the center of the tower location shall be noted and recorded for determining the amount of earthwork required to meet approved design parameters.

1.3.2 The changes desired by the Owner in the preliminary tower schedule shall be carried out by the Contractor and he shall thereafter submit a final tower schedule for the approval of the Owner. The tower schedule shall show position of all towers, "type of towers, span length, type of foundation for each towers and the deviation at all angles as set out with other details.

1.3.3 Excavation work must not be started until the approved tower schedule and profile has been given by the Owner.

1.3.4 The Owner may get certain tower foundations constructed by other agencies. However, the Contractor shall be responsible for check survey, location marking on the ground and stub setting work.

1.4 Way Leaves and Trees Cutting

1.4.1 Any way leave which may be required shall be arranged by the Contractor, after submission of the final alignment. Necessary help if required for establishing way leave and right of way shall given by the representatives of the MSETCL. However the tree cutting required for way leave, approach road and tower location shall be carried out by the contractor with the prior permission from Forest/ Local authorities. The payment for compensation of way leave and plantation shall be made by the successful bidder.

1.4.2 The Owner shall not be held responsible for any claim on account of damage done by the contractor or his gangs to trees, crops or other property without specific consent from the Owner.

Technical specifications Conductor (ACSR & AAA) and earth wire

1.0 Technical specifications for conductor(ACSR) and earth wire

- 1.1 ACSR type twin moose, shall be used for 400 KV switchyard portion and ACSR type zebra, shall be used for the 220/100/22 KV switchyard portion. Quadruple conductor shall be used for 400 KV main bus and twin conductor shall be used for 220 /132 KV main buses, 100 KV main buses, 100 KV incomers, 22 KV incomers, 33/22 kV main bus.
- 1.2 Aluminum strands of ACSR shall be manufactured from electrolytic grade aluminum rods suitably hard-drawn on wire drawing machines.
- 1.3 Re-enforcing steel wire (galvanized) of ACSR shall be drawn from high carbon steel rods produced by any of the following processes.
 - a) Acidic or open heat process.
 - b) Electric furnace process or basic oxygen process.
- 1.4 No joints shall be permitted in the Aluminum wires in the outermost layer of ACSR. Similarly, no joints shall be permitted in the galvanized steel wire except those in the base rod or wire before final drawings.

2.0 The conductor shall meet with the following technical parameters

No.	Parameter	Specification	
		<u>ACSR "Z"</u>	<u>ACSR "M"</u>
1	Number of strands / wire diameter		
	Aluminum	54/ 3.18 mm	54/3.53 mm
	Steel	7 / 3.18 mm	7/3.53 mm
2	Sectional area (overall)	484.5 mm ²	597 mm ²
3	Sectional area (aluminum only)	428.9 mm ²	528.5 mm ²
4	Overall diameter	28.62 mm	31.77 mm
5	Approximate weight	1621 Kg/Km	1998 Kg/Km
6	Calculated DC resistance at 20°C	0.06915 Ω/Km	0.05596 Ω/Km

3.0 The earth wire shall meet the following technical parameters

	<u>7/3.15 mm</u>	<u>7/3.66 mm</u>	
1	Size of strand	3.15 mm	3.66 mm
2	Number of strands	7 Nos	7 Nos
3	Type of Galvanizing	Heavily hot dip galvanized	Heavily hot dip galvanized
4	Overall diameter of earth wire	9.45 mm	10.98 mm
5	Ultimate tensile strength	54 KN	68.4 KN

- 4.0 TECHNICAL SPECIFICATION FOR 640 mm² (AAA) CONDUCTOR:** This specification covers manufacture, testing, supply and delivery of 640 mm² All Aluminum Alloy conductors required for construction/ maintenance of 400 KV lines & substation works of Maharashtra State Electricity Transmission Company Limited. The conductor shall conform to the Indian Standards as per list

- 5.0 MATERIAL:** The conductor shall be constructed of heat treated aluminum-magnesium-silicon alloy wires containing approximately 0.5 % Silicon & 0.5 % magnesium and shall offer excellent erosion resistance, better strength to weight ratio and improved conductivity. The solution treatment should be done in a very sophisticated and advanced technology furnace with automatic quenching system.

6.0 TECHNICAL PARTICULARS OF 640 MM² AAA CONDUCTOR

The line conductor shall meet the following requirements:

- (a) Nominal Aluminum Alloy area : 640 Sq. mm.
- (b) Stranding & Wire diameter : 61 /3.66 mm
- (c) No. of Aluminum Alloy strands:
- | | |
|-----------------------|----|
| Centre Wire | 1 |
| 1 st layer | 6 |
| 2 nd layer | 12 |
| 3 rd layer | 18 |
| 4 th layer | 24 |
- (d) Sectional area of Aluminum Alloy : 641.8 Sq.mm.
- (e) Approximate overall diameter : 32.94 mm.
- (f) Approximate weight : 1771 Kg/Km
- (g) Calculated d.c. resistance at 20 deg. C. : 0.05340 ohm/Km.
- (h) Approximate calculated breaking load : 178.43 KN (Min.)
- (i) Co-efficient of linear expansion of Aluminum Alloy : 23×10^{-6} per deg.C.
- (j) Final modulus of elasticity : 0.5500×10^6 Kg/Sq.mm.
- (k) Resistivity of Aluminum Alloy wire at 20 deg. C.: 0.0328 ohms sq mm/m (Maximum).
- (l) Electrical conductivity at 20 deg. C. : 53.3 % (standard) of IACS (International Annealed Copper Standard).
- (m) Lay Ratio of Conductor:
- | | Max. | Min. |
|-----------------------------------|------|------|
| Aluminum Alloy | | |
| 1 st layer of 6 wires | 17 | 10 |
| 2 nd layer of 12 wires | 16 | 10 |
| 3 rd layer of 18 wires | 15 | 10 |
| 4 th layer of 24 wires | 14 | 10 |
- (n) Strand Details:
- | | |
|--------------------|------|
| Diameter: (in mm.) | |
| Standard | 3.66 |
| Maximum | 3.70 |
| Minimum | 3.62 |

- (p) Cross Sectional area for nominal diameter of wire (in Sq.mm.) 10.52
- (q) Weight (in Kg/Km) 26.41
- (r) Minimum Breaking Load(in KN) (After stranding) 3.09
- (s) D.C. resistance at 20 deg C. 3.187 ohms/Km.(maximum)
- (t) Joints:
 Outer Layer: Not permitted
 Inner Layer: Joints by cold butt pressure welding.
 No two joints shall be less than 15 meters apart in a complete stranded conductor.
- (u) Stranding: There shall be no tendency to untwist or spring apart, when the conductor is cut, successive layers to have opposite direction of lay. Outermost layer being right handed. Wires in each layer shall be evenly & closely stranded. Preforming & post forming shall be done for 18 & 24 wires layers. preforming & post forming shall be done for 6 wire & 12 wire layers.
- (v) Packing: One conductor length per drum.
- (w) Temperature rise curve To be submitted along with offer.
- (x) Standard length/drum 1800 metres +/- 5 %.
- (y) Corona Extinction Voltage Minimum 320 KV phase to ground.
 at 50 Hz (AC)
- (z) RIV at 1 MHz for phase (i) 266 KV (dry condition) --- Not to exceed 500 μ V
 to ground voltage
 (ii) 100 KV (wet condition) --- Not to exceed 1000 μ V

7.0 TYPE TESTS

The following type tests shall be conducted on the samples of conductor in presence of Purchaser's representative. The sample for type tests shall be selected by Purchaser's representative. The type test shall be conducted once on sample/samples of conductor for every **1500 Kms** or part thereof of production from each manufacturing facility.

- 7.1 Ultimate Tensile Strength.
- 7.2 Corona Extinction Voltage on twin or quadruple conductor as the case may be.
- 7.3 Radio Interference Voltage on twin or quadruple conductor as the case may be.
- 7.4 DC Resistance at 20 Deg C and at various temperatures.
- 7.5 Stress-Strain Test and design stress-strain curves shall be submitted to the purchaser.
- 7.6 Ampacity Test (current carrying capacity test) at various temperatures.

8.0 ROUTINE/ACCEPTANCE TESTS

- 8.1 Visual and Dimensional Check on Drum
- 8.2 Visual Check for Joints, Scratches etc.

- 8.3 Dimensional Check on Aluminum Alloy/Aluminium Strands
- 8.4 Lay- Ratio Test of Various Layers
- 8.5 Elongation and Torsion Tests
- 8.6 Breaking Load Test on Aluminium/Aluminum Alloy Strands
- 8.7 Breaking Load Test on welded Aluminium/Aluminium alloy strands.
- 8.8 Breaking Load Test on Steel Strands.
- 8.9 Resistance Test
- 8.10 Length/Weight verification of conductor/earthwire by rewinding method.
- 8.11 Wrapping test on Aluminum & Steel strands for ACSR conductor.
- 8.12 Dip test & mass of zinc test for steel strands.

9 LIST OF STANDARDS

The 560 Sq.mm. AAA conductor shall conform to the following Indian Standard which shall mean latest revision/amendments/changes adopted and published:

- | | |
|-------------------------|--|
| (i) IS 398(IV)-1994 | Specification for Aluminum/Alloy |
| Part I to V as relevant | Conductors for overhead transmission purposes. |
| (iii) IS: 1778:1980 | Reel and Drums for bare conductors. |
| (iii) IS: 8263: 1976 | Method of Radio Interference tests on High Voltage insulators |
| (iv) IS: 1841 | EC grade Aluminum rod produced by rolling (2 nd revision) |
| (v) IS: 7623 | Specification for Lithium soap grease. |
| (vi) IS: 9997 –1988 | Aluminum Alloy redraws rods. |
| (vii) IS 12776-2002 | Specification for G.S. earthwire. |

Annexure III E

FOR INSULATOR HARDWARE & CONDUCTOR/EARTHWIRE ACCESSORIES

1.0 GENERAL REQUIREMENTS:

- a) The material offered shall be of best quality, well finished workmanship, latest design and conforming to the best modern practices adopted in the Extra high voltage field. All drop forged parts shall be free from flaws, cracks or other defects and shall be smooth, close grained and of true forms and dimensions. All machined surface shall be true, smooth and well finished.
- b) Metal fittings of specified material for string hardware, are required to have excellent mechanical and electrical properties such as strength, toughness, mobility, high electrical conductivity, low power losses, freedom from corona formation or discharges likely to cause interference to tele-transmission of signals of any kind and high corrosion resistance.
- c) All components shall be clean, free from indents, cracks, shrinks, slender, air holes, burrs or rough edges and shall have smooth finished surface throughout. All current carrying parts shall be designed to have minimum contact resistance and shall be smooth finished. Adequate bearing area between fittings shall be provided and 'Point' or 'Line' contacts shall be avoided.
- d) All steel components shall be made of forged steel of Class IV grade by drop forging method and normalized. They shall be smooth finished with rounding off the edges. The minimum failing load shall be as indicated in the approved drawing. The component shall bear the name of manufacturer by **embossing**.
- e) Special attention shall be paid in the manufacture of aluminum dead end clamps and jumper to ensure that the finished material is free from surface defects like laminations, rough, jagged and imperfect edges, deep scratches, cracks and any other harmful defects. The jumper shall be uniformly and adequately pressed so as to be free from air gaps. The contact surface between clamp and jumper shall be straight to ensure full contact area between them. After machining the clamps and jumper shall be made free from dirt, oil, grease etc. The steel sleeve shall be made of forged steel of Class II grade by drop forging method and normalized.
- f) No component shall be made by joining, welding, shrink fitting or any other process from more than one piece of material except for Corona Control Ring.
- g) The Suspension and tension hardware shall be suitable for insulators with nominal pin shank diameter of 16 mm and 20 mm respectively of IS:2486 Part II 1989 for 220/132 KV system and 20 mm of IS:2486 Part II 1989 for 400 KV system.
- h) All forged and cast components shall necessarily bear identification mark of the manufacturer by 'Embossing'.
- i) Both suspension and tension type hardware shall be of ball and socket type and should invariably be with 'R' type security clip of stainless steel conforming to IS:2486 (Part III & IV).

- j) Unless specifically mentioned, the tension clamps shall be of **compression type** and shall have a steel sleeve to be compressed on the steel core end of the ACSR conductor.
- k) The suspension clamp (envelop type and drop type) shall be suitable for supporting respective ACSR and AAA conductors without armour rods.

The clamps shall be corrosion resistant, light in weight and easy to handle. The clamps shall be designed, manufactured and finished to give it a suitable shape without sharp angles at the ends and shall have such radius of curvature so as to avoid any possibility of hammering between the clamp and conductor due to vibrations. It should, however, have sufficient contact surface to minimise damage due to fault currents. If dissimilar materials are used for suspension clamp suitable precautions shall be taken to minimise electrolytic corrosion.

- l) The purchaser reserves the right to insist upon the Supplier for proving the composition and the quality of the material at any stage, either during or after the execution of the contract.
- m) All bolts, nuts shall conform to IS:1367-1991. Bolt heads and nuts shall be locked in an approved manner. The threads in nuts and tapped holes shall be cut after galvanizing and shall be well lubricated or greased. All other threads shall be cut before galvanizing. The bolt threads shall be under-cut to take care of increase in diameter due to galvanizing. Rivet type arrangement shall not be used for any item.
- n) The mechanical strength of the insulator hardware strings shall be as under:
 - i) 400 Single suspension string (with straight / Drop clamp) for Single/Twin/Quad Conductors - 120 KN
 - ii) 220/33 KV Single suspension string (with straight / Drop clamp) for Single/Twin/Quad Conductors - 70 KN
 - iii) 400 KV Double suspension string (with straight / Drop clamp) for Single/Twin/Quad Conductors -120 KN per string
 - iv) 220/33 KV Single Tension string for Single/Twin/Quad Conductors -120 KN
 - v) 400 KV Double Tension string for Twin/Quad Conductors -120 KN per string

2.0 **LOCKING DEVICES:**

l) **SECURITY CLIPS**

- a) 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 III & 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.
- b) 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 energised conditions. The force required for pulling the clip into its unlocked position shall not be less than 50 N (5 Kgs) or more than 500 N (50 Kgs).

II) **SPLIT PINS**

The split pin to be used as locking device for Bolt and Nut shall be 'R' shaped hump type to prevent disengagement of Nut from the bolt. The split pin shall be of stainless steel grade AISI 304. The legs of the split pin shall allow for spreading after installation to prevent complete withdrawal from the bolt. The split pin shall be resilient, corrosion resistant and of sufficient mechanical strength. The dimensions of split pin shall conform to requirements given in IS:2486 (Part III & IV).

3.0 **BOLTS, NUTS AND PLAIN / SPRING WASHERS :**

- a) Bolts and nuts shall conform to latest edition of IS:1363, IS:1367, IS:2614 and IS:12427. The mechanical properties shall conform to class 8.8 and 5.6 for bolts and class 5 for nuts.
- b) Spring washers shall conform to latest edition of IS:3063, IS:6821 and IS:1586 and shall be electro-galvanized in accordance with IS:1573 (1986) service condition IV.
- c) Plain washers shall conform to IS:2016.

4.0 **COMPONENT ASSEMBLY:**

The insulator string hardware shall be in general conformity with the MSETCL drawings and each suspension and tension hardware set shall comprise of components indicated therein.

The manufacturer may however, offer any other suitable type of insulator hardware / component which is more efficient / suitable than the MSETCL standard drawing. However, in such a case the decision of MSETCL regarding suitability of the same for the intended purpose shall be final.

5.0 **GALVANIZING:**

- a) After all shop work is complete, all ferrous parts of hardware and accessories shall be hot dip galvanized in conformity with IS:2629 and IS: 2633. Before galvanization, the steel section shall be thoroughly cleaned of any paint, grease, rust, scale, acid/alkali or such other foreign matters as are likely to interfere with the galvanizing process or with the quality and durability of the zinc coating. Pickling shall be very carefully done and shall be proper.
- b) The zinc used for galvanizing shall be of grade Zn 98 (% of zinc \geq 99.95%) as per IS:209. The mass of zinc coating on various components shall be as follows:

Sr. No.	Thickness of steel article	Mass of zinc coating	Thickness of zinc coating
1)	5 mm and above	610 gm/m ²	86 microns
2)	Below 5 mm	460 gm/m ²	64 microns
3)	Fasteners	300 gm/m ²	42 microns
4)	Spring washers	272 gm/m ²	38 microns

1 gm/m² = 0.14 Microns

- c) The galvanized surface shall consist of continuous and uniformly thick coating of zinc, firmly adhering to the surface of steel. The finished surface shall be clean and smooth and shall be free from defects like discolored patches, bare spots, unevenness of coating, spelter which is loosely attached to the steel, globules, spiky deposits, blistered surface, flaking or peeling off etc. The presence of any of these defects noticed on visual or microscopic inspection shall render the material liable to rejection.
- d) There shall be no flaking or loosening when struck squarely with a chisel faced hammer. The galvanized components shall withstand minimum **four** one minute dips in standard copper sulphate solution as per IS:2633.
- e) All bolts, nuts, plain washers etc. shall be hot dip galvanized conforming to IS 5358. Spring washers shall be electro-galvanized in accordance with IS 1573(1986) service condition IV. Excess spelter from bolts, nuts, etc. shall be removed by centrifugal spinning. Rethreading of bolts after galvanizing shall not be done. Nuts however, may be tapped, but this should not cause appreciable recking of the nuts on the bolts.

6.0 **RIGID SPACER (TWIN & QUADRUPAL):**

The spacer shall be manufactured in one piece without any loose parts, by gravity die casting from aluminium alloy grade 4600. In case any other material is used it shall be ensured that it is non-corrosive. All ferrous metal parts shall be galvanised conforming to IS:2633, 2629.

The spacer shall be of simple design. Installation of units shall be simple and achieved without use of special tools.

Spacer shall firmly grip the conductors without causing any damage to the conductor strands. Also it shall not be damaged when subjected to vibrations during service.

Spacer shall have sufficient resilience to allow longitudinal, vertical and torsional movements of the conductors relative to each other and shall maintain their correct separation, with no lubrication and maintenance, of 450 mm and 350 mm without any wear and tear.

No rubbing, other than conductor clamp hinges or clamp swing bolts, shall take place between any part of the spacer.

7.0 **EARTH WIRE ACCESSORIES**

Accessories suitable for 7/3.66 mm earthwire shall be offered.

1) **TENSION CLAMP**

Suitable **compression type** tension clamps shall be used to hold earthwire. 16 mm diameter anchor shackle shall be supplied which shall be suitable for attaching the tension clamp to strain plate. The anchor shackle shall be made of forged steel of Class IV grade by drop forging method and normalised. The same shall be smooth finished with rounding off the edges.

The clamp shall be made of Mild steel/Forged steel of class II grade for G.I. earthwire by drop forging method and normalized. The same shall be smooth finished with rounding off the edges and corners. The clamp shall also be provided with an aluminium cover and filler tube.

The tension clamp shall have a jumper plate, for attaching jumper terminal to it. The same shall be attached with 2xM12 size bolts, nuts and plain washers of mild steel and spring washer of spring steel. The length of one of the bolts shall be more than the other for connecting earth bond to the tower body.

The clamp shall have adequate area of bearing surface to ensure positive electrical and mechanical contact. The clamp shall not permit any slippage of earthwire under working tension and vibration. The electrical resistance of the clamp when compressed on the earthwire shall be less than 75% of measured resistance of equivalent length of earthwire. The slip strength of the assembly shall not be less than 95% of the ultimate tensile strength of the earthwire. The angle of jumper terminal shall be 30° with respect to the vertical line.

The clamp shall be complete with all the components including anchor shackle, bolt, nuts, washers, split pin, jumper arrangement etc.

2) **EARTH BOND**

The earth bond shall be made of E.C. grade (% of Copper \geq 99.8%) tinned flexible copper cable of size 37/7/0.417 mm with 8.757 mm diameter and copper area equivalent of 34 mm². Two tinned copper lugs having suitable holes for 12 mm & 16 mm diameter bolts shall be press jointed at either ends of the copper cable. One 45 mm long galvanised Mild Steel bolt with nut and plain, spring washer shall also be provided. This shall be suitable for providing proper bondage between earthwire, suspension/tension clamp and gantry. The pulloff load shall not be less than 300 kg.

8.0 **Type Tests:**

- a) Test Reports for all the type tests as specified in MSETCL Technical Specification, conducted within last 5 years from the date of opening of tender shall be submitted.
- b) In case, the tests have been conducted earlier than 5 years or if there is any change in the manufacturing process, material or design in the equipment

since after earlier passing of the type tests, the type test(s) shall be carried out, after award of contract, in presence of purchaser's representative, free of cost.

9.0 **Acceptance Tests:**

The following acceptance tests shall be conducted in presence of purchasers representative for the purpose of acceptance of a lot:

Sr. No.	Particulars of test	Reference standard
I)	Suspension hardwares:	
1)	Visual examination	As per MSETCL specification.
2)	Verification of Dimensions	
3)	Mechanical strength test on clamp and components	
4)	Mechanical strength test on Corona control rings	
5)	Mechanical strength test on welded joints	
6)	Galvanising/Electroplating test	
II)	Tension hardwares:	
1)	Visual examination	As per MSETCL specification.
2)	Verification of Dimensions	
3)	Mechanical strength test on components	
4)	Mechanical/slip strength test on dead end assembly	
5)	Mechanical strength test on Corona control rings	
6)	Mechanical strength test on welded joints	
7)	Galvanising/Electroplating test	
III)	Tests on locking devices(Security clip):	
1)	Verification of resistance to bending	As per IS:2486(IV)
2)	Hardness test	
3)	Operation test	
IV)	Conductor accessories:	
a)	Rigid Spacer	As per MSETCL specification.
1)	Visual examination	
2)	Verification of Dimensions	
3)	Clamp slip test	
4)	Clamp bolt torque test	
5)	Tension Compression test	

Sr. No.	Particulars of test	Reference standard
V)	Earthwire accessories:	
a)	Tension clamp	
1)	Visual examination	As per MSETCL specification.
2)	Verification of Dimensions	
3)	Mechanical strength test on components	
4)	Slip strength test on clamp	
5)	Hardness test	
6)	Galvanising/Electroplating test	
VI)	Earth Bond	
1)	Visual examination	As per MSETCL specification.
2)	Verification of Dimensions	
3)	Slip strength test	

9.0 **ROUTINE TESTS:**

This shall mean those tests, which are to be carried out on each item to check the requirements which are likely to vary during production. The same shall be as per relevant IS.

Insulators

- 1.1 The insulators shall be supplied as per technical details given in **ANNEXURE-I**. The insulators considered in the schedules are Anti fog type disc insulators. However rates for long rod insulators shall be quoted separately so that while placing LOA the Anti fog type disc insulators can be replace by long rod insulators if so desired by the owner.
- 2.2.2 Detailed dimensioned drawings of all material to be supplied by contractor shall be got approved by the contractor from owner before type testing of the same.
- 2.2.3 All material covered under contractor's scope of supply shall be satisfactorily type tested as per relevant standards in presence of owner's representatives before commencement of mass manufacturing.

GENERAL TECHNICAL REQUIREMENTS

1.0 SYSTEM PARAMETERS :-

Following are the salient parameters of the electrical and environmental systems:

a.	Nominal System Voltage	: 400/220/132/100 KV
b.	Frequency	: 50 Hz
c.	System highest voltage	: 420/245/145 KV
d.	Maximum ambient temperature	: 50 °C
e.	Minimum ambient temperature	: 0 °C
f.	Maximum daily average temperature	: 32 °C
g.	Maximum relative humidity (in %)	: 90
h.	Maximum annual rain fall (in mm)	: 1500 to 3800
i.	Number of rainy days/year	: 90
j.	Average number of thunder storm (days per annum)	: 50
k.	Pollution level category	: Moderately polluted as per IEC:71-2

ANNEXURE – I

TECHNICAL SPECIFICATION FOR PORCELAIN DISC /ANTIFOG/ LONGROD INSULATORS & GLASS DISC INSULATORS

1.0 GENERAL

This section details the technical particulars of Porcelain disc /Antifog/ Longrod insulators and Glass disc insulators for 132KV / 220 KV / 400 KV Transmission Lines. The Insulators shall conform in all respects to high standards of Engineering, design, workmanship and latest revisions of relevant standards.

Contractor may quote for disc insulator made of either electro-porcelain or toughened glass or porcelain longrod insulator.

2.0 STANDARDS APPLICABLE:

2.1 Except as modified in this specification, the insulators to be supplied shall conform to the latest version, with amendments thereof, of the following Bureau of Indian Standards and equivalent International Standards.

Sr. Indian No. 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 nominal voltage greater than 1000V	BS 137(I&II) IEC:274
4. IS: 2071 Part (I to III)	Method of High Voltage Testing	
5. IS: 2486	Specification for Insulator fittings for overhead power lines with a nominal voltage greater than 1000V	
Part I	General Requirements and Tests	BS: 3288
Part II	Dimensional Requirements	IEC: 120
Part III	Locking Devices	IEC: 372
Part IV	Tests for Locking Devices	IEC: 372
Sr. Indian	Title	International

No. Standard		Standard
6. IS: 2629	Recommended practice for Hot Dip Galvanization for iron and steel	
7. IS: 2633	Testing for Uniformity of Coating of Zinc coated articles	
8. IS: 3188	Dimensions for Disc Insulators	IEC: 305
9. IS: 6745	Determination of Weight of Zinc coating on Zinc coated iron and steel articles	
10. IS: 8263	Methods of RIV Test of HV Insulators	IEC: 437, NEMA Publication No. 107/1964 CISPR
11. IS: 8269	Methods for Switching impulse test on HV insulators	IEC: 506
12.	Thermal Mechanical performance test and mechanical performance test on string insulator units	IEC: 575
13.	Tests on insulators of Ceramic material or glass or glass for overhead lines with a nominal voltage greater than 1000V	IEC: 60383

2.2 Insulators conforming to any other International standards are also acceptable provided always that such standard are equivalent to or better than the corresponding standards specified in above. However, in such an event the salient points of comparison between the standards adopted and the standards quoted herein shall be detailed in the offer. One copy of authentic English version of such standards shall be submitted (in soft form) alongwith the offer.

3.0 GENERAL REQUIREMENTS:

- a) All raw materials to be used in the manufacture of 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.
- b) The design, manufacturing, process and material control at various stages shall 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.

- c) 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.
- d) The cap and pin 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 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.
- e) Insulator units after assembly shall be concentric and coaxial within limits as permitted by Indian/International standards.
- f) The insulator design shall be such that when units are coupled together to form a string, there shall be no contact between the shell of one unit and metal of the adjacent unit.
- g) 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 microscopically visible cracks, inclusions and voids.
- h) Cap, Pin shall not be manufactured by joining, welding, shrink fitting or by any other process from more than one piece of metal.
- i) The insulator design shall be such that the insulating medium shall not directly engage with hard metal. The surface of porcelain shall be coated with resilient paint to offset the effect of difference in thermal expansion of these materials.
- j) The porcelain longrod insulators shall have sheds of 'open aerodynamic profile' with good self cleaning properties. Insulator shed profile, spacing, projection etc. shall be strictly in accordance with the recommendations of IEC:60815.
- k) For 400 KV and 220 KV strings, the porcelain longrod insulators shall be supplied with intermediate ball pins and intermediate arcing horns.

4.0 DETAILS OF INSULATORS:

4.1 DISC INSULATORS:

- a) The insulator strings shall consist of standard discs for a three phase 50 Hz, effectively earthed 400 KV transmission system in a moderately polluted atmosphere. The discs shall be cap and pin, ball and socket type.

- b) The size of disc insulator, minimum creepage distance, the number to be used in different type of strings, their electromechanical strength; and mechanical strength of insulator string alongwith hardware fitting shall be as follows:

Type of String		Size of disc insulator (mm) of each	Minimum creepage distance (Nos.) disc (mm)	No. of standard discs string with	Mechanical strength of insulator H/W fitting (KN)
<u>400 KV</u>					
Single Suspension 'I' string/pilot string	(N)	255x145	320	23	120
	(AF)	280x145	430	23	120
Double Suspension 'I' string	(N)	255x145	320	2x23	240
	(AF)	280x145	430	2x23	240
Single Suspension 'V' string	(N)	280x170	320	2x23	210
	(AF)	280/305x170	430	2x23	210
Double Suspension 'V' string	(N)	280x170	320	2x2x23	420
	(AF)	280/305x170	430	2x2x23	420
Double Tension string	(N)	280x170	320	2x24	320
	(AF)	280/305x170	430	2x24	320
Quadruple Tension String	(N)	280x170	320	2x2x24	640
	(AF)	280/305x170	430	2x2x24	640
<u>220 KV</u>					
Single Suspension	(N)	255x145	320	14	70
	(AF)	280x145	430	14	70
Double Suspension	(N)	255x145	320	2x14	2x70
	(AF)	280x145	430	2X14	2X70
Type of String		Size of disc insulator (mm) of each disc (mm)	Minimum creepage distance (Nos.)	No. of standard discs string with H/W fitting	Mechanical strength of insulator
(KN)Single	N)	255x145	320	15	120

tension	(AF)	280x145	430	15	120
Double tension	(N)	255x145	320	2x15	2x120
	(AF)	280x145	430	2X15	2X120

132 KV

Single Suspension	(N)	255x145	320	9	70
	(AF)	280x145	430	9	70
Double Suspension	(N)	255x145	320	2x9	2x70
	(AF)	280x145	430	2X9	2X70
Single tension	(N)	255x145	320	10	120
	(AF)	280x145	430	10	120
Double tension	(N)	255x145	320	2x10	2x120
	(AF)	280x145	430	2X10	2X120

NOTE: Details applicable for strings required only be considered.

4.2 **LONGROD INSULATORS:**

- The insulator strings shall consist of standard longrod insulators for a three phase 50 Hz, effectively earthed 400 KV/220 KV/132 KV transmission system in a moderately polluted atmosphere. The insulators shall be cap and pin, ball and socket type.
- The length of longrod insulator, minimum creepage distance, the number to be used in different type of strings and mechanical strength of insulator string alongwith hardware fitting shall be as follows:

Type of String	Length of longrod insulator (mm)	Minimum creepage distance of each string (mm)	No. of units per string (Nos.)	Mechanical strength of insulator string with H/W fitting (KN)
----------------	----------------------------------	---	--------------------------------	---

400 KV

Single Suspension 'I' string	(N)	3335	7360	1x3	120
	(AF)	3335	9890	1x3	120

Type of String	Length of longrod insulator (mm)	Minimum creepage distance of each string (mm)	No. of units per string (Nos.)	Mechanical strength of insulator string with H/W fitting (KN)	
Double Susp-	(N)	3335	7360	2x3	240

ension 'I' string	(AF) 3335	9890	2x3	240
Single Susp- ension 'V' string	(N) 4075 (AF) 4075	7680 10320	2x3 2x3	210 210
Double Susp- ension 'V' string	(N) 4075 (AF) 4075	7680 10320	2x2x3 2x2x3	420 420
Double Tension string	(N) 4075 (AF) 4075	7680 10320	2x3 2x3	320 320
Quadruple Tension string	(N) 4075 (AF) 4075	7680 10320	2x2x3 2x2x3	640 640
<u>220 KV</u>				
Single Susp- ension	(N) 2030 (AF) 2030	4480 6020	2 2	70 70
Double Susp- ension	(N) 2030 (AF) 2030	4480 6020	2x2 2x2	140 140
Single tension	(N) 2175 (AF) 2175	4800 6450	2 2	120 120
Double tension	(N) 2175 (AF) 2175	4800 6450	2x2 2x2	240 240
<u>132 KV</u>				
Single Susp- ension	(N) 1305 (AF) 1305	2880 3870	1 1	70 70
Double Susp- ension	(N) 1305 (AF) 1305	2880 3870	1x2 1x2	70 70
Single tension	(N) 1450 (AF) 1450	3200 4300	1 1	120 120
Double tension	(N) 1450 (AF) 1450	3200 4300	1x2 1x2	240 240

NOTE: Details applicable for strings required only be considered.

- c) The electro-mechanical strength of individual disc/longrod in strings mentioned above are as follows:

Sr.	Type of String	Electro-Mechanical strength of
-----	----------------	--------------------------------

No.	individual disc/longrod insulator	
A)	<u>400 KV</u>	
1)	Single/Double Suspension 'I' string	120 KN
2)	Single Suspension 'Pilot' string	120 KN
3)	Single/Double Suspension 'V' string	160 KN
4)	Double Tension string	160 KN
5)	Quadruple Tension string	160 KN
B)	<u>220/132 KV</u>	
1)	Single/Double Suspension string	70 KN
2)	Single/Double Tension string	120 KN

NOTE: Details applicable for strings required only be considered.

5.0 DRAWINGS:

5.1 The bidder shall furnish outline drawings of disc insulator unit/longrod indicating all dimensions for scrutiny and approval. All drawings shall be neatly arranged, and all drafting and lettering shall be standard and legible. Dimensions shall be in SI units. The drawings shall give following information:

- 1) The bill of material indicating quantity and nature of material used for various parts.
- 2) Details like Ball and Socket designation, Maximum Axial & Radial Runout, Minimum & Protected Creepage distance, Colour of Glaze, Electro-mechanical strength, Identification mark and weight of insulator.
- 3) Electrical characteristics like One minute power frequency withstand and flashover voltage under dry and wet conditions, Lightning impulse withstand and flashover voltage, Switching surge impulse withstand voltage, Visible discharge and Radio Interference Voltage.
- 4) After award of contract, the bidder shall submit 3 sets of drawings to C.E.(Tr. Proj.), giving details as mentioned above, for scrutiny and approval. Once the drawings have been approved, no alteration or modification will be carried out without prior approval of the Purchaser.

6.0 SPECIFIC TECHNICAL REQUIREMENTS:

IA) NON-METALLIC PARTS (PORCELAIN)

a) 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, 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, zinc or dust. The manufacturing shall be by the wet process and impervious character obtained by thorough verification.

b) **PORCELAIN GLAZE**

Surfaces to come in contact with cement shall be made rough by sand 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 glaze shall be uniform throughout and the colour of glaze shall be brown. The glaze shall have a visible luster, shall be 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.

c) **FILLER MATERIAL**

Cement to be used, as a filler material shall be quick setting, fast curing port land 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.

IB) **NON-METALLIC PARTS (TOUGHENED GLASS)**

The glass used for the shells shall be sound, free from defects such as flaws, bubbles, inclusions etc. and be of uniform toughness over its entire surface. All exposed glass surfaces shall be smooth.

II) **METALLIC PARTS**

a) **BALL PINS / TWIN BALL PINS**

These shall be made of forged steel of grade EN-8D(BS:970)/CL-IV(IS:2004) or equivalent, by drop forging method and normalized. They shall not be manufactured by joining, welding, shrink fitting or by any other process from more than one piece of metal. The ball pins shall be free from forging defects.

The bidder shall specify the grade, composition and mechanical properties of steel used in manufacture of ball pin, in Quality Assurance Plan.

b) **METAL CAP**

The caps shall be cast from black heart malleable cast iron of grade BM 320 (IS: 14329) or equivalent and annealed. The caps shall be made in single piece and shall be free from casting defects like misran, cold shut etc.

The bidder shall specify the grade, composition and mechanical properties of steel used in manufacture of caps, in Quality Assurance Plan.

c) **INTERMEDIATE ARCING HORN**

For 220KV and 400 KV longrod insulators besides arcing horn on tower side of the hardware fittings, intermediate arcing horns alongwith fixtures and fasteners shall also necessarily be provided. The arcing horn shall be of mild steel tube.

d) **SECURITY CLIPS**

- i) These shall be made of Stainless Steel grade AISI 304/316 (ASTM A276) or Phosphor Bronze.
- ii) 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). 'W' type security clips are also acceptable. 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.
- iii) 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.
- iv) The force required for pulling the R-clip into its unlocked position shall not be less than 50 N (5 Kgs) or more than 500 N (50 Kgs).
- v) The force required for pulling the W-clip into its unlocked position shall not be less than 25 N (2.5 Kgs) or more than 250 N (25 Kgs).

7.0 GALVANISING:

- a) All ferrous parts shall be hot dip galvanized in accordance with IS: 2629 and IS: 2633. Before galvanization, the steel section shall be thoroughly cleaned of any paint, grease, rust, scale, acid/alkali or such other foreign matters as are likely to interfere with the galvanizing process or with the quality and durability of the zinc coating. Pickling shall be very carefully done and shall be proper.
- b) Before ball fittings are galvanized, all die flashing on the shank and on bearing surface of the ball shall be carefully removed without reducing the designed dimensional requirements.
- c) The zinc used for galvanizing shall be of grade Zn 98 (% of zinc \geq 99.95%) as per IS: 209. The mass of zinc coating shall not be less than 610 gm/m² (86 microns).
- d) The galvanized surface shall consist of continuous and uniformly thick coating of zinc, firmly adhering to the surface of steel. The finished surface shall be clean and smooth and shall be free from defects like discolored patches, bare spots, unevenness of coating, spelter which is loosely attached to the steel, globules, spiky deposits, blistered surface, flaking or peeling off etc. The presence of any of these defects noticed on visual or microscopic inspection shall render the material liable to rejection.
- e) There shall be no flaking or loosening when struck squarely with a chisel faced hammer. The galvanized components shall withstand minimum four one minute dips in standard copper sulphate solution as per IS: 2633.

- f) Defect in any component indicating presence of impurities in the galvanizing bath in quantities larger than that permitted by the specifications, or lack of quality control in any manner in the galvanizing plant, shall render the entire production in the relevant shift liable to rejection.

8.0 BALL AND SOCKET DESIGNATION:

The dimensions of ball and socket for 120 KN and 160 KN discs shall be 20 mm in accordance with the standard dimensions stated in IS: 2486 (Part II)/IEC:120.

9.0 INTERMEDIATE BALL PIN DESIGNATION:

The dimensions of intermediate ball pin shall be in accordance with standard dimensions stated in IEC:471.

10.0 DIMENSIONAL TOLERANCES:

a) DISC INSULATORS

The dimensions of the disc insulators shall be within the limits specified below:

	Standard	Maximum	Minimum
<u>Diameter of Disc</u> (in mm)			
120 KN (N)	255	266	244
120 KN (AF)	280	293	267
160 KN (N)	280	293	267
160 KN (AF)	280/305	293/318	267/292
<u>Ball to Ball Spacing between Discs</u> (in mm)			
120 KN (N, AF)	145	149	141
160 KN (N, AF)	170	175	165

b) LONGROD INSULATORS

The tolerance on all dimensions e.g. diameter, length and creepage distance shall be as follows:

$$\pm (0.04d + 1.5) \text{ mm when } d < 300 \text{ mm}$$

$$\pm (0.025d + 6) \text{ mm when } d > 300 \text{ mm}$$

where d stands for dimensions in millimeters for diameter, length or creepage distance as the case may be.

However, for creepage distance no negative tolerance shall be applicable.

11.0 INTERCHANGEABILITY:

The insulators inclusive of ball and socket fittings shall be of standard design suitable for use with hardware fittings of any make conforming to relevant Indian Standards.

12.0 CORONA AND RIV PERFORMANCE:

All surfaces shall be even, smooth, without cuts, abrasions or projections. No part shall be subjected to excessive localized pressure. The metal parts and porcelain shall not produce any noise-generating corona under all operating conditions. The insulators and metal parts shall be so designed and manufactured that it shall avoid local corona formation and not generate any radio interference beyond specified limit under operating conditions.

13.0 SUITABILITY FOR LIVE LINE MAINTENANCE:

- a) The insulators shall be compatible for use with hot line or live line maintenance techniques so that usual hot line operations can be carried out with ease, speed and safety.
- b) All insulators shall be designed to facilitate cleaning and insulators shall have minimum practical number of sheds and grooves. All grooves shall be so proportioned that any dust deposit can be removed without difficulty either by wiping with cloth or by remote washing under live line condition.

14.0 FREEDOM FROM DEFECTS:

Insulators shall have none of the following defects:

- a) Ball pin shake
- b) Cementing defects near the pin like small blowholes, hair cracks, lumps, etc.
- c) Sandfall defects on the surface of the insulator.

15.0 STRING CHARACTERISTICS:

The characteristic of the complete string shall be as follows:

Sr. No.	STRING TYPE ► PARTICULARS ▼		SUSPENSION			TENSION		
			400 KV	220 KV	132 KV	400 KV	220 KV	132 KV
1	Switching Surge Withstand Voltage (Dry & Wet) (KVp)	N	1050	--	--	1050	--	--
		AF	1050	--	--	1050	--	--
2	Dry Lightning Impulse Withstand Voltage (KVp)	N	1600	1050	650	1700	1050	675
		AF		1080	670		1110	690
3	50% Lightning Impulse flashover voltage (KVp)	N	1650	1100	680	1770	1100	710
		AF		1130	700		1125	720
4	Dry Power frequency withstand voltage (KV rms)	N	740	510	335	740	550	375
		AF		520	365		570	380
5	Wet Power frequency withstand voltage (KV rms)	N	690	460	300	690	500	350
		AF		480	330		520	360

6	Corona extinction Voltage (KV rms)	N	320	176	105	320	176	105
		AF	320	176	105	320	176	105
7	Maximum RIV for complete string Including corona Rings, arcing horns, clamps etc. at 1.1 times max. Line to Ground Voltage (μ V)	N	500	500	--	500	500	--
		AF	500	500	--	500	500	--
8	Maximum voltage across any disc	N	9%	13%	--	10%	13%	--
		AF	9%	13%	--	10%	13%	--

16.0 TESTS

16.1 TYPE TESTS:

- a) The bidder shall offer the Insulator that are already type tested within the last five years and manufactured by reputed manufacturer approved by MSETCL. In case the insulators are not type tested within last 5 (five) years as on the date of opening of bids, fresh type tests as specified hereunder shall be carried out in presence of purchaser's representative before supply of materials
- b) In case of manufacturers of foreign origin, reports for all the type tests specified under Clause No. 15.1.1 of this specification, conducted in internationally accredited laboratories (accreditation based on ISO/IEC vide 25/17025 or EN 45001 by the National accreditation body of the country where laboratory is located) or at the manufacturers works in presence of users representative can also be submitted alongwith the offer as evidence to establish the fulfillment of above requirement. However, in such a case all type tests as specified under clause No. 15.1.1 of this specification shall be organized by the successful bidder, after award of contract, in presence of Purchaser's representative, at the cost of bidder. The arrangement of journey of purchaser's representative (2 nos.) from his headquarter to the place of testing shall be made by the bidder at his cost.
- c) In case, the test(s) on insulator have been conducted earlier than 5 years, the respective type test(s) shall be carried out by the successful bidder, after award of contract, in presence of purchaser's representative, free of cost.
- d) If there is any change in manufacturing process or insulator design since after earlier passing of the type tests, all the type tests as specified under Clause No. 15.1.1 shall be carried out by the successful bidder, after award of contract, in presence of purchaser's representative, free of cost.

16.1.1. LIST OF TYPE TESTS

The list of type tests to be conducted is as follows:

I) On Disc/Longrod Insulator Unit:

Sr. No.	Particulars of test	Reference Standard
a)	Visual examination	} IS:731
b)	Verification of dimensions test	} IS: 731
c)	Thermal-Mechanical performance test	} IEC: 575 and } Annexure- a of } this specification
d)	Power frequency voltage flashover test	}
	i) Dry	} IEC:60383
	ii) Wet	}
e)	Lightning Impulse voltage withstand test (Dry)	} IEC: 60383
f)	50% Lightning Impulse voltage flashover test (Dry)	} IEC: 60383
g)	Visible Discharge test (Dry)	} IS:731
h)	Radio Interference Voltage test (Dry)	} IEC: 60437 & } Annex.- a of this } specification
i)	Residual strength test (On 160KN disc insulator only)	} As per Annex.- a } of this specification
Sr. No.	Particulars of test	Reference Standard
j)	Steep wave front test (On 160KN disc insulator only)	} As per Annexure - a } of this specification

II) On complete insulator string with hardware fittings:

- a) The type tests on 132KV and 220KV strings specified hereunder, shall be conducted on Single Suspension (1x70 KN) and Double tension (2x120 KN) insulator strings alongwith hardware fittings except for mechanical strength test which shall be conducted on all strings mentioned.

- b) The type tests on 400KV strings specified hereunder, shall be conducted on Single 'T' Suspension (1x120 KN) and Double tension (2x160 KN) insulator strings alongwith hardware fittings.

Sr. No.	Particulars of test	Reference Standard
A) <u>On 132KV String of 70KN & 120KN insulators</u>		
a)	Power frequency voltage withstand test i) Dry ii) Wet	} } } }
		IEC:60383
b)	Lightning Impulse voltage withstand test (Dry)	} }
		IEC:60383
c)	50% Lightning Impulse voltage flashover test (Dry)	} }
		IEC:60383
d)	Mechanical strength test on i) Single suspension string ii) Double suspension string iii) Single Tension string iv) Double Tension string	} } } } }
		As per Annexure-II of this specification
B) <u>On 220KV String of 70KN & 120KN insulators</u>		
a)	Power frequency voltage withstand test i) Dry ii) Wet	} } }
		IEC:60383
b)	Lightning Impulse voltage withstand test (Dry)	} }
		IEC:60383
c)	50% Lightning Impulse voltage flashover test (Dry)	} }
		IEC:60383
Sr. No.	Particulars of test	Reference Standard
d)	Voltage distribution test (For Disc insulator only)	} }
		IEC:60383
e)	RIV test under dry condition	} }
		As per Annexure-II of this specification
f)	Mechanical strength test on	}

- | | | |
|------------------------------|---|---|
| i) Single suspension string | } | As per Annexure-II
of this specification |
| ii) Double suspension string | } | |
| iii) Single Tension string | } | |
| iv) Double Tension string | } | |

C) On 400KV String of 120KN & 160KN insulators

I) On 1st sample

- | | | |
|---|---|---|
| a) Power frequency voltage withstand test with corona control/grading rings and arcing horn | } | IEC:60383 and
Annexure-a of
this specification |
| i) Dry | } | |
| ii) Wet | } | |
| b) Switching Surge voltage withstand test (Wet) | } | IEC:60383 and
Annexure-a of
this specification |
| | } | |
| c) Lightning Impulse voltage withstand test (Dry) | } | IEC:60383 and
Annexure-a of
this specification |
| | } | |
| d) 50% Lightning Impulse voltage flashover test (Dry) | } | IEC: 60383 and
Annexure-a of
this specification |
| | } | |
| e) Voltage distribution test | } | IEC: 383 and
Annexure-a of
this specification |
| | } | |
| f) Corona and RIV test under dry condition | } | As per Annexure - a
of this specification |
| | } | |
| g) Mechanical strength test | } | As per Annexure-a
of this specification |
| i) Single 'I' suspension string | } | |
| ii) Double Tension string | } | |

Sr. No.	Particulars of test	Reference Standard
II)	On 2nd sample	
h)	Dynamic test (Vibration test)	As per Annexure - a of this specification
III)	On 3rd sample	
i)	Time Load test	As per Annexure - a of this specification

16.2 ACCEPTANCE TESTS:

This shall mean those tests, which are to be carried out on samples taken from each lot offered for pre dispatch inspection for the purpose of acceptance of the lot.

16.2.1 LIST OF ACCEPTANCE TESTS:

The following acceptance tests shall be conducted on 70KN, 120KN and 160KN disc (Porcelain/Glass) / longrod insulators in presence of purchasers representative for the purpose of acceptance of a lot:

Sr. No.	Particulars of test	Reference Standard
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: 60575
f)	Test on locking device for ball and socket coupling	} IS: 2486(IV) }
g)	Eccentricity test (Axial & Radial Runout)	} IEC:60383/60168
h)	Electro-mechanical strength test	} IS: 731
i)	Puncture test (Only for Porcelain Disc insulators)	} IS: 731
j)	Porosity test (Only for Porcelain Disc insulators)	} IS: 731
k)	Thermal shock test (Only for Glass Disc insulators)	} IEC:60383
l)	Steep wave front test/Puncture test	} As per Annexure - a
Sr. No.	Particulars of test	Reference Standard
	(Only for Glass Disc insulators)	} of this specification
m)	Mechanical failing load Test (Only for Glass Disc insulators)	} As per Annexure - a } of this specification

n)	Power frequency voltage withstand test (Dry) (Only on Disc insulator)	}	IEC: 60383
o)	Mechanical strength test (On longrod insulator only)	}	IEC:60383-1

16.3 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.

16.3.1 LIST OF ROUTINE TESTS:

The following routine tests shall be conducted on each insulator and results certified by the manufacturer:

Sr. No.	Particulars of test		Reference Standard
a)	Visual Inspection	}	IS: 731
b)	Mechanical routine test	}	IS: 731
c)	Electrical routine test (For disc insulator only)	}	IEC: 60383
d)	Thermal shock routine test (for glass insulator only)	}	IEC: 60383
e)	Polarized Light Inspection (for glass insulator only)	}	As per Annexure - a of this specification

16.4 TESTS DURING MANUFACTURING:

Stage tests during manufacturing shall mean those tests, which are to be carried out during the process of manufacturing to ensure quality control such that the end product is of the designed quality conforming to the intent of this specification.

16.4.1 LIST OF TESTS DURING MANUFACTURING:

The following tests, including but not limited to, shall be conducted on raw and in process material during the process of manufacturing:

Sr. No.	Particulars of test		Reference Standard
a)	Fineness, Raw appearance, Fired appearance, Free Magnetic Iron content, Grain size, Chemical	}	Relevant Indian
	Analysis, Free Moisture Content on raw materials like Quartz Powder, Feldspar Powder, China Clay, Ball Clay etc.	}	/International/ Plant standard
b)	Raw appearance, Fired appearance, Chemical Analysis of Glaze material	}	Relevant Indian /International/

		} Plant standard
c)	Visual inspection, Grain size, Compressive Strength, Optimum water content, Initial and final setting time, Auto Clave Expansion of Cement	} } } } Relevant Indian /International/ Plant standard
d)	Hydraulic Pressure Proof load test, High Frequency test on Porcelain Shell	} } } Relevant Indian /International/ Plant standard
e)	Visual inspection, Dimension/Guage Checking, Chemical Analysis, Tensile Strength, Hardness, Grain size, Inclusion rating, Heat treatment, Magnetic Particle Inspection on ball pins	} } } } } As per Annexure - a of this specification
f)	Visual inspection, Dimension/ Guage Checking, Chemical Analysis, Tensile Strength, Hardness, Microstructure, Magnetic Particle Inspection on MCI caps	} } } } As per Annexure - a of this specification
g)	Visual inspection, Dimensional verification, Resistance to Bending, Operation test, Hardness test on Security Clip	} } } As per Annexure - a of this specification
h)	Chemical analysis of Zinc used for galvanizing	} } As per Annexure - a of this specification

17.0 TEST VALUES:

For all type and acceptance tests, the acceptance values shall be the values guaranteed by the Bidder in the guaranteed technical particulars or the acceptance value specified in this specification or the relevant standard whichever is more stringent for that particular test.

18.0 TEST PROCEDURE AND SAMPLING NORMS:

- a) The test procedure and sampling norms for carrying out type tests; acceptance tests and routine tests shall be as per reference standards specified under clause No. 15.0 of this specification.
- b) The test procedure and sampling norms for carrying out tests during manufacturing shall be as per relevant Indian/ International Standard where applicable and plant standard for others. The sampling norm for conducting tests on bought out items shall be as outlined in Annexure-a of this specification.
- c) The bidder shall furnish details regarding sampling norm and reference standard followed, in Quality Assurance Plan.

19.0 ADDITIONAL TESTS:

The Purchaser reserves the right for carrying out any other test(s) of a reasonable nature at the works of the supplier 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 himself that the material complies with the intent of this specification.

20.0 IDENTIFICATION MARK:

- a) The shell of each disc/longrod insulator shall be legibly and indelibly marked with the trade mark/name of the manufacturer, the month and year of manufacture, country of manufacture, guaranteed electro-mechanical strength in Kilo-Newton's abbreviated by 'KN' to facilitate easy identification and proper use. The marking shall be printed and not impressed and the same shall be applied before firing.
- b) The metal cap of each disc/longrod insulator shall bear the name of manufacturer by embossing. The identifying letters shall be at least 5 mm high. The characters shall be distinct, durable, and conspicuous after galvanizing.

21.0 INSPECTION:

- a) The work and materials covered by this specification shall be subject to inspection by the authorised representative of the Purchaser at manufacturer's/ sub-vendors work.
- b) Inspector shall have free access at all times to all parts of the shop where raw material is stacked, and where material is being manufactured and shall be provided with all reasonable facilities for inspection and tests. Equipments and instruments required for carrying out the tests shall be furnished by the manufacturer. No material shall be dispatched without inspection unless such inspection is waived in writing by Purchaser.
- c) Inspection by inspector or waiver of inspection shall neither relieve the manufacturer from the responsibility of supplying materials conforming to the requirements of this specification nor invalidate any claims which may be made because of defective or unsatisfactory material, workmanship, galvanizing etc.
- d) The correct grade and quality of raw material shall be used by the manufacturer. To ascertain the grade of material, the Purchaser may at his discretion get the material tested at an approved laboratory of his choice.
- e) The arrangement of journey (by air) of purchaser's representative (2 nos.) from his headquarter to the place of testing and boarding/lodging shall be made by the bidder at his cost.

22.0 PACKING & FORWARDING:

- a) All disc/longrod insulators shall be packed in strong seasoned wooden crates. The gross weight of the crates alongwith insulators shall not normally exceed 50 Kg for disc insulators and 65 Kg for longrod insulators to avoid handling problem.
- b) The packing shall be of sufficient strength to withstand rough handling during transit, storage at site and subsequent handling in the field.
- c) Suitable cushioning, protective padding, dunnage or spacers shall be provided to prevent damage or deformation during transit and handling.

- d) All packing cases shall be marked legibly and correctly so as to ensure safe arrival at their destination and avoid the possibility of goods being lost or wrongly despatched on account of faulty packing and faulty or illegible markings. Each wooden case/crate shall have all the markings stenciled on it in indelible ink.

23.0 GUARANTEED TECHNICAL PARTICULARS FOR INSULATORS:

The Guaranteed Technical Particulars for Insulators enclosed as SCHEDULE- "IIC" shall be duly filled in and submitted along with the offer.

SCHEDULE- IIC

A) GUARANTEED TECHNICAL PARTICULARS FOR UNIT DISC INSULATOR

Sr. No.	INSULATOR TYPE ► PARTICULARS ▼	70 KN (N)	70 KN (AF)	120 KN (N)	120 KN (AF)	160 KN (N)	120 KN (AF)
1)	Manufacturers name, address and country						
2)	Size and designation of Ball & Socket and standard to which it will conform (mm)						
3)	Outside diameter of disc (mm)						
4)	Spacing (mm)						
5)	Eccentricity of disc						
a)	Axial runout(mm)						
b)	Radial runout(mm)						
6)	Creepage distance of disc (mm)						
7)	Electro-mechanical strength of disc(KN)						
8)	Withstand voltage of disc						
8.1	Power frequency						

a)	Dry (kV rms)						
b)	Wet (kV rms)						
8.2	Impulse voltage (1.2/50 μ sec)						
a)	+ve (kV peak)						
b)	-ve (kV peak)						

Sr. No.	INSULATOR TYPE ►	70 KN (N)	70 KN (AF)	120 KN (N)	120 KN (AF)	160 KN (N)	120 KN (AF)
	PARTICULARS ▼						
9)	Flashover voltage of Disc						
9.1	Power frequency						
a)	Dry (kV rms)						
b)	Wet (kV rms)						
9.2	50% Lightning impulse voltage (1.2/50 μ sec)						
a)	+ve (kV peak)						
b)	-ve (kV peak)						
10)	Corona inception voltage (kV rms)						
11)	Corona extinction voltage (kV rms)						
12)	Max. RIV at 1 MHz and 10 KV AC (rms)						
13)	Weight of each disc (kgs)						

NOTE:1) Please furnish GTP, only for insulators mentioned in tender document.

Signature of the Bidder.....

Name.....

Designation.....

Date.....

Common authorized seal of the bidder.....

SCHEDULE- IIC

B) GUARANTEED TECHNICAL PARTICULARS FOR 132KV AND 220KV DISC / LONGROD INSULATOR STRING

Sr. No.	STRING TYPE ► PARTICULARS ▼	SINGLE SUSPENSION (70 KN)	DOUBLE SUSPENSION (2x70KN)	SINGLE TENSION (120KN)	DOUBLE TENSION (2x120 KN)
1)	No. of insulator discs per string				
2)	Withstand voltage of complete string				
2.1	Power frequency				
a)	Dry (kV rms)				
b)	Wet (kV rms)				
2.2	Impulse voltage (1.2/50 μ sec)				
a)	+ve (kV peak)				
b)	-ve (kV peak)				
3)	Flashover voltage of complete string				
3.1	Power frequency				
a)	Dry (kV rms)				
b)	Wet (kV rms)				
3.2	50% Lightning impulse voltage (1.2/50 μ sec)				
a)	+ve (kV peak)				
b)	-ve (kV peak)				

4)	Corona inception voltage (kV rms)				
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Sr. No.	STRING TYPE ►	SINGLE SUSPENSION (70 KN)	DOUBLE SUSPENSION (2x70KN)	SINGLE TENSION (120KN)	DOUBLE TENSION (2x120 KN)
	PARTICULARS ▼				
5)	Corona extinction voltage (kV rms)				
6)	Max. RIV for complete string including corona rings, arcing horns, clamps etc. at 1.1 times maximum line to ground voltage (in μ volts)				
7)	Max. voltage (%) across any disc in the string				
8)	Electromechanical strength of complete string (KN)				

- NOTE:** 1) Separate sheets to be filled in for each voltage class.
2) Please furnish GTP, only for insulators mentioned in tender document.

Signature of the Bidder.....

Name.....

Designation.....

Date.....

Common authorised seal of the bidder.....

SCHEDULE- IIC

C) GUARANTEED TECHNICAL PARTICULARS FOR 400 KV DISC / LONGROD INSULATOR STRING

Sr. No.	STRING TYPE ► PARTICULARS ▼	SINGLE"1" SUSPENSION (120 KN) N/AF	DOUBLE"1" " SUSPENSIO N (120KN) N/AF	QUAD TENSION (160KN) N/AF
1)	No. of insulator discs per string			
2)	Withstand voltage of complete string			
2.1	Power frequency			
a)	Dry (kV rms)			
b)	Wet (kV rms)			
2.2	Impulse voltage (1.2/50 μ sec)			
a)	+ve (kV peak)			
b)	-ve (kV peak)			
3)	Flashover voltage of complete string			
3.1	Power frequency			
a)	Dry (kV rms)			
b)	Wet (kV rms)			
3.2	50% Lightning impulse voltage (1.2/50 μ sec)			
a)	+ve (kV peak)			
b)	-ve (kV peak)			
4)	Corona inception voltage (kV rms)			

5)	Corona extinction voltage (kV rms)			
6)	Max. RIV for complete string including corona rings, arcing horns, clamps etc. at 1.1 times maximum line to ground voltage (in μ volts)			
7)	Max. voltage (%) across any disc in the string			
8)	Electromechanical strength of complete string (KN)			

Signature of the Bidder.....

Name.....

Designation.....

Date.....

Common authorized seal of the bidder.....

ANNEXURE – I(i)

TEST PROCEDURE

1.0 PROCEDURE FOR MOUNTING INDIVIDUAL DISC AND COMPLETE STRING FOR MEASUREMENT OF RIV, VOLTAGE DISTRIBUTION & VISIBLE DISCHARGE:

- a) The insulator unit or insulator string shall be suspended vertically by means of an earthed wire rope or other suitable means from a supporting structure. The distance between the upper most point of the insulator metal work and the supporting structure shall be not less than 1 meter. No other object shall be nearer to the insulator than 1 meter or 1.5 times the length of the insulator string, whichever is greater. A length of conductor in the form of a straight smooth metal rod or tube shall be attached to the lower integral fitting of the insulator unit or insulator string so that it lies in a horizontal plane and the distance from the lowest shed of porcelain part to the upper surface of the conductor shall be as short as possible but greater than 0.5 times the diameter of the lowest insulator.
- b) The diameter of the conductor shall be about 1.5% of the length of the insulator unit or insulator string with a minimum of 25 mm.
- c) The length of the conductor shall be at least 1.5 times that of the insulator unit or insulator string and it shall extend at least 1 meter on each side of the vertical axis.
- d) Precaution shall be taken to avoid flashover from the ends of the conductor.
- e) The test voltage shall be applied between the conductor and earth.

2.0 MOUNTING PROCEDURE FOR COMPLETE STRING FOR WET POWER FREQUENCY, WET SWITCHING SURGE AND DRY IMPULSE WITHSTAND TESTS:

- a) The insulator string shall be suspended vertically in an arrangement simulating a tower body and cross arm. The cross arm is simulated by a horizontal member, the insulator string being at one end and the vertical member simulating the tower body at the other. Both members and the link supporting the insulator string shall be earthed. The width of each member facing the insulator string shall be from 400 mm minimum to at least 20% of the length of the insulator string. The distance between the axis of the insulator string and the vertical member simulating the tower body shall be between 1.2 and 1.5 times the length of the insulator string. The distance between the upper most point of the insulator string and the lower part of the horizontal member simulating the cross arm shall be equal to about 300 mm. The member simulating the tower body shall extend to at least twice the length of the insulator string below the member simulating the tower cross arm.
- b) A bundle consisting of two/quad sub conductors in the form of straight smooth metal rods or tubes shall be attached to the lower integral fittings of the insulator

string at right angles to the cross arm. The two/quad sub conductors of the bundle shall be maintained parallel by means of horizontal spacers, the sub conductor spacing shall be equal to about one tenth of the length of the insulator string. The bundle shall extend approximately for the length of the insulator string on each side of the axis of the insulator string and diameter of each sub conductor shall be between 0.75% and 1.25% of the length of insulator string. To avoid spark over from the two ends of the bundle, each end shall be protected by means of a suitable device (for instance by means of metal ring). The height of the conductor above ground shall be equal to about 1.5 times the length of the insulator string but not less than 6 meters.

- c) The test voltage shall be applied between the conductor bundle and earth, the H.V. connection being made at one end of the conductor bundle.
- d) During the test, no object other than those described in this clause shall be nearer to the live end of the insulator string than 1.5 times the length of string.
- e) The insulator string shall be complete with those parts, which are considered necessarily associated with the string and are specified as such by the manufacturer.

3.0 TESTING PROCEDURE FOR DYNAMIC TEST (VIBRATION TEST):

Complete string is to be subjected to aeolian vibrations by suitable arrangement, while keeping the tension at every day stress (e.d.s). The string shall be vibrated at frequencies and double amplitude as already agreed between purchaser and supplier for 10 million cycles. After 5 million cycles, the string shall be rotated through 90 in horizontal plane. For 'V'/T suspension string & quad tension string, the e.d.s. will be 4600 kgs per conductor. All discs shall be thoroughly checked for any damage, cracks, loosening of pins/caps. Thereafter, all the discs will be subjected to electrical routine test, electro mechanical failing load test and porosity test. The string shall be deemed to have passed the dynamic test if it withstands all these tests.

4.0 TESTING PROCEDURE FOR WET POWER FREQUENCY WITHSTAND TEST :(As per IEC: 60383/IS: 731)

- a) The insulator string shall be mounted as per mounting arrangement given above in Clause 2.0.
- b) The characteristics of artificial rain shall be in accordance with Clause 3.3 of IS 2071 (Part-I).
- c) The test voltage to be applied to the insulator string shall be the wet power frequency withstands voltage adjusted for atmospheric conditions at the time of test.
- d) A voltage of about 75% of the test voltage so determined shall be applied and then increased gradually with a rate of rise of about 2% of this voltage per second.

The test voltage at full value shall be maintained for one minute. No flashover or puncture shall occur during this period.

5.0 TESTING PROCEDURE FOR WET SWITCHING SURGE WITHSTAND TEST: (As per IEC: 60381/IS: 731)

- a) The insulator string shall be mounted as per mounting arrangement given above (Clause 2.0). The impulse generator shall be adjusted to produce a 250/2500 μ second impulse wave. Impulse waves of both positive and negative polarity shall be used. Wet tests shall be made under the conditions prescribed in specified standards.
- b) The withstand test shall be performed at a specified switching impulse voltage with application of corrections for atmospheric conditions. Fifteen impulses shall be applied to the insulator string under test. If the number of flashovers on the external insulation does not exceed two, the insulator string shall be deemed to have complied with this test requirement.
- c) The insulators shall not be damaged by the test but slight marks on the surface of the insulating parts or chipping of the cement or other material used for assembly is permitted.

6.0 TESTING PROCEDURE FOR DRY LIGHTNING IMPULSE VOLTAGE WITHSTAND TEST: (As per IEC: 60383/IS: 731)

- a) The insulator string shall be arranged as per mounting arrangement given above (Clause 2.0). Impulse waves of both positive and negative polarity shall be used. However, when it is evident which polarity will give the lowest flashover voltage it will suffice to test with that polarity.
- b) The impulse generator shall be adjusted to produce a standard 1.2/50 μ second impulse wave of a value equal to the specified value of the impulse withstand voltage corrected for atmospheric conditions.
- c) Five such impulses shall be applied. If there is no flashover or puncture, the insulator shall be considered to have passed the test. If during the application of these five impulses, puncture occurs or if there is more than one flashover, the insulator shall be considered to have failed to comply with the test requirement. If only one flashover occurs, a new series of ten impulses shall be applied. The insulator will be considered to have passed the test only if during this new series of impulses there is no flashover or puncture.
- d) The insulators shall not be damaged by the test but slight marks on the surface of the insulating parts or chipping of the cement or other material used for assembly is permitted.

7.0 TESTING PROCEDURE FOR MECHANICAL STRENGTH TEST ON STRING:

- a) The complete disc/longrod insulator string consisting of number of units as stipulated alongwith its hardware fitting excluding arcing horn, corona control ring/grading ring and suspension/dead end assembly shall be mounted in the Tensile Testing Machine.

- b) The assembly shall then be subjected to a tensile load equal to 50% of the specified minimum ultimate tensile strength (UTS) which shall be increased at a steady rate to 67% of the minimum UTS specified. This load shall be maintained on the string for five minutes and then removed. After removal of the load the string shall be unloaded and dismantled with hand or small hand tools and the string components shall be inspected for visual deformation. Should any difficulty be experienced in dismantling and re-assembling the string with hand or small hand tool and/or if there is any visual deformation caused by the application of the above load, the string shall be deemed to have failed in this test.
- c) If the string can be re-assembled, it shall again be mounted in the tensile testing machine and loaded up to 50% of UTS and the load shall be further increased at a steady rate till the specified minimum UTS is reached and held there for one minute. No fracture should occur during this period. The applied load shall then be increased until the failing load is reached and the value recorded. The string shall be deemed to have passed the test if the breakage occurs at a load not lower than guaranteed E&M strength.

8.0 TESTING PROCEDURE FOR TIME LOAD TEST:

- a) The insulator string shall first be subjected to 5 minutes power frequency routine test. After successful completion of this test, the insulator string shall be mounted vertically/horizontally and subjected to a load equal to 66% of the specified mechanical strength for duration of 24 hours.
- b) After the completion of above period if the string is found to be intact on visual examination, it shall again be subjected to 5 minutes power frequency routine test. The string shall be deemed to have passed the time load test if it successfully withstands 5 minutes power frequency routine test.

9.0 TESTING PROCEDURE FOR 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 so as to give a total of 100% distribution. The voltage across any disc shall not exceed the specified values.

10.0 TESTING PROCEDURE FOR 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 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.

11.0 TESTS ON INDIVIDUAL DISCS:

11.1 VISUAL EXAMINATION:

- a) Visual examination shall be made at random on the lot of insulators. The color of the insulator shall approximate to the color specified. Some variation of color shade is permitted and shall not justify rejection of the insulator. The insulator shall be free from physical distortion of shape within tolerance specified. Defects such as looseness of pins/caps, cracks etc. in the metal part shall be checked.
- b) The area specified as glazed on the drawing shall be covered by a smooth hard glaze, free from cracks and other defects prejudicial to satisfactory performance in service.
- c) Out of the areas specified as glazed on the drawing the total area not covered by glaze shall not exceed.

$$1 + \frac{DF}{2000} \text{ cm}^2$$

Also the area of any single glaze defect shall not exceed:

$$0.5 + \frac{DF}{20000} \text{ cm}^2$$

Where:

D is the greatest diameter of the insulator in cm.

F is the creepage distance of the insulator in cm.

11.2 VERIFICATION OF DIMENSIONS:

The dimension of the insulator shall be checked with the approved drawing. Unless otherwise specified, the tolerance in the diameter shall be:

$\pm (0.04D + 1.5)$ mm for D less than or equal to 300 mm and
 $\pm (0.03D + 6)$ mm for D more than 300 mm.

Where: **D** = Specified insulator diameter in mm.

The tolerance in spacing shall be $\pm (0.03S + 0.3)$ mm.

Where: **S** = Specified insulator spacing in mm.

11.3 ECCENTRICITY TEST (AXIAL RUNOUT & RADIAL RUNOUT):

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 petticoat. 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 the maximum and minimum position of the slider reached on the scale are found out. The difference between the above readings shall satisfy the guaranteed value for radial run out.

11.4 DRY LIGHTNING IMPULSE VOLTAGE WITHSTAND TEST:

Please refer to Clause No. 6.0 for Testing Procedure.

11.5 WET POWER FREQUENCY WITHSTAND TEST:

Please refer to Clause No. 4.0 for Testing procedure.

11.6 RADIO INTERFERENCE VOLTAGE TEST :(As per IS 8263)

- a) Insulator string or insulators shall be mounted as per mounting arrangement given above (Clause 1). As radio interference level may be affected by fibres or dust setting on the insulator, the insulators may be wiped with a clean cloth before taking a measurement. The atmospheric conditions during tests shall be recorded. It is not known what correction factors apply to radio interference testing, but it is known that test may be sensitive to high relative humidity exceeding 80%.
- b) The test circuits may be either NEMA-107 or as per Fig.1 of IS: 8263. The measuring set shall be tuned to 1MHz + 10% frequency and the results shall be expressed as dB above 1 μ volt across a resistance of 300 Ohm.
- c) A voltage of 10% higher than the specified test voltage shall be applied to the object under test and maintained for at least 5 minutes. The voltage shall then be decreased by steps down to 30% of the specified test voltage, raised again by steps to the initial value and finally decreased by steps to the 30% value. At each step, a radio interference level as recorded during third run v/s the applied voltage shall be plotted.

The curve so obtained is the radio interference characteristics of the insulator. Each voltage step shall be approximately 10% of the specified test voltage.

- d) The insulator unit passes the radio interference test if the radio interference level at the specified test voltage, as read from the radio interference characteristic, does not exceed the specified radio interference level. Furthermore, no sudden increase shall be found on the radio interference characteristic between the specified test voltage and 1.1 times the specified test voltage. Because of high variability, it is preferable to make radio interference measurements on a number of insulators. The radio interference characteristic is the mean corona obtained after taking into account all measurements made on insulators of one type.

11.7 TEST PROCEDURE FOR THERMAL-MECHANICAL PERFORMANCE TEST (As per IEC 575)

The test shall be conducted on string of 5 or 10 or 15 units.

- a) This test has an initial stage of thermal cycles together with mechanical loading and unloading and a concluding stage of testing the insulator units to failure. Such a failing load test constitutes the basis of the thermal mechanical performance test in judging the test results.
- b) During the initial stage of test, the insulator units shall be subjected to four 24 hours cycles of cooling and heating and to a tensile load equal to 60% of the specified electro-mechanical failing load. The tensile load shall be applied to the insulator units at room temperature before starting the first thermal cycle.
- c) Each 24 hours cycle shall comprise a cooling to $-30 \pm 5^{\circ}\text{C}$ and a heating to $+40 \pm 5^{\circ}\text{C}$. The temperature limits for temporary range of 40°C may be suitably changed where the prevailing conditions so require. The temperature sequence shall be first cooling, then heating. The temperature equipment shall be such as to permit keeping of minimum and maximum temperatures each for at least four consecutive hours of the temperature cycle.
- d) The tensile load shall be completely removed and reapplied towards the end of each heating period, the last one excepted.
- e) On completion of the fourth 24 hours cycle and cooling to room temperature the tensile load shall be removed on the same day. After this load removal, the insulator units shall be subjected individually to an electromechanical strength test.
- f) The performance of insulator unit will be determined by comparison of the failing load values and the fracture pattern obtained during the electromechanical strength test.

11.8 RESIDUAL STRENGTH TEST

The test shall be conducted in accordance with clause No. 4.4 and 4.5 of IEC: 797 proceeded by temperature cycle test. The sample size shall be 25 and the evaluation of results and acceptance criteria shall be as per Clause No. 4.6 of IEC: 797.

11.9 POLARISED LIGHT INSPECTION (Only for Glass Disc Insulator)

The disc insulator shall be held over a polarised light source and the stress lines viewed thereon. There shall be no uneven stress distribution in the toughened glass insulators. This shall be carried out on 100% glass shells.

11.10 STEEP WAVE FRONT TEST (Only for Glass Disc Insulator)

Following test shall be performed on 10 insulator units in case of disc insulators selected at random from the lot offered for inspection.

- a) Each insulator unit shall be subjected to five successive positive and negative impulse flashovers with a wave having minimum effective rate of rise of 2500 kV per microseconds.
- b) Each unit shall then be subjected to three dry power frequency voltage flashovers.

Acceptance Criteria

An insulator shall be deemed to have met the requirement of this test if, having been successfully subjected to the ten impulse flashovers, the arithmetic mean of the three subsequent dry power frequency voltage flashover values equals or exceeds 95% of the rated dry power frequency flashover voltage.

An insulator shall be deemed to have failed to meet the requirement of above testing if,

(a) It has not flash over when the oscillogram or peak voltage indicator shows a marked reduction in voltage.

or

(b) Any one of the subsequent three dry power frequency voltage flashover value is less than 80% of the value specified.

In case of failure of any one unit either in the steep wave front or subsequent low frequency voltage test, above tests shall be conducted on double number of units.

11.11 MECHANICAL FAILING LOAD TEST

The test shall be performed in accordance with clause No. 18 and 19 of IEC 383 with the following acceptance criteria:

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

Where

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

R = Rated electro-mechanical / mechanical failing load.

S = Standard deviation.

(ii) The minimum sample size shall be taken as 20 for disc insulators units and 5 for long rod units. However, for larger lot size, IEC 591 shall be applicable.

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

12.0 HYDRAULIC INTERNAL PRESSURE TEST ON SHELLS:

The test shall be carried out on 100% disc insulator shells before assembly. The insulator should withstand required pressure for the preset time of one second (min.) without breaking.

13.0 HIGH FREQUENCY TEST ON SHELLS:

The test shall be carried out on 100% disc insulator shells before assembly. The insulators should withstand applied High Frequency voltage for 5 minutes without puncture.

A) **TESTS ON BOUGHT-OUT ITEMS:**

1) **Forged Components (Ball Pins):**

- a) Visual inspection: All material (100% samples) shall be visually checked for forging defects and general appearance.
- b) Dimensional check: At random check of not less than 1 sample per lot. The acceptance norm shall be dimensions as per drawing.
- c) Guage Check: The test shall be conducted on 100% samples with 'GO' and 'NO GO' gauges. The acceptance norm shall be dimensions as per approved drawing/relevant IS.
- d) Normalising: Time temperature chart/Graph from output of recorder shall be verified. The same shall conform to required standard.
- e) Hardness test: The test shall be conducted on minimum of 2 samples per lot of 1000 nos. The acceptance norm shall be hardness as per IS:1500/175-210 BHN.
- f) Grain Size: The test shall be conducted on minimum of 2 samples per lot of 1000 nos. The acceptance norm shall be grain size of 6 microns and above (ASTM No. 6 and above).
- g) Inclusion rating: The test shall be conducted as per IS: 4163 on minimum of 1 sample per lot of 1000 nos. The acceptance norm shall be inclusion rating of ASTM 2 thick series or less.
- h) Chemical analysis: The test shall be conducted on minimum of 1 sample per lot per heat no. The acceptance norm shall be chemical composition as per BS: 970 for EN-8D steel or equivalent.
- i) Failing Load test: At random check of not less than 2 samples per lot of 1000 nos. The sample shall be subjected to proof load limit and held for one minute. The load shall be released and there shall not be any crack or permanent deformation. Thereafter, the sample shall be subjected to further loading up to its recommended breaking load and actual breaking load shall be noted.
- j) Magnetic Particle Examination: The test shall be conducted on 100% samples as per IS: 3703 for detection of longitudinal and transverse cracks. There shall not be any surface or sub-surface cracks.

2) **Malleable Cast Iron Cap:**

- a) Visual inspection: All material (100% samples) shall be visually checked for freedom from casting defects and identification mark. The surface shall be free from casting defects and shall be cleanly fettled. The cap shall bear identification mark of the manufacturer.

- b) Dimensional check: At random check of not less than 1 sample per lot of 1000 nos. The acceptance norm shall be dimensions as per drawing.
- c) Guage Check: The test shall be conducted on 100% samples with 'GO' and 'NO GO' gauges. The acceptance norm shall be dimensions as per approved drawing/relevant IS.
- d) Hardness test: The test shall be conducted on minimum of 2 samples per lot of 1000 nos. The acceptance norm shall be hardness as per IS:2108/150 BHN max.
- e) Chemical analysis: The test shall be conducted on minimum of 1 sample per 5000 nos. The acceptance norm shall be chemical composition confirming to grade BM:320 or equivalent.
- f) Failing Load test: At random check of not less than 2 samples per lot of 1000 nos. The sample shall be subjected to proof load limit and held for one minute. The load shall be released and there shall not be any crack or permanent deformation. Thereafter, the sample shall be subjected to further loading upto its recommended breaking load and actual breaking load shall be noted.
- g) Magnetic Particle Examination: The test shall be conducted on 100% samples as per IS:3703 for detection of longitudinal and transverse cracks. There shall not be any surface or sub-surface cracks.

3) **Security clip:**

- a) Visual inspection: All material (100% samples) samples shall be inspected for corrosion and surface irregularities. The acceptance norm shall be as per IS:3063.
- b) Dimensional check: At random check of not less than 1% sample per lot. The acceptance norm shall be dimensions as per IEC: 372/ IS: 2486(IV).
- c) Resistance to bending: At random check of not less than 1 sample per lot. The acceptance norm shall be as per IEC: 372/IS: 2486(IV).
- d) Operation test: At random check of not less than 1 sample per lot. The acceptance norm shall be as per IEC: 372/IS: 2486(IV).
- e) Hardness test: At random check of not less than 2 samples per lot. The acceptance norm shall be hardness not less than 152 BHN for R-clip and 143 BHN for W-clip.
- f) Chemical analysis: At random check of not less than 1 sample per lot. The acceptance norm shall be chemical composition confirming to AISI: 304/316 grade as per ASTM A 276.

B) **Hot Dip Galvanized components:**

I) **Test on Raw material**

- 1) Chemical analysis of Zinc: At random check of not less than one sample per lot. The acceptance norm shall be grade Zn98 (% of zinc > 99.95%) as per IS: 209.

II) **Galvanizing checking:**

- 1) Visual inspection: All material (100% samples) shall be visually checked as per IS: 2629. The finished surface shall be clean, smooth and shall be free from defects like discoloured patches, bare spots, unevenness of coating, spelter which is loosely attached to the steel, globules, spiky deposits, blistered surface, flaking or peeling off etc.
- 2) Uniformity of zinc coating: At random check of not less than 2 samples per lot. The test shall be conducted as per IS: 2633 and the samples shall withstand minimum 4 dips of 1 minute each in standard CuSO₄ solution without showing signs of red deposits of copper.
- 3) Thickness of zinc coating: At random check of not less than 1 sample per lot. The acceptance norm shall be thickness of coating not less than 610 gms/mm².
- 4) Adherence of zinc coating: At random check of not less than 2 samples per lot. There shall be no flaking or loosening when struck squarely with a chisel faced hammer.

References:-

**1) TENDER NO. MSETCL/CO/C&M/CONTRACTS-II/Line/T-1326
(Consider for 0.4 & 0.2 ACSR Zebra / Panther Hardware accessories
& insulators)**

**2)TENDER FOR SE/EHV CC/T-08/2012-13
(Consider for 0.5 ACSR Moose Hardware accessories)**

**LILO on 220kv Chitegaon - Chittimpalgaon Line for JSW Limited at DMIC BIDKIN
from Loc. No. 03 of Proposed Diversion Line**

Detailed Survey						
Sr. No.	Loc. No.	Tower Type	Deviation Angle	Span in MTR	Remarks	
1	EXI Loc. No. 03	MDN + 9			LLO Tower Loc. No. 03 of Proposed Diversion Line	
2	Prop-1	D+6		28	D/END	
3	Prop-2	CTT + 3		110		
4	Prop-3	D + 3		90		
5	Prop-4	D + 3	44°00'00"LT	266		
6	Prop-5	D + 0		130	Road Crossing, Proposed 400kv PGCL Line Crossing	
7	Gantry			55	Gantry at Proposed 220kv S/s JSW Switchyard	
TOTAL				679 M		

Note : Proposed 400kv M/C PGCL line crossing between Loc. No.04 and 05 required to be provide Extension to their Loc. at this line crossing to maintain clearance between two lines.

Surveyor,
S & I Sub Division, MSETCL,
Chhatrapati Sambhaji Nagar


J. Engineer,
S & I Sub Division, MSETCL,
Chhatrapati Sambhaji Nagar

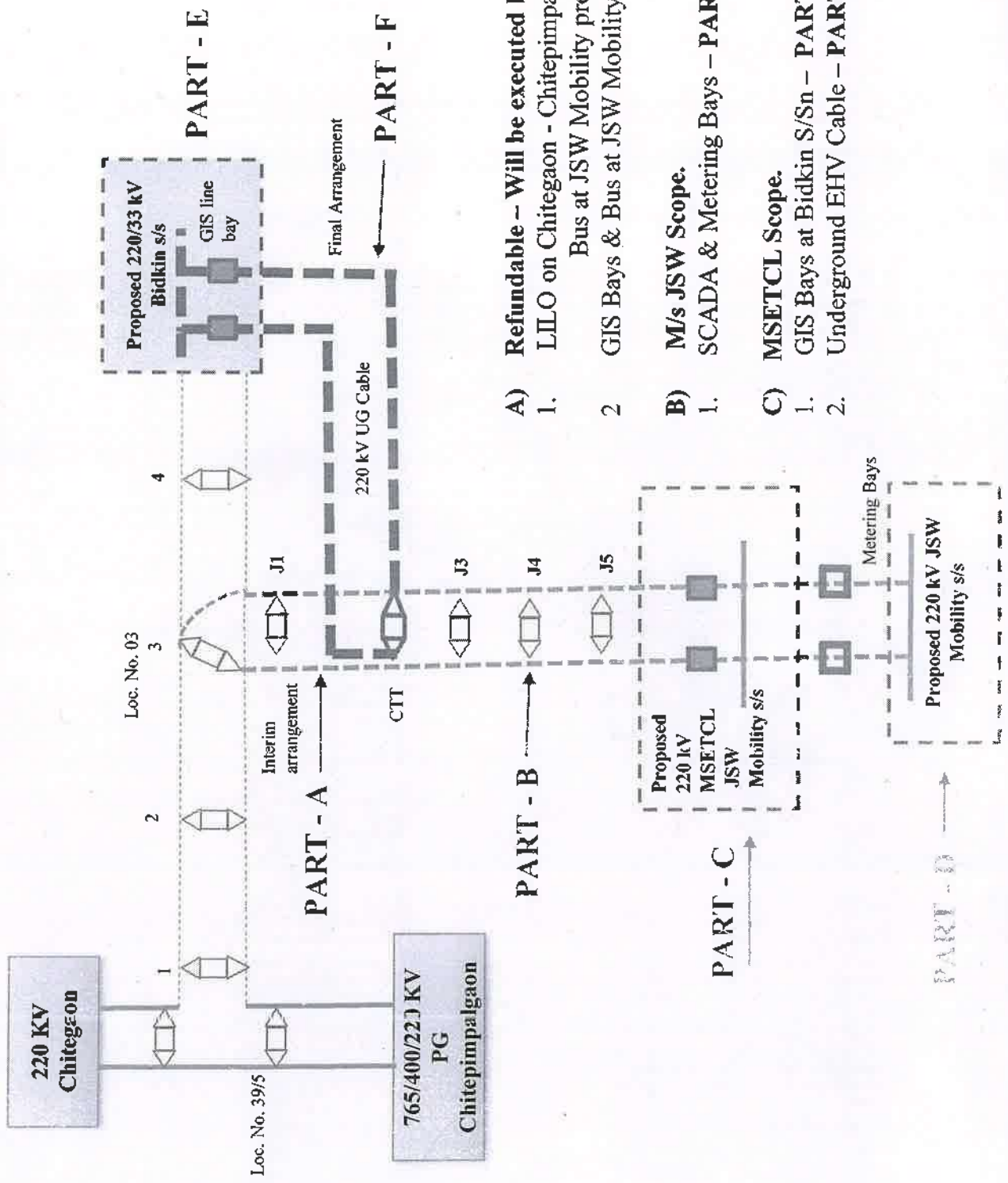
Asstt. Ex. Engineer,
S & I Sub Division, MSETCL,
Chhatrapati Sambhaji Nagar


Executive Engineer,
EHV Project Division,
Chhatrapati Sambhaji Nagar.

Chhatrapati Sambhaji Nagar.

NETWORK DIAGRAM

Power Supply arrangement to M/s JSW Mobility Ltd. for Power demand of 75 MVA from MITL at Sector - 22, Phase - II, Bidkin Industrial area, Ch. Sambhaji Nagar.



- A) Refundable - Will be executed by JSW / MITL.**
1. LLO on Chitegaon - Chitepimpalgaon line at MSETCL Bus at JSW Mobility premises - **PART - A & B**
 2. GIS Bays & Bus at JSW Mobility premises- **PART - C**
- B) M/s JSW Scope.**
1. SCADA & Metering Bays - **PART - D.**
- C) MSETCL Scope.**
1. GIS Bays at Bidkin S/Sn - **PART - E.**
 2. Underground EHV Cable - **PART - F**

MAHARASHTRA INDUSTRIAL TOWNSHIP LIMITED
(CIN No. U74999MH2014SGC260132)



Tender No. MITL/SBIA/2026-27/T-01

Work of LILO on 220KV Chitegaon - Chitepimpalgaon line at MSETCL Bus including Supply,erection,and commissioning of required Lattice Towers for Power Supply arrangement to JSW Mobility Ltd at Bidkin Industrial Area, Dist.Chh.Sambhajinagar.

BOOK III

PRICE SCHEDULE

LETTER OF PRICE BID

Date: [insert date of Bid submission]

To:

The Managing Director,
Maharashtra Industrial Township Limited
Udyog Sarathi, MIDC Office, Marol Industrial Area
Andheri (East), Mumbai – 400093
Maharashtra

We, the undersigned, declare that:

We have examined the Instructions to Bidders and Conditions of Contract, Employer's Requirements, Corrigendum Nos. and the matters set out in the Contract Data Sheet. We have understood and checked these documents and have not found any errors in them. We accordingly offer for **“Work of LILO on 220KV Chitegaon - Chitepimpalgaon line at MSETCL Bus including Supply,erection,and commissioning of required Lattice Towers for Power Supply arrangement to JSW Mobility Ltd at Bidkin Industrial Area, Dist.Chh.Sambhajinagar.”** and remedy any defects therein, fit for purpose in compliance with these documents and the enclosed proposal, for the fixed lump sum amount of Rs. _____[figure] (Indian Rupees.....only) or such other sums as may be determined in accordance with the Contract. The above amounts are in accordance with the Price Schedules herewith and are made a part of this tender. We also understand that total Lump sum amount quoted only shall be considered for deciding the award of contract.

- a) We agree to abide by the tender for the period of 180 (one hundred eighty) days from the date of opening of technical proposal, and it shall remain binding upon us and may be accepted at any time before the expiration of that period. We acknowledge that the Contract Data Sheet forms a part of this tender.
- b) If your tender is accepted, we will provide the specified performance security, commence the work as soon as reasonably possible after receiving the Employer's Letter of Acceptance and complete the Works in accordance with the above named documents within the time stated in the Contract Data Sheet.
- c) We understand that this Bid, together with your written acceptance thereof included in your Letter of Acceptance, shall constitute a binding contract between us, until a formal contract is prepared and executed.
- d) We understand that you are not bound to accept the lowest evaluated Bid or any other Bid that you may receive.

Name of the Bidder [insert complete name of person signing the Bid]

Name of the person duly authorized to sign the Bid on behalf of the Bidder***[insert complete name of person duly authorized to sign the Bid]

Title of the person signing the Bid [insert complete title of the person signing the Bid]

Signature of the person named above [insert signature of person whose name and capacity are shown above]

Date signed [insert date of signing] day of [insert month], [insert year]

*: This form is to be attached with Financial Proposal only.

***: Person signing the Bid shall have the power of attorney given by the Bidder to be attached with the Bid.

NOTE: Evaluation of Bid Price schedule will be basis on total amount including applicable taxes

Abstract - Estimate

Work of LILO on 220KV Chitegaon - Chitepimpalgaon line at MSETCL Bus including Supply,erection,and commissioning of required Lattice Towers for Power Supply arrangement to JSW Mobility Ltd at Bidkin Industrial Area, Dist.Chh.Sambhajinagar.

Sr. No.	Electrical cost(Line)	Part A w/o CTT (0.138 Km)	Part B with CTT (0.541 Km)
1	Tower Line Supply (Including of all taxes & duties) (Annexure A + Annexure B)		
2	Sub-Total-I		
3	Spare 1% on Sub-Total-I		
4	Sub-Total-II (Sr.No.2 + Sr.No.3)		
5	Tower Line ETC (Including of all taxes & duties) (Annexure C + Annexure D)		
6	Sub-Total-III (Sr.No.4+Sr.No.5)		
7	Total = Subtotal III		
8	<u>Grand Total Part A + Part B</u>		

PRICE SCHEDULE: QUOTED PRICE

**ANNEXURE - D
ERECTION PORTION PART B**

Work of LILO on 220KV Chitegaon - Chitepimpalgaon line at MSETCL Bus including Supply,erection,and commissioning of required Lattice Towers for Power Supply arrangement to JSW Mobility Ltd at Bidkin Industrial Area, Dist.Chh.Sambhajinagar.

Sr.No.	Item / Description	UoM	Quantity	Ex Works Unit Rate in Rs	Amount Excluding Taxes F= D X E	Labour Cess @1% G=E X 1%	GST @ 18% I = (E+G)*18%	Unit Rate including Taxes J= E+G+I	Total Amt in Rs. K= D X J
A	B	C	D	E	F	G	I	J	K
1	Check Survey - 220kV & Below Lines	KM	0.541						
2	Excavation of Pit (Nor Soil/sand/Gra/)	M3	67						
3	Excavation of Pit (BC/Submergd Soil)	M3	1201						
4	Excavation of Pit (Hard Murum/Soft Rock)	M3	67						
5	P&C in-situ CC 1:1.5:3(M-20)	M3	685						
6	TE: Casting in-situ CC M10	M3	39						
7	Steel Reinforcement for Tower	MT	38						
8	Stub Setting- 220kV 60° D/C Tower	EA	1						
9	Stub Setting- 220kV 60° D/C Tower+3m	EA	2						
10	Stub Setting- 220kV Special Tower	EA	1						
11	Pipe Earthing for Tower	EA	4						
12	Erection of Tower	MT	55						
13	Tack Welding of D/C Tower	EA	4						
14	Stringing 0.4 ACSR/AAAC 220kV D/C	KM	0.541						
15	Stringing 48C OPGW & FOAC	KM	0.541						
16	Dismantling of Tower incl. Transp.	MT	10						
17	Removal of Stub upto 1.5 m	EA	1						
18	Destring 220kV D/C for Sp. Crossing	KM	0.138						
Total									