MAHATRANSCO
Maharashtra State Electricity Transmission Co. Ltd.

ISO 9001-2000 certified

MAHARASHTRA STATE ELECTRICITY TRANSMISSION COMPANY LIMITED

TENDER. No. EE/EHVPD-I/PN/T/T-01/2020-21

Work Contract for S/C to D/C conversion of 132 kV Mundhwa tap point to 220 kV Magarpatta tap point by Supply of material, Foundation, Erection, associated de-stringing, re-stringing with Testing and Commissioning at Loc No. 23 with special design tower.

BOOK – I OF II

BOOK – I **General Terms and Conditions**

BOOK – II Technical Specifications for Line works.

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Tender Fees: Rs. 500/- + Taxes

C O N T E N T S

PREAMBLE

1.0 This specification covers the requirements associated with Work Contract for S/C to D/C conversion of 132 kV Mundhwa tap point to 220 kV Magarpatta tap point by Supply of material, Foundation, Erection, associated de-stringing, re-stringing with Testing and Commissioning at Loc No. 23 with special design tower. - 0.906 Km

Name of Project	Scope of work
Work Contract for S/C to D/C conversion of 132 kV Mundhwa tap point to 220 kV Magarpatta tap point by Supply of material, Foundation, Erection, associated de-stringing, re-stringing with Testing and Commissioning at Loc No. 23 with special design tower. - 0.906 Km	Supply, foundation, erection, de-stringing, re-stringing at Loc No. 23 with special design tower of 132 kV SC D/C Mundhwa tap point to 220 kV Magarpatta tap point

2.0 For ease of handling, this specification is divided into Four Books.

Book-I : General terms and conditions
Book-II : Technical Specifications for Electrical work for Line .

3.0 Commercial terms and conditions covered in Book-I are generally applicable for works against contract.

4.0 The quantities of items for supply as well as civil works & erection are purely tentative and based on estimate as per preliminary data. While awarding the contract, the quantities for supply, civil works and erection shall be worked out as per detailed inspection report. The contract value shall be decided on the basis of unit rates for supply, civil works and erection indicated in Price Schedule offered by the Bidder.

5.0 The offer shall be submitted with only essential particulars which are in line with the requirement of this specification.

SECTION II

GENERAL TERMS & CONDITIONS OF CONTRACT (GTC)

1.0 DEFINITION OF TERMS

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' shall mean the Maharashtra State Electricity Transmission Co. Ltd, Mumbai and shall include its 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 'Equipments' '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 (wherever applicable), testing, supply of equipment, materials erection, testing and commissioning of various equipment's of substation and lines 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 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 subcontractor for the performance of the works.

1.11 'Notice of Award of Contract'/'Letter of Award' (LOA) 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 there to 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 appropriable 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 LOA 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 the Engineer.

1.18 'Delivery period' shall mean the time period required from the date of handing over of site/Line profile 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 re-assembly 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 covered 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 including all associated activities of dismantling/re-erection etc. 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, Judgment, etc. is understood to be a function of the Owner/ Engineer.

1.25 'Drawings' 'Plans' shall mean all:-

a) Drawings furnished by the Owner as a basis 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 'Codes' shall mean the following, but not limited to including the latest amendments and/or replacements, if any:-

i) Indian Electricity Act 1910 / 2003, and Rules and Regulations made there under.

ii) Indian Factory Act, 1948 and Rules and Regulations made there under:

iii) A.S.M.E Test Codes.

iv) A.I.R.E. Test codes.

v) Standards of the Bureau of the Indian Standards 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 The scope of work will be broadly as under:
Work Contract for S/C to D/C conversion of 132 kV Mundhwa tap point to 220 kV Magarpatta tap point by Supply of material, Foundation, Erection, associated de-stringing, re-stringing with Testing and Commissioning at Loc No. 23 with special design tower. - 0.906 Km

3.2 The scope of work given above is only indicative and detailed scope is described in the bid documents.

4.0 CONTRACTOR TO INFORM HIMSELF FULLY

4.1 The Contractor shall be deemed to have satisfied himself as to all the conditions and circumstances affecting the contract price and as to the possibility of executing the works as shown and described in the contract. The Contractor shall be deemed to have inspected and examined the site and its surroundings, examined the approach roads etc., loading/unloading/ fabrication space etc. 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.

4.2 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.

4.3 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 fulfill his obligations under the contract.

5.0 CONTRACT DOCUMENTS

The term 'contract documents' shall mean and include the following which shall be deemed to form an integral part of the contract.

a) Bidding Document of the Owner, covering the instructions to Bidders, general terms and conditions of contract, special terms and conditions, technical specifications, annexure, schedules amendments etc.

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.

c) All the data/information of any sort given by the Contractor along with his bid, subject to the approval of the Owner/Engineer.

d) Any mutually agreed variations to the conditions of the documents, specifications terms and conditions of contract, if any.

6.0 PERFORMANCE GUARANTEE IN LIEU OF SECURITY DEPOSIT

6.1 The Performance Bank Guarantee for the proper fulfillment of the contract shall be furnished by the Contractor in the prescribed form within Thirty (30) days of Notice of Award of Contract/Letter of Award. The performance Guarantee shall be as per proforma attached (Schedule-E) to the Bid Document. This guarantee shall be for an amount equal to 10% (ten percent) of the contract price. BG should be payable at Pune. Any claim against said BG by MSETCL should be admissible by concerned bank for period of at least 6 months from the expiry of BG.

6.2 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."

6.3 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.

6.4 The Performance Guarantee shall be returned to the Contractor 90 days after the end of the guarantee 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 guarantee period.

6.5 The termination of the contract under the clause 30 ‘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.

6.6 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 10% of the value of increase in contract value, valid for period as indicated in sub clause 6.5

6.7 **After issue of the Notice of Award /Letter of Award of contract, if the contractor have not submitted the Performance Bank Guarantees within 60 days, the action of cancellation of Notice of Award/ Letter of Award will be initiated against the contractor and EMD Bank Guarantees will be forfeited.**

7.0 CONTRACT PRICE, TAXES & DUTIES

7.1 The lump sum prices (on firm price basis) 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, supply, transportation, loading/unloading, receipt and storage at site, inspection, erection, testing and commissioning of the works covered under this specification and documents, shall be treated as the Contract price. **The cost towards inspection as above at factory includes cost of travel including that of by Air, Hotel accommodation, etc. for at least 2 Engineers from MSETCL.**

7.2.1 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. No additional payment will be done over & above Bid price submitted.
Further, if Bid is separately quoting charges such as Freight, Insurance, Fees, Cesses, Octroi etc, owner shall be liable for payment of such items which are above Ex-works price only on basis of documentary evidences submitted bidder along with R.A. bills. If documents are not submitted, owner shall not entertain claims as mentioned above.

7.2.2 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.

7.3 The Bidder to furnish invariably break-up of the prices of taxes and duties on unit rate considered (for the items in BOM including ETC) in the bid in the prescribed Proforma.

7.4 The contract price shall include any cost or charges for obtaining any permits or license etc. wherever applicable.

7.5 The contract is to be treated as a works contract. The contract shall include all applicable taxes, duties cesses/fees etc. existing in India on the date of bid. The bidder shall note this point while quoting the prices against this invitation to bid.

8.0 PRICE ADJUSTMENT

8.1 Bidder shall, in his proposals, quote a base rate (such as ex-works price for supply of material and basic price for erection and civil works) which will be subject to price adjustment on account of variations in the cost elements during the period of the Contract. The price adjustment provisions detailed shall not be taken into consideration for the purpose of bid evaluation. The intent of the price adjustment provisions in the Bid Documents is to provide reasonable protection to the parties to the Contract against

fluctuations of the cost of materials, labour etc. during execution of the Contract and resulting in variation in the Contract Price.

8.2.1 The price variation will be applicable to the items as indicated in clause no 8.3 of Book I (GTC).

8.2.2 Price variation shall be given on Ex-works price mentioned in MSETCL's estimation cost or bidder's ex-works price whichever is less.

8.3 **PRICE VARIATION:**

Bids for the all the packages having completion schedule more than 6 months will be on variable price basis. Bids for all the packages having completion schedule equal to or less than 6 months will be on firm price basis.

8.3.1 For the purpose of calculation of price adjustment for substation/line:
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 bid will be the base indices for calculation of PV.

8.3.2 The formula for calculation of price variation will be as per IEEMA. For supply of materials (as specified under clause 8.3.4 below) and civil services (Erection). Latest revision of IEEMA. P.V. formula will be applicable.

8.3.3 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.

8.3.4 **Components for which PV is applicable**:

(i) Line equipment's: Structural steel & ACSR conductor

(ii) ETC works

8.4 The price variation will be evaluated as per latest IEEMA PV formula or otherwise as specified in the tender document.

8.5 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.

9.0 **PRICE VARIATION DUE TO VARIATION IN TAXES**

9.1.1 Variation in Statutory Taxes / Duties if any **will not be payable**. Therefore, price variation due to variation in taxes **is applicable for this tender.**

The taxes / duties will be paid / reimbursed as per actual OR as stated in Price break up statement whichever is lower on submission of valid documentary proof.

10.0 **ENGINEER'S SUPERVISION**

10.1 **ENGINEER'S INSTRUCTIONS:**

All instructions and orders to the Contractor shall, except as herein otherwise provided, be given by the Engineer.

10.2 **ENGINEER'S REPRESENTATIVE**

The Engineer 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.

10.3 **RESIDENT ENGINEERS**

10.3.1 Resident Engineer/Engineers shall mean the Engineer/Engineers to be appointed by the Owner to execute the works on the site. The Contractor shall afford him every reasonable facility for doing so 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.

10.3.2 The Engineer shall during the progress of the work, have following powers to order, in writing, from time to time.

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.

b) The substitution by proper and suitable material.

c) The removal and proper re-execution (not-with-standing 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.

d) Removal of materials obstructing the operation of existing station/equipments.

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.

11.0 SUPERVISION OF CONTRACTOR

The Contractor, upon award of the Contract shall, in addition to a Project Co-coordinator, 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 tendency 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.

12.0 ASSIGNMENT AND SUBLETTING OF CONTRACT

12.1 The Contractor shall not assign the contract or any part thereof or any benefit or interest therein or there under without the prior written consent of the Owner.

12.2 **The Contractor shall not sublet any part of the works without prior written consent of the Engineer / Owner.**

12.3 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 sub-contractor, his agents, servants or workmen as fully as if those were the acts, defaults, neglects of the Contractor, his agents, servants or workmen.

12.4 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. 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 subcontractor shall be subject to the approval of Engineer.

13.0 CONTRACT DRAWINGS

Line- The D/C standard towers (Broad base /Narrow base) drawings up to +9 mtr Extension & M/C Towers (broad base / Narrow base) up to +6 mtr extension along with their standard foundation drawings will be provided to the contractor by the C.E. (Des, C & M). There is no need for drawing approvals as well as inspection of items like conductor, regular tower material, hardware, earth wire, insulator & other accessories. Only tower above +9 mtr extension & special tower drawings & prototype assembly is required to be got approved from MSETCL Corporate office.

14.0 MISTAKES IN DRAWINGS

14.1 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 the drawings and information supplied by the Engineer.

14.2 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.

15.0 EFFECT AND JURISDICTION OF CONTRACT

15.1 The Contract shall be considered as having come into force from the date of the issue of Letter of Award by the Owner.

15.2 The laws applicable to this contract shall be the laws in force in India. The Courts of Pune shall have exclusive jurisdiction in all matters arising under this contract.

16.0 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. The metric system of measurement shall be used exclusively in the Contract.

17.0 PATENT RIGHTS & ROYALTIES

17.1 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.

17.2 The Contractor shall be responsible for the observance by his sub-contractors of the foregoing.

18.0 WORKMANSHIP & MATERIALS

18.1 The plant and/or the work shall be manufactured, constructed, provided, put in possession, carried out and maintained in all respects 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.

18.2 All materials used in the manufacture shall be high grade, free from defects and imperfection, recent manufacture & unused. Materials shall conform to the latest specifications of BIS, where applicable.

18.3 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.

19.0 PACKING, FORWARDING AND TRANSPORTATION ETC.

19.1 The Contractor shall be fully responsible for packing, forwarding, transportation by railways or any other authorized mode of transport, clearance of equipment and further transportation at site to place of works/storage yards etc, in respect of material in his scope/possession.

19.2 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.

19.3 The Contractor shall notify the Owner of date of each shipment from his/manufacturer'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.

19.4 The contractor shall also be fully responsible for safe transportation of owner supplied material to be issued from his stores by owner for the works against contract.

20.0 INSPECTION, TESTING & INSPECTION CERTIFICATE:

Line- There is no need for inspection of items like conductor, regular tower material, hardware, earth wire, insulator & other accessories. Only tower above +9 mtr extension & special tower drawings & prototype assembly is required to be got approved from MSETCL Corporate office.

21.0 DEMURRAGE AND WHARFAGE ETC.

When the equipments/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.

22.0 PROGRESS REPORT

The Contractor shall submit fortnightly reports to the engineer showing the progress of 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 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 equipments be lost or damaged due to improper packing, transport, handling, the contractor shall make best efforts to ensure that the replacement is arranged expeditiously so that commissioning schedule shall not be affected.

23.0 CO-ORDINATION MEETINGS

23.1 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.

23.2 The Contractor will also be called upon to attend to design coordination 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 cooperate with the engineer/owner and other agency involved during these discussions.

24.0 TIME: THE ESSENCE OF CONTRACT

24.1 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 organize his resources and perform his work as to complete it not later than the date agreed to.

24.2 The Contractor shall submit a detailed PERT network/ Bar chart and activity schedule 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 inter face 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 during finalization 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.

24.3 The above PERT network/bar chart shall be reviewed and periodic review reports shall be submitted by the contractor as directed by the Engineer.

25.0 **FORCE MAJEURE**

25.1 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 cause, notify the other party in writing of such cause with sufficient documentary proof.

25.2 **Not-with-standing any provision under clause 25.1, 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/execution.**

25.3 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.

25.4 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.

25.5 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 with-out any extra charge for storage for a reasonable time.

26.0 **EXTENSION OF TIME LIMIT FOR COMPLETION**

26.1 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 well in advance prior to schedule date of completion 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 herein above mentioned.

27.0 LIQUIDATED DAMAGES

27.1 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 in case the progress is not to the satisfaction of owner.

27.2 **The liquidated damages shall be levied at 1/2% (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 along with GST Extra as applicable**. In case of such maximum 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.

27.3 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.

28.0 TERMS OF PAYMENT

28.1 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 only. The final payment shall be made on completion of the whole work as per the contract and on fulfillment by the contractor of all his liabilities under the contract.

28.2 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.

28.3 PAYMENT SCHEDULE:

a) For supply of Material/Equipments:

i) 60% of the cost of supplied items will be paid within 60 days from the date of receipt at site.

ii) Balance 30% of the equipment cost shall be payable within 60 days from the date of erection of equipments

iii) The balance 10% of the cost of supply of material/equipment shall be payable within 60 days upon successful commissioning and either after finalization of levy of Liquidated

Damages (Time limit extension Proposal) or after retaining applicable amount of Liquidated damages if not retained previously.

b) For Erection, Testing & Commissioning (ETC) :

i) 90% of the charges towards ETC shall be paid within 60 days from the date of erection of equipment.

ii) Balance 10% shall be paid within 60 days from the date of successful commissioning of the works and either after finalization of levy of Liquidated Damages (Time limit extension Proposal) or after retaining applicable amount of Liquidated damages if not retained previously.

The invoice/bill for supply/works should be separately submitted. Along with details of GST paid to govt for previous invoices I.e. GST return & invoice wise summary if details as mentioned are not submitted, the amount to the tune of GST involved for those RA bills will be retained.

Note:- The **60 days** period indicated above for payments shall be reckoned from the date of successful clearance of verification of documents such as a) Commercial invoice (b) Excise invoice c) Delivery challan d) Endorsed RR/LR copy e) Pre-dispatch inspection report/letter f) Validity of PBG/ABG etc.

The 10% retention amount will be released in case of completion of full awarded scope of LOA / Work Order of Turnkey Contracts of Substation/line works, which cannot be commissioned due the reasons beyond the scope of the agency.

In such cases, the validity of Performance Bank Guarantee (PBG) shall be considered from the date of actual commissioning of project on rated voltage or fully commissioned as per scope. Consent for the same shall be taken from agency before release of the retention.

28.4 **Payment For Price Variation & Taxes**:

The payments of Price Variation claims shall be made within 60 days from the date of submission of claim with relevant documents in support of P.V. claims. The P.V. Bill shall be submitted by contractor against each lot and after monthly completion of works, duly certified by engineer In-charge of works.

28.4.1 All the above payment periods shall commence on the date of submission of the bills duly certified by Engineer in-charge and accompanied with relevant documents complete in all respects, supporting the claim(s) made.

28.4.2 The price variation will be applicable to the items as indicated in clause no 8.3.4 of Book-I (GTC).

28.4.3 Price variation shall be given on Ex-works price mentioned in MSETCL's estimation cost or bidder's ex-works price whichever is less.

28.4.4 The taxes / duties will be paid / reimbursed as per actual OR as stated in Price break up statement whichever is lower on submission of valid documentary proof.

28.5 **MODE OF PAYMENT TO CONTRACTOR**

All payments due to the contractor shall be paid only by 'Account Payee cheques' or by RTGS/NEFT.

28.6 The Contractor shall present every month his invoice for the supply/works done in the preceding month (R.A. Bills) and **final bill shall be submitted within Six months from date of commissioning of Project.** After verification of such invoices by Owner, all items having financial value shall be entered and certified in Owner's Measurement Book by the "Engineer" and the invoices prepared based on the same and connected technical documents which form part of this bid specification.

28.7 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.

28.8 If, at any time due to any reason whatsoever, it becomes necessary to re-measure the work done in full or in part, the expense towards such re-measurement shall be borne by the Contractor.

28.9 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.

28.10 The measurement entered in the measurement books and the bills prepared shall be signed and dated by both the contracting parties.

28.11 The Contractor will be intimated in writing by the Engineer the proposed date of measurement. If the Contractor does not turn up 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.

28.12 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.

28.13 The Contractor shall be directly responsible for payment of wages to his workmen. A pay roll 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.

28.14 The payment for the works shall be made directly to the Contractor by the Owner.

29.0 **DEDUCTION FROM CONTRACT PRICE**

All costs, 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 in form of letters 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.

30.0 CONTRACTOR'S DEFAULT

30.1 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.

30.2 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.

30.3 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.

30.4 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.

30.5 Such incidences, execution of clause no. 30.4 if exercised three (3) times for the project, the contractor shall be blacklisted from the participation in the future tenders of MSETCL for further three year.

31.0 TERMINATION OF CONTRACT

31.1 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 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.

31.2 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 & 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.

31.3 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.

31.4 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.

31.5 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.

32.0 REJECTION

32.1 In the event any of the 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 expense. 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 (b) terminate the contract for Contractor's default as provided for in the contract.

32.2 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.

33.0 DELAYS BY OWNER OR HIS AUTHORISED REPRESETATIVES

33.1 In case the Contractor's performance is delayed due to any act of omission on the 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.

33.2 **The Contractor desirous of extension of time for completion of work on this ground shall apply in writing to the Engineer at least 90 days (ninety 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.

34.0 MODIFICATION & RECTIFICATION

34.1 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 requirements, 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.

34.2 For the above work, any material and consumable required will also have to be arranged by the Contractor at his cost.

34.3 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.

35.0 COMPLETION OF CONTRACT

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.

36.0 ARBITRATION

36.1 The matters to be determined by the Chief Engineer (C.E.):

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 the C.E. and the C.E. shall (within 120 days) after receipt of the contractor's representation make and notify decisions of all matters referred to by the contractor in writing.

36.1.1 **Demand for Arbitration**:

In the event of any dispute or difference between the parties hereto as to the construction or operation of this contract, or the respective rights and liabilities of the parties on any matter in question, the dispute or difference on any account or as to the withholding by MSETCL of any certificate to which the contractor may claim to be entitled to, or if the C.E. 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 matters, shall demand in writing that the dispute or difference to be referred to arbitration.

36.1.2 The demand for arbitration shall specify the matters which are in question, or subject of the dispute or 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 or 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 Board.

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 Arbitral Tribunal.

c) The Board shall submit its defense 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.

36.1.3 No new claim shall be added during the proceedings by either party. However, a party may amend or supplement the original claim or defense thereof during the course of arbitration proceedings subject to acceptance by Tribunal having due regard to the delay in making it.

36.1.4 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 Board, that the final bill is ready for payment, he/they will be deemed to have waived his/their claim(s) and the Board shall be discharged and released of all liabilities under the contract in respect of these claims.

36.2 **Obligation during pendency of Arbitration :**

Work under the contract shall, unless otherwise directed by the Engineer, continue during the arbitration proceedings, and no payment due or payable by the Board shall be withheld on account of such proceedings, provided, however, it shall be open for Arbitral Tribunal to consider and decide whether or not such work should be continued during arbitration proceedings.

36.2.1 In cases where the total value of all claims in question added together does not exceed Rs. 1,00,00,000/- (Rupees One Crore) the Arbitral Tribunal shall consist of a Sole Arbitrator who shall be either not below the rank of C.E. serving or retired officer of the Government or equivalent to C.E. or a judicial officer retired not below the rank of Dist. Judge, nominated by the Chairman of the 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 MSETCL.

36.2.2 In cases where the value of the claim exceeds Rs. 1,00,00,000/- (Rupees One Crore) as above, the Arbitral Tribunal shall consist of a panel of 3 serving or retired officers of Govt. not below the rank of C.E./C.A.O. or a judicial officer retired not below the rank of Dist. Judge, as the Arbitrators. For this purpose, the MSETCL will send a panel of more than 3 names of arbitrators who may be either serving or retired Govt. officials, / judicial officer retired not below the rank of Dist. Judge, to the contractor who will be asked to suggest to the Chairman at least 2 names for appointment as contractor's nominee. The Chairman shall appoint at least one of them as contractor's nominee. The Chairman of MSETCL will also appoint the owner's/company nominee either from the panel or from outside the panel. Further above both the arbitrator nominated by the respective parties shall appoint the third arbitrator who shall act as presiding arbitrator. While nominating arbitrators, it will be necessary to ensure that one of them is or has worked in Accounts department.

36.2.3 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 Chairman fails to act without undue delay, the Chairman 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).

36.2.4 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.

36.2.5 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 Board'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.

36.2.6 Arbitral award shall state item wise, the sum and reasons upon which it is based.

36.2.7 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.

36.2.8 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.

36.2.9 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.

36.2.10 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.

36.2.11 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 Board 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.

36.2.12 MSETCL shall maintain a list of arbitrators. The Chairman 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.

36.2.13 The arbitral proceedings should be completed and the award be finalized within one year from the date of appointment of arbitrators.

36.2.14 Subject to the provisions as aforesaid, Arbitration & conciliation Act, 1996 and its amendment published on 01.01.2016 in The Gazette of India and the rules there under, and any statutory notification thereof shall apply to the arbitration proceedings under this clause.

37.0 SUSPENSION OF WORK

The Contractor shall, on the written order of the Engineer, suspend the progress of the 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 corresponding to the duration of the suspension of works.

38.0 TERMINATION OF CONTRACT ON OWNER'S INITIATIVE

38.1 The Owner reserves the right to terminate the Contract either in part or in full for reasons other than those covered 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.

38.2 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.

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

39.0 POWER TO VARY OR OMIT WORK

39.1 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.

39.2 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.

39.3 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.

39.4 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.

39.5 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.

39.6 Not-with-standing 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.

40.0 ENFORCEMENT OF TERMS

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.

41.0 ACCESS TO SITE AND WORKS ON SITE

41.1 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.

41.2 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.

42.0 LINES AND GRADES

42.1 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 he 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.

42.2 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.

42.3 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.

43.0 CONTRACTOR'S MATERIAL BROUGHT TO SITE

43.1 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.

43.2 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.

43.3 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.

44.0 CO-OPERATION WITH OTHER CONTRACTORS AND OWNER

44.1 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 minimise, 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.

44.2 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.

45.0 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 authorised agent shall be considered to have the same force and effect as if those had been given to the Contractor himself.

46.0 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.

47.0 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 here-in after 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.

48.0 EMPLOYMENT OF LABOUR

48.1 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.

48.2 All traveling 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.

48.3 The Contractor's employees shall wear identification badges while on work at site.

48.4 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), The building and other construction worker's welfare cess Act 1996** 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.

48.5 As far as possible, unskilled workers shall be engaged from the local area in which the work is being executed.

48.6 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 religious 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.

48.7 The Contractor, in the event of his engaging 20 or more workmen at the Project, shall obtain independent license under the Contract Labour (Regulation and Abolition) Act, from the concerned State Labour Authorities.

48.8 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.

48.9 The Contractor shall fulfill all his obligations in respect of accommodation including proper medical facilities for the personnel employed by him.

48.10 The Contractor shall submit to the Engineer, on the first day of 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.

49.0 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.

50.0 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 neighborhood of the works.

51.0 CLEANLINESS

51.1 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.

51.2 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.

51.3 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.

52.0 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.

53.0 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.

54.0 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 unfavorable 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 unfavorable construction conditions will in no way relieve the Contractor of his responsibility to perform the works as per the Schedule.

55.0 WORKS & SAFETY REGULATIONS

55.1 The Contractor shall ensure the safety of all the workmen, materials and equipment either belonging to him or to others working at site.

55.2 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.

55.3 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.

55.4 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.

55.5 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.

56.0 ELECTRICAL SAFETY REGULATIONS

56.1 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.

56.2 The Contractor shall employ the necessary number of qualified, full-time electricians to maintain his temporary electrical installation, wherever necessary.

57.0 INSURANCE

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.

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 or from United India Insurance Co. Ltd. (UIICL) on co-insurance cum servicing basis in the ratio of 40:60 (i.e. Govt. Insurance Fund @ 40% and UIICL @ 60%) under indirect method through their following designated offices :

1) Mumbai – D.O. Jainson Plaza, 201, S.V.Road, Malad (W), Mumbai-400 064 , phone no. 022-2888 6930,

2) Pune- D.O.-II, Gayatri Sadan, 2060, Vijaynagar Colony, Sadashiv Peth, Pune- 411 030, phone no. 020-2432 1003,

3) Vashi- D.O., Shanti Centre, Room no. 5/6/12, Sector-17, Vashi- 400 703,phone no. 022-2765 3215,

4) Nashik – D.O., Soubhagya Chambers, Bitco Point, Nashik Road, Nashik- 422 101, phone no. 0253-246 2237,

5) Karad- B.O., 50, Super Market, Near Mohite Hospital, Shanivar Peth, Karad, phone no. 02164-233 126 ,

6) Aurangabad – D.O.-I, H.No:5/5/76. V.P.No:506, V.P.Chowk, Aurangabad- 431 005, phone no. 0240- 233 4176 and

7) Nagpur- D.O.-III, Medical College Square, Opp. Mohta Petrol Pump, Nagpur- 440 009 , phone no. 0712- 274 4691.

The Nodal Officer, 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

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.

58.0 INDEMNIFICATION OF OWNER

58.1 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.

58.2 The Contractor shall necessarily indemnify the owner in all these respects and the indemnification and insurance policy shall be to the approval of Engineer.

58.3 The recommended value for the third party insurance policy to be taken by the Contractor are as follows:

a) Maximum liability for injury to any person. : Rs.5,00,000/-

b) Maximum liability for any one accident. : Rs.10,00,000/-

c) Maximum liability for total number of accidents during the contract period. : Rs.50,00,000/-

58.4 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.

59.0 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.

60.0 COMPREHENSIVE AUTOMOBILE INSURANCE

This insurance shall be in such a form to protect the Contractor against all claims for injuries, disability, 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 of the Ownership of such vehicles.

61.0 COMPREHENSIVE GENERAL LIABILITY INSURANCE

61.1 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 "Defense of Suits".

61.2 The hazards to be covered will pertain to all the works which and areas where the Contractor, his sub-contractors, his agents and his employees have to perform work pursuant to the contract.

61.3 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.

62.0 GUARANTEE/WARRANTY

62.1 **The Contractor shall guarantee/warranty that the 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 Three (3) years from the date of final commissioning of project**. Any defect developed due to defective materials and/or workmanship during testing and commissioning / performance of the works executed or **during the guarantee/warranty period of Three (3) years from the date of final commissioning of project** 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, transportation etc. shall be to the account of Contractor.

62.2 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 an emergency, wherein the judgment 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 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.

62.3 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 three year from the date of such replacement or renewal.

62.4 The acceptance of the works by the engineer shall in no way relieve the Contractor of his obligation under this clause.

62.5 If at any time during the guarantee/warranty 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.

62.6 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.

62.7 **The Contractor shall promptly provide adequate staff at site during the guarantee period to attend to defects, if any.**

63.0 **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 be 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 in whom the contract may become vested or (b) to give such receiver, liquidator or other person the option of carrying out the contract subject to his providing a guarantee for the due and faithful performance of the contract upto an amount to be agreed.

64.0 **NOTICES**

64.1 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).

64.2 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.

65.0 **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.

66.0 POLICY FOR BIDS UNDER CONSIDERATION

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.

67.0 EVALUATION CRITERIA:

67.1 As already stated elsewhere in this specification, prices are to be quoted in the relevant bid-proposal sheets. The evaluation shall be based on net total offer price of Supply, ETC & Civil work quoted by the bidder after loadings on account of discounts, taxes or any other additions / deletions.

68.0 MODE OF AWARD OF CONTRACT:

The contract is to be treated as a works contract. The contract shall include all applicable taxes, duties, cesses etc. in specification. The bidder shall note this point while quoting the prices against this invitation to bid.

69.0 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.

70.0 WITHDRAWAL OF INVITATION FOR 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 for bid at any time before its acceptance.

71.0 REPRESENTATIVE/AGENT OF BIDDER

71.1 All the bidders are requested to mention the name of their authorized representative / agent if any, with full address in the offer.

71.2 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.

SECTION-III

INSTRUCTIONS TO BIDDERS

1.0 GENERAL INSTRUCTIONS

1.1 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.

1.2 Owner reserves the right to accept any bid or reject any or all bids or cancel/withdraw Invitation for 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.

1.3 The new bidders are requested to complete the contractor registrations with MSETCL 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.

2.0 COST OF BIDDING

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.

3.0 UNDERSTANDING OF BID DOCUMENT

3.1 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.

3.2 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.

4.0 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 on MSETCL's website www.mahatransco.in and SRM e-Tender website https://srmetender.mahatransco.in only.

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.

5.0 BID PRICES AND CURRENCIES

5.1 The Bidders shall quote the prices inclusive of all Taxes & Duties, in the Price Schedule. Bidders quoting a system of pricing other than that so specified run the risk of rejection. The prices shall be quoted for items given in Price Schedule. The same shall only be considered for evaluation of the bid.

5.2 The bidders shall indicate the bid price in Indian Rupees only.

6.0 BID SECURITY DEPOSIT(BSD)

6.1 Notwithstanding whether the Bidder has already deposited a bank guarantee with the Owner, an amount of **1% of the estimated cost shall** be paid as BSD along with the offer in the form of Bank Guarantee, as per proforma enclosed/ online on SRM portal.

6.2 The BSD 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 BSD as specified.

6.3 The BSD will be valid for a period of 6 months from the date of opening of bid.

6.4 The request for paying BSD after opening of tender will not be considered. The BSD will be refunded only after the finalization of work order & submission of Application along with all details of payment for the unsuccessful bidder & for the successful bidder Bid Security Deposit will be refunded immediately after the payment of security deposit & submission of application along with all details of payment.
The BSD will be forfeited by the M.S.E.T.C.L.if…..

a) Tenderer withdraws the tender offer during validity.
b) The successful Tenderer fails to pay the security deposit within given period.
c) Bidder who submits Fake documents in support of Bid

6.5 Earnest money deposited will be refunded online through SRM System after approval from competent Authority. EMD will be credited to the bank account maintained by bidder in vendor Profile in SRM system. Bidders are requested to ensure that the bank details i.e. Account No., IFSC Code, Account Holder Name, Bank Name, Bank Address are correctly maintained in SRM System and update the same, if required.

Note:

1) **In case bank details are not maintained by the bidders in their SRM Vendor profile, EMD will not be refunded online and MSETCL will not be responsible for the delay.**

2) **MSETCL will not be responsible for any financial implications in case incorrect bank details are maintained by the bidders as it is the sole liability of the bidder to maintain correct bank details to facilitate online refund of EMD.**

7.0 **SIGNING OF BIDS:**

7.1 The Bid must contain the name and places 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 in ink only and signed by the bidder where required.

7.2 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).

7.3 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 authorised to bid on behalf of such Corporation/Company in the matter.

7.4 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.

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

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

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

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

8.0 **INFORMATION REQUIRED WITH THE BID:**

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

8.2 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.

8.3 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 contract if awarded.

8.4 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.

9.0 **VALIDITY OF BID**

Validity of the offer should be for a period of 6 months from the date of opening of price Bid.

10.0 **DOCUMENTS COMPRISING THE BID**

The Bidder should upload the bid on SRM e-Tender website of MSETCL https://srmetender.mahatransco.in. The documents to be uploaded are as mentioned below.

Techno-Commercial Bid should comprise of following documents

a) Bid Security in prescribed form on Stamp paper in accordance with Maharashtra Stamp Act 2015 (EMD/BSD BG).
b) Screenshot of tender document purchase Bank Transaction.
c) Documentary proof of meeting the Qualifying Requirements
d) Consortium agreement (in case of Consortium)
e) Power of Attorney of authorized person signing the Bid documents/contract agreement.
f) Form of deviation from specifications i.e., Schedule - A
g) Complete details regarding Financial, Technical and organizational capability/ structure etc. of the bidder shall be submitted for the assessment of the Owner. Only relevant information is to be furnished.
h) The statement of Networth duly certified by Chartered accountant clearly indicating in certificate that the figure are given on the basis of audited financial statements only. As per schedule 'D'
i) The statement of Annual Turnover duly certified by Chartered accountant clearly indicating in certificate that the figure are given on the basis of audited financial statements only. As per schedule 'C'
j) Audited annual accounts including balance sheets and other financial statements for past three financial years duly signed by Chartered accountant.
k) List of works in hand & percentage of works completed there of shall be given.

Note:- 1**) All pages should be numbered properly and indexed at starting page of the bid.**
2) All the uploaded documents should be as per qualifying requirement clause nos.

11.0 **SUBMISSION OF BIDS**

11.1 **The bidder should submit their offer online only by SRM e-tendering**

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

11.3 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 there-after be subjected to the dead line as extended.

11.4 Any bid received by the Owner after the deadline for submission of bids prescribed by the Owner in Clause of Section-I of this specification will be rejected and/or returned unopened to the Bidder.

11.5 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.

11.6 The Bidder's modification or withdrawal notice shall be prepared, sealed, marked and dispatched in accordance with the provisions of clause 11.0 through 11.2 above. A withdrawal notice may also be sent by telex or cable followed by a signed confirmation copy, post marked not later than the deadline for submission of bid.

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

11.8 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.

12.0 **CONTACTING THE OWNER:**

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

13.0 **MODE OF AWARD OF CONTRACT**

13.1 For Operational convenience, the contract shall be awarded to the successful bidder, as works contract for

(a) Equipment / Material Supply
(b) Service (Erection, Testing and commissioning)

14.0 **EVALUATION CRITERIA**

The bids shall be evaluated on the basis of total price including all the taxes, duties and levies as quoted for the package

(Ashok Madavi)
Executive Engineer
EHV Projects Division-I, Pune

SECTION IV : SCHEDULE - A to L

Sr. No.	Particulars	Schedule
1	Deviation from specification	A
2	Details of works executed for line	B
3	Details of annual turnover for last three years	C
4	Details of net worth	D
5	Performance security form (performance guarantee in lieu of security deposit)	E
6	Bid security form (bank guarantee in lieu of bid security equivalent to 1% of estimated cost)	F
7	Proforma of joint undertaking by the collaborator /associate alongwith the bidder	G
8	Proforma of indemnity bond to be executed by the contractor for the materials handed over in installments by MSETCL for performance of its contract	H
9	Undertaking by bidder to supply the equipments / materials conforming to GTP / Specification given in tender document and from the approved manufacturers / vendors of MSETCL	I
10	Undertaking by the bidders regarding type testing of the equipment	J
11	Agreement	K
12	ANNEXURE-G	L

SCHEDULE 'A'

DEVIATION FROM SPECIFICATION

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 : Clause No.	: Details of : deviation	: Justification/ : Reasons

Signature of the Bidder: _____

Name : _____

Designation : _____

Date : _____

Authorized Common Rubber Stamp/Seal of The Bidder : _____

SCHEDULE 'B'

Tender Specification No. :

Name of Project: :

Name of Bidder & Address :

DETAILS OF WORKS EXECUTED FOR LINE

TENDER SPECIFICATION NO.:
NAME OF PROJECT:
BIDDER'S NAME & ADDRESS:

The following is the list of orders executed by us for 220/132kV and above voltage transmission
line, the details of which are furnished in the support of Qualifying Requirement.

Sr. no	Customer	Order Ref. & Date	Order value (Rs. Lakhs)	Line Volt. (KV)	Total Line Length in Ckt. KM	Scope of Work					Date of commis-sioning
						Survey *	Profiling & spotting *	Tower Design*	Tower fon-dations & erection*	Stringing	
1	2	3	4	5	6	7	8	9	10	11	12

Remarks : 1)Copies of User's certificates should be enclosed.
2)Bidder is requested to indicate Yes/No regarding scope of work

Date
Place: SIGNATURE & SEAL OF THE BIDDER

SCHEDULE 'C'

Tender Specification No.

Name of Project:

Name of Bidder & Address:

DETAILS OF ANNUAL TURNOVER FOR LAST THREE YEARS

Sr.No.	Financial Year (Specify)	Annual Turnover (in Rs. Lakhs)
1		
2		
3		

Average Annual Turnover for last three financial years: Rs……Lakhs

Figures as mentioned above are taken on the basis of audited financial statement i.e. Balance sheet and profit & loss A/c.

NOTE: The above details should be duly certified by the Chartered Accountant and should be only in format as mentioned above, along with UDIN(Unique Document Identification Number).

Signature of the Bidder: _____

Name : _____

Designation : _____

Date : _____

Authorized Common Rubber Stamp/Seal of The Bidder : _____

SCHEDULE 'D'

Tender Specification No.

Name of Project:

Name of Bidder & Address:

DETAILS OF NET WORTH

Sr. No.	Financial Year	Equity Capital *	Reserves *	Revaluation Reserves *	Intangible assets *	Misc. Exp.to the extent not written off & carry forward lossess *	Net Worth *
1							

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

Figures as mentioned above are taken on the basis of audited financial statement i.e. Balance sheet and profit & loss A/c.

NOTE: The above details should be duly certified by the Chartered Accountant and should be only in format as mentioned above, along with UDIN(Unique Document Identification Number).

Signature of the Bidder: _____

Name : _____

Designation : _____
Date : _____

Authorized Common Rubber Stamp/Seal of The Bidder : _____

SCHEDULE 'E'
PERFORMANCE SECURITY FORM
(PERFORMANCE GUARANTEE IN LIEU OF SECURITY DEPOSIT)
(To be Stamped in accordance with Maharashtra Stamp Act)

The Bank of .....(Name & Address) hereby agree unequivocally and unconditionally to pay, at Pune within 48 hours, on demand in writing from the Maharashtra State Electricity Transmission Co. Ltd. or any Officer authorized by it in this behalf, of any amount up to and not exceeding Rs. ……..... (in Words) Rs..... to the said Electricity Transmission Co. Ltd on behalf of M/s..... who have tendered and/or contracted or may tender or contract hereafter for unit scope of works for the Maharashtra State Electricity Transmission Co. Ltd; against order No..... dated..... . Total value of order is Rs..... and the BG is payable at Pune.

This agreement shall be valid and binding on this Bank up to and including.....and shall not be terminable by notice or any change in the constitution of the Bank or the firm of contractors or by any other reasons whatsoever and our liability hereunder shall not be impaired or discharged by any extension of time or variations or alterations made, given, concerned or agree with or without our knowledge or consent, by or between parties to the said written contract. The validity of this Bank Guarantee will be extended by us for the further period, of six months, for period mentioned in communication by MSETCL one month prior to its present validity period at the request of Maharashtra State Electricity transmission Co. Ltd.

In case of any dispute arising out of or in connection the extension or encashment of Bank Guarantee, the courts in Pune will have jurisdiction.

Our liability under this Guarantee is restricted to 10% value of Contract Rs..... (Rs..... only). Our Guarantee shall remain in force until.....and claim against this BG with this bank will be valid, & admissible to this bank upto at least 6 months from expiry of this BG.

Date: Signature:.....……

Address: Name & Designation:.....……..

Fax no.:..... (For:.....……

(Banker's Rubber Seal)

WITNESS:

(Signature)

(Name)

(Official Address of branch with any official communication regarding this BG can be done

E-mail address:

SCHEDULE 'F'

BID SECURITY FORM
(BANK GUARANTEE IN LIEU OF BID SECURITY EQUIVALENT TO 1% OF ESTIMATED COST)

(To be Stamped in accordance with Maharashtra Stamp Act)

Ref.....

Date.....

Bank Guarantee No.....

In accordance with invitation to Bid for the Establishment of ….. KV substation/construction of ….. KV Line at……. in accordance with the contract specification _____ Messers (Bidders) _____ or Mr._____ Address _____ Director(s) _____wish/wishes to participate in the said tender and as a bank guarantee for the sum of Rs.....(in words Rs.....) as specified in the invitation to Bid valid for..... days from..... is required to be submitted by the tenderer, this bank hereby guarantees and undertakes, during the above said period, to immediately pay on written request by Maharashtra State Electricity Transmission Co. Ltd; Owner) the amount ..... to the said Electricity transmission Co. Ltd; without any reservations. This guarantee would remain valid upto 4 P.M. on..... (this date shall be 6 months after last date for submission of bid) and if any further extension to this is required, the same will be extended on receiving instructions from the .....on whose behalf this Guarantee has been issued. The BG is payable at Pune.

Witness: .....

(Signature)

(Signature)
(Name)

Mailing address including Fax No. H.O.of Bank

(Official Address)

(Seal of the Bank)

E-mail address:

SCHEDULE 'G'
PROFORMA OF JOINT UNDERTAKING BY THE COLLOBORATOR /ASSOCIATE ALONGWITH THE BIDDER

(On Non-judicial stamp paper of Appropriate value)

THE DEED OF UNDERTAKING executed this.....day of ..... (month) Two thousand ..... by a Company incorporated under the laws of ..... and having its registered office at..... (hereinafter called the collaborator"/"Associate" which expression shall include its successors, executors and permitted assigns) and "Bidder"/"Contractor" which expression shall include its Successors, executors and permitted assigns) in favour of Maharashtra State Electricity Transmission Co. Ltd: having its Registered office at Mumbai,(hereinafter called the "Owner" which expression shall include its successors, executors and assigns).

WHEREAS THE OWNER invited bids as per its specification TENDER NO. .....

AND WHEREAS clause 3.0 of Section I , Part-I interalia stipulates that the Bidder along with its Collaborator/ Associate must fulfill the qualifying requirements and be jointly and severally bound and responsible for the successful performance of the contract in the event the bid is accepted by the Owner resulting in a "Contract".

AND WHEREAS the bidder has submitted its bid to the Owner vide Proposal No..... dated ..... based on the Collaboration/Association of the Collaborator/ Associate.

NOW THEREFORE THIS UNDERTAKING WITNESSETH AS UNDER:

1) In consideration of the award of Contract by the Owner to Bidder (hereinafter referred to as the "Contract") we, the Collaborator/Associate and the Bidder/Contractor do hereby declare that we shall be jointly and severally bound unto the Maharashtra State Electricity Transmission Co. Ltd; (Owner) for the successful performance of the Contract and shall be fully responsible for the design, manufacture, erection, testing and commissioning including civil works and successful performance of the 220 kV -132 kV substations/Lines in accordance with contract specifications.

2) In case of any breach of the contract by the Contractor, we, the Collaborator/ Associate do hereby agree to be fully responsible for successful performance of the

Contract and undertake the Contract in order to discharge the Contractor's obligations stipulated in the contract. Further if the Owner suffers any loss or damage on account of any breach in the contract, we the Collaborator/ Associate and the Contractor jointly and severally undertake to pay such loss or damage to the Owner on its demand without any demur. This is without prejudice to any rights of the Owner against the Contractor under the contract and connected documents/guarantees. It shall not be necessary or obligatory for the Owner to proceed against individual Collaborator/ Associate before proceeding against the while dealing with the Contractor, nor any extension of the time or any relaxation by the Owner to the Contractor shall prejudice any rights of the Owner under the deed of undertaking against the Collaborator/ Associate or the Contractor.

3) Without in anyway affecting the generality and total responsibility in terms of this deed of Undertaking, the Collaborator/Associate in particular hereby agrees to depute their technical experts from time to time to contractors works/Owner's project site as mutually considered necessary by the Owner, Contractor and the Collaborator/ Associate to ensure proper design, manufacture, erection, testing and successful performance of the material package in accordance with contract specifications and if necessary the Collaborator/Associate shall advise the Contractor suitable modifications of designs and implement necessary corrective measures to discharge the obligations under the Contract.

4) The financial liability of the Collaborator/Associate to MSETCL (Owner) with respect to any and all claims arising out of the performance or non performance of the obligations set forth in this Deed of Undertaking read in conjunction with the relevant provisions of the contract, shall however, be limited to the extent of 100% price of the contract as established in the contract awarded by the Owner to the Contractor in terms of the Contract and this Deed of Undertaking.

5) This Deed of Undertaking shall be construed and interpreted in accordance with the laws of India and the courts in Pune shall have exclusive jurisdiction in all matters arising under the Undertaking.

6) As security, the Collaborator/Associate shall, apart from the Contractor's performance guarantee, furnish contract performance guarantee from its Bank in favor of the Owner in a form acceptable to it. The value of such guarantee shall be equal to 2% of the total contract value as established in the 'Contract' awarded by the Owner to the Contractor and it shall be part of guarantee towards the faithful performance/ compliance of this DEED OF UNDERTAKING in terms of the 'Contract'. The guarantee shall be unconditional, irrevocable and valid for the entire period of the Contract, namely till the end of the warranty of the works under the

Contract. The bank guarantee amount shall be payable to the Owner on demand without any reservation or demur.

7) We, the Collaborator, Associate and the Bidder/ Contractor agree that this undertaking shall be irrevocable and shall form an integral part of the contract and further agree that this Undertaking shall continue to be enforceable till the Owner discharges and it shall become operative from the effective date of the contract.

IN WITNESS WHEREOF the Collaborator/Associate and the Bidder/ Contractor have, through their authorized representatives, executed these presents and affixed common seal of their respective Companies, on the day, month and year first above mentioned.

WITNESS

1. .....For Collaborator/Associate
(Signature)

.....(Signature of Authorised Representative)
(Name)

.....……..
(Official Address) (Name)

.....
(Designation)

Common Seal of the Company

2. .....For Bidder/Contractor
(Signature)

.....…… ….....……
(Name in Block Letters) (Signature of the Authorized Representative)
....
(Official Address) (Name)

.....
(Designation)
Common Seal of the Company

SCHEDULE 'H'

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

(On non-Judicial stamp paper of appropriate value)

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 in ……..Maharashtra State. (hereinafter called the MSETCL which expression shall include its successors and assigns):

WHEREAS 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 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 MSETCL for the materials handed over to it by the 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 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 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 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 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-alias constitute a criminal breach or trust on the part of the Contractor for all intents and purposes including legal/penal consequences.

4.The 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 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 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 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 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 Docume-ment	Value of the Material receipt. ---------- RR/LR/ Carrier No.,date of bill/ Date of loading.	Signature of Attorney in token of

(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 authorized 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-I

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. ……..

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-J

SUPPLY OF MATERIALS AND CONSTRUCTION OF ……KV SUBSTATION/LINE AGAINST TENDER NO. T-……..

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 Bidder :

Name :

Designation :

:

Date :

Seal of the company :

SCHEDULE-K

AGREEMENT

This agreement made at_____on dt. Of _____ between _____ (hereafter called '**The contractor**' which expression shall unless excluded by or repugmant to the context include its successors or permitted assigns) of the one part and the Maharashtra state Electricity Transmission Co. Ltd. (hereafter called 'The company' which expression shall unless excluded by or repugmant to the context include its successors or permitted assigns) of the other part.

Whereas the _____ Invited E-tender according to the Powers held by him/her as per rules, for the work of _____

Opened on in accordance with the plans & specifications annexed thereto and whereas the said E-Tender was accepted by Maharashtra State Electricity Transmission Co. Ltd under ref._____Placed with said contractor on the terms and on the conditions specified in the E-tender/order and aforesaid work order letter of the company and on the conditions of the contract as specified in the tender and in the Booklet viz 'Tender/Works and Contract for works' of the Maharashtra State Electricity Transmission Co. Ltd with the tender

NOW THIS AGREEMENT WITNESS AND IT IS HEREBY AGREED AND DECLARED AS UNDER.

In consideration of the value of the (Work contract) viz. (Rs _____/-) placed with contractor on the terms and conditions specified in the contract. The contractor hereby covenants with the company that they shall and will duly provide and execute the work and shall do & perform all work and things in this contract mentioned and described or which implied there from or may reasonable be necessary for the completion of the said the work within and the same time and in the manner and subject to the terms and condition and stipulations contained in this contract and company shall pay to the contract.

The contractor shall undertake the work as mentioned and described in the contract as per specifications and tender/ order Accepted vide _____. And will complete the same in the stipulated period in accordance with specification and annexed.

The contractor shall complete the work as per terms and conditions specification in company vide ref._____. And Terms and conditions specified in the booklet viz.TENDER/ WORKS AND CONTRACTOR FOR WORKS" attached with the tender.

The Contractor shall indemnify the company for all claims of the injury caused to any person whether workmen or not while in or upon the works for the site and the company shall not be bound to defend any claims brought under the Workmen's compensation Act. And the contractor shall be liable for any such claims.

The company's aforesaid letter along with bid submitted by the contractor along with the plans and specifications and his acceptance Letter No. and the booklet viz, "TENDER/WORK AND CONTACT FOR WORKS" of the Maharashtra State Electricity Transmission Co. Ltd shall be deemed to be the part of this contract.

The said Paper as listed below signs

_____for and on behalf of the 'contractor' & _____ on behalf of the 'company'.

List of documents foming schedule hereto

1) The letter of acceptance/PO
2) Bid and appendix to bid form
3) Conditions of contract
4) Form of agreement
5) Scope of work
6) Technical specifications
7) Bill of quantities i.e. Schedule 'B'
8) Work schedule
9) Schedule of supplementary informations
10) Drawing

IN WITNESS THERE OF the parties hereto signed this agreement on the date respectively against the signature.

Signed and delivery by

Contractor(Name & sign)

Duly constituted attorney for and on behalf of the contractor in the presence of

	FullName	Signature
1)	_____	_____

2) _____ _____

Signed & Delivered by

SE MSETCL EHV Project Circle, Pune.

Maharashtra State Electricity Transmission Co. Ltd. On behalf Of

1)_____

Maharashtra State Electricity Transmission Co. Ltd on behalf of

2)_____

SCHEDULE-L

ANNEXURE-G

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

I/We hereby declare that I/We is/are participating in MSETCL's Tender No._____

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 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 the Firm

ISO 9001-2000 certified

MAHARASHTRA STATE ELECTRICITY TRANSMISSION COMPANY LIMITED

TENDER. No. EE/EHVPD-I/PN/T/T-01/2020-21

Work Contract for S/C to D/C conversion of 132 kV Mundhwa tap point to 220 kV Magarpatta tap point by Supply of material, Foundation, Erection, associated de-stringing, re-stringing with Testing and Commissioning at Loc No. 23 with special design tower.

BOOK – II OF II

BOOK – I General Terms and Conditions

BOOK - II **Technical Specifications for Line works.**

Email : ee6610@mahatransco.in

EXECUTIVE ENGINEER
EHV PROJECTS DIVISION-I,
3RD FLOOR, ADM. BUILDING,
925, KASABA PETH,
JUNA BAZAR ROAD, PUNE

PHONE : 020-24579223

Tender Fees: Rs. 500/- + Taxes

INDEX

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) 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, earthwire, insulstors, Insulator hardwares, accessories for conductor, 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 for 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 quantities for supply of items are tentative and may vary. The supply is to be effected as per actual requirement and supply effected limiting to order value. For increase in order value, the proposal for approval shall be submitted. You have to first approach concern field office for confirmation of material available with MSETCL and then place order with your manufacturer for balance material.** 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/0.2 AAAC/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 relevant standards listed in this specification.

3.2.2 The conductor accessories shall be suitable for 0.2 ACSR Panther/0.2 AAAC/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 insulators shall be supplied as per technical details given in **Annexure-VII**. The insulators considered in the schedules are disc insulators.

3.4 **Conductor, OPGW and Earth-wire**

Size of conductor required for the line:

0.2 ACSR Panther(for 132 KV)/0.2 AAAC (for 132 kV)/0.4 ACSR zebra conductor (for 220 kV) line.
Details of the OPGW for 220 kV line
48 Fibre G.652D Dual-window Single Mode OPGW, 11.7 mm dia

Size of earth wire required for the line:

7/3.15 mm G.S. wire (For 132 kV lines only)

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

Re-inforcing steel wire (galvanized) of ACSR/AAAC 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, G/S earthwire and OPGW shall conform to technical specification contained in **Annexure-VIII, IX and X** 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, OPGW and Earthwire as per technical details given in **Annexure-I,** shall also be procured by the contractor.

4.0 Quantity of Conductor and Earth-Wire

4.1 The contractor shall intimate the Owner the requirement of line materials based on final tower quantities for approval.

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.

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. The owner will provide all necessary co-operation required for obtaining the same and 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 co-operation 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 Award (LOA).

7.0 Completion period

7.1 All the EHV lines covered in this tender shall be completed within the period as mentioned in Book – I (including monsoon season) from the date of handing over of ground/route profile.

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 SST and foundation for towers

3. Supply of tower

4. Erection of towers

5. Supply of insulator hardwares & accessories for tower, Conductor, insulator and earthwire

6. Stringing of conductor & ground wire along with hoisting of insulators with hardwares & installation of accessories and tree cutting with clearing of site

7. 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 prices on percentage basis below/above on estimated price given in the Price Schedule '**SCHEDULE B (I) FOR EHV LINE**', enclosed with the Book-II

8.2 The unit prices & total costs shall be applicable for supply, erection, casting of foundation (including soil investigation) in various soils fixing of accessories for all types of towers as indicated in the Price Schedule 'H', enclosed with the Book-II. Quantity wise break up of probable types of soils for different types of towers is given in Price Schedule 'H', enclosed with the Book-II for the assessment purpose of the bidder. Type of earthings and foundation to be cast for any location will have to be got approved from the concerned engineer in charge at site. The unit price & cost of benching & protection to tower foundation near nallas, riverbeds hilly/undulated terrain etc required at few locations shall be as per the price schedule.

The quantities mentioned in the price schedule are tentative. The contractor should asses the exact quantities after completion of detailed/check survey and get it approved from Engineer In Charge for procurement of line material. The payment shall be made only for the quantities utilized/actual executed for completion of line work. No additional / surplus material shall be accepted except specifically requisitioned by Engineer In Charge. Any extra material supplied and paid during execution, the recovery will be made in final bill.

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 ^{o}C
e.	Minimum ambient temperature	: 0 ^{o}C
f.	Maximum daily average temperature	: 32 ^{o}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/ : AAA conductor	: 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 Qlty.	: One : OPGW E/W (11.70 mm Dia.) 110 KGF Qlty.
d.	Phase Configuration	: Vertical	: Vertical
e.	Max. Wind pressure	: 43 Kg/m^2 : 45 Kg/m^2	: 43 Kg/m^2 on wires : 45 Kg/m^2

f.	Ruling design span	: 320 meters	: 350 meters

The G.I earthwire of 7/3.15 mm shall be used for 132 kV lines and Optical Fibre Ground Wire, OPGW of 11.70 mm dia. shall be used for 220 kV lines.

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 tongue

h) External link

i) 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, details of the same are given in **Annexure-XI (Enclosure)**.

The structural drawings would be spared to the successful bidder only. The Bidder shall fabricate proto type towers 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 dia 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.

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 confirm to IS:6639-1972 or IS.12427 - 1988 as applicable and shall be of approved makes only. All bolts and nuts shall be 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 vendors by M.S.E.T.C.L., list 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, if the credentials of such vendors are submitted for verification to 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 3mm and not more than 8mm 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 3.5mm 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 (mm)	Hole diameter spacing (mm)	Min. Bolt distance (mm)	Min. rolled distance (mm)	Min.sheared edge (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 175mm long, spaced not more than 450mm 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 along with 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/AAA 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

5.2 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.

Height of support Unit	45m	50m	60m	70m	80m	100m	120m
Kgf/m^2							
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 2^0 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 ^{0}C or full wind pressure at 32 ^{0}C such that the initial unloaded tensions at 32 ^{0}C do not exceed 30 % of their ultimate strength and the final unloaded tension at 32 ^{0}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 45^0 to the tower body and 90^0 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 IS	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	Code of practice for use of structural steel in overhead transmission line.
	Part I: IS:802 (Part-II)1978	Load and permissible stresses. Code of practice for use of structural steel in overhead transmission line.
	Part II :	Fabrication, Galvanising, inspection and Packing.
	IS:802 (Part-III) 1978	Code of practice for use of structural steel in overhead transmission line towers.
	Part III : Testing	

Sr. No.	Indian Standards IS	Title
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 galvanising of iron and steel.
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 galvanised 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.	Indian Electricity Rules - 1956 and revisions thereof	
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	

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 hardwares shall be suitable for 0.2 ACSR Panther conductor/AAA 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 INSULATORS STRING ALONGWITH 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 hardwares 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

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 30^0 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/m^2 for fasteners and 610 gm/m^2 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) **<u>TYPE TESTS</u>**

The contractor shall offer the hardwares and accessories which are already type tested within the last five 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	}	IS:2486(I)/ MSETCL specification
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	} IS:2486(I)
4)	Galvanising/Electroplating test	}
II)	**Tension hardwares**:	
1)	Visual examination	}
2)	Verification of Dimensions	}
3)	Mechanical strength test on components	} IS:2486(I)
4)	Mechanical/slip strength	}

	test on dead end assembly	}	
5)	Galvanising/Electroplating test	}	
III)	**Tests on locking devices(Security clip):**		
1)	Verification of resistance to bending	} }	IS:2486(IV)
2)	Hardness test	}	
3)	Operation test	}	

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 test for aluminum, aluminum alloy tubes and flats.	- do -
5)	Chemical analysis of zinc for galvanising.	- do -

Sr. No.	Particulars of test	Reference standard
6)	Visual inspection, Dimensional check, chemical analysis and hardness test for Stainless steel bolts, U-bolts, Nuts and washers.	- do -
7)	Visual inspection, Dimensional check, Resistance to bending, Operation, Hardness and Resistance to internal corrosion tests on security clip.	- do -
8)	Visual inspection, Dimensional check and mechanical strength tests on M.S bolts, nuts and plain washers.	- do -
9)	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 Contractor'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 alloy bars, rods, tubes and 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
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 l367-1991 Part-I	Technical supply conditions for threaded steel fasteners – Introduction and general information
22)	IS l367-1979 Part-III	Technical supply conditions for threaded steel fasteners –

		Mechanical properties and test methods for Bolts, screws & studs with full loadibility
23)	IS l367-1980 Part-VI	Technical supply conditions for threaded steel fasteners – Mechanical properties and test Methods for nuts with specified proof loads
24)	IS l367-1979 Part-IX	Technical supply conditions for threaded steel fasteners – Surface discontinuities on Bolts, screws & studs
25)	IS l367-1979 Part-X	Technical supply conditions for threaded steel fasteners – Surface discontinuities on nuts
26)	IS l367-1979 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/AAA/Zebra CONDUCTOR

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

Sr. No.	Item	Material	Grade

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 •

Sr. No.	Item	Material	Grade
F)	**Clamp assembly** (Common for tension hardwares)		
1)	Steel sleeve •		
2)	Compression tube and jumper •		

Sr.No.	Particulars	Guaranteed value
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	•

ANNEXURE-III

TECHNICAL PARTICULARS OF CONDUCTOR & EARTHWIRE ACCESSORIES

1.0 Accessories suitable for 0.2 ACSR Panther / AAA conductor(for 132 kV line), 0.4 ACSR Zerbra 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/mm^2. 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/mm^2. 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^o 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 (EARTHWIRE)

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 mm^2. 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/m^2 for fasteners and 610 gm/m^2 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 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
I)	**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	
2)	Verification of Dimensions	

3)	Mass pull off test	}	
4)	Magnetic power loss test	}	
5)	Clamp slip test	}	
	(Before & after fatigue test)	}	IS:9708
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	IS:2121
2)	Verification of Dimensions	
3)	Mechanical/slip strength test	
B)	**Repair Sleeves**	
1)	Visual examination	IS:2121
2)	Verification of Dimensions	
3)	Mechanical/slip strength test	
C)	**P.A. Rod**	
1)	Visual examination	IS:2121
2)	Verification of Dimensions	
3)	Tensile Strength test	
4)	Resilience test	
5)	Electrical resistance test	
D)	**Vibration Damper**	
1)	Visual examination	IS:9708
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	
II)	**Earthwire accessories**:	
A)	**Suspension clamp**	
1)	Visual examination	
2)	Verification of Dimensions	

3)	Mechanical strength test	}	IS:2486
4)	Galvanising/Electroplating test	}	
B)	**Tension clamp**		
1)	Visual examination	}	
2)	Verification of Dimensions	}	
3)	Mechanical strength test on clamp & components	}	IS:2486
4)	Galvanising/Electroplating test	}	
C)	**MSCJ**		
1)	Visual examination	}	
2)	Verification of Dimensions	}	

Sr. No.	Particulars of test	Reference standard	
3)	Mechanical/slip strength test	}	IS:2121
4)	Galvanising test	}	
D)	**Earth Bond**		
1)	Visual examination	}	
2)	Verification of Dimensions	}	IS:2121
3)	Slip strength test	}	

C) **<u>ROUTINE TESTS</u>**:

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)	Suspension clamp		
1)	Visual Inspection	}	IS:2486
2)	Mechanical routine test	}	
B)	Tension Clamp		
1)	Visual Inspection	}	IS:2486
C)	MSCJ		
1)	Visual Inspection	}	
2)	Verification of Dimensions	}	IS:2121
D)	Earth Bond		
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 mechanical strength tests for malleable Cast Iron castings.	As per relevant IS standards
2)	Dimensional check and chemical analysis test for Copper wire/ bars.	- do -
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 Contractor'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 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 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/AAAC/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/AAAC/ 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/AAAC/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/AAAC/0.4 ACSR Zebra

Manufacturer's name and address	•	
Identification mark	•	

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

Refer website (www.mahatransco.in) for updated list of approved vendors.

A) TOWERS

1) M/s. Unitech Power Transmission Ltd., Nagpur

2) M/s. Bajaj Electricals Ltd., Ranjangaon

3) M/s. Jyoti Structures Ltd., Nasik

4) M/s. Kalpataru Power Transmission Ltd., Gandhinagar

5) M/s. EMCO, Vadodara

6) M/s. KEC International Ltd.,Mumbai

7) M/s. B.G.Shirke Construction Technology Ltd., Pune

8) Meghraj Industries, Supa

B) INSULATOR HARDWARES & CONDUCTOR AND EARTHWIRE ACCESSORIES

1) Krsna Transmission, Vadodara

2) Dharia Eng.& Founders, Pune

4) M/s. Modern Malleables Ltd.,Kolkatta

C) CONDUCTORS

ACSR ZEBRA/ PANTHER/ AAAC

1)STERLILTE
2)APAR
3)GALADA

D) G.S EARTHWIRE

1)BHARATH WIRE
2)GEEKAY WIRE
3)BEDMITHA SINNER

E) INSULATORS

A) PORCELAIN DISC

1) M/s ADITYA BIRLA INSULATORS , Rishra

2) M/s BHEL, BANGALORE JAGDISHPUR

3) M/s WSI(I) LTD. CHENNAI

B) Glass Disc

1) M/s SEDIVER, TIANJIN(CHINA)

C) POECELAIN LONG ROD

1) M/s MODERN INSULATORS LTD, Abu Road

2) M/s SARAWANA GLOBLE ENERGY LTD,CUDDALORE

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, literate, 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	90
b)	Weight of earth	KN/m^3	14.40
c)	Angle of respose degree	Degrees	30^0
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^o
5)	**Hard Rock**		
a)	Ultimate Bearing Capacity	KN/m^2	1250.0

Sr. No.	Particulars	Unit	Value
b)	Ultimate bond between steel and concrete	KN/m^2	0.147
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^o
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^o

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 45^0, with respect to the vertical. However, bidders can design foundation with reinforced concrete pyramid/slab, in which case the limitation of 45^0 is not applicable. Mild steel bars shall not be used for reinforcement steel.

5.3 At least 50mm thick pad of size equal to the base of pyramid with its sides vertical will be provided blow 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 75mm 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 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 an 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.

16.3 Form boxes shall be used for casting all types of foundation. The concrete shall be laid down in 150 mm 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 back

filling 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 IS	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 hall 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 de-scribed 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 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 smoothened.

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, anticliming 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 & GLASS DISC INSULATORS

1.0 GENERAL

This section details the technical particulars of Porcelain disc / 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. 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

Sr. No.	Indian Standard	Title	International 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 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 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)
400 KV					
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
220 KV					
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 tension	N)	255x145	320	15	120
	(AF)	280x145	430	15	120
Double tension	(N)	255x145	320	2x15	2x120
	(AF)	280x145	430	2X15	2X120
132 KV					
Single Susp-ension	(N)	255x145	320	9	70
	(AF)	280x145	430	9	70
Double Susp-ension	(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)
400 KV					
Single Susp-ension '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 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
220 KV					
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 tension	(N)	2175	4800	2x2	240
	(AF)	2175	6450	2x2	240
132 KV					
Single Suspension	(N)	1305	2880	1	70
	(AF)	1305	3870	1	70
Double Suspension	(N)	1305	2880	1x2	70
	(AF)	1305	3870	1x2	70
Single	(N)	1450	3200	1	120

tension	(AF)	1450	4300	1	120
Double	(N)	1450	3200	1x2	240
tension	(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)	**400 KV**	
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)	**220/132 KV**	
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, Lightening 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 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.

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 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 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 ≥ 99.95%) as per IS: 209. The mass of zinc coating shall not be less than 610 gm/m^2 (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
Diameter of Disc (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
Ball to Ball Spacing between Discs (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:

± (0.04d + 1.5) mm when d < 300 mm
± (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 (μV)	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 (accredition based on ISO/IEC vide 25/17025 or EN 45001 by the National accredition 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) **<u>On Disc/Longrod Insulator Unit</u>**:

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 '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 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 ii) Double suspension string iii) Single Tension string iv) Double Tension string	} } } } }	As per Annexure-II of this specification

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	}	As per Annexure - **a**

	condition	}	of this specification
g)	Mechanical strength test	}	
	i) Single 'I' suspension string	}	As per Annexure-**a**
	ii) Double Tension string	}	of this specification

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 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 (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	}	IS: 731

	(Only for Porcelain Disc insulators)		
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)	Polarised 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
Sr. No.	Particulars of test	Reference Standard
	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 waival of inspection shall neither relieve the manufacturer from the responsibility of supplying materials confirming 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 SUSPENS-ION (70 KN)	DOUBLE SUSPENS-ION (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 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)				

Sr. No.	STRING TYPE ► / PARTICULARS ▼	SINGLE SUSPENS-ION (70 KN)	DOUBLE SUSPENS-ION (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 μvolts)				
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"I" SUSPENSION (120 KN) N/AF	DOUBLE"I" SUSPENSION (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 μvolts)			
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.

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 petticot 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 petticot. 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 ± 5^0 C and a heating to $+40 \pm 5^0$ C. The temperature limits for temporary range of 40^0 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 $CuSO_4$ 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/mm^2.

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.

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ANNEXURE- VIII

TECHNICAL SPECIFICATION FOR 0.2 ACSR "PANTHER", AAA CONDUCTOR AND 0.4 ACSR "ZEBRA" CONDUCTOR FOR EHV TRANSMISSION SCHEMES

1.0 GENERAL

This section details on the ACSR aluminum conductors / AAA 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) / ALL AALOY ALLUMINIUM CONDUCTOR 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 / AAA 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 GENERAL TECHNICAL REQUIREMENTS

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

Sr.No.	Particulars	Values
(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.

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 X 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 X 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-in forced 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 CONDUCTORS GALVANISED STEEL REINFORCED	'PANTHER' CONDUCTOR	ZEBRA conductor
(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 **LENGTH OF THE CONDUCTOR**

(i) **STANDARD LENGTH:**

The standard length of the "Panther"/ "Zebra" conductor shall be minimum 2000/2000 metres. tolerance of +/- 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 The bidder shall furnish the guaranteed technical particulars of item offered in the form enclosed at SCHEDULE "a" of this specification.

6.0.0 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 be required to submit 4 copies of the type test reports along with the offer in PHYSICAL FORM i.e. HARD COPY.

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.

6.2.0 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 1500 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).

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-7.5.0

(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.

(c) Check that drums are as per specifications.

(d) All acceptance tests as mentioned in Clause 6.2.0 above 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.

6.3.0 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.(in Physical Form).

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.

6.4.0 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.

6.5.0 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 acceptance tests successfully in the presence of purchaser's representative before dispatch.

6.6.0 TEST REPORTS (DOCUMENTS IN PHYSICAL FORM)

6.6.1 Four 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 Four 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.

6.7.0 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.

6.8.0 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.

6.9.0 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 sample**s** of conductor selected from the lot supplied at site. The entire conductor shall be rejected if the test results are not satisfactory.

7.0.0 INSPECTION

7.1.0 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.

7.2.0 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.

7.3.0 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.

7.4.0 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.

7.5.0 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 declare by the Supplier in the packing list shall be applied to all the drums if the conductor is found short during checking."

8.0.0 PACKING & FORWARDING

8.1.0 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 for 0.2 ACSR "Panther" Conductor, No.EEPL/WM-II/234 Dt25-03-1997 is enclosed for ready reference.

8.2.0 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.

8.3.0 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 four copies of full dimensioned drawing of the drum he wished to supply, for Purchaser's approval before taking up manufacturing of Conductor. After getting approval from the Purchaser, Supplier shall submit 30 more copies of the approved drawing to Purchaser for further distribution and field use at Purchaser's end.

8.4.0 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.

8.5.0 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.

8.6.0 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.

8.7.0 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.

8.8.0 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.

8.9.0 The inner check of the flanges and drum barrel surface shall be painted with a bitumen based paint.

8.10.0 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.

8.11.0 A minimum space of 75 mm shall be provided between the inner surface of the external protective layer and outer layer of the conductor.

8.12.0 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.

8.13.0 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.

8.14.0 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.

8.15.0 Only one length of conductor shall be wound on each drum.

8.16.0 **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 :

(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"/ AAA/"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 :

(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. :

(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. :
(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 deg. C (ohm/km)	:	3.41		
xiv)	Strand lay and lay length (mm)	:	Minimum Maximum	: :	123 265
xv)	Direction of lay of outer layer	:	Right hand		
xvi)	Density at 20 deg.C (g/cm^3)	:	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.

Element	Composition
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 not withstanding 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 of 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 confirm 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 Annexure-a
(b)	Chemical analysis of steel for making steel strands	))	

4.7 **Testing Expenses**

4.7.1 The purchaser may opt for repeatation 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 ± 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 anslysis 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 Wrappping 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	Description	Unit	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 $\pm$ 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	Yes/No	

	charts, whether furnished.	
23.	Standard according to which the steel wire will be manufactured	IS or equivalent
24.	Other particulars, if any	
25.	Separate winding & unwinding facilities for inspection purpose whether available.	Yes/No

Name of the Firm:

Signature of the Bidder:

Designation:

Date:

ANNEXURE- X

TECHNICAL SPECIFICATION FOR OPTICAL FIBRE GROUND WIRE (OPGW)

(Not Applicable)

TECHNICAL SPECIFICATION FOR SUPPLY OF OPGW CABLE & OFAC ALONG WITH ACCESSORIES

1.0 DEFINITIONS:

1.1 OPGW means an optical fibre unit embedded in the core or first layer of the ground wire, whose shield wire consists of one or more layers of Aluminium clad steel/Aluminium alloy wires.

1.2 Optical waveguide fibres means the optical fibres embedded in the OPGW/OFAC – which would serve as medium for the proposed optical communication system.

1.3 Termination joint box means outdoor box to terminate/splice the OPGW/OFAC in an organized manner. The box shall be located on the terminal gantries at each end of the lines.

1.4 Shield wire joint box means outdoor box to terminate/splice the OPGW/ OFAC in an organized manner.

1.5 The contractor means the contractor entrusted with the work of fabrication, supply and erection of OPGW system.

1.6 OFAC means Optic Fibre Approach all dielectric Cable including cables suitable for cable trench/buried duct installation, with heavy duty thermosetting jacketing and shall contain optical wave guide fibres. The approach cable shall be installed between the terminal joint boxes suitable for OPGW and Fibre Distribution Frame installed at the substation.

1.7 Distribution Rack/Termination Box means the indoor rack/box for termination of the OFAC and connection to the OLTE.

1.8 The supplier means the manufacturer of the OPGW/OFAC cable selected by the bidder and nominated as such in his bid.

1.9 THE BIDDER MEANS THE CONTRACTOR PRIOR TO AWARD OF CONTRACT.

2.0 FIBRE OPTIC CABLING:

This section defines the requirements for 48 Fibers G.652D Dual-window Single mode (DWSM) telecommunications grade fibre optic cable. Bidders shall furnish with their bids, detailed descriptions of the fibres & cable(s) proposed.

All optical fibre cabling including fibre itself and all associated installation hardware shall have a minimum guaranteed design life span of 25 years. Documentary evidence in support of guaranteed life span of cable and fibre shall be submitted by the contractor during detailed engineering.

3.0 REQUIRED OPTICAL FIBRE CHARACTERISTICS:

This section describes the characteristics of optical fibre to be provided under this specification.

3.1 PHYSICAL CHARACTERISTICS:

Dual-Window Single mode (DWSM), G.652D optical fibres shall be provided in the fibre optic cables. DWSM optical fibres shall meet the requirements defined in Table 1(a).

3.2 ATTENUATION

The attenuation coefficient for wavelengths between 1525nm and 1575nm shall not exceed the attenuation coefficient at 1550nm by more than 0.05dB/km. The attenuation coefficient between 1285nm and 1330nm shall not exceed the attenuation coefficient at 1310nm by more than 0.05dB/km. The attenuation of the fibre shall be distributed uniformly throughout its length such that there are no point discontinuities in excess of 0.10dB. The fibre attenuation characteristics specified in table 1(a0 below shall be “guaranteed” fibre attenuation of any & every fibre reel.
The overall optical fibre path attenuation shall not be more than calculated below:

Maximum attenuation @ 1550nm: 0.21dB/km x Total km + 0.05dB/splice x No. of Splices + 0.5dB/connector x No. of Connectors

Maximum attenuation @ 1310nm: 0.35dB/km x Total km + 0.05dB/splice x No. of Splices + 0.5dB/connector x No. of Connectors

DWSM OPTICAL FIBRE CHARACTERISTICS Table 1(a)	
Fibre Description	Dual-Window Single-Mode
Mode Field Diameter	8.6 to 9.5 μm (± 0.6μm) at 1310 nm
Cladding Diameter	125.0 μm ± 1 μm
Core Field Concentricity Error	≤ 0.6 μm
Cladding Non-Circularity	≤ 1%
Cable Cutoff Wavelength, λcc	≤ 1260 nm
1550nm Loss Performance	as per G.652D
Proof Stress	≥ 0.69 Gpa

Attenuation Co-efficient	@ 1310 nm ≤ 0.35 dB/km @ 1550 nm ≤ 0.21dB/km
Chromatic Dispersion: Maximum Zero Dispersion Wavelength Zero Dispersion Slope	18 ps/(nm x km) @ 1550 nm 3.5 ps/(nm x km) 1288-1339nm 5.3 ps/(nm x km) 1271-1360nm 1300 to 1324nm 0.092 ps/(nm2xkm) maximum
Polarization Mode Dispersion Coefficient	≤ 0.2 ps/km^½
Temperature Dependence	Induced attenuation ≤ 0.05 dB (-60°C - +85°C)
Bend Performance	@ 1310 nm (75±2 mm dia Mandrel), 100 turns; Attenuation Rise ≤ 0.05 dB/km @ 1550 nm (30±2 mm dia Mandrel), 100 turns; Attenuation Rise ≤ 0.10 dB/km @ 1550 nm (32±0.5 mm dia Mandrel, 1 turn; Attenuation Rise ≤ 0.50 dB/km

4.0 FIBRE OPTIC CABLE CONSTRUCTION:

Overhead Fibre Optic Cables shall be OPGW (Optical Ground Wire). The OPGW cable is proposed to be installed on 220 kV & above transmission line in Maharashtra. The design of each cable type shall account for the varying operating and environmental conditions that the cable shall experience while in service. The OPGW cable to be supplied shall be designed to meet the overall requirements of the 220 kV transmission line. The normal span for 220 kV towers is 350 mtrs, however, some of the spans may be more than 350 mtrs. The exact details shall be collected by the contractor during survey. It may also be noted that part of the transmission line route may be diverted/modified during the engineering stage.

4.1 OPTICAL FIBRE CABLE LINK LENGTHS:

The estimated total optical fibre lengths are provided in BOQ/Price Schedule. However, the contractor shall supply & install the optical fibre cable as required based on detailed site survey to be carried out by the contractor during the project execution. The contractor shall prepare the drum schedule according to approved tower schedule/stringing chart and submit the same for approval. For the purpose of payment, the optical fibre link lengths are defined as transmission line route lengths from Gantry at one terminating station to the Gantry in the other terminating station. The actual cable lengths to be delivered shall take into account various factors such as sag, service loops, splicing, working lengths & wastage etc. and no additional payment shall be payable in this regard. The unit rate for FO cable quoted in the bid price schedules shall take in to account all such factors.

4.2 OPTICAL FIBRE IDENTIFICATION:

Individual optical fibres within a fibre unit and fibre units shall be identifiable in accordance with EIA/TIA 598 or IEC 60304 or Bellcore GR-20 colour-coding scheme. Colouring utilized for colour coding optical fibres shall be integrated into the fibre coating and shall be homogenous. The colour shall not bleed from one fibre to another and shall not fade during fibre preparation for termination or splicing. Each cable shall have traceability of each fibre back to the original fibre manufacturer's fibre number and parameters of the fibre. If more than the specified numbers of fibres are included in any able, the spare fibres shall be tested by the cable manufacturer and any defective fibres shall be suitably bundled, tagged and identified at the factory by the vendor.

4.3 BUFFER TUBE:

Loose tube construction shall be implemented. The individually coated optical fibre(s) shall be surrounded by a buffer for protection from physical damage during fabrication, installation and operation of the cable. The fibre coating and buffer shall be strippable for splicing and termination. Each fibre unit shall be individually identifiable utilizing colour coding. Buffer tubes shall be filled with a water-blocking gel.

4.4 OPTICAL FIBRE STRAIN & SAG-TENSION CHART:

The fibre optic cable shall be designed and installed such that the optical fibres experience no strain under all loading conditions defined in IS 802. Zero fibre strain condition shall apply even after a 25 year cable creep. For the purpose of this specification, the following definitions shall apply:

- Maximum Working Tension (MWT) is defined as the maximum cable tension at which there is no fibre strain.
- The No Fibre Strain condition is defined as fibre strain of less than or equal to 0.05%, as determined by direct measurements through IEC/ETSI (FOTP) specified optical reflectometry techniques.
- The Cable Strain Margin is defined as the maximum cable strain at which there is no fibre strain.
- The cable Maximum Allowable Tension (MAT) is defined as the maximum tension experienced by the Cable under the worst case loading condition.
- The cable Max Strain is defined as the maximum strain experienced by the Cable under the worst case loading condition.
- The cable Every Day Tension (EDT) is defined as the maximum cable tension on any span under normal conditions.

- The Ultimate /Rated Tensile Strength (UTS/RTS/Breaking Strength) is defined as the maximum tensile load applied and held constant for one minute at which the specimen shall not break.

While preparing Sag-tension charts for the OPGW cable the following conditions shall be met:

- The Max Allowable Tension (MAT)/max strain shall be less than or equal to the MWT/ Strain margin of the cable.
- The sag shall not exceed the earthwire sag in all conditions.
- The Max Allowable Tension shall also be less than or equal to 0.4 times the UTS.
- The 25 year creep at 25% of UTS (creep test as per IEEE 1138) shall be such that the 25 year creep plus the cable strain at Max Allowable Tension (MAT) is less than or equal to the cable strain margin.
- The Every Day Tension (EDT) shall not exceed 20% of the UTS for the OPGW cable.

The sag tension chart of OPGW cable indicating the maximum tension, cable strain and sag shall be calculated and submitted alongwith the bid under various conditions mentioned below:

1. 53^0 C, no wind and no ice
2. 32^0 C, no wind and no ice
3. 0^0 C, no wind and no ice
4. 32^0 C, full wind and no ice
5. 32^0 C, 75% full wind and no ice
6. 0^0 C, 2/3rd /36% of full wind (IS 802:1977/1995)

The above cases shall be considered for the spans from 100 m to 350 m or higher span length in the range of 50 m spans. Max. Vertical sag, Max. Tension and Max. Sag at 0^0C & no wind shall be considered for inline with the design parameter of transmission line. The full wind load shall be considered as the design wind load for all the transmission lines as per relevant IS 802 version and the sag tension chart shall be submitted considering the transmission lines. The contractor shall submit the stringing chart for review of employer.

4.5 CABLE MATERIALS:

The materials used for optical fibre cable construction, shall meet the following requirements:

4.5.1 Filling Materials

The interstices of the fibre optic unit and cable shall be filled with a suitable compound to prohibit any moisture ingress or any water longitudinal migration within the fibre optic unit or along the fibre optic cable. The water tightness of the cable shall meet or exceed the test performance criteria as per IEC-794-1-F-5.

The filling compound used shall be a non-toxic homogenous waterproofing compound that is

free of dirt and foreign matter, non hygroscopic, electrically nonconductive and non-nutritive to fungus. The compound shall also be fully compatible with all cable components it may come in contact with and shall inhibit the generation of hydrogen within the cable.

The filling compound shall remain stable for ambient temp. between -20°C and +65°C and shall not drip, flow or leak with age or at high temperatures during short duration lightning strike and short circuit currents The filling compound shall meet the requirements of "Seepage of Filling Compound test" as per EIA/TIA 455-81 for 80°C temperature.

The waterproofing filling materials shall not affect fibre coating, colour coding, or encapsulant commonly used in splice enclosures, shall be dermatologically safe, non-staining and easily removable with a non-toxic cleaning solvent.

4.5.2 Metallic Members

When the fibre optic cable design incorporates metallic elements in its construction, all metallic elements shall be electrically continuous.

4.5.3 Marking, Packing and Shipping

This section describes the requirements for marking, packaging and shipping the overhead fibre optic cable.
a) Drum Markings: Each side of every reel of cable shall be permanently marked in white lettering with the vendor's address, the purchaser's destination address, cable part number and specification as to the type of cable, length, number of fibres, a unique drum number including the name of the transmission line and segment no. factory inspection stamp and date.
b) Cable Drums: All optical fibre cabling shall be supplied on strong drums provided with lagging of adequate strength, constructed to protect the cabling against all damage and displacement during transit, storage and subsequent handling during installation. Both ends of the cable shall be sealed as to prevent the escape of the filling compounds and dust & moisture ingress during shipment and handling. Spare cable caps shall be provided with each drum as required.

The spare cable shall be supplied on sturdy, corrosion resistant, steel drums suitable for long periods of storage and re-transport & handling.
There shall be no factory splices allowed within a continuous length of cable. Only one continuous cable length shall be provided on each drum. The lengths of cable to be supplied on each drum shall be determined by a "schedule" prepared by the contractor.
4.6 OPGW CABLE INSTALLATION REQUIREMENT:

The OPGW cable shall be installed at the top of tower under off line condition during

construction of line. The tentative bill of quantities for off line OPGW installations have been specified in the BOQ/Price Schedule and the actual quantities shall be finalised during project execution after detailed survey.

The stringing of OPGW cable shall be carried out by contractor as per stringing chart/Procedure submitted by them and approved by employer. The splicing work shall be carried out by contractor. All hardware & fittings needed to tie the OPGW to the towers/gantries shall be provided and fitted by contractor.

Before installation, the testing (fibre loss and length measurement using OTDR) of OPGW in each drum shall be carried out by contractor in presence of employers representative. After installation of OPGW cable, the testing of each section shall be carried out again by the contractor in presence of employer's representative. In case of any damage/high loss in the fibre, the length of that particular section of OPGW cable shall be replaced by contractor at his own cost.

Contractor shall supervise the stringing at site as per the approved stringing procedure. The Supervision/Inspection work in contractor's scope shall mainly include inspection as per stringing procedure, proper location of drum site, installation of stringing blocks/pulleys, proper sagging, proper installation of hardware, proper tension as per Sag-Tension chart, provision of service loops of OPGW in jointing locations etc.

4.7 OPTICAL GROUND WIRE (OPGW):

OPGW cable construction shall comply with IEEE-1138, 2009. The cable provided shall meet both the construction and performance requirements such that the ground wire function, the optical fibre integrity and optical transmission characteristics are suitable for the intended purpose. The cable shall consist of optical fibre units as defined in this specification. There shall be no factory splices within the cable structure of a continuous cable length.

The composite fibre optic overhead groundwire shall be made up of multiple buffer tubes embedded in a water tight aluminium/aluminium alloy/stainless steel protective fibre optic unit surrounded by concentric-lay stranded metallic wires in single or multiple layers. Each buffer tube shall have maximum 12 no of fibres. All fibres in a single buffer tube or directly in central fibre optic unit is not acceptable. The dual purpose of the composite cable is to provide the electrical and physical characteristics of conventional overhead ground wire while providing the optical transmission properties of optical fibre. The bidder shall conduct all the type tests or shall submit the type test reports of OPGW earthwire.

4.7.1 Central Fibre Optic Unit

The central fibre optic unit shall be designed to house and protect multiple buffered optical fibre units from damage due to forces such as crushing, bending, twisting, tensile stress and moisture. The central fibre optic unit and the outer stranded metallic conductors shall serve together as an integral unit to protect the optical fibres from degradation due to vibration and galloping, wind and ice loadings, wide temperature variations, lightning and fault current, as well as environmental effects which may produce hydrogen.

The OPGW design of dissimilar materials such as stainless steel tube with aluminium or aluminium clad-steel wire strands are not allowed. Central Fibre optic unit may be of aluminium or stainless steel tube or stainless steel tube with aluminium protective coating. In case of aluminium protective coating the coating must completely cover the tubes leaving no exposed areas of tubing that can make electrical contact either directly or indirectly through moisture, contamination, protrusions etc with the surrounding stranded wires. The tube may be fabricated as a seamless tube, seam welded, or a tube without a welded seam.

4.7.2 Basic Construction

The cable construction shall conform to the applicable requirements of specification, applicable clauses of IEC 61089 related to stranded conductors and Table 2(a) OPGW Mechanical and Electrical Characteristics. In addition, the basic construction shall include bare concentric lay stranded metallic wires with the outer layer having left hand lay. The wires may be of multiple layers with a combination of various metallic wires within each layer. The direction of lay for each successive layer shall be reversed. The finished wires shall contain no joints or splices. The wires shall be so stranded that when the complete OPGW is cut, the individual wires can be readily regrouped and then held in place by one hand.

4.7.3 Breaking Strength

The rated breaking strength of the completed OPGW shall be taken as no more than 90 percent of the sum of the rated breaking strengths of the individual wires, calculated from their nominal diameter and the specified minimum tensile strength. The rated breaking strength shall not include the strength of the optical unit. The fibre optic unit shall not be considered a load bearing tension member when determining the total rated breaking strength of the composite conductor.

4.7.4 Electrical and Mechanical Requirements

Table 2(a) provides OPGW Electrical and Mechanical Requirements for the minimum performance characteristics. Additionally, the OPGW mechanical & electrical characteristics shall be similar to the electrical & mechanical characteristics of 7/3.15 GI Earthwire such that there is no or minimal consequential increase in stresses on towers.

Table2(a)

OPGW ELECTRICAL AND MECHANICAL REQUIREMENTS

A)

1	Everyday Tension	≤ 20% of UTS of OPGW
2	D. C. Resistance at 20°C	< 1.0 ohm/Km
3	Short Circuit Current	≥ 6.32 kA for 1.0 second

B) TECHNICAL PARTICULARS OF OPGW EARTHWIRE

Physical properties

1	Overall diameter	11.70 mm Nominal diameter
2	Ultimate tensile strength	54 KN minimum
5	Approximate weight (kg/ Km)	400

4.7.5 Operating Conditions

Since OPGW shall be located at the top of the EHV transmission line support structure, it will be subjected to Aeolian vibration, galloping and lightning strikes. It will also carry ground fault currents. Therefore, its electrical and mechanical properties shall be the same or similar as those required of conventional ground conductors.

4.7.6 Installation

OPGW shall be installed under off line condition during construction of line. The installation shall be generally in accordance with the IEEE Guide to the Installation of Overhead Transmission Line Conductors (IEEE Standard 524 with latest revisions), with additional instructions and precautions for live line working and fibre optic cable handling. The stringing procedure and stringing chart shall be submitted prior to stringing for MSETCL's approval.

The OPGW cable sections shall normally be terminated & spliced only on tension towers. In exceptional circumstances, and on employer specific approval, cable may be terminated on suspension towers, but in this case tower strength shall be examined to ensure that tower loads are within safe limits and if required, necessary tower strengthening shall be carried out by the contractor.

4.7.7 Installation Hardware

The scope of supply of the optical cable includes the assessment, supply and installation of all required fittings and hardware such as Tension assembly, Suspension assembly, Vibration dampers, Reinforcing rods, Earthing clamps, Downlead clamps, splice enclosure etc. The Bidder

shall provide documentation justifying the adequacy and suitability of the hardware supplied. The quantity of hardware & fittings to meet any eventuality during site installation min. @ 1% shall also be provided as part of set/km. for transmission line without any additional cost to owner.The parties shall determine the exact requirements of all accessories used to install and secure the OPGW.

The OPGW hardware fittings and accessories shall follow the general requirements regarding design, materials, dimensions & tolerances, protection against corrosion and markings as specified in clause 4.0 of EN 61284:1997 (IEC 61284). The shear strength of all bolts shall be at least 1.5 times the maximum installation torque. The OPGW hardware & accessories drawing & Data Requirement Sheets (DRS) document shall consist of three parts: (1) A technical particulars sheet (2) An assembly drawing i.e. level 1 drawing and (3) Component level drawings i.e. level 2 & lower drawings. All component reference numbers, dimensions and tolerances, bolt tightening torque & shear strength and ratings such as UTS, slip strength etc. shall be marked on the drawings.

The fittings and accessories described herein are indicative of installation hardware typically used for OPGW installations and shall not necessarily be limited to the following:

(a) Suspension Assemblies: Preformed armour grip suspension clamps or aluminium alloy armour rods/ reinforcing rods shall be used. The supply shall include all the components of the suspension assembly including shackles, bolts, nuts, washers, split pins, P. G. clamp etc.

(b) Dead End Clamp Assemblies: All dead end clamp assemblies shall preferably be of preformed armoured grip type. The supply shall include all necessary components of the Dead end assembly for attaching the assembly to the tower strain plates including shackles, Turn buckle, bolts, nuts, washers, split pins etc..

(c)Earth Bond: The earth bond shall be made of E.C. grade (% of Copper ≥ 99.9%) tinned flexible copper cable of size 37/7/0.417 mm with 8.757 mm diameter and copper area equivalent of 34 mm^2 confirming to IS:191(VI).

One / Two tinned copper lugs having suitable holes for 12 mm & 16 mm diameter bolts shall be press jointed at both ends for connecting it to the Suspension Clamp assembly and tower body.

For Tension Clamp assembly, one tinned copper lug having suitable hole for 16 mm diameter bolt shall be press jointed at one end for connecting it to the tower body. The other end of the copper cable shall be provided with press jointed tinned closed copper lug for fixing it in the Parallel Groove Clamp.

One 45 mm long Hot Dip galvanised Mild Steel bolt with nut and plain, spring washer (Electro Galvanised) shall also be provided. This shall be suitable for providing proper bondage between

suspension / tension clamp assembly and the tower body. The pulloff load shall not be less than 300 kg.

The length of the Earth Bond shall be suitable for the Single / Double Suspension and Tension clamp assembly and shall be 750 mm minimum.

(d) Structure Attachment Clamp Assemblies: Clamp assemblies used to attach the OPGW to the structures, shall have two parallel grooves one for for the OPGW and other for copper Earth bond on either side of the connecting bolt.

(e) Vibration Dampers: Vibration dampers type 4R Stockbridge or equivalent, having four (4) different frequencies spread within the Aeolian frequency bandwidth corresponding to wind speed of 1m/s to 7 m/s shall be used for suspension and tension points in each span. The parties shall determine the exact numbers and placement of vibration dampers through a detailed vibration analysis. Vibration damper clamps shall be made of aluminium or aluminium alloy and shall support the dampers during installation.

One damper minimum on each side per OPGW cable for suspension points and two dampers minimum on each side per OPGW cable for tension points shall be used for nominal design span of 350 meters. For all other ruling spans, the number of vibration damper shall be based on vibration analysis.

The clamp of the vibration damper shall be made of high strength aluminium alloy of type LM-6. It shall be capable of supporting the damper and prevent damage or chaffing of the conductor during erection or continued operation. The clamp shall have smooth and permanent grip to keep the damper in position on the OPGW cable without damaging the strands or causing premature fatigue failure of the OPGW cable under the clamp. The clamp groove shall be in uniform contact with the OPGW cable over the entire clamping surface except for the rounded edges. The groove of the clamp body and clamp cap shall be smooth, free from projections, grit or other materials which could cause damage to the OPGW cable when the clamp is installed. Clamping bolts shall be provided with self locking nuts and designed to prevent corrosion of threads or loosening in service.

The messenger cable shall be made of high strength galvanised steel/stain less steel. It shall be of preformed and post formed quality in order to prevent subsequent droop of weight and to maintain consistent flexural stiffness of the cable in service. The messenger cable other than stainless steel shall be hot dip galvanised in accordance with the recommendation of IS:4826 for heavily coated wires.

The damper mass shall be made of hot dip galvanised mild steel/cast iron or a permanent mould cast zinc alloy. All castings shall be free from defects such as cracks, shrinkage, inclusions and

blow holes etc. The surface of the damper masses shall be smooth. The damper mass shall not slip out of the messanger cable at a load less than 500 kg.

The damper clamp shall be casted over the messenger cable and offer sufficient and permanent grip on it. The messenger cable shall not slip out of the grip at a load less than the mass pull-off value of the damper. The damper masses made of material other-than zinc alloys shall be fixed to the messenger cable in a suitable manner in order to avoid excessive stress concentration on the messenger cable which shall cause premature fatigue failure of the same. The messenger cable ends shall be suitably and effectively sealed to prevent corrosion. The damper mass made of zinc alloy shall be casted over the messenger cable and have sufficient and permanent grip on the messenger cable under all service conditions.

The contractor must indicate the clamp bolt tightening torque to ensure that the slip strength of the clamp is maintained between 2.5 KN to 5 KN. The clamp when installed on the OPGW cable shall not cause excessive stress concentration on the OPGW cable leading to permanent deformation of the OPGW strands and premature fatigue failure in operation.

The technical particulars for vibration analysis and damping design of the system are as follows :-

Sr.No	Description	Technical Parameters
1	Span Length in meters i) Ruling design span ii) Maximum span iii) Minimum span	 350 meters 800 meters 136 meters
2	Configuration	As per specification
3	Tensile load in each	As per sag-tension calculations
4	Armour rods used	Standard Preformed Armour Rods/AGS
5	Maximum permissible dynamic strain	+/- 150 micro strains

The damper placement chart for spans ranging from 136 m to 800 m shall be submitted by the Bidder. Placement charts should be duly supported with relevant technical documents and sample calculations.

The damper placement charts shall include the following:-

1) Location of the dampers for various combinations of spans and line tension clearly indicating the number of dampers to be installed per OPGW cable per span.

2) Placement distances clearly identifying the extremities between which the distances are to be measured.

3) Placement recommendation depending upon type of suspension clamps (viz Free center type /Armour grip type etc.)

4) The influence of mid span compression joints, repair sleeves and armour rods (standard and AGS) in the placement of dampers.

The bidder shall conduct all the type tests or submit the type test reports of accessories of OPGW earthwire.

5.0 FIBRE OPTIC SPLICE ENCLOSURES (JOINT BOX):

All splices shall be encased in Fibre Optic Splice Enclosures. Suitable splice enclosures shall be provided in line with TECGR/OJC-02/02 Sept 2003 to encase the optical cable splices in protective, moisture and dust free environment. Splice enclosures shall comply to ingress protection class IP 66 or better. The splice enclosures shall be designed for the storage and protection of required no of optical fibre splices and equipped with sufficient number of splice trays for splicing all fibres in the cable. No more than 6 fibres shall be terminated in a single splice tray. They shall be filled with suitable encapsulate that is easily removable should re-entry be required into the enclosures. Splice enclosures shall be suitable for outdoor use with each of the cable types provided under this contract. Splice enclosures shall be appropriate for mounting on transmission line towers above anti-climb guard levels at about 10 meters from top of the tower and shall accommodate pass through splicing. The actual mounting height and location shall be finalised after survey. Contractor shall be responsible for splicing of fibres and installation of splice enclosures.

5.1 OPTICAL FIBRE SPLICES:

Splicing of the optical fibre cabling shall be minimized through careful contractor planning. There shall be no mid-span splices allowed. All required splices shall be planned to occur on tower structures. All optical fibre splicing shall comply with the following:

(a) All fibre splices shall be accomplished through fusion splicing.
(b) Each fibre splice shall be fitted with a splice protection sheath fitted over the final splice.
(c) All splices and bare fibre shall be neatly installed in covered splice trays. No more than six (6) fibres shall be installed in each splice tray.
(d) For each link, bi-directional attenuation of single mode fusion splices, shall not average more than 0.05 dB and no single splice loss shall exceed 0.1 dB when measured at 1550 nm.
(e) For splicing, fibre optic cable service loops of adequate length shall be provided so that all splices occurring at tower structures can be performed at ground level.

6.0 FIBRE OPTIC APPROACH CABLES:

For purposes of this specification, a fibre optic approach cable is defined as the armoured underground fibre optic cable required to connect Overhead Fiber Optic Cable (OPGW) between the final in line splice enclosure on the gantry/tower forming the termination of the fibre cable on the power line and the Fibre Optic Distribution Panel (FODP) installed within the building. The estimated fibre optic approach cabling length shall be decided during site survey or detailed engineering. However, the Contractor shall supply & install the optical fibre approach cable as required based on detailed site survey to be carried out by the Contractor during the project execution and the Contract price shall be adjusted accordingly.

6.1 BASIC CONSTRUCTION:

The cable shall be suitable for direct burial, laying in trenches & PVC/Hume ducts, laying under false flooring and on indoor or outdoor cable raceways.

6.2 JACKET CONSTRUCTION & MATERIAL:

The Approach Cable shall be a UV resistant, rodent proof, armoured cable with metallic type of armouring. The outer cable jacket for approach cable shall consist of carbon black polyethylene resin to prevent damage from exposure to ultra-violet light, weathering and high levels of pollution. The jacket shall conform to ASTM D 1248 for density.

6.3 OPTICAL, ELECTRICAL AND MECHANICAL REQUIREMENTS:

Approach cable shall contain fibres with identical optical/ physical characteristics as those in the OPGW cables. The cable core shall comprise of tensile strength member(s), fibre support/bedding structure, core wrap/bedding, and an overall impervious jacket.

7.0 INSTALLATION OF APPROACH CABLE:

A network of cable trenches and/or ducts may exist at some sites. The parties shall make its best effort to route the cable through the existing available cable trenches. The approach cable shall be laid in the HDPE pipe in all conditions. In order to utilize the existing trenches, the approach cable may be required to be co-located with HV and LV cables. Accordingly, the approach cable shall be installed in corrosion resistant flexible conduit. Suitable provisions shall be made by the parties to ensure adequate safety earthing and insulated protection for the approach cable. All required fittings, supports, accessories, ducts, inner ducts, conduits, risers and any item not specially mentioned but required for lay and installation of approach cables shall be supplied and installed by the parties.

8.0 OPTICAL FIBRE TERMINATION AND SPLICING:

Optical fibre terminations shall be installed in Fibre Optic Distribution Panels (FODP) designed to provide protection for fibre splicing of preconnectorized pigtails and to accommodate connectorized termination and coupling of the fibre cables. The contractor shall provide rack mounted Fibre Optic Distribution Panels (FODPs) and shall terminate the fibre optic cabling upto the FODPs. The location of FODP rack shall be fixed by the Contractor, with the Employer's approval.

8.1 FIBRE OPTIC DISTRIBUTION PANELS:

At each location requiring the termination of at least one fibre within a cable, all fibres within that cable shall be connectorized and terminated in Fibre Optic Distribution Panels in a manner consistent with the following.

1) All fibre optic terminations shall be housed using FODPs provisioned with splice organizers and splice trays. All fibres within a cable shall be fusion spliced to preconnectorized pigtails and fitted to the "Back-side" of the provided fibre optic couplings. 2) FODPs shall be suitable for use with each of the cable types provided as part of this contract. FODPs shall accommodate pass-through splicing and fibre terminations.
3) FODPs for indoor use shall be supplied in suitable cabinets/racks with locking arrangement.
4) All FODPs shall be of corrosion resistant, robust construction and shall allow both top or bottom entry for access to the splice trays. Ground lugs shall be provided on all FODPs and the Contractor shall ensure that all FODPs are properly grounded. The FODP shall meet or exceed ingress protection class IP55 specifications.
5) Flexible protection shall be provided to the patch cord bunches going out from FODP to other equipment.

8.2 Optical Fibre Connectors.
Optical fibres shall be connectorised with FC-PC type connectors preferably. Alternatively connector with matching patch cord shall also be acceptable. Fibre optic coupling supplied with FODPs shall be appropriate for the fibre connectors to be supported. There shall be no adapaters.

8.3 Service Loops
For purposes of this specification, cable and fibre service loops are defined as slack (extra) cable and fibre provided for facilitating the installation, maintenance and repair of the optical fibre cable plant.

Outdoor Cable Service Loops: In-Line splice enclosures installed outdoors and mounted on the utility towers, shall be installed with sufficient fibre optic cable service loops such that the recommended minimum bend radius is maintained while allowing for installation or maintenance of the cable to be performed in a controlled environment at ground level.

Indoor Cable Service Loops: FODPs shall provide at least three (3) meters of cable service loop. Service loops shall be neatly secured and stored, coiled such that the minimum recommended bend radius is maintained.

Fibre Units Service Loops: For all fibre optic cable splicing, the cable shall be stripped back a sufficient length such that the fan-out of fibre units shall provide for at least one (1) meter of fibre unit service loop between the stripped cable and bare fibre fan-out.

Pigtail Service Loops: Connectorised pigtails spliced to bare fibres shall provide at least 1 meter of service loop installed in the FODP fibre organizer and at least one (1 meter) of service loop to the couplings neatly stored behind the FODP coupling panels.

Fibre Service Loops: At least 0.5 meters of bare fibre service loop shall be provided on each side of all fibre splices. The bare fibre service loops shall be neatly and safely installed inside covered splice trays.

9.0 Methodology for Installation and Termination.

All optical fibre cable termination, installation, stringing and handling plans, guides and procedures, and engineering analysis (e.g. tension, sag, vibration etc.) shall be submitted to the Employer for review and approval in the engineering/design phase of the project, prior to establishing the final cable lengths for manufacture. Installation procedures including details of personnel and time required shall be documented in detail and submitted to Employer for approval. All installation practices shall be field proven and ISO accredited.

All cable segments shall include service loops as specified in this specification. The maximum allowable stringing tension, maximum allowable torsional shear stress, crush strength and other physical parameters of the cable shall not be exceeded. The preventative measures to be taken shall be documented in detail and submitted to Employer in advance of installation.

Optical fibre attenuation shall be measured after installation and before splicing. Any increase in attenuation or step discontinuity in attenuation shall not be acceptable and shall constitute a cable segment failure. In the event of cable damage or any fibre damage, the complete section (tension location to tension location) shall be replaced as mid span joints are not acceptable.

Any or all additional steel work or modifications required to attach the fibre cabling to the overhead transmission/distribution line towers shall also be carried out by the Contractor. It shall be the Contractors responsibility to provide adequate communications among all crew members and support staff to ensure safe and successful installations.

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 15^0 ,30^0 or 60^0 type towers on either side, depending on the merits of each case and shall be constructed in confirmity 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 man River crossing shall be 60^0 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, 2^0 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 Indian Electricity Rules, 1956. 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 30^0 may be permitted under exceptionally different situations. When the angle of crossing has to be below 60^0, 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 Indian Electricity Rules, 1956 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 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.

Annexure - XI

GUARANTEED WEIGHTS OF TOWERS

Sr. No.	Type of Tower	Unit Weight (MT)	
		Steel Structure	**Nuts & Bolts**
	132 kV D/C NB Special Tower	9.2	0.5

Annexure - XII

Guaranteed Excavation volumes, Concrete volumes and Reinforcement for 132 kV DC NB Special tower

Sr.	Tower Type	**FISSURED ROCK FOUNDATION**		
No.		Concrete	Excavation	Reinforcement
		Vol. (M^3)	Vol. (M^3)	(Kg)
		1:1.5:3		
		30	136	2.5

SCHEDULE'A'

DEVIATION FROM SPECIFICATION

All the deviations from this specification shall be set out by the tenderer, 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 : Caluse No.	: Details of : deviation	: Justification/ : Reasons

Name of the firm :_____

Signature of the bidder:_____

Designation ::_____

Date : _____

Seal of company :_____

SCHEDULE- B

SUMMARY SHEET OF LUMPSUM PRICE BID
FOR
LINES:---------- (Comprising Lines----------,----------,----------,----------)

Sr. No.	Name of the Work	Total Lumpsum Bid price	
		In figures	In words
1	Supply of Materials and construction & commissioning of EHV Lines on Turnkey basis (including foundation & Erection works). as per Tender -------	---	---
	Total		

Place:

Date:

Signature:

Name :

Designation:

Company Seal

SCHEDULE B (I) FOR EHV LINE

Sr. No.	Description	Price in Rupees
1	**2**	**3**
A	**Price Schedule of Supply of materials for EHV line**	
1	Estimated cost (as per schedule I of book II of specification)	
2	% Lower/Higher quoted by the bidder on estimated cost	
3	**Corresponding value of supply of material as per % Lower/Higher quoted**	
4	**Bid Price for Supply of Equipments/material (inclusive of all taxes, duties, levies, Octroi, freight charges, etc.), (A4=A1+A3) (in Rs.)**	
B	**Price Schedule of Erection(Including foundation) for line**	
1	Estimated cost (as per schedule I of book II of specification)	
2	% Lower/Higher quoted by the bidder on estimated cost	
3	**Corresponding value for erection as per % Lower/Higher quoted**	
4	**Bid Price for Erection(including foundation), (B4 = B1+B3) in Rs.**	
C	**BID PRICE = (A4 + B4), in Rs.**	
	TOTAL PRICE (in Words)..... only	

PRICE SCHEDULE

Above price schedule for all the Lines in the Tender should be brought forward to Summary Schedule 'B' for Line Works.

Notes:

1. 1) Offered Price:-
   For Supply…..…..% Above / Below (Calculated Value in Rs…… ……..)
   For ETC…..…..% Above / Below (Calculated Value in Rs…… ……..)
   (**Percentage rate should be equally distributed to all items**)

2. Break-up of taxes /duties and other charges shall be given in a separate schedule by the bidder as per the proforma in Price Schedules .
   (Break-up of taxes and duties should be percentagewise)

3. Variation in Taxes/Duties will not be payable.

4. The Prices have been quoted for all the activities for construction of line including Supply and ETC as per Bid Specification.

5. The tentative BOQ and Billing Schedule of Price are enclosed herewith. In case of any variation, the offer price shall be corrected limiting to above quoted price for Supply, and ETC.

6. All items / activities required for completion of job as per specification have been considered in the offer.

7. The discount, if offered, shall be distributed proportionately for each item rate.

8. The MVAT/CST & Octroi will be considered for evalution of the bids. Bidder should note & express the willingness of such process as per Clause No. 21.2.1 of Section II, Book-I, General terms and conditions.

SEAL OF COMPANY

SIGNATURE _____

NAME _____

DESIGNATION _____

COMPANY'S ADDRESS_____

DATE _____

SCHEDULE – 'C'

QUALIFYING REQUIREMENT DATA SCHEDULE - Form No. 1

Tender Specification No.

Name of Project:

Name of Bidder & Address:

DETAILS OF FULFULLMENT OF FOLLOWING CONDITIONS.

Sr. No.	Particulars of registration	Registration No.	Period of Validity From – To
1	Valid Electrical Contractor's license		
2	GST Certificate Service Tax Act. Any other Taxes (returns of preceding 3 financial years, IT returns)		
3	P.F. Act		

SIGNATURE & SEAL OF THE BIDDER

DATE

PLACE

SCHEDULE – 'C'

QUALIFYING REQUIREMENT DATA SCHEDULE- Form – 2

Tender Specification No.
Name of Project:
Name of Bidder & Address:
DETAILS OF EXPERIENCE IN RESPECT OF FABRICATION & SUPPLY OF TOWER MATERIAL/SUBSTATION STRUCURE MATERIAL

A		Indicate source of the Tower/Substation Structure Supply Owned - □ Associate - □ Please specify……. Please Tick - □ Yes
B	1	Details of source i.e. Manufacturer of tower/substation structure material Name & Address: Telephone No …… Fax No. …….. Contact person……
	2	Equipment Capacities: (a) Manufacturing Capacity/Year: (b) Quantity manufactured, tested and supplied by manufacturer during last three years:

Sr. No.	Year (specify)	Voltage class of Towers/substation Structure	Quantity MT	Supplied to
1				
2				

(C) Details of current commitments

Sr. No.	Customer	Order Ref.	Order Value	Tonnage	Date of order	Date of completion / Expected date of completion
1						
2						

SIGNATURE & SEAL OF THE BIDDER

DATE
PLACE

SCHEDULE – 'C'

QUALIFYING REQUIREMENT DATA SCHEDULE Form No. – 3

Tender Specification No.
Name of Project:
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 & SEAL OF THE BIDDER

DATE
PLACE

SCHEDULE- C

QUALIFYING REQUIREMENT DATA SCHEDULE-Form No.4

TENDER SPECIFICATION NO.:
NAME OF PROJECT:
BIDDER'S NAME & ADDRESS:

The following is the list of orders executed by us for 220/132kV and above voltage transmission line, the details of which are furnished in the support of Qualifying Requirement.

Sr. no	Custo Mer	Order Ref. & Date	Order value (Rs. Lakhs)	Line Volt. (KV)	Total Line Length in Ckt. KM	Scope of Work					Date of commiss-ioning
						Survey*	Profiling & spotting*	Tower Design*	Tower fon-dations & erection*	Strin ging	
1	2	3	4	5	6	7	8	9	10	11	12

Remarks : 1)Copies of User's certificates should be enclosed.
2)Bidder is requested to indicate Yes/No regarding scope of work

Date
Place: SIGNATURE & SEAL OF THE BIDDER

SCHEDULE– 'C'

QUALIFYING REQUIREMENT DATA SCHEDULE- Form No. 5

Tender Specification No.
Name of Project:

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 & SEAL OF THE BIDDER

DATE
PLACE

SCHEDULE – 'C'

QUALIFYING REQUIREMENT DATA SCHEDULE Form No. 6

Tender Specification No.

Name of Project:

Name of Bidder & Address:

DETAILS OF FULFILLMENT OF CONSORTIUM / ASSSOCIATE CONDITIONS

Sr.No.	Particulars	Remarks
1	Name of principal /lead bidder	
2	Name of consortium / associate	
3	Details of Qualifying Requirements fulfilled by the principal bidder 1) 2) 3)	
4	Details of Qualifying Requirements fulfilled by the consortium / associate 1) 2) 3)	

NOTE: The principal /lead bidder alongwith consortium / associate fulfill all the Qualifying Requirements jointly.

SIGNATURE & SEAL OF THE BIDDER

DATE
PLACE

SCHEDULE – 'C'

QUALIFYING REQUIREMENT DATA SCHEDULE Form No. 7

Tender Specification No.
Name of Project:
Name of Bidder & Address:
DETAILS OF ANNUAL TURNOVER FOR LAST THREE YEARS IN TRANSMISSION SECTOR

Sr.No.	Financial Year (Specify)	Annual Turnover (in Rs. Lakhs)
1		
2		
3		
4		

Average Annual Turnover for last three financial years: Rs……Lakhs
NOTE: The above details should be duly certified by the Chartered Accountant.

SIGNATURE & SEAL OF THE BIDDER

DATE
PLACE

SCHEDULE – 'C'

QUALIFYING REQUIREMENT DATA SCHEDULE Form No. 8

Tender Specification No.
Name of Project:
Name of Bidder & Address:
DETAILS OF NET WORTH

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

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

NOTE: The above details should be duly certified by the Chartered Accountant.

2. Details of comfort letter from a Nationalized Bank / Scheduled Bank
   A) Name of a Bank with address & telephone /fax no. :
   B) Amount for which the Bank agrees to provide adequate cash flow. :
   C) Letter from a Bank is Enclosed Yes / No

SIGNATURE & SEAL OF THE BIDDER

DATE
PLACE

SCHEDULE-C
QUALIFYING REQUIRMENT DATA SCHDULE FORM NO.9
(SAMPLE FORM)
LETTER OF ASSURED LINE OF CREDIT

Bid No.
(To be submitted by a Reputed Bank on the Bank's Letterhead)

Date: (Insert Date)

To : Maharashtra State Electricity Transmission Company Limited
Represented by
Executive Engineer
EHV Project Dn-1
3rd floor, Adm. building,
925, Kasaba peth, Juna bazar road,
Pune

Subject: Letter of Assurance of Providing a Revolving Line of Credit for Turnkey construction work of

Dear Sir,

WHEREAS_____(name and address of Bidder) (hereinafter called the Bidder) intends to submit a Bid for design, manufacture and supply of all materials, execution of relevant civil works, erection, testing and commissioning including a five year guarantee (defects liability) period for the construction work of 132KV transmission lines covered under Bid No._____ for _____ transmission line on a single point responsibility "Turnkey basis" (hereinafter called "the Bid"), of 132kV transmission lines, in response to the Notice inviting Tenders issued by the **Maharashtra State Electricity Transmission Company Limited (MSETCL**) (hereinafter called the Owner) on _____20_____; and

WHEREAS the Bidder has requested that an assured revolving line of credit be provided to it for executing the works in the event that it is determined to be qualified to undertake the Works and is subsequently determined to be eligible for award of contract; then

KNOW ALL THESE PEOPLE by these presents that We _____(name of Bank) of _____(name of Country) having our registered office at _____(address of registered office) are willing to provide to _____(the Bidder) a sum of up to Rs._____(Rupees_____only) as an assured revolving line of credit for executing the Works under construction of 132 KV transmission lines should the Bidder be selected for award of contract based on its tendered prices. The assured line of credit will be in addition to any existing lines of credit, which the Bidder has with our Bank, and will not be transferable to any other project that the Bidder may have.

We understand that this assurance may be taken into consideration by the Owner during evaluation of the Bidder's financial capabilities, and further assure that we intend to maintain this revolving line of credit until such time as the Works are completed and taken over by the Owner.

SEALED with Common Seal of the said Bank on the _____day of _____20_____.
Date :_____ Signature of the Bank :_____

Witness: _____Seal: _____

(Signature, name and address)

SCHEDULE – D

SCHEDULE OF UNIT PRICE

Note :

The bidder shall indicate the unit rate for all the equipments /material to be supplied against this specification / and also unit rate for erection, testing & commissioning of each item so as to enable calculation of revised order value due to any increase/decrease in scope of work that may become necessary during execution.

Name of the LINE : ----------

PROFORMA OF TAXES AND DUTIES FOR SUPPLY WORKS- ENCLOSED SEPERATELY

For Erection Portion :

PROFORMA FOR TAXES AND DUTIES FOR ERECTION- ENCLOSED SEPERATELY

SCHEDULE 'E'

PERFORMANCE SECURITY FORM
(PERFORMANCE GUARANTEE IN LIEU OF SECURITY DEPOSIT)
(To be Stamped in accordance with Stamp Act)

The Bank of .....(Name & Address) hereby agree unequivocally and unconditionally to pay, at Mumbai with in 48 hours, on demand in writing from the Maharashtra State Electricity Transmission Co. Ltd, or any Officer authorized by it in this behalf, of any amount up to and not exceeding Rs.....(in Words) Rupees..... to the said Electricity Transmission Co. Ltd on behalf of M/s..... who have tendered and/or contracted or may tender or contract hereafter for unit scope of works for the Maharashtra State Electricity Transmission Co. Ltd; against order No..... dated..... . Total value of order is Rs.....

This agreement shall be valid and binding on this Bank up to and including.....and shall not be terminable by notice or any change in the constitution of the Bank or the firm of contractors or by any other reasons whatsoever and our liability hereunder shall not be impaired or discharged by any extension of time or variations or alterations made, given, concerned or agree with or without our knowledge or consent, by or between parties to the said within written contract. The validity of this Bank Guarantee will be extended by us for the further period, of six months, one month prior to its present validity period at the request of Maharashtra State Electricity transmission Co. Ltd.

In case of any dispute arising out of or in connection the extension or encashment of Bank Guarantee, the courts in Mumbai will have jurisdiction.

Our liability under this Guarantee is restricted to 10% value of Contract Rs..... (Rs..... only). Our Guarantee shall remain in force until.....

Date: Signature:.....

Address: Name & Designation:.....
(For:.....
(Banker's Rubber Seal)

Fax no.:.....

WITNESS:

(Signature)

(Name)

(Official Address)

SCHEDULE 'F'

BID SECURITY FORM
(BANK GUARANTEE IN LIEU OF BID SECURITY EQUIVALENT TO 1% OF ESTIMATED COST)

(To be Stamped in accordance with Stamp Act)

Ref.....

Date.....

Bank Guarantee No.....

In accordance with invitation to Bid for the work of construction of EHV lineS as per scope of tender No.--------- in accordance with the tender specification _____ Messers (Bidders) _____ or Mr._____ Address _____ Director(s) _____wish/wishes to participate in the said tender and as a bank guarantee for the sum of Rs.....(in words Rs.....) as specified in the invitation to Bid valid for..... days from..... is required to be submitted by the tenderer, this bank hereby guarantees and undertakes, during the above said period, to immediately pay on written request by Maharashtra State Electricity Transmission Co. Ltd; Owner) the amount ..... to the said Electricity transmission Co. Ltd; without any reservations. This guarantee would remain valid upto 4 P.M. on..... (this date shall be 8 months after last date for submission of bid) and if any further extension to this is required, the same will be extended on receiving instructions from the .....on whose behalf this Guarantee has been issued.

Witness: .....

(Signature)

(Signature)

(Name)

(Official Address)

Mailing address
including Fax No.
H.O.of Bank

(Seal of the Bank)

SCHEDULE 'G'

PROFORMA OF JOINT UNDERTAKING BY THE COLLOBORATOR/ASSOCIATE ALONGWITH THE BIDDER

(On Non-judicial stamp paper of Appropriate value)

THE DEED OF UNDERTAKING executed this.....day of ..... (month) of year two thousand seven by a Company incorporated under the laws of ..... and having its registered office at..... (hereinafter called the collaborator"/"Associate" which expression shall include its successors, executors and permitted assigns) and "Bidder"/"Contractor" which expression shall include its Successors, executors and permitted assigns) in favour of Maharashtra State Electricity Transmission Co. Ltd: having its Registered office at Mumbai,(hereinafter called the "Owner" which expression shall include its successors, executors and assigns).

WHEREAS THE OWNER invited bids as per its specification No. ---------- for the supply of materials, erection and stringing of 132 KV transmission line.

AND WHEREAS clause 3.0 of Section I , Part-I interalia stipulates that the Bidder along with its Collaborator/ Associate must fulfill the qualifying requirements and be jointly and severally bound and responsible for the successful performance of the contract in the event the bid is accepted by the Owner resulting in a "Contract".

AND WHEREAS the bidder has submitted its bid to the Owner vide Proposal No..... dated ..... based on the Collaboration/Association of the Collaborator/ Associate.

NOW THEREFORE THIS UNDERTAKING WITNESSETH AS UNDER:

1) In consideration of the award of Contract by the Owner to Bidder (hereinafter referred to as the "Contract") we, the Collaborator/Associate and the Bidder/Contractor do hereby declare that we shall be jointly and severally bound unto the Maharashtra State Electricity Transmission Co. Ltd; (Owner) for the successful performance of the Contract and shall be fully responsible for the design, manufacture, erection, testing and successful performance of the 220kV-132 KV line-Substation in accordance with contract specifications.

2) In case of any breach of the contract by the Contractor, we, the Collaborator/Associate do hereby agree to be fully responsible for successful performance of the Contract and undertake the Contract in order to discharge the Contractor's obligations stipulated in the contract. Further if the Owner suffers any loss or damage on account of any breach in the contract, we the Collaborator/ Associate and the Contractor jointly and severally undertake to pay such loss or damage to the Owner on its demand without any demur. This is without prejudice to any rights of the Owner against the Contractor under the contract and connected documents/guarantees. It shall not be necessary or obligatory for the Owner to proceed against individual Collaborator/Associate before proceeding against the while dealing with the Contractor, nor any extension of the time or any relaxation by the Owner to the Contractor shall prejudice any rights

of the Owner under the deed of undertaking against the Collaborator/Associate or the Contractor.

3) Without in anyway affecting the generality and total responsibility in terms of this deed of Undertaking, the Collaborator/Associate in particular hereby agrees to depute their technical experts from time to time to contractors works/Owner's project site as mutually considered necessary by the Owner, Contractor and the Collaborator/Associate to ensure proper design, manufacture, erection, testing and successful performance of the material package in accordance with contract specifications and if necessary the Collaborator/Associate shall advise the Contractor suitable modifications of designs and implement necessary corrective measures to discharge the obligations under the Contract.

4) The financial liability of the Collaborator/Associate to MSETCL (Owner) with respect to any and all claims arising out of the performance or non performance of the obligations set forth in this Deed of Undertaking read in conjunction with the relevant provisions of the contract, shall however, be limited to the extent of 100% price of the supply portion as established in the contract awarded by the Owner to the Contractor in terms of the Contract and this Deed of Undertaking.

5) This Deed of Undertaking shall be construed and interpreted in accordance with the laws of India and the courts in Mumbai shall have exclusive jurisdiction in all matters arising under the Undertaking.

6) We, the Collaborator, Associate and the Bidder/ Contractor agree that this undertaking shall be irrevocable and shall form an integral part of the contract and further agree that this Undertaking shall continue to be enforceable till the Owner discharges and it shall become operative from the effective date of the contract.

IN WITNESS WHEREOF the Collaborator/Associate and the Bidder/ Contractor have, through their authorised representatives, executed these presents and affixed common seal of their respective Companies, on the day, month and year first above mentioned.

WITNESS

1. .....For Collaborator/Associate
   (Signature)

   .....(Signature of Authorised
   (Name) Representative)

   .....
   (Official Address) (Name)

(Designation)

Common Seal of the Company

2. .....For Bidder/Contractor
(Signature)

....
(Name in Block Letters) (Signature of the Authorized Representative)

....
(Official Address) (Name)

.....
(Designation)

Common Seal of the Company

SCHEDULE 'H'
PROFORMA OF JOINT DEED OF UNDERTAKING BY THE TOWER MANUFACTURER ALONGWITH THE BIDDER
(On Non-judicial stamp paper of Appropriate value)

THE DEED OF UNDERTAKING executed this.....day of ..... (month) of year two thousand _____ by a Company incorporated under the laws of India and having its registered office at..... (hereinafter called the "Tower Manufacturer" which expression shall include its successors, executors and permitted assigns) and "Bidder"/"Contractor" which expression shall include its Successors, executors and permitted assigns) in favour of Maharashtra State Electricity Transmission Co. Ltd: having its Registered office at Mumbai,(hereinafter called the "Owner" which expression shall include its successors, executors and assigns).

WHEREAS THE OWNER invited bids as per its specification No. ---------- for the supply of materials, erection and stringing of _____.

AND WHEREAS clause 3.2.1(a) i & 3.2.1(a) ii of **"Invitation for Bid"** Documents – inter – alia stipulates that the Bidder along with its **"Tower Manufacturer"** must fulfill the qualifying requirements and be jointly and severally bound and responsible for the quality and timely supply of tower parts in the event the bid submitted by the Bidder is accepted by the Owner resulting in a contract.

And whereas the bidder has submitted its bid to the Owner vide Proposal No..... dated ..... based on tie-up with the Tower Manufacturer for Supply of Tower Parts..

NOW THEREFORE THIS UNDERTAKING WITNESSETH AS UNDER:

1) In consideration of the award of Contract by the Owner to Bidder (hereinafter referred to as the "Contract") we, the Tower Manufacturer and the Bidder/Contractor do hereby declare that we shall be jointly and severally bound unto the Maharashtra State Electricity Transmission Co. Ltd; (Owner) for the design, manufacture, testing, supply of tower parts on FOR destination delivery at site basis in accordance with the Contract Specifications.

2) Without in any way affecting the generality and total responsibility in terms of this deed of Undertaking, the Tower Manufacturer hereby agrees to depute their representatives from time to time to the Owner's project site as mutually considered necessary by the Owner, Bidder/Contractor and the Tower Manufacturer to ensure proper quality, manufacture, testing and supply on FOR destination delivery at site basis and successful performance of the material in accordance with contract specifications. Further, if the Owner suffers any loss or damage on account of non-performance of the material (tower parts) fully meeting performance guaranteed as per Bid Specification in terms of the contract, we the Tower Manufacturer and the Bidder/ Contractor jointly and severally undertake to pay such loss or damages to the Owner on its demand without any demur.

3) This Deed of Undertaking shall be construed and interpreted in accordance with the laws of India and the courts in Mumbai shall have exclusive jurisdiction in all matters arising under the Undertaking.

4) We, the Tower Manufacturer and the Bidder/ Contractor agree that this undertaking shall be irrevocable and shall form an integral part of the contract and further agree that this Undertaking shall continue to be enforceable till the Owner discharges it. It shall become operative from the effective date of the contract.

IN WITNESS WHEREOF the Tower Manufacturer and/or the Bidder/ Contractor have, through their authorised representatives, executed these presents and affixed common seal of their respective Companies, on the day, month and year first above mentioned.

WITNESS

1. .....For Collaborator/Associate
(Signature)

.....(Signature of Authorised
(Name) Representative)

.....
(Official Address) (Name)

(Designation)

Common Seal of the Company

2. .....For Bidder/Contractor
(Signature)

....
(Name in Block Letters) (Signature of the Authorized Representative)

....
(Official Address) (Name)

.....
(Designation)

Common Seal of the Company

SCHEDULE 'I'

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

(On non-Judicial stamp paper of appropriate value)

INDEMNITY BOND

THIS INDEMNITY BOND is made on this..... day of .... 200 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 favour of Maharashtra State Electricity Transmission Co. Ltd; constituted under the Electricity (Supply) act 1948 having its Registered Office at Mumbai and its project in ------ District. (hereinafter called the MSETCL which expression shall include its successors and assigns):

WHEREAS 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 MSEB 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 favour of the MSETCL for the materials handed over to it by the MSETCL for the purpose of performance of the Contract/Erection portion of the Contract. (hereinafter called the "Material").

NOW THEREFORE, this indemnity Bond witnesseth 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 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 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 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 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-alias constitute a criminal breach or trust on the part of the Contractor for all intents and purposes including legal/penal consequences.

4.The 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 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-utilised 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 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-utilised 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 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 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 the Title Document receipt. ---------- RR/LR/ Carrier	Value of Material in token3of	Signature of Attorney

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 authorized 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.

ISO 9001-2000 certified

MAHARASHTRA STATE ELECTRICITY TRANSMISSION COMPANY LIMITED

TENDER. No. EE/EHVPD-I/PN/T/T-01/2020-21

Work Contract for S/C to D/C conversion of 132 kV Mundhwa tap point to 220 kV Magarpatta tap point by Supply of material, Foundation, Erection, associated de-stringing, re-stringing with Testing and Commissioning at Loc No. 23 with special design tower.

BOOK – I General Terms and Conditions

BOOK-II Technical Specifications for Line works.

Email : ee6610@mahatransco.in

EXECUTIVE ENGINEER
EHV PROJECTS DIVISION-I,
3RD FLOOR, ADM. BUILDING,
925, KASABA PETH,
JUNA BAZAR ROAD, PUNE

PHONE : 020-24579223

Tender Fees: Rs. 500/- + Taxes

MAHATRANSCO
Maharashtra State Electricity Transmission Co. Ltd.

INVITATION FOR BID (IFB)
(LOCAL COMPETETIVE BIDDING)

1.0 The Executive Engineer, MSETCL, EHV Projects Division-I, Pune, herein after referred to as the 'Owner' (MSETCL) invites bids through SRM e-Tender in TWO bid system (Techno-commercial Bid & Price Bid) from eligible bidders in India having executed similar projects in transmission sector on turnkey basis for work Contract for S/C to D/C conversion of 132 kV Mundhwa tap point to 220 kV Magarpatta tap point by Supply of material, Foundation, Erection, associated de-stringing, re-stringing with Testing and Commissioning at Loc No. 23 with special design tower - 0.906 Km

2.0 Scope of Work :-

1	Work Contract for S/C to D/C conversion of 132 kV Mundhwa tap point to 220 kV Magarpatta tap point by Supply of material, Foundation, Erection, associated de-stringing, re-stringing with Testing and Commissioning at Loc No. 23 with special design tower - 0.906 Km

SRM e-Tender No. EE/EHVPD-I/PN/T/T-01/2020-21

Name of Projects	**Estimated Cost**	**Completion period from date of Site/Profile handing over (Including Monsoon)**
Work Contract for S/C to D/C conversion of 132 kV Mundhwa tap point to 220 kV Magarpatta tap point by Supply of material, Foundation, Erection, associated de-stringing, re-stringing with Testing and Commissioning at Loc No. 23 with special design tower - 0.906 Km	13,06,965.92/- (Supply) 11,09,238.54/- (Erection) **Total Cost 24,16,204.46/-**	4 Months from the date of handing over of approved profiles.

- The prices to be quoted against this IFB shall be in Indian rupees only.
- The tender will be considered as Works Contract in totality.
- For Evaluation of the Tender, the total price of Supply & ETC including all Taxes & Duties shall be considered.
- The LOA will be placed on final accepted price for Supply and ETC parts including all applicable Taxes & Duties and Cess.

- Price variation shall be given on ex-works price mentioned in MSETCL's estimate or bidder's quoted ex-works price whichever is lower.
- Variation in taxes & duties if any shall not be payable.

3.0 QUALIFYING REQUIREMENT

In order to be qualified for award of Contract, the bidder will be required to satisfy the following minimum criteria, which will take precedence over any qualifying requirements that may be stated in the specifications or elsewhere in the bidding document. The bidder shall satisfy the following conditions:

3.1 STATUTORY QUALIFYING CRITERIA

Statutory Licenses/Registration

3.1.1 The bidder or his associate should have a valid Govt. Electrical Contractor's License.

3.1.2 The lead bidder should be registered under GST. The bidder should have returns of preceding 3 financial years. (GST returns).

3.1.3 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 photocopies of the same will not be entertained.

3.2 TECHNICAL QUALIFYING CRITERIA

MSETCL invites bid through SRM e –tender in two bid system from eligible bidders in India.

For Line Works

3.2.1. (a) The bidder should have, in last 5 years executed the work on turnkey basis including supply of material, erection, testing & commissioning as mentioned at **(i)** and **(ii)** below

(i) The bidder should be an approved vendor of MSETCL or PGCIL 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 than the voltage class as mentioned in scope of tender. (In this case at least 100 kV).

OR

The bidder not satisfying above condition shall furnish a legally enforceable Joint Deed of Undertaking duly notarized (Format enclosed) from the manufacturer who satisfies such condition fully, to guarantee for quality & timely supply of tower material.

(ii) The bidder should have constructed (including tower foundation, tower erection and stringing) at least S/C Tr. Line of route length **at least 50%** of route length mentioned in the scope of this tender (In this case at least 0.453 km) in single order and of voltage class at least one step below than the voltage class as mentioned in scope of tender. (In this case at least 100 kV).

3.2.1 (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 & period taken for completion etc.

3.2.2. The owners reserves the right to accept/reject the bid.

Note: The original colored scan copy should be uploaded as bid documents in support of 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.

3.3 FINANCIAL QUALIFYING CRITERIA

3.3.1 The average annual turnover of the bidder during last three financial years should be not below than 60% of estimated cost.

3.3.2 The bidder should have a Net Worth (which is defined as "Equity share capital + Reserves – Revaluation reserves – Intangible assets – Miscellaneous expenditure to the extent not written off and carry forward losses") of not less than 25% (Twenty Five Percent) value of estimated cost of tender offered. The bidder should submit the statement of Net worth duly certified by Chartered Accountant for the last financial year.

Note: 1. The original colored scan copy should be uploaded as bid documents in support of Financial Qualifying Criteria. The Attested/Notarized photocopies of the same will not be entertained strictly. **In the prescribed format annexed in the tender specifications as Schedule 'C' & Schedule 'D'.**

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 strictly. **In the prescribed format annexed in the tender specifications as Schedule 'C' & Schedule 'D'.**

3.4 IN CASE OF CONSORTIUM

(Not more than 2 partners including lead partner)

3.4.1 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.

Ø The bid, and in case of a successful bid, the Contract Agreement shall be signed so as to be legally binding on both partners.

Ø Both partners of the consortium shall be jointly and severally liable for execution of the contract in accordance with the Contract terms.

3.4.2 Both the consortium partners should individually satisfy 100% technical qualifying criteria at 3.2 (A or B) and subject to fulfillment of remaining qualifying criteria jointly by both the partners.

3.4.3 The number of partners in a consortium should not be more than two, including the lead partner.

3.4.4 The lead partner shall be authorized to be in charge and this authorization shall be evidenced by submitting a duly registered/ notarized power of attorney signed jointly by legally authorized signatories of both partners.

3.4.5 A copy of agreement entered into by the consortium partners as specified in Schedule 'G' shall be submitted with the bid.

3.4.6 The bid document should have been purchased and submitted by the Lead Partner only.

3.5 Other Mandatory Documents for Valid Bid

3.5.1 Original color scan copy of duly signed/sealed schedules given in Book-I (GTC).

3.5.2 Bid Security Deposit (BSD) for an amount equal to 1% (one percent) of the estimated cost of tender **online on SRM portal or in the form of Bank Guarantee** from Scheduled/ Nationalized Commercial Bank in the prescribed format annexed in the tender specifications as Schedule 'F', along with the offer. The validity of Bank Guarantee should at least be for six (6) months from the originally scheduled date of techno-commercial bid opening. BG should be payable at Pune. The Stamp Duty should be paid as applicable in Maharashtra.

3.5.3. Documents as mentioned in clause no. 10, Section-III of Book-I, General terms & conditions (GTC), Page no. 45

4.0 General Points:-

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

4.2 A complete set of documents can be downloaded by the bidder from MSETCL's SRM e-Tendering website https://srmetender.mahatransco.in 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.

4.3 The tender is invited on individual percentage basis for Supply & ETC. For Evaluation of the Tender, the total price of Supply & ETC including all taxes & duties shall be considered. The LOA will be placed on the final accepted price for Supply & ETC including all applicable Taxes & duties.

4.4 The price variation will be applicable to the items as indicated in clause no 8.3.4 of Book-I (GTC).

4.5 Price variation shall be given on Ex-works price mentioned in MSETCL's estimation in price schedules or Bidders quoted Ex-works price whichever is lower.

4.6 Variation in statutory Taxes/Duties : see the detail clause no.9 of BOOK-I.

4.7 It may please be noted that the taxes / duties will be paid / reimbursed as per actual OR as stated in price break-up statement whichever is lower on submission of valid documentary proof.

4.8 **On submission of Fake documents in support of bid, owner shall Blacklist the bidder for this tender and future works and terminate existing contracts on Risk & Cost basis.**

4.9 Interested bidders may obtain further information, if needed, on our Website https://srmetender.mahatransco.in or from the Office of, the **Executive Engineer EHV Projects Division-I, Adm. Building, 3rd Floor, 925, Kasaba Peth, Una Bazar Road, Pune - 411011. Tel No. 020-24579223, email to ee6610@mahatransco.in.**

4.10 The new bidders are requested to complete the contractor registrations for SRM e Tendering with MSETCL 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.

4.11 The owner reserves the right to accept / reject the Bid without assigning any reasons thereof.

(Ashok Madavi)
Executive Engineer
EHV Projects Division-I, Pune

ESTIMATE ABSTRACT

Name of line:Conversion of 132 kV S/C Line into D/C Line between Mundhawa Tap to Magarpatta tap L.N. 23

As per SOR circulated vide ltr no. 546 dt.16.01.2019

Total (Supply)		**1306965.92**
Total (Erection)		**1109238.54**
	Sub Total (A) Rs.	**2416204.46**
3% contingences on sub total A		72486.13
15% Crop Compensation on sub total A		362430.67
5% Price variation on sub total A		120810.22
5% Statutory Charges on sub total A		120810.22
	Sub Total (B) Rs.	**3092741.71**
10% centages on sub total B		309274.1706
Grand Total Rs.		**3,402,016**

ESTIMATE (SUPPLY)

Name of line: Conversion of 132 kV S/C Line into D/C Line between Mundhawa Tap to Magarpatta tap L.N. 23

SN	Material No	HSN Code	DESCRIPTION OF ITEM	UNIT	Ex Works Unit Rate in Rs	Freight @1% of Ex Works	Insurance @1% of Ex Works	Total	GST @ 18 %	Total Amt in RS	Labour Cess @ 1%	Final Unit Rate in Rs	QTY	AMOUNT (Rs.)
1	2	3	4	5	6	7	8	11					12	13
1	500000038	73082019	Fabrcation, galvanising, supply of 132 kV special design NB towers (Viz, 2º,15º,30º, 60º) normal, its extentions with set of stubs, super structures, templates, step bolts, U-bolts, D'Shackles, chain links etc. complete as per approved design & drawings.	M.T	85613.80	856.13803	856.14	87326.08	15718.69	103044.77	1030.45	104075.22	9.20	957492.03
2	500000039	76169990	Supply at site store of galvanised nut & bolts with spring wasers, plain washer.	M.T	139171.00	1391.71	1391.71	141954.42	25551.80	167506.22	1675.06	169181.28	0.50	84590.64
3			**Tower accessories:**											
	500000709	83100090	a) Danger Board	Nos	252.11	2.5211	2.52	257.15	46.29	303.44	3.03	306.47	1	306.47
	500003465	83100090	b) Number Plate	Nos	209.83	2.0983	2.10	214.03	38.52	252.55	2.53	255.08	1	255.08
	500000712	83100090	c) Phase Plate (Set of RYB)	Set	336.13	3.3613	3.36	342.85	61.71	404.57	4.05	408.61	2	817.22
	500003466	83100090	d) Circuit Plate (Set of C1 & C2)	Set	348.36	3.4836	3.48	355.33	63.96	419.29	4.19	423.48	1	423.48
	500003467	73130010	e) Anticlimbing devices with BB	Set	4123.18	41.2318	41.23	4205.64	757.02	4962.66	49.63	5012.29	1	5012.29
	500000713	39162019	f) Bird guard	Set	568.30	5.683	5.68	579.67	104.34	684.01	6.84	690.85	0	0.00
4			**Disc Insulators:**											
	500000324	85462029	a) 70 KN (Normal)	Nos	795.34	7.9534	7.95	811.25	146.02	957.27	9.57	966.84	0	0.00
	500000323	85462029	b) 120 KN (Normal)	Nos	942.54	9.4254	9.43	961.39	173.05	1134.44	11.34	1145.79	70	80204.99
5	500003736	76041010	Supply of conductor of 0.2 A.C.S.R.	Kms	133796.25	1337.9625	1337.96	136472.18	24564.99	161037.17	1610.37	162647.54	0.150	24397.13
6			Supply of conductor of 0.2 AAAC	Kms	133796.25	1337.9625	1337.96	136472.18	24564.99	161037.17	1610.37	162647.54	0.150	24397.13
7			**Conductor hardwares for 0.2 ACSR.:**											
	500000811	72103010	g) D.T.N.	Set	7223.49	72.2349	72.23	7367.96	1326.23	8694.19	86.94	8781.13	6	52686.81
8			**Conductor hardwares for 0.2 AAAC.:**											
	500000811	72103010	g) D.T.N.	Set	7223.49	72.2349	72.23	7367.96	1326.23	8694.19	86.94	8781.13	6	52686.81
9			**Conductor accessories for 0.2 ACSR:**											
	500000813	76169990	a) M S Joints	Set	910.04	9.1004	9.10	928.24	167.08	1095.32	10.95	1106.28	3	3318.83
	500000814	76169990	b) Repair sleeve	Nos	291.11	2.9111	2.91	296.93	53.45	350.38	3.50	353.88	0	0.00
	500002879	76169990	c) P A Rod	Set	1656.80	16.568	16.57	1689.94	304.19	1994.12	19.94	2014.07	0	0.00
	500002903	76169990	d) Vibration dampers	Nos	725.16	7.2516	7.25	739.66	133.14	872.80	8.73	881.53	6	5289.18

SN	Material No	HSN Code	DESCRIPTION OF ITEM	UNIT	Ex Works Unit Rate in Rs	Freight @1% of Ex Works	Insurance @1% of Ex Works	Total	GST @ 18 %	Total Amt in RS	Labour Cess @ 1%	Final Unit Rate in Rs	QTY	AMOUNT (Rs.)
1	2	3	4	5	6	7	8	11					12	13
10			**Conductor accessories for 0.2 AAAC:**											
	500000813	76169990	a) M S Joints	Set	910.04	9.1004	9.10	928.24	167.08	1095.32	10.95	1106.28	3	3318.83
	500000814	76169990	b) Repair sleeve	Nos	291.11	2.9111	2.91	296.93	53.45	350.38	3.50	353.88	0	0.00
	500002879	76169990	c) P A Rod	Set	1656.80	16.568	16.57	1689.94	304.19	1994.12	19.94	2014.07	0	0.00
	500002903	76169990	d) Vibration dampers	Nos	725.16	7.2516	7.25	739.66	133.14	872.80	8.73	881.53	6	5289.18
			Earth Wire											
11			7/3.15 mm galvanised steel wire including 1% extra for sag and wastages	Kms	48009.33	480.0933	480.09	48969.52	8814.51	57784.03	577.84	58361.87	0.05	2918.09
			Accessories for Earth wire											
12	500000792	76169990	Earth wire tension clamp	set	682.68	6.8268	6.83	696.33	125.34	821.67	8.22	829.89	2	1659.78
	500000793	76169990	MS joint	Set	180.60	1.806	1.81	184.21	33.16	217.37	2.17	219.54	1	219.54
	500000795	76169990	Copper Earth Bond	Nos	691.98	6.9198	6.92	705.82	127.05	832.87	8.33	841.20	2	1682.39
														1306965.92

Note: The rate are considered from SOR criculated by corporate office vide ltr no.546 dt.16.01.2019
Tower supply qunatity is conisidered from budgetory offer received from M/s United Industries vide ltr no. 17 dt. 03.11.2017

Remarks
14
As per ltr no. 17 dt. 03.11.2017 received from M/s United Industries (M/s Shreem) rate for HT steel is genrally about 10% more than normal MS steel. Hence supply rate mentioned in SOR 546 dt.16.01.2019 for steel is taken 10% heigher for this special tower supply
170 No.s will be used from balance material of conversion of S/C D/C line from 132kV Kuruli tap - Whirlpool tap point being credited by M/s Ashtavinayaka
Rate consider same as 0.2 ACSR Cond as the rate is not available
Rate consider same as 0.2 ACSR Cond h/w as the rate is not available

Remarks
14
Rate consider same as 0.2 ACSR Cond accessories as the rate is not available

EHV PROJECTS DIVISION - I PUNE

ESTIMATE (ERECTION)

Name of line: Conversion of 132 kV S/C Line into D/C Line between Mundhawa Tap to Magarpatta tap L.N. 23

SN	Material / Service No	DESCRIPTION OF ITEMS	UNIT	Ex Works Unit Rate in Rs	GST @18% in Rs.	Total with GST in RS	Labour cess@ 1%	Final Unit rate	QTY	AMOUNT (Rs.)	Remarks
1	2	4	5	6	10	11			12	14	
1		**Survey:**									
	300008620	a) Preliminary survey with GPS survey, Theodolite, marking route on topo sheets representing actual field conditions etc. complete in all respect.	KM.	3400.00	612	4012	40.12	4052.12	0	0.00	
	300006597	b) Detailed survey with GPS/Total station/ Thedoilite etc. Including tower spotting & schedules, preparation of tower profiles, approval of alignment, marking of route/corridor on topo sheet, village map & kasra map, identification of forest, railway crossing, highway crossing, proposed development along the route/corridor etc., collection of 7/12 along the route/corridor.	KM.	12900.00	2322	15222	152.22	15374.22	0.0	0.00	
	300002036	c) Check Survey to carry out as per approved tower profiles, Digital Theodolite/Total sation/ GPS etc. & location marking by fixing three pegs in alignment for suspention tower & by fixing of five pegs in bisection for angle tower, including bush cutting along the centre line of alignment & repege marking if necessary etc. complete. Check survey including revision of profiles if required.	KM.	4300.00	774	5074	50.74	5124.74	0.59	3023.60	
2		Excavation of pits for tower footing in earth soil of all types, sand, gravel & normal soil including removing of excavated material beyond tower locations up to 50 mtrs. lead and all lifts, shoring, shutering, prepearing the bed for foundations and necessary back filling ramming after stub setting, compacting, finishining & curing complete in all respect as per drawing & direction of Engineer In-charge.									
	300002037	a) Normal soil/Sand/Gravel/Soft murum	Cum.	179.85	32.373	212.223	2.12	214.35	7	1500.42	
	300002039	b) Black cotton soil / Submerged soil	Cum.	303.00	54.54	357.54	3.58	361.12	0	0.00	
	300002038	c) Soft rock / Hard murum	Cum.	372.35	67.023	439.373	4.39	443.77	7	3106.37	
	300002040	d) Dry fissured rock	Cum.	909.00	163.62	1072.62	10.73	1083.35	95	102917.89	
	300002041	e) Hard rock by chiseling	Cum.	1173.00	211.14	1384.14	13.84	1397.98	27	37745.50	
3		Stub setting in all types of soil with help of PROP setting including transportation if required to the desired location, fixing the stubs in position as per the alingment, jacking, fixing & leveling the template & the stub as per directed by Engineer In-charge.									
		i)132 kV D/C NB towers.:			0	0	0.00	0.00		0.00	
	300008649	Special tower	Per Loc.	6575	1183.5	7758.5	77.59	7836.09	1	7836.09	
		Total			0	0	0.00	0.00	**1**	0.00	

SN	Material / Service No	DESCRIPTION OF ITEMS	UNIT	Ex Works Unit Rate in Rs	GST @18% in Rs.	Total with GST in RS	Labour cess@ 1%	Final Unit rate	QTY	AMOUNT (Rs.)	Remarks
1	2	4	5	6	10	11			12	14	
4		**Concreting of foundation:**			0	0	0.00	0.00		0.00	
		Providing and casting in situ cement concrete of trap metal of size 20 to 40 mm as applicable including cost of cement, sand, metal & water, frame work, finishing, compaction, coping & curing for 21 days complete as per drawing and direction of Enginner In-charge in the following grades.									
	300009290	a) 1:1.5:3 (M-20) with graded metal for foundation	Cum	7016.08	1262.8944	8278.9744	82.79	8361.76	30	250852.92	
	300009292	b) 1:3:6 (M-10) with graded metal for foundation/bedding	Cum	5708.35	1027.503	6735.853	67.36	6803.21	3	20409.63	
5	300009294	Providing and fixing in position of Steel Reinforcement in concrete foundation including supply of TMT bars with epoxy coating/Meta cam of various dimeters for RCC work like raft, footing of column etc. as per drawing & direction which will be furnished by MSETCL including cutting, bending, hooking the bars, binding with binding wires or tack welding etc. complete as directed by Engineer In-charge. (Steel to be provided by contractor)	MT	72180.00	12992.4	85172.4	851.72	86024.12	2.5	215060.31	
6	300002045	**Pipe type earthing:** Normal earthing including excavation of pits/trenches, laying of earthing pipe, strips,flat etc. supplying and laying salt and soft coke as directed & as per the drawing to be frnished by MSETCL and back filling, complete in all respect.(Inclusive supply of GI strip / flat & nut- bolts)	No.	5050	909	5959	59.59	6018.59	0	0.00	
7	300002046	**Counter Poise type earthing:** Including excavation of pits/trenches, laying of earthwire & fitting plates/lugs to the tower legs & back filling, complete in all respect as per drawing to be furnished by MSETCL.(Inclusive supply of GI wire, lugs & nut - bolts etc.)	No.	11110	1999.8	13109.8	131.10	13240.90	1	13240.90	
8	300002048	Complete erection of DC/MC/ Horrizontal towers (including special towers) with its extensions for EHV lines (as per requirement) with fixing of bolts & nuts, tightening, punching & fitting including attachments (like step bolts, ladders, platforms, "U" bolts, shackles, hangers, strain plates etc.) & including transportation of material from site stores to work sites, tightiening & punching of bolts & nuts complete in all respect, punching of bolts, fixing of danger plates, number plates, phase plates, circuit plates, anticlimbing devices, bird guard etc.	MT	6525.00	1174.5	7699.5	77.00	7776.50	9.70	75432.00	
11		Electric tack welding (half round welding) to GI nuts bolts of tower from thread end (Two spots to be welded to each nuts & bolts near thread end) & painting the welded portion with two coats of zinc reach paint for two sections of each tower.			0	0	0.00	0.00		0.00	
	300007350	a) For D/C Tower	Per Tower	2400.00	432	2832	28.32	2860.32	1	2860.32	

SN	Material / Service No	DESCRIPTION OF ITEMS	UNIT	Ex Works Unit Rate in Rs	GST @18% in Rs.	Total with GST in RS	Labour cess@ 1%	Final Unit rate	QTY	AMOUNT (Rs.)	Remarks
1	2	4	5	6	10	11			12	14	
12	300002073	Destringing of conductors on S/C, D/C, M/C, H/Z towers including transportation of conductor & required material from site store to site locations, laying, paving, jointing, rough sagging, final sagging, clipping, fixing of accessories, hosting of insulators, jumpering, etc. on tower complete in all respect including tree cutting if required as per the direction of Engineer In-charge. (which includes the works involved in the crossing of LT, HT & EHV power lines, railway & river crossing), during outage as well as without outage including E/W.			0	0	0.00	0.00		0.00	
		a) 0.2 ACSR S/C on D/C	KM.	36220.16	6519.6288	42739.7888	427.40	43167.19	0.906	39109.47	
		a) 0.2 AAAC S/C on D/C	KM.	36220.16	6519.6288	42739.7888	427.40	43167.19	0.906	39109.47	
13		Restringing of conductors on S/C, D/C, M/C, H/Z towers including transportation of conductor & required material from site store to site locations, laying, paving, jointing, rough sagging, final sagging, clipping, fixing of accessories, hosting of insulators, jumpering, etc. on tower complete in all respect including tree cutting if required as per the direction of Engineer In-charge. (which includes the works involved in the crossing of LT, HT & EHV power lines, railway & river crossing), during outage as well as without outage including E/W.									
		a) 0.2 ACSR S/C on D/C	KM.	36220.16	6519.6288	42739.7888	427.40	43167.19	0.906	39109.47	
		a) 0.2 ACCC S/C on D/C	KM.	36220.16	6519.6288	42739.7888	427.40	43167.19	0.906	39109.47	
14		**Misc. works:**									
	300002077	a) Dismantling of existing D/C tower (1 No.) & transporting to the MSETCL site store.	MT	5220.00	939.6	6159.6	61.60	6221.20	3.64	22645.15	
	50007994	b) Removal of stub upto 1.5 mtr.	Per Tower	7070.00	1272.6	8342.6	83.43	8426.03	1	8426.03	
		Design charges for special tower	LS	157529.40	28355.292	185884.6891	1858.85	187743.54	1	187743.54	As per ltr no. 17 dt. 03.11.2017 received from M/s United Industries (M/s Shreem) Beign a special tower, design charges to be considered 20% of supply of steel work. Hence calculated on tower supply ex work amt as below: (85613.80*20%)*9.2MT=Rs.157529.40/-
										1109238.54	

Note: The rate are considered from SOR criculated by corporate office vide ltr no.546 dt.16.01.2019
The foundation quantities are considered from budgetory offer received from M/s United industries vide ltr no. 17 dt.03.11.2017

Working sheet

Name of line:Conversion of 132 kV S/C Line into D/C Line between Mundhawa Tap to Magarpatta tap L.N. 23

A	**Supply Part:**		
1	Supply of tower	9.2	MT
2	Supply of N/B	0.5	MT
3	Supply of tower accessories:		
a	Danger board	1	Nos.
b	Number plate	1	Nos.
c	Phase plate (Set of RYB)	2	Set
d	Circuit plate(Set of C1 & C2)	1	Set
e	Anticlimbing devices with barbed wire	1	Nos.
f	Bird guard	0	Nos.
4	Disc insulators:		
a	70 KN (N)	0	Nos.
b	120 KN (N)	240	Nos.
5	Supply of 0.2 ACSR Panther conductor	0.15	Kms.
6	Supply of 0.2 AAAC Panther conductor	0.15	Kms.
6	Supply of 0.2ACSR conductor hardwares:		
e	DTN	6	Nos.
7	Supply of 0.2 AAAC conductor hardwares:		
e	DTN	6	Nos.
7	Supply of 0.2 ACSR conductor accessories:		
a	Mid span joints	3	Nos.
b	Repair sleeves	0	Nos.
c	PA rods	0	Nos.
d	Vibration dampers	6	Nos.
7	Supply of 0.2 AAAC conductor accessories:		
a	Mid span joints	3	Nos.
b	Repair sleeves	0	Nos.
c	PA rods	0	Nos.
d	Vibration dampers	6	Nos.
8	Supply of 7/3.15 E/W	0.05	Km
9	Supply of 7/3.15 E/W Hardware		
	a) E/W tension clamp	2	Set
B	**Erection part:**		
1	Survey		
a	Preliminary survey	0	Kms.
b	Detailed survey	0.0	Kms.

c	Check survey	0.59	Kms.
2	Excavation of pits:		
a	NS/Sand/Gravel/SM	7	Cum.
b	BC soil / Submerged soil	0	Cum.
c	SR/HM	7	Cum.
d	DFR	95	Cum.
e	HR by chiseling	27	Cum.
3	Stub setting in all types of soil:		
	132 kV Special towers:		
c	23 deg	1	Nos.
	Total	1	Nos.
4	Concreting of foundation:		
a	M20 (1:1.5:3)	30	Cum.
b	M10 (1:3:6)	3	Cum.
5	Steel reinforcement	2.50	MT
6	Tower earthing:		
a	Pipe type earthing (Including earthing set supply)	0	Nos.
b	CP type earthing (Incuding earthing set supply)	1	Nos.
7	Complete erection of tower	9.7	MT
8	Protection of tower footing		
i	Excavation for revetment wall:		
a	NS/Sand/Gravel/SM	0	Cum.
b	BC soil / Submerged soil	0	Cum.
c	SR/HM	0	Cum.
d	DFR	0	Cum.
e	HR by chiseling	0	Cum.
ii	P & C in 1:2:4 concrete	0	Cum.
iii	P & C in 1:3:6 concrete	0	Cum.
iv	Providing & constcting of UCR masonary of trap stone in cement mortar 1:6	0	Cum.
9	Benching:		
a	NS/Sand/Gravel/SM	0	Cum.
b	BC soil / Submerged soil	0	Cum.
c	SR/HM	0	Cum.
d	DFR	0	Cum.
e	HR by chiseling	0	Cum.
10	Electric tack welding:		
a	For D/C tower (Upto two sections)	1	Per tower
11	De-stringing of 0.2 ACSR conductor:		
	132 kV S/C line on D/C tower including E/W L.N. - 22 to 25	0.906	Km
12	De-stringing of 0.2 AAAC conductor:		
	132 kV S/C line on D/C tower L.N. - 22 to 25	0.906	Km
13	Re-stringing of 0.2 ACSR conductor:		

	132 kV S/C line on D/C tower L.N. - 22 to 25	0.906	Km
14	Re-stringing of 0.2 AAAC conductor:		
	132 kV S/C line on D/C tower L.N. - 22 to 25	0.906	Km
15	Re-stringing of 7/3.15 E/Wr:		
	L.N. - 22 to 25	0.906	Km
16	Dismantling of tower 30 deg DC tower 1 No.	3.64	MT
17	Removal of stubs upto 1.5 mtr	1	Per tower
17	RCC REVETMENT / PROTECTION WALL : for L.N. - 10,11,12,13,14 &15		
	A. Excavation of soil in all types of soil	0	Cum
	B. Providing & casting in concrete mix 1:2:4	0	Cum
	C. Providing & casting in concrete mix 1:1.5:3	0	Cum
	D. Providing steel reinforcement	0	Cum
	E. Providing & filling in plinth (backfilling) (Rate of backfilling is included in above items)	0	Cum

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Name of line: Conversion of 132 kV S/C Line into D/C Line between Mundhawa Tap to Magarpatta tap L.N. 23

SN	Type of tower	Qty.	Unit Wt.		For supply		For erection	
			SS	N/B	Wt. Of SS	Wt. of N/B	Wt of SS	Wt. Of N/B
1	132 kV 30 R Special							
	Stub	1						
	Super Structure with Stub	1	9200	475	9200	475	9200	475
		Total Weight (KG)			**9200.000**	**475.000**	**9200.000**	**475.000**
		Total Weight (MT)			**9.20**	**0.48**	**9.20**	**0.48**

Total wt. for supply of tower = 9.200 MT 9.2 Say
Total wt. for supply of N/B = 0.475 MT 0.5 Say

Total wt. for erection of tower = 9.68 MT 9.7 Say

Dismantling of tower:

L.N. 28 (DR+0)	Superstructure weight	3495.674
	N/B Weight	135.842
	Total weight (KG)	**3631.516**
	Total weight (MT)	**3.64 Say**

Not DR+0 weight is considered from approved BOM for Conversion of 132 kV S/C Line into D/C Line between Mundhawa Tap to Magarpatta tap (W.O. No. 3151 dt. 05.10.2009)

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Name of line: Conversion of 132 kV S/C Line into D/C Line between Mundhawa Tap to Magarpatta tap L.N. 23

Details of DFR foundations: 132 kV D/C Special tower Towers

Type	Total no.	N.S.	DFR	B.C.	Remark
Special 23° deviation tower	1	0	1	0	
TOTAL	1	0	1	0	

SN	TYPE OF TOWER	TOTAL QTY REQD.	QYT. CONSIDER FOR DFR	QTY/TOWER FOR DFR FDN				TOTAL QTY.FOR DFR FDN			
				EXC.	CONCRATING		STEEL	EXC.	CONCRATING		STEEL
					1:3 :6	1:1.5:3			1:3:6	1:1.5:3	
A	132 kV D/C										
1	special	1	1	135	3	30	2.4	135	3	30	2.4
		1	**1**	TOTAL QTY ---------				135	3	30	2.4

Total excavation qty.:		135		**say**
NS/Sand/SM	5%	6.750		7
BC soil	0%	0.000		0
SR/HM	5%	6.750		7
DFR	70%	94.500		95
HR	20%	27.000		27
Total 1:1.5:3 concrete		30	**Cum**	**30**
Total 1:3:6 concrete		3	**Cum**	**3**
Total reinforcement		2.4	**MT**	**2.5**

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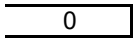

LOCATION WISE MATERIAL STATEMENT

Name of line: Conversion of 132 kV S/C Line into D/C Line between Mundhawa Tap to Magarpatta tap L.N. 23

Sr. No	Loc No	Type of Tower	Span In Mtr	Insulator (N)		0.2 AAAC AND ACSR Conductor Hardwares								0.2 ACSR Conductor Accessories				0.2 AAAC Conductor Accessories				Tower Accessories						Earthing	
				70 KN	120 KN	SSN	SSA	DSN	DSA	STN	STA	DTN	DTA	MSJ	RS	P A Rods	VD	MSJ	RS	P A Rods	VD	DB	NP	PP	CP	ACD	BG	CP type	Pipe
	22	Q+3																											
			270											3				3											
	23	Special 23° deviation tower			240							12					6				6	1	1	2	1	1		1	0
			320																										
	24	P+6																											
TOTAL			**590**	**0**	**240**	**0**	**0**	**0**	**0**	**0**	**0**	**12**	**0**	**3**	**0**	**0**	**6**	**3**	**0**	**0**	**6**	**1**	**1**	**2**	**1**	**1**	**0**	**1**	**0**

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TOWER SCHEDULE

Name of line: Conversion of 132 kV S/C Line into D/C Line between Mundhawa Tap to Magarpatta tap(L.N. 23)

SN	Loc. No.	Tower type	Span	Remark
1	22	Q+3		
			270	
2	23	Special 23° deviation tower		
			320	
3	24	P+6		
			316	
4	25	DN+6		

Total span 906 m

0.906 Kms.

1 De-stringing of 0.2 ACSR conductor:

a 132 kV S/C line on D/C tower

L.N. - 22 to 25		906	m.
	Total	906	m.
		0.906	Kms.

2 De-stringing of 0.2 AAAC conductor:

a 132 kV S/C line on D/C tower

L.N. - 22 to 25		906	m.
	Total	906	m.
		0.906	Kms.

3 Re-stringing of 0.2 ACSR conductor:

a 132 kV S/C line on D/C tower

L.N. - 22 to 25		906	m.
	Total	906	m.
		0.906	Kms.

4 Re-stringing of 0.2 AAAC conductor:

a 132 kV S/C line on D/C tower

L.N. - 22 to 25		906	m.
	Total	906	m.
		0.906	Kms.

4 Re-stringing of 7/3.15 E/Wr:

L.N. - 22 to 25		906	m.
	Total	906	m.
		0.906	Kms.

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