TECHNICAL SPECIFICATION FOR ACSR MOOSE, ZEBRA & PANTHER CONDUCTOR

1.0 SCOPE:

1.1 This specification provides for design, manufacture, engineering inspection stage testing and testing before dispatch, packing and delivery unloading and stacking of ISI marked Aluminum Conductor Steel Reinforced as per IS 398 (Part-II).

1.2 The tenderer shall furnish a copy of valid BIS license for ISI marking together with offer without which the offer shall be treated as non responsive.

1.3 The bidder shall be required to submit with the bid the declaration by the manufacturer or supplier revealing the actual source of aluminium wires, rods and ingots used for making the conductors/cables through a certification from their statutory auditor/Cost Auditor. The submission of such certification from their Statutory Auditor of Cost Auditor shall be a pre-condition for participation in the bid for procurement of conductors or cables to be used in electric power lines.

1.4 All primary aluminium manufacturers have their own testing facilities and provide their own test / quality certificates mentioning the elemental analysis of aluminium wires, wire rods and ingots supplied to their customers. The bidder shall produce the certificate to the procurer of conductors / cables at the time of participation in the bid.

2.0 STANDARDS

The power conductor shall conform to the following Indian / International Standards, which shall mean latest revisions, amendments/changes adopted and published, unless otherwise specified herein before.

Sl No.	Indian Standards	Title	International Standards
1.	IS:209	Specification for zinc	BS:3436
2.	IS:398 Part II	Specification for aluminum Conductors for overhead Transmission purpose	IEC:1089 BS:215 (Part II)
3.	IS:1778	Reels and Drums for Bare Conductors	BS:1559
4.	IS:1521	Method for Tensile Testing of steel wire	ISO/R89
5.	IS:2629	Recommended practice for Hot Dip Galvanizing of Iron and Steel	
6.	IS:2633	Method for Testing Uniformity of coating of zinc coated Articles	
7.	IS:4826	Hot dipped galvanized coatings on Round Steel Wires	ASTM A-472 729 BS:443
8.	IS:6745	Methods of Determination of weight of zinc coating of zinc coated Iron and Steel Articles	BS:443
9.	IS:5484	EC grade Aluminium rod produced by continuous casting and rolling.	
10.	IS:2067	Wrought Aluminium wire for electric purposes.	
11.	IS:4026	Aluminium ingots billets and wire bars (EC GRADE)	

3.0 CLIMATIC CONDITIONS:

3.1 The conductor is being installed directly in air with the support of Towers and with the help of Hardware and accessories and Insulators The conductor shall be therefore suitable for satisfactory operation under the tropical climatic conditions listed in Annexure-I

4.0 PRINCIPAL PARAMETERS:

4.1 The details of conductors are tabulated below :-

	PARAMETER	PANTHER	ZEBRA	MOOSE
a)	Stranding and wire diameter	30/3.00 mm Aluminium 7 / 3.00 mm Steel	54/3.18 mm Aluminium 7 / 3.18 mm Steel	54/3.53 mm Aluminium 7 / 3.53 mm Steel
b)	Number of Strands Central Steel wire 1st Steel Layer 1st Aluminium Layer 2nd Aluminium Layer 3rd Aluminium Layer	 1 6 12 18 -	 1 6 12 18 24	 1 6 12 18 24
c)	Sectional area of Aluminium (Sq.mm)	212.10	428.90	528.50
d)	Total Sectional area (Sq.mm)	261.50	484.50	597.00
e)	Overall diameter (mm)	21.00	28.62	31.77
f)	Approximate weight (kg/km)	974	1621	1998
g)	Calculated maximum D.C resistance at 20 deg. C (Ohm/km)	0.139	0.06868	0.05595
h)	Minimum UTS (kN)	89.67	130.32	159.60
i)	Modulus of Elasticity (gN/Sq.meter)	80	69	69
j)	Coefficient of linear expansion per deg C	17.80×10^{-6}	19.30×10^{-6}	19.30×10^{-6}

The details of aluminium strand are as follows

	PARAMETER	PANTHER	ZEBRA	MOOSE
a)	Minimum breaking load of strand before stranding (kN)	1.17	1.29	1.57
b)	Minimum breaking load of strand after stranding (kN)	1.11	1.23	1.49
c)	Maximum D.C resistance of strand at 20 deg. C (Ohm / km)	4.079	3.626	2.954
d)	Diameter mm (Standard / Max / Min)	3.00 / 3.03 / 2.97	3.18 / 3.21 / 3.15	3.53 / 3.57 / 3.49
e)	Mass (kg / km) (at normal diameter)	19.11	21.47	26.45

The details of steel strand are as follows

	PARAMETER	PANTHER	ZEBRA	MOOSE
a)	Minimum breaking load of strand before stranding (kN)	9.29	10.43	12.86
b)	Minimum breaking load of strand after stranding (kN)	8.83	9.91	12.22
c)	Diameter mm (Standard / Max / Min)	3.00 / 3.06 / 2.94	3.18 / 3.24 / 3.12	3.53 / 3.60 / 3.46
d)	Zinc coating testing	3 dips of 1 min each	3 dips of 1 min each	3 dips of 1 min each
e)	Minimum weight of Zinc coating (gm / Sq.mm)	250	250	250
f)	Mass of steel strand at normal diameter (kg/km)	55.13	61.95	76.34

5.0 GENERAL TECHNICAL REQUIREMENT

5.1 The ACSR conductor shall be suitable for being installed directly in air supported on suspension insulator strings or anchored through tension insulator strings at the power cross arms of single circuit and double circuit transmission line towers.

5.2 The conductor shall therefore be suitable for satisfactory operation under the tropical climatic conditions listed under the clause 3.0. The applicable design particulars of the conductor to be used on the lines is furnished in Annexure. I. "System Particulars".

5.3 Physical constants of materials

5.3.1 Physical constants for Hard-drawn Aluminium are taken as per latest edition of IS-398 Part-II.

5.3.2 Resistivity : The resistivity of aluminium depends upon its purity and its physical condition. For the purpose of this specification the maximum value permitted is 0.028264 ohm. sq. mm/m at 20 degree centigrade, 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.

5.3.3 Density :At a temperature of 20 degree centigrade the density of hard drawn aluminium has been taken as 2.703 g/cubic cm.

5.3.4 Constant-Mass Temperature Co-efficient of Resistance : At a temperature of 20 deg C the constant-mass temperature co-efficient of resistance of hard drawn aluminium measured between two potential points rigidly fixed to the wire, the metal being allowed to expand freely, has been taken as 0.00403 per degree Celsius.

5.3.5 Co-efficient of Linear Expansion : The co-efficient of linear expansion of hard-drawn aluminium at zero degree centigrade has been taken as 23.0×10^{-6} per degree centigrade. This value holds good for all practical purposes over the range of temperatures from zero degree centigrade to highest safe operating temperature.

5.4 Physical constants for Galvanized steel wire :-

5.4.1 Density :- At a temperature of 20 degree centigrade, the density of galvanized steel wire is to be taken as 7.80 g/cubic cm.

5.4.2. Co-efficient of Linear Expansion:- The co-efficient of linear expansion of galvanised steel wire at Zero Degree Centigrade has been taken as 11.5 x 10^{-6} per deg C. This value holds good for all practical purposes over the range of temperatures from Zero Degree Centigrade to highest safe operating temperature.

5.5 Materials

5.5.1 The conductor shall be manufactured from EC grade aluminium rods suitably hard-drawn on wire drawing machines. The aluminium rods used shall comply with IS:5484. The mechanical and electrical properties of aluminium wire shall comply with the requirements given in relevant standard. The aluminium wire shall be manufactured from not less than 99.5% pure electrolytic aluminium rods of E.C. Grade.

5.5.2 Aluminium ingots, wire rods and wires used for the manufacture of conductors shall be made only from primary aluminium from the producers who have registered their wires, wire rods and aluminium ingots with BIS and are eligible as per the " Preference to Make in India Order" issued by relevant authorities under Ministry of Power, in line with the Department for Promotion of Industry and Internal Trade's(DPIIT's) Public Procurement Order 2017 and its subsequent revisions.

5.5.3 Aluminium wires, wire rods and ingots procured from open market and not bearing the BIS mark shall not be used for the manufacture of conductors.

5.5.4 Galvanized 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.

Element	**Percentage Composition**
Carbon	0.50 to 0.85
Manganese	0.50 to 1.10
Phosphorus	**Not more than 0.035**
Sulphur	Not more than 0.045
Silicon	**0.10 to 0.35**

5.5.5 The zinc used for galvanizing shall be electrolytic high-grade Zinc not less than 99.95 percent purity. It shall conform to and satisfy all the requirements of IS:209-1979. Galvanizing may be done either by hot process or electrolytic process. Neutral grease may be applied between the layers of wires.

NOTE : Lithium soap grease corresponding to Grade II of IS:7623-1974 (Specification for lithium soap greases) is suitable for such application.

5.6 **Freedom from Defects**:

5.6.1 The wires shall be smooth and free from all imperfections such as spills, splits, 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.

5.7 **Wire sizes**:-

5.7.1 **Nominal size :**

The aluminium and galvanized steel wires for the stranded conductor covered by this standard shall have diameters specified in clause 4.1. The diameter of the steel wire shall be measured over the zinc coating.

5.7.2 Tolerances on normal size:

5.7.2.1 **Aluminium Wires**:- A tolerance of +/-1% is permitted on the nominal diameter of Conductor.

5.7.2.2 Galvanized Steel earth wire: A tolerance of +/-2 percent is permitted on the nominal diameter. The variation from the weights shall not be more than +/-5 percent.

NOTE : In order to maintain the circularity of the wires the tolerance allowed in 5.7.2.1 and 5.7.2.2 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) Third Revision)

5.8 **Joints in wires**

5.8.1 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 meters 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 lines.

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

NOTE : *Joints have not been permitted in the steel wires 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.*

5.9 **Stranding**:

5.9.1 The wires used in the construction of galvanized steel reinforced aluminium conductor shall, before stranding, satisfy all the relevant requirements of this specification.

5.9.2 The lay ratio of the different layers shall be within the limits given in the table below.

No. of wires	Ratio of Aluminium Wire Diameter to Steel wire Diameter	Lay Ratios for steel core (6 wire layer)	Lay Ratios for Aluminium Wires		
			Outside Layer	Layer Immediately beneath outside layer	Inner most Layer of conductor with 3 Al wire Layers

Al	St.		Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
30	7	1.0	13	18	10	12	12	14	-	-
54	7	1.0	13	18	10	12	11	13	12	14

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 this table.***

5.9.4 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.

5.9.5 In conductors having multiple layers of aluminium wires, the lay ratio of any aluminium layer shall not be greater than the lay ratio of the aluminium layer immediately beneath it.

5.10 Standard Length

5.10.1 The standard length of the conductor shall be 1100 metres for Moose ACSR Conductor. A tolerance of +/-5% on the standard length shall be permitted. All lengths outside this limit of tolerance shall be treated as random lengths.

5.10.2 Random lengths are permissible not more than 10 percent of the ordered quantity. But none of them shall be shorter than one-third of nominal length.

5.10.3 Bidder shall also indicate the maximum single length above the standard length, he can manufacture, in the guaranteed technical particulars. This is required for special stretches like river crossing etc. The Purchaser reserves the right to place orders for the above length to the extent of 5 percent of the total ordered quantity on the same terms and conditions applicable for the standard lengths during the pendency of the contract.

NOTE: ***"The Guaranteed Technical Particulars for the Conductor being supplied shall be provided with the Bid as specified in the Technical Specification. The Bids without the Guaranteed Technical Particulars shall be treated as Non-Responsive."***

6.0 TESTS:

6.1 The Type Tests, Acceptance and Routine tests and tests during manufacture, shall be carried out on the conductor as per the IS-398(part 2 & part 5) of 1996 or latest revision.

6.1.1 All the quoted Conductor shall be fully type tested by the Bidder as per the relevant standard including the type tests mentioned below. The type tests must have been conducted on the Moose/Zebra/Panther ACSR conductor from recognized test laboratory. The Bidder shall furnish one set of type test reports as per relevant standards for each type of conductor offered along with the bid. The type tests must have been conducted not earlier than five years form the date of bid opening.

6.1.2 Acceptance Tests shall mean those tests, which are to be carried out on samples taken from each lot offered for pre-dispatch inspection, for the purposes of acceptance of that lot.

6.1.3 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.

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

6.1.5 Samples for individual wires for tests shall be taken before stranding from not less than ten percent of the spools in the case of aluminium wires and ten percent of the coils in the case of steel wires. If samples are taken after stranding, they shall be obtained by cutting 1.2 metres from the outer end of the finished conductor from not more than ten percent of the finished reels.

6.1.6 The standards and norms to which these tests will be carried out are listed against them. Where a particular test is a specific requirement of this specification, the norms and procedures of the test shall be as specified in Annexure-II or as mutually agreed to between the Bidder and the Purchaser in the Quality Assurance Program.

6.1.7 For all type and acceptance tests, the acceptance values shall be the values guaranteed by the Supplier in the proforma for "Guaranteed Technical Particulars", furnished in this Specification or acceptance value specified in this specification, whichever is more stringent for that particular test.

6.2 **Testing Expenses:**

6.2.1 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.

6.2.2 In case of failure in any type test, the Supplier is required to modify the design of the material and the material shall be type tested again for the modified design, with out any extra cost to the purchaser. No delivery extension shall be given for this additional testing.

6.2.3 Bidders shall indicate the laboratories in which they propose to conduct the type tests. They shall ensure that the tests can be completed in these laboratories within the time schedule guaranteed by them in the appropriate schedule.

6.3 Additional Tests:

Sampling and inspection of conductors shall also be conducted at the site of delivery mentioned in Dispatch Instructions. Such sampling and inspections shall be over and above the existing on-site inspection(s) and testing at facility of manufacturer or supplier.

“DC resistance tests of conductors shall also be carried out at the site post installation over and above existing on site inspection and testing at supplier facility.”

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

6.4 The Bidder is required to carry out all the acceptance tests successfully in the presence of Purchaser's representative before dispatch and also on site testing as mentioned above.

6.5 Test Reports:

6.5.1 Copies of acceptance test reports shall be furnished in at least four (4) copies along with one original. After approval of Test Certificates by the Purchaser only the material will be despatched.

6.5.2 Record of routine test reports shall be maintained by the Bidder at his works for periodic inspection by the Purchaser's representative.

6.5.3 Test Certificates of tests conducted during manufacture shall be maintained by the Bidder. These shall be produced for verification as and when desired by the Purchaser.

6.6 TEST FACILITIES

6.6.1 The following additional test facilities shall be available at Bidder's works:-

a) Calibration of various testing and measuring equipment including tensile testing machine, resistance measurement facilities, burette, thermometer, barometer etc should be done only by NABL accredited calibration laboratories.

b) Standard resistance for calibration of the resistance measuring equipment shall be of 0.001 ohms and should be calibrated by NABL accredited laboratory.

c) 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 shall be free from vibrations, jerks etc. with transverse layering facilities.

7.0 INSPECTION

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

7.2 The Bidder 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 can be made for inspection.

7.3 The supplier shall give 15 days advance intimation to enable the purchaser to depute his representative for witnessing acceptance and routine tests.

7.4 No material shall be despatched from its point of manufacture before it has been satisfactorily inspected and tested, unless the inspection is 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 and approved by the Purchaser.

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

7.6 Invoices for the procurement of raw materials like aluminium wires, wire rods and ingots shall be furnished for each consignment of conductors to be supplied along with manufacturers test report for verification.

7.7 The verification of the procurement invoices of raw materials (aluminium wires, wire rods and ingots) and linking them to invoices of final products (conductors/cables), shall be undertaken through a digital or mechanical mechanism for stamping/verification by TSTRANSCO to prevent any re-use or duplication of raw material invoices

7.8 The supplier shall furnish the following documents as proof of purchase of RAW material along with each inspection offer

a) Invoice of supplier
b) Supplier Test Certificate
c) Packing List
d) Bill of Landing
e) Bill of Entry Certificate by custom
f) Description of material, electrical analysis, physical inspection, certificate of surface defects, thickness and width of material wherever applicable.

7.9 At least 5% of the total number of drums subject to minimum of two in any lot put up for inspection, shall be selected at random to ascertain the length of conductor by the 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 & Cyclometer. The difference in the average length thus obtained and as declared by the Bidder in the packing list shall be applied to all the drums if the conductor is found short during checking."

7.10 At least 10% of the total drums in any lot put up for inspection, shall be selected at random as per clause 6.1.5 of this technical specification to conduct the “Acceptance Tests” by the inspector. The acceptance Tests shall be carried out on all the samples drawn from the sampling drums selected as above. If any sample drawn does not pass the Acceptance tests, the drum from which the sample is drawn will be rejected and another drum from the same lot shall be selected at random to repeat the “Acceptance Tests”. <u>If the second sample also fails in the same Test, the entire lot offered for Inspection will be rejected.</u>

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

8.0 Approval of drawing/TCs by Purchaser shall not relieve the Bidder of his responsibility and liability for ensuring correctness and correct interpretation of the latest revision of applicable standards, rules and codes of practices. The material shall conform in all respects to high standards of engineering, design, workmanship and latest revisions of relevant standards at the time of ordering and Purchaser shall have the power to reject any work or material , which in his judgment is not in full accordance therewith.

9.0 PACKING & FORWARDING

9.1 The conductor shall be supplied in non-returnable, strong wooden drums provided with lagging of adequate strength capable of withstanding displacement during transit, storage and subsequent handling and stringing operations in the field. The drums shall generally conform to IS:1778-1980 except otherwise specified hereinafter.

9.2 The drums shall be suitable for wheel mounting and for jetting off the conductor under a minimum controlled tension of the order of 6 KN.

9.3 The Bidder shall submit the proposed drum drawings along with the bid. However, the same shall be in line with the requirements as stated herein. After placement of the Letter of Award, the Bidder shall submit four copies of fully dimensioned drawing of the drum he wishes to supply, for Purchaser's approval before taking up manufacturing of Conductor. After getting approval from the Purchaser, the Bidder shall submit 30 more copies of the approved drawing to Purchaser for further distribution and field use at Purchaser's end.

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

9.5 The flanges shall be of two/three ply construction with each ply at right angles to the other and nailed together. The nails shall be driven from the inside face flange, punched and then clenched on the outer face. The tolerance in thickness of each ply shall be +3 mm only. There shall be at least 3 nails per plank of 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 line with the periphery of the barrel.

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

9.7 Barrel studs shall be used for construction of drums. The flanges shall be holed and the barrel supports slotted to receive them. The barrel studs shall be threaded over a length on either end, sufficient to accommodate washers, spindle plates and nuts for fixing flanges at the required spacing. Barrel studs should be tack-welded with the nuts after tightening.

9.8 Normally, the nuts on the studs shall stand proud of the flanges. All the nails used on the inner surface of the flanges and the drum barrel shall be countersunk. The ends of barrel shall generally be flushed with the top of the nuts.

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

9.10 Before reeling, cardboard or double corrugated or thick bitumen zed 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 Kraft paper shall be used in between the layers of the conductor**. After reeling the conductor, the exposed surface of the outer layer of conductor shall be wrapped with thin polythene sheet across the flanges to preserve the conductor from dirt, grit and damage during transportation and handling and also to prevent ingress of rain water during storage/transport.

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

9.12 Each batten shall be securely nailed across grains as far as possible to the flange edges with at least 2 nails per end. The length of the nails shall not be less than twice the thickness of the battens. The nail shall not protrude above the general surface and shall not have exposed sharp edges or allow the battens to be released due to corrosion.

9.13 Outside the protective layer, there shall be a minimum of two binders consisting of hoop iron/galvanized steel wire. Each protective layer shall have two recess to accommodate the binders.

9.14 The conductor ends shall be properly sealed and secured with the help of U-nails on one side of the flanges. The end securing shall be done by taking out at least 500 mm of steel core on either ends by U-nails. The composite conductor shall be hinged by use of galvanized steel wire/aluminium wire at three locations at least 75 mm apart or more covered with PVC adhesive tape so as to avoid loosening of conductor layers in transit and handling.

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

9.16 **Marking**

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

a) Purchase order 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) ISI mark

ANNEXURE - I

A) ATMOSPHERE CONDITIONS

Maximum ambient air temperature (in shade)	45^0 C
Minimum ambient air temperature (in shade)	10^0 C
Maximum ambient air temperature in sun	55^0 C
Limits of ambient temperature over a period of 24 hours	20 Deg. C
Maximum daily average ambient air temperature	35^0 C
Maximum yearly average ambient air temperature	30^0 C
Maximum humidity	100%
Altitude above M.S.L.	Up to 1000M
Average No. of thunder storm days per annum	50
Average No. of dust storm days per annum	Occasional
Average No. of rainy days / annum	90
Average Annual Rain fall	925mm
Maximum rainfall per annum	120 Cms
Normal tropical monsoon period	4 months
Maximum wind pressure	150 kg/Sq.M.
Average number of dust storms per annum	Occasional

B. SYSTEM PARTICULARS

1. Electrical System Data for 400 kV:

a)	System Voltage (kV rms)	400
b)	Max. voltage (kV rms)	420
c)	Lightning impulse withstand voltage (dry & wet) (kVp)	1425
d)	Power frequency withstand voltage (wet) (kV rms)	630
e)	Short circuit level (kA) and duration	63/1 sec

2. Electrical System Data for 220 kV:

a)	System Voltage (kV rms)	220
b)	Max. voltage (kV rms)	245
c)	Lightning impulse withstand voltage (dry & wet) (kVp)	1050
d)	Power frequency withstand voltage (wet) (kV rms)	460
e)	Short circuit level (kA) and duration	50/1 sec

3. Electrical System Data for 132 kV:

a)	System Voltage (kV rms)	132
b)	Max. voltage (kV rms)	145
c)	Lightning impulse withstand voltage (dry & wet) (kVp)	650
d)	Power frequency withstand voltage (wet) (kV rms)	275
e)	Short circuit level (kA) and duration	40/1 sec

ANNEXURE-II

(TO BE FILLED IN BY THE BIDDER)

GUARANTEED TECHNICAL PARTICULARS OF PANTHER AND MOOSE CONDUCTOR

Sl. No.	Particulars.	For Moose ACSR Conductor	For Zebra ACSR Conductor	For Panther ACSR Conductor
1.	Code word.			
2.	Maker's name, address and country. a) Aluminium wire b) Steel Wire c) Complete Conductor			
3.	Stranding and wire diameter. (Standard/Maximum / Minimum) in mm. a) Aluminium b) Steel			
4.	Standard nominal copper area in Sq. mm.			
5.	Calculated equivalent aluminium area in Sq.mm.			
6.	Actual aluminium area in sq.mm.			
7.	Standard area of cross-section in sq.mm. a) Aluminium strand b) Steel strand c) Conductor			
8.	Diameter of complete conductor in mm			
9.	Minimum ultimate tensile stress of strand in kg / sq.mm. a) Aluminium strand b) Steel strand			
10.	Guaranteed ultimate tensile strength of conductor in kg..			
11.	Minimum breaking load in kg. for a) Aluminium strand b) Steel strand			
12.	Purity of Aluminium rods in %			
13.	Zinc coating of steel strand a) Thickness of coating number and duration of dips(Precede test). b) Minimum weight of coating in gms/sq.mtr..			
14.	Maximum working tension.			
15.	Weight in kg. per km. (Max/Min) a) Aluminium b) Steel c) Conductor			
16.	Max. resistance in ohms per kM at 20 deg.C. a) Aluminium strand b) Conductor			
17.	a) Continuous max. current rating of conductor in still air at 45 deg.C. ambient temperature.(Amps.) b) Temperature rise for the above current. (deg.C)			

Sl. No.	Particulars.	For Moose ACSR Conductor	For Zebra ACSR Conductor	For Panther ACSR Conductor
18.	Lay Ratio : Steel Core : 6 Wire layer. Aluminium : 12 Wire layer. 18 Wire layer. 24 Wire layer.	Max. Min.	Max. Min.	Max. Min.
19.	Whether the drum on which the conductor is wound conforms to the specification and whether the detailed dimensioned drawing submitted with the Bid.			
20.	Modulus of elasticity of a) Aluminium strand Kg/sq. cm. b) Steel strand kg/sq. cm. c) Conductor kg/sq. cm.			
21.	Co-efficient of linear expansion per degree centigrade of a) Aluminium strand b) Steel strand c) Conductor			
22.	Percentage of carbon in steel wire.			
23.	Standard length of each piece in km.			
24.	Maximum single length of conductor which can be manufactured. (km)			
25.	Tolerance, if any, on standard lengths.			
26.	No. of standard lengths in one reel.			
27.	Dimensions of the reel in centimeters.			
28.	Weight of the conductor in one reel in kg			
29.	Weight of the reel in kg.			
30.	Gross weight of the reel including weight of the conductor. (kg.)			
31.	Standard according to which the conductor will be manufactured and tested.			
32.	Other particulars, if any.			

Signature of Bidder
With Seal and Date

ANNEXURE-III
Test Procedures

A) At least 5% of the total number of drums subject to minimum of two in any lot put up for inspection, shall be selected at random to ascertain the length of conductor by the 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 & Cyclometer. The difference in the average length thus obtained and as declared by the Bidder in the packing list shall be applied to all the drums if the conductor is found short during checking."

B) At least 10% of the total drums in any lot put up for inspection, shall be selected at random to conduct the "Acceptance Tests" by the inspector. The acceptance Tests shall be carried out on all the samples drawn from the sampling drums selected as above. If any sample drawn does not pass the Acceptance tests, the drum from which the sample is drawn will be rejected and another drum from the same lot shall be selected at random to repeat the "Acceptance Tests". If the second sample also fails in the same Test, the entire lot offered for Inspection will be rejected.

1.0 Visual and Dimensional Check on Drums:
The drum shall be visually and dimensionally checked to ensure that they conform to the requirements of this specification.

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

3.0 Dimensional check of Steel and Aluminium Strands:
The individual strands shall be dimensionally checked to ensure that they conform to the requirements of this specification.

4.0 Check for Lay-ratios of various Layers:
The lay-ratios of various layers shall be checked to ensure that they conform to the requirements of this specification and clause No.9.4 & 9.5 of IS-398 (Part-II).

5.0 Galvanizing Test:
The test procedure shall be as specified in IS:4826-1968. The material shall conform to the requirements of this specification.

6.0 Torsion and Elongation Tests on Steel Strands:
The test procedures shall be as per clause No.12.3.1 and 12.3.2 of IS:398 (Part-II)-1982. In torsion test, the number of complete twists before fracture shall not be less than 18 on a length equal to 100 times the standard diameter of the strand. In case test sample length is less or more than 100 times the standard diameter of the strand, the minimum number of twist will be proportionate to the length and if number comes in the fraction then it will be rounded off to next higher whole number. In elongation test, the elongation of the strand shall not be less than 4 percent for a gauge length of 200 mm.

7.0 Breaking load test on Aluminium strand:
The Aluminium strands shall be able to withstand the minimum breaking load of the individual strand guaranteed by the Bidder.

8.0 Breaking load test on welded Aluminium strand:
Two Aluminium wires shall be welded as per the approved quality plan and shall be subjected to tensile load. The welded point of the wire shall be able to withstand the minimum breaking load of the individual strand guaranteed by the Bidder.