SECTION-V

TECHNICAL SPECIFICATION

FOR

UPGRADATION OF EXISTING ACSR PANTHER CONDUCTORS BY EQUIVALENT SIZE HTLS(HIGH TEMPERATURE LOW SAG) CATEGORY CONDUCTOR IN EHT LINES OF OPTCL.

Sl.No	Name of the Package	Name of the Line.	Circuit KM of the Line.
1	Package-I	132KV Joda-Barbil Single circuit (S/C)	12.0
2		132 KV Mendhasal-Khurda Single circuit (S/C)	17.0

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1. GENERAL INFORMATION AND SCOPE

1.1 General Information.

1.1.1 The **ORISSAPOWER TRANSMISSION CORPORATION LIMITED**, hereinafter called 'OPTCL'/'OWNER' will receive bids for replacement of the existing ACSR Panther conductor by HTLS Conductor Annealed aluminium solid core conductor" except GAP conductor as set forth in the technical specification at section-V. All bids shall be prepared and submitted in accordance with these instructions. The tender is invited in **two-part** basis i.e. (1) Techno-commercial bid consisting all the documents except price bid & (2) Price Bid.

Sl.No	Name of the Package	Name of the Line.	Circuit KM of the Line.
1	Package-I	132KV Joda-Barbil Single circuit (S/C)	12.0
2		132 KV MendhasalKhurda Single circuit (S/C)	17.0

1.2 Scope

1.2.1 The scope of work inter-alia includes:

(i) Design, manufacturing, testing & supply of High Temperature Low Sag (HTLS) conductor Annealed aluminium solid core conductor" except GAP conductor as well as required associated hardware fittings and accessories viz. suspension clamps, dead end clamps, mid-span compression joints, repair sleeves, T-Connectors, vibration dampers, etc.

(ii) Survey & profiling of existing line route using Total stations, verification of availability of statutory electrical clearances using PLS-CADD software; de-stringing of existing Conductor including dismantling of associated fittings & accessories from the above lines and stringing of each circuit with HTLS conductor along with associated fittings and accessories with the other circuit under live condition; testing & commissioning.

1.2.2 The material to be supplied on final destination at site basis as covered in the bidding documents shall be designed, manufactured, tested, supplied and installed as per the requirements specified in this volume. The requirements, conditions, appendices etc. as specified in other Sections of bidding documents shall also apply to.

1.2.3 The standard type disc insulators (90 & 120 KN) along with hardware fittings (except suspension clamps at suspension tower and dead end clamps at tension tower) of the existing line shall be used for re-conductoring of line with HTLS conductor. The existing insulators and hardware fittings shall be inspected by the contractor for any defects and those found defective shall be replaced after approval of engineer-in-charge with fresh items to be supplied by Owner.

1.2.4 The ACSR PANTHER conductor removed from the existing line is envisaged for re-use/ utilization by the Owner in other projects. Proper handling and safety of the conductor during de-stringing, storage at site, measurement of conductor lengths, rewinding on drums at site and safe transportation to Owners designated stores along the transmission line shall be included in the scope of work.

1.2.5 The Owner shall arrange shut down of one circuit at a time and the other circuit shall be kept under charged condition. The contractor shall destring the existing conductor and restring the circuit with the HTLS conductor section by section and restore the line in original conditions as per program finalized in co-ordination with site.Appropriate safety measures along with necessary safety tools and equipments to carry out destringing and stringing operations under the above conditions including mechanical/ structural safety of the towers, shall be the responsibility of the contractor. Necessary calculations shall be carried out by the contractor to ensure that by replacing the existing ACSR PANTHER conductor with the HTLS conductor offered, the loadings on the towers due to conductor tensions as well as loads on account of the reconductoring activities shall be within specified limits. These calculations shall be submitted by the bidder alongwith bid.

1.2.6 The materials covered in this package shall be supplied complete in all respects, including all components, fittings and accessories which are necessary or are usual for their efficient performance and satisfactory maintenance under the various operating and atmospheric conditions. Such parts shall be deemed to be within the scope of the Contract, whether specifically included or not in the Specification or in the Contract Schedules. The Supplier shall not be eligible for any extra charges for such fittings, etc.

1.2.7 The entire stringing work of conductor shall be carried out by tension stringing technique except where geography/ topographical or other site constraints do not permit use of tension stringing equipment. In such cases manual stringing along with other appropriate tools and equipments may be employed with the approval of Owner's site in charge. Contractor is to indicate the sets of TSE in his proposal and indicate no. of stringing equipments which the bidder plans to deploy so as to meet his schedule in their offer.

1.2.8 Submission of complete technical details of the proposed HTLS conductor with relevant calculation along with the bid to adjudge the sufficiency of existing towers for carrying out the up-rating works. This shall be carried out in compliances / adherence to all safety and standard requirements as per Indian Electricity Rules 1956. Design parameters and submission of detailed drawings of conductor hardware and accessories and preparation of sag tension chart, stringing chart, of the conductor used showing, sag & tension at various temperatures are included in the scope of the Bidder.

1.2.9 The existing insulators shall be inspected by the contractor in advance for any defects and those found defective shall be replaced with good ones by OPTCL. During stringing if any existing insulator found defective, it will be supplied by OPTCL.

1.2.10 The entire stringing work of HTLS conductor shall be carried out by tension stringing technique except where geographical / topographical or other

site constraints do not permit use of tension stringing equipment. In such cases manual stringing along with other appropriate tools and equipment may be employed with the approval of engineer in charge. The contractor shall indicate in their offer, the sets of tension stringing equipment he is having in his possession and the sets of stringing equipment he would deploy exclusively for this package. The contractor shall also engage sufficient manpower so that stringing of the conductor in one stretch is complete within the allowed shut down period of one day. No mid span joint will be allowed & hence the length of the conductor shall be decided by referring the tower schedule.

1.2.11 Only important road & river crossings and lines passing over civil structures will have double insulator strings. Vibration dampers are to be provided in all suspension & tension locations.

1.2.12The rollers, which will be used during stringing, should be so designed that the line can be charged with the roller.

1.2.13 Contractor should deploy stringing/ installation experts during erection of the offered type of conductor.

2. DESIGN PARAMETERS

2.1 Technical Particulars of HTLS Conductor

The design and other parameters on which the up rating is to be planned are:

The HTLS conductor shall meet the following minimum requirements:

Overall diameter of complete conduct	Overall diameter of the conductor should less than or equal to 21 mm.
Approx. mass of complete conductor (kg/Km)	Less than or equal to 974kg/km
Direction of lay of outer layer	Right Hand

The bidder shall indicate the technical particulars and details of the construction of the conductor in the relevant schedule of GTP. The bidder shall also guarantee the DC resistance of conductor at 20 deg C and AC resistance at the calculated temperature corresponding to 50Hz alternating current flow of 800 amperes per conductor at specified ambient conditions (maximum continuous operating temperature).

The bidder shall submit the supporting calculations for the AC resistance indicating details & justifications of values of temperature coefficient of

resistance & DC to AC resistance conversion factor(s) with due reference to construction / geometry of the conductor.

2.2Climatic & Technical details: The climatic and system parameters are detailed below.

2.2.1 Climate details.

Location:- In the state of Orissa

Maximum ambient temperature= 50 ºC

Minimum ambient temperature=05 ºC

Every day temperature=32ºC

Maximum relative humidity=100%

Average rainfall per year=1150mm. Approx.

Isokeraunic level = 100 / year

Number of rainy days per year = 100 days

Altitude = Less than 350 Meters.

2.2.2 Current Carrying Capacity / Ampacity Requirements

Each HTLS conductor shall be suitable to carry minimum 50 Hz alternating current of 800 Amperes conductor under the ambient conditions & maximum conductor sag specified below while satisfying other specified technical requirements/ parameters.

Ambienttemperature: 50 deg C

Solar Absorption coefficient =0.8

Solar Radiation = 1045 watt/sq.m

Emisitivity Constant= 0.45

Wind velocity = 0.6 m/sec

Maximum Conductor sag for 320m span at steady state conductor temperature and no wind corresponding to 50 Hz alternating current of 800 Amperes per conductor under ambient conditions specified at 2.2.3 will be such that the statutory ground clearance will be maintained throughout the route keeping (erection) tension at 25% of UTS of conductor.

The calculations for Ampacity shall be based on IEEE Standard 738. The bidder in his bid shall furnish calculations for the ampacity based on the above Standard for the proposed HTLS conductor.

The design of conductor shall be suitable for operation at a steady state conductor temperature experienced for AC current flow of 800 Amperes under the above ambient conditions based on ampacity calculations mentioned above. The bidder shall also indicate the maximum permissible conductor temperature for continuous operation without any deterioration of its electrical, mechanical & metallurgical properties. The bidder shall also furnish the maximum permissible conductor temperature for short-term operations including permissible duration of such short-term operation.

2.2.3 Sag-Tension Requirements

The HTLS conductor shall meet the following sag tension requirements for ruling span of 320 metres.

Particulars	Limiting value
Tension at every day condition (32°C, no wind)	≤2285 kgs& Not exceeding 25% of UTS of proposed conductor
Tension at 32°C, full wind (52 kg/m2)	≤2918 kgs& not exceeding 50% of UTS of proposed conductor
Tension at 5°C, 2/3 wind pressure (52/3 kg/m2)	≤3077 kgs& not exceeding 50% of UTS of proposed conductor
Sag at continuous operating temp (corresponding to 800 amperes and no wind), including all of the above conditions.	≤6.0 meters

Sag-Tension calculations at various conditions mentioned above using parabolic equations shall be submitted along with the bid. These calculations shall also include calculations for determination of transition / knee point temperature.

The bidder shall also furnish sag & tensions under no wind for various temperatures starting from 0 deg C to maximum continuous operating temperature in steps of 5 degC.

After award of the contract, the Supplier shall submit Sag-Tension calculations corresponding to various conditions given above for all the existing spans and spans ranging from 50 m to 350 m in intervals of 50 m.

Besides above, the Supplier shall also furnish details of creep characteristics in respect of HTLS conductor based on laboratory investigations/ experimentation (creep test as per IEE1138) conducted on similar type of conductor and shall indicate creep strain values corresponding to 1 month, 6 month, 1 year & 10 year creep at everyday tension & at maximum continuous operating temperature.

2.3.1 EVALUATION OF OHMIC LOSSES & DIFFERENTIAL PRICE LOADING.

Based on the conductor parameters guaranteed by the bidders, average ohmic losses for different type of conductors offered by the bidders shall be calculated as per the following.

Average ohmic losses= Loss load factor X Line length X (Desire operating current i.e.800A)² X AC resistance corresponding to 800A.(Considering loss load factor=0.53)

Where Rac is the AC resistance per KM guaranteed by the bidder at temperature corresponding to the continuous operating current of 800 A under normal condition.

Differential price evaluation for the conductors offered by the bidder shall be carried out considering the average Ohmic losses calculated as above and considering **Rs.1,65,110. per KW.**

The best parameter of loss (Lowest Ohmic loss for conductor) corresponding to lowest AC resistance quoted among bidders by the technically responsive & qualified bidders shall be taken as basis & that quoted by the particular bidder shall be used to arrive at differential price to be applied for each bid.

2.3.2 :Liquidated damage for excessive losses:-

On testing ,if it is found that actual losses are more than the values ,quoted in the bid, undisputed liquidated damages shall be recovered from the supplier at the following rates.

For each KW of excess loss **Rs.3, 30,220.00/ KW.**

For fractional Kilowatt , penalties shall be applied on prorata basis . No bonus shall be payble for loss, which are less than those, stated in the bid.

2.4 **Design of Hardware & accessories** should be compatible with the supplied HTLS conductor and existing insulators & structures.

TECHNICAL SPECIFICATIONS FOR HARDWARE FITTINGS & ACCESSORIES FOR HTLS CONDUCTOR.

2.4.1 Technical Description of Hardware Fittings

2.4.2 General

This section details technical particulars of fittings viz. suspension clamps and compression type dead end clamps for the HTLS Conductor to be supplied by the bidder. Each fitting shall be supplied complete in all respects.

2.4.3 The fittings shall be suitable for attachment to suspension and tension insulator strings along with hardware fittings and shall include 2.5 % extra fasteners and Aluminium filler plugs. Indicative drawings of complete insulator strings along with hardware fittings as well as indicative drawings for suspension clamps and dead end clamps are enclosed with this specification. The supplier shall be responsible for satisfactory performance of complete conductor system along with fittings offered by them for continuous operation at the maximum temperature specified by them for the conductor.

2.4.4 **Corona and RI Performance**

Sharp edges and scratches on all the hardware fittings shall be avoided. All surfaces must be clean, smooth, without cuts and abrasions or projections. The Supplier shall be responsible for satisfactory corona and radio interference performance of the materials offered by him.

2.4.5 **Maintenance**

The hardware fittings offered shall be suitable for employment of hot line maintenance technique so that usual hot line operations can be carried out with ease, speed and safety. The technique adopted for hot line maintenance shall be generally bare hand method & hot stick method.

2.4.6 **Split Pins** Split pins shall be used with bolts & nuts.

2.4.7 **Suspension Assembly**

2.4.7.1 The suspension assembly shall be suitable for the HTLS Conductor, the bidder intend to supply. The technical details of the conductor shall be as proposed by the bidder.

2.4.7.2 The suspension assembly shall include either free centre type suspension clamp along with standard preformed armour rods or armour grip suspension clamp

2.4.7.3 The suspension clamp along with standard preformed armour rods set shall be designed to have maximum mobility in any direction and minimum moment of inertia so as to have minimum stress on the conductor in the case of oscillation of the same.

2.4.7.4 The suspension clamp suitable for various type of Conductor along with standard preformed armour rods/armour grip suspension clamp set shall have a slip strength between 20 to 29 KN.

2.4.7.5 The suspension clamp shall be designed for continuous operation at the temperature specified by the bidder for conductor.

2.4.7.6 The suspension assembly shall be designed, manufactured and finished to give it a suitable shape, so as to avoid any possibility of hammering between suspension assembly and conductor due to vibration. The suspension assembly shall be smooth without any cuts, grooves, abrasions, projections, ridges or excrescence which might damage the conductor.

2.4.7.7 The suspension assembly/clamp shall be designed so that it shall minimise the static & dynamic stress developed in the conductor under various loading conditions as well as during wind induced conductor vibrations. It shall also withstand power arcs & have required level of Corona/RIV performance.

2.4.7.8 The magnetic power loss shall not be more than 4 watts per suspension clamp, at designed rated sub-conductor current of 800 amperes.

2.4.8 **Free Centre Type Suspension Clamp**

For the Free Centre Suspension Clamp seat shall be smoothly rounded and curved into a bell mouth at the ends. The lip edges shall have rounded bead. There shall be at least two U-bolts for tightening of clamp body and keeper pieces together.

2.4.9 **Standard Preformed Armour Rod Set**

2.4.9.1 The Preformed Armour Rods Set shall be used to minimize the stress developed in the sub-conductor due to different static and dynamic loads because of vibration due to wind, slipping of conductor from the suspension clamp as a result of unbalanced conductor tension in adjacent spans and broken wire condition. It shall also withstand power arcs. chafing and abrasion from suspension clamp and localized heating effect due to magnetic power losses from suspension clamps as well as resistance losses of the conductor.

2.4.9.2 The preformed armour rods set shall have right hand lay and the inside diameter of the helics shall be less than the outside diameter of the conductor to have gentle but permanent grip on the conductor. The surface of the armour rod when fitted on the conductor shall be smooth and free from projections, cuts and abrasions etc.

2.4.9.3 The pitch length of the rods shall be determined by the Bidder but shall be less than that of the outer layer of conductor and the same shall be accurately controlled to maintain uniformity and consistently reproducible characteristic wholly independent of the skill of linemen.

2.4.9.4 The length of each rod shall not be less than 1930 ± 25 mm and diameter shall not be less than 6.35 $\pm$ 0.10 mm. The tolerance in length of the rods in complete set should be within 13 mm between the longest and shortest rod. The ends of armour rod shall be parrot billed.

2.4.9.5 The number of armour rods in each set shall be eleven. Each rod shall be marked in the middle with paint for easy application on the line.

2.4.9.6 The armour rod shall not loose their resilience even after five applications.

The conductivity of each rod of the set shall not be less than 40% of the conductivity of the International Annealed Copper Standard (IACS).

2.4.10 **Armour Grip Suspension Clamp**

2.4.10.1 The armour grip suspension clamp shall comprise of retaining strap, support housing, elastomer inserts with aluminium reinforcements and AGS preformed rod set.

2.4.10.2 Elastomer insert shall be resistant to the effects of temperature up to maximum conductor temperature guaranteed by the bidder corresponding to peak current, Ozone, ultraviolet radiations and other atmospheric contaminants likely to be encountered in service. The physical properties of the elastomer shall be of approved standard. It shall be electrically shielded by a cage of AGS performed rod set. The elastomer insert shall be so designed that the curvature of the AGS rod shall follow the contour of the neoprene insert.

2.4.10.3 The length of the AGS preformed rods shall be such that it shall ensure sufficient slipping strength and shall not introduce unfavourable stress on the conductor under all operating conditions. However the length of AGS preformed rods shall not be less than 1760 $\pm$ 16 mm for HTLS Conductor.

2.4.11 **Dead end Assembly**

2.4.11.1 The dead end assembly shall be suitable for the proposed HTLS Conductor.

2.4.11.2 The dead end assembly shall be of compression type with provision for compressing jumper terminal at one end. The angle of jumper terminal to be mounted should be 30° with respect to the vertical line. The area of bearing surface on all the connections shall be sufficient to ensure positive electrical and mechanical contact and avoid local heating due to I^2R losses. The resistance of the clamp when compressed on Conductor shall not be more than 75% of the resistance of equivalent length of Conductor.

2.4.11.3 Die compression areas shall be clearly marked on each dead-end assembly designed for continuous die compressions and shall bear the words 'COM PRESS FIRST' suitably inscribed near the point on each assembly where the compression begins. If the dead end assembly is designed for intermittent die compressions it shall bear identification marks 'COMPRESSION ZONE' AND 'NON-COMPRESSION ZONE' distinctly with arrow marks showing the direction of compressions and knurling marks showing the end of the zones. Tapered aluminium filler plugs shall also be provided at the line of demarcation between compression & non-compression zone. The letters, number and other markings on the finished clamp shall be distinct and legible. The dimensions of dead end assembly before & after compression along with tolerances shall be shall be guaranteed in the relevant schedules of the bid and shall be decided by the manufacturer so as to suit the conductor size & conform to electrical & mechanical requirement stipulated in the specification.

2.4.11.4 The assembly shall not permit slipping of, damage to, or failure of the complete conductor or any part there of at a load less than 95% of the ultimate tensile strength of the conductor.

2.4.12 **Fasteners : Bolts, Nuts and Washers**

2.4.12.1 All bolts and nuts shall conform to IS 6639. All bolts and nuts shall be galvanised as per IS 1367 (Part-13)/IS 2629. All bolts and nuts shall have hexagonal heads, the heads being forged out of solid truly concentric, and square with the shank, which must be perfectly straight.

2.4.12.2 Bolts upto M16 and having length upto 10 times the diameter of the bolt should be manufactured by cold forging and thread rolling process to obtain good and reliable mechanical properties and effective dimensional control. The shear strength of bolt for 5.6 grade should be 310 MPa minimum as per IS 12427. Bolts should be provided with washer face in accordance with IS 1363 (Part-1) to ensure proper bearing.

2.4.12.3 Nuts should be double chamfered as per the requirement of IS 1363 Part-III 1984. It should be ensured by the manufacturer that nuts should not be over tapped beyond 0.4 mm oversize on effective diameter for size upto M16.

2.4.12.4 Fully threaded bolts shall not be used. The length of the bolt shall be such that the threaded portion shall not extend into the place of contact of the component parts.

2.4.12.5 All bolts shall be threaded to take the full depth of the nuts and threaded enough to permit the firm gripping of the component parts but no further. It shall be ensured that the threaded portion of the bolt protrudes not less

than 3 mm and not more than 8 mm when fully tightened. All nuts shall fit and tight to the point where shank of the bolt connects to the head.

2.4.12.6 Flat washers and spring washers shall be provided wherever necessary and shall be of positive lock type. Spring washers shall be electro-galvanized. The thickness of washers shall conform to IS:2016.

2.4.12.7 The Contractor shall furnish bolt schedules giving thickness of components connected. the nut and the washer and the length of shank and the threaded portion of bolts and size of holes and any other special details of this nature.

2.4.12.8 To obviate bending stress in bolt, it shall not connect aggregate thickness more than three time its diameter.

2.4.12.9 Bolts at the joints shall be so staggered that nuts may be tightened with spanners without fouling.

2.4.12.10 To ensure effective in-process Quality control it is essential that the manufacturer should have all the testing facilities for tests like weight of zinc coating, shear strength, other testing facilities etc, in-house. The manufacturer should also have proper Quality Assurance system which should be in line with the requirement of this specification and IS-.14000 services Quality System standard.

2.4.12.11 Fasteners of grade higher than 8.8 are not to be used and minimum grade for boltshall be 5.6.

2.4.13 **Materials**

The materials of the various components shall be as specified hereunder. The Bidder shall indicate the material proposed to be used for each and every component of hardware fittings stating clearly the class, grade or alloy designation

of the material, manufacturing process & heat treatment details and the reference standards.

2.4.13.1 The details of materials for different component are listed as in Table No-1.

2.4.14 **Workmanship**

2.4.14.1 All the equipment shall be of the latest design and conform to the best modern practices adopted in the Extra High Voltage field. The Bidder shall offer only such equipment as guaranteed by him to be satisfactory and suitable for 132 kV transmission lines and will give continued good performance.

2.4.14.2 High current, heat rise test shall be conducted by the supplier to determine the maximum temperature achieved in different components of fittings under simulated service condition corresponding to continuous operation of conductor at rated maximum temperature. The material of the components should be suitable for continued good performance corresponding to these maximum temperatures. The supplier shall submit relevant type/performance test certificates as per applicable standards/product specifications tp confirm suitability of the offered material.

2.4.14.3 The design, manufacturing process and quality control of all the materials shall be such as to give the specified mechanical rating, highest mobility,

elimination of sharp edges and corners to limit corona and radio-interference, best resistance to corrosion and a good finish.

2.4.14.4 All ferrous parts including fasteners shall be hot dip galvanized, after all machining has been completed. Nuts may, however, be tapped (threaded) after galvanizing and the threads oiled. Spring washers shall be electro galvanized. The bolt threads shall be undercut to take care of the increase in diameter due to galvanizing. Galvanizing shall he done in accordance with IS 2629 / IS 1367 (Part-13) and shall satisfy the tests mentioned in IS 2633. Fasteners shall withstand four dips while spring washers shall withstand three dips of one minute duration in the standard Preece test. Other galvanized materials shall have a minimum average coating of zinc equivalent to 600 gm/sq.m., shall be guaranteed to withstand at least six successive dips each lasting one (1) minute under the standard preece test for galvanizing.

2.4.14.5 The zinc coating shall be perfectly adherent. of uniform thickness, smooth, reasonably bright. continuous and free from imperfections such as flux,. ash rust, stains, bulky white deposits and blisters. The zinc used for galvanizing shall be grade Zn 99.95 as per IS:209.

2.4.14.6 In case of casting, the same shall be free from all internal defects like shrinkage, inclusion, blow holes, cracks etc. Pressure die casting shall not be used for casting of components with thickness more than 5 mm.

2.4.14.7 All current carrying parts shall be so designed and manufactured that contact resistance is reduced to minimum.

2.4.14.8 No equipment shall have sharp ends or edges, abrasions or projections and cause any damage to the conductor in any way during erection or during continuous operation which would produce high electrical and mechanical stresses in normal working. The design of adjacent metal parts and mating surfaces shall be such as to prevent corrosion of the contact surface and to maintain good electrical contact under service conditions.

2.4.14.9 All the holes shall be cylindrical, clean cut and perpendicular to the plane of the material. The periphery of the holes shall be free from burrs.

2.4.14.10 All fasteners shall have suitable corona free locking arrangement to guard against vibration loosening.

2.4.14.11 Welding of aluminium shall be by inert gas shielded tungesten arc or inert gas shielded metal arc process. Welds shall be clean, sound, smooth, uniform without overlaps, properly fused and completely sealed. There shall be no cracks, voids incomplete penetration, incomplete fusion, under-cutting or inclusions. Porosity shall be minimised so that mechanical properties of the aluminium alloys are not affected. All welds shall be properly finished as per good engineering practices.

2.4.15 **Bid Drawings**

2.4.15.1 The Bidder shall furnish full description and illustrations of materials offered.

2.4.15.2 Fully dimensioned drawings of the hardwares and their component parts shall be furnished in five (3) copies alongwith the bid. Weight, material and

fabrication details of all the components should be included in the drawings.

All drawings shall be identified by a drawing number and contract number. All drawings shall be neatly arranged. All drafting & lettering shall be legible. The minimum size of lettering shall be 3 mm. All dimensions & dimensional tolerances shall be mentioned in mm.

The drawings shall include :

(i) Dimensions and dimensional tolerance.

(ii) Material, fabrication details including any weld details & any specified finishes & coatings. Regarding material designation & reference of standards are to be indicated.

(iii) Catalogue No.

(iv) Marking

(v) Weight of assembly

(vi) Installation instructions

(vii) Design installation torque for the bolt or cap screw.

(viii) Withstand torque that may be applied to the bolt or cap screw without failure of component parts.

(ix) The compression die number with recommended compression pressure.

(x) All other relevant terminal details.

2.4.15.3 After placement of award, the Contractor shall submit fully dimensioned drawing including all the components in three (3) copies to the Owner for approval. After getting approval from the Owner and successful completion of all the type tests, the Contractor shall submit ten (10) more copies of the same drawings to the Owner for further distribution and field use at Owner's end.

TABLE-1 (Details of Materials)

Sl. No.	Name of item	Material treatment	Process of Standard	Reference	Remarks
1.	Security Clips	Stainless Steel/ Phospher Bronze	-	AISI 302 or 304-L/ IS-1385	
2.	Arcing Horn	Mild Steel Rod/ Tube Type	Hot dip galvanised	As per IS-226 or IS-2062	

3.	Ball Fittings, Socket, all shackles links cleves	Class-IV Steel	Drop forged & normalized Hot dip galvanised	As per IS: 2004	
4.	Yoke Plate	Mild Steel	Hot dip galvanized	As per IS-226 or IS-2062	
5.	Sag Adjustment plate	Mild Steel	Hot dip galvanized	As per IS-226 or IS-2062	
6(a).	Corona Control ring/ Grading ring	High Strength Al. Alloy tube (6061/ 6063/1100 type or 65032/ 63400 Type)	Heat treated Hot dip galvanized	ASTM-B429 or as per IS	Mechanical strength of welded joint shall not be less than 20 KN
6(b).	Supporting Brackets & Mounting Bolts	High Strentgth Al Alloy 7061/ 6063/ 65032/63400 Type) or Mild Steel	Heat treated Hot dip galvanized	ASTM-B429 or as per IS:226 or IS:2062	
7(a).	Dead End Assembly: Outer Sleeve	EC grade Al of purity not less than 99.50%			
7(b).	Steel Sleeve	Mild Steel	Hot Dip Galvanised	IS:226/ IS-2062	

Note : Alternate materials conforming to other national standards of other countries also may be offered provided the properties and compositions of these are close to the properties and compositions of material specified. Bidder should furnish the details of comparision of material offered viz a viz specified in the bid or else the bids are liable to be rejected.

2.5 **Accessories For the HTLS Conductor**

2.5.1 **General**

This portion details the technical particulars of the accessories for Conductor.

2.5.2 2.5% extra fasteners, filler plugs and retaining rods shall be provided.

2.5.3 The supplier shall be responsible for satisfactory performance of complete conductor system along with accessories offered by him for continuous operation at temperature specified for the HTLS Conductor.

2.5.4 **Mid Span Compression Joint**

2.5.4.1 Mid Span Compression Joint shall be used for joining two lengths of conductor. The joint shall have a resistively less than 75% of the resistivity 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 95% of the ultimate tensile strength of the conductor. It must be able to withstand the continuous design temperature of conductor.

2.5.4.2 The dimensions of mid span compression joint before & after compression alongwith tolerances shall be shall be guaranteed in the relevant schedules of the bid and shall be decided by the manufacturer so as to suit the conductor size & conform to electrical & mechanical requirement stipulated in the specification.

2.5.5 **Connector**

Connector of compression type shall be used for jumper connection at tension tower . It shall be manufactured out of 99.5% pure aluminium / aluminium alloy and shall be strong enough to withstand normal working loads as well as able to withstand the continuous maximum operating temperature of conductor. The connector shall have a resistivity across jumper less than 75% resistivity of equivalent length of conductor. The connector shall not permit slipping off, damage to or failure of complete conductor . The welded portions shall be designed for 30 kN axial tensile load. Leg sleeve of connector should be kept at an angle of 15 deg. from vertical and horizontal plane of the conductor in order to minimize jumper pull at the welded portion . The dimensions of connector along with tolerances shall be shall be guaranteed in the relevant schedules of the bid and shall be decided by the manufacturer so as to suit the conductor size & conform to electrical & mechanical requirement stipulated in the specification.

2.5.6 **Repair Sleeve**

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 99.5% pure aluminium / aluminium alloy and shall have a smooth surface.It shall be able to withstand the continuous maximum operating temperature of conductor 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. The dimensions of Repair sleeve alongwith tolerances shall be guaranteed in the relevant schedules of the bid and shall be decided by the manufacturer so as to suit the conductor size & conform to electrical & mechanical requirement stipulated in the specification.

2.5.7 **Vibration Damper**

2.5.7.1 Vibration dampers of 4R-stockbridge type with four (4) different resonances spread within the specified aeolian frequency band width corresponding to

wind speed of 1 m/s to 7 m/s are installed in the existing line at suspension and tension points on each conductor in each span alongwith bundle spacers to damp out aeolian vibration as well as sub- span oscillations,. One damper minimum on each side per sub-conductor for suspension points and two dampers minimum on each side per sub-conductor for tension points has been used for a ruling design span of 320 meters.

2.5.7.2 The bidder shall offer damping system including Stockbridge type dampers and bundle spacers for HTLS conductor for its protection from wind induced vibrations which could cause conductor fatigue /strand breakage near a hardware attachment,such as suspension clamps. Alternate damping systems with proven design offering equivalent or better performance also shall be accepted provided the manufacturer meets the qualifying requirements stipulated in the Specifications. Relevant technical documents including type test reports to establish the technical suitability of alternate systems shall be furnished by the Bidder alongwiththe bid.

The damper shall be designed to have minimum 4 nos of resonance frequencies to facilitate dissipation of vibration energy through interstrand friction of the messanger cable and shall be effective in reducing vibration over a wide frequency range (depending upon conductor dia) or wind velocity range specified above. The vibration damper shall meet the requirement of frequency or wind velocity range and also have machanicalimpedence closely matched with the offered HTLS conductor. The vibration dampers shall be installed at suitable positions to ensure damping effectiveness across the frequency range. The power dissipation of the vibration dampers shall exeed the wind power so that the vibration level on the conductor is reduced below its endurence limit ie 150 micro strain. The bidder shall clearly indicate the method for evaluating performance of dampers including analytrical and laboratory test methods. The bidder shall indicate the the type tests to evaluate the performance of offered damping system .

2.5.7.3 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 chafing of the conductor during erection or continued operation. The clamp shall have smooth and permanent grip to keep the damper in position on the conductor without damaging the strands or causing premature fatigue failure of the conductor under the clamp. The clamp groove shall be in uniform contact with the conductor 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 conductor 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.

2.5.7.4 The messenger cable shall be made of high strength galvanised steel/stain less steel with a minimum strength of 135 kg/sqmm. It shall be of preformed and post formed quality in order to prevent subsequent drop 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 recommendations of IS:4826 for heavily coated wires.

2.5.7.5 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 blowholes etc. The surface of the damper masses shall be smooth.

2.5.7.6 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 alloy shall be fixed to the messenger cable in a suitable manner in order to avoid excessive stress concentration on the messenger cables 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.

2.5.7.7 The damper assembly shall be so designed that it shall not introduce radio interference beyond acceptable limits.

2.5.7.8 The vibration damper shall be capable of being installed and removed from energised line by means of hot line technique. in addition, the clamp shall be capable of being removed and reinstalled on the conductor at the designated torque without shearing or damaging of fasteners.

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

2.5.7.10 The vibration analysis of the system, with and without damper and dynamic characteristics of the damper as detailed under Annexure-A, shall have to be submitted. The technical particulars for vibration analysis and damping design of the system are as follows:

Sl. No.	Description	Technical particulars
1.	Span length in meters	
i)	Ruling design span	320 meters
ii)	Maximum span	336meters
iii)	Minimum span	50 meters
2.	Configuration	Double / Single Circuit conductor per phase in vertical configuration.
3.	Tensile load in Conductor at temperature of 0 deg. C and still air	2884 kGF
4.	Armour rods used	Standard preformed armour rods/AGS
5.	Maximum permissible dynamicstrainieendurencelimit.	+/- 150 micro strains

2.5.7.11 The damper placement chart shall be submitted for spans ranging from 50 m to 320 m. Placement charts should be duly supported with relevant technical documents and sample calculations.

2.5.7.12 The damper placement charts shall include the following

(1) Location of the dampers for various combinations of spans and line tensions clearly indicating the number of dampers to be installed per conductor 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 (vizFreecentre type/Armour grip type etc.)

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

2.5.8 **Material and Workmanship**

2.5.8.1 All the equipment shall be of the latest proven design and conform to the best modern practice adopted in the extra high voltage field. The Bidder shall offer only such equipment as guaranteed by him to be satisfactory and suitable for 132 kV transmission line application with HTLS conductors and will give continued good performance at all service conditions.

2.5.8.2 The design, manufacturing process and quality control of all the materials shall be such as to achieve requisite factor of safety for maximum working load, highest mobility, elimination of sharp edges and corners, best resistance to corrosion and a good finish.

2.5.8.3 High current, heat rise test shall be conducted by the supplier to determine the maximum temperature achieved in different components of fittings under simulated service condition corresponding to continuous operation of conductor at rated maximum temperature. The material of the components should be suitable for continued good performance corresponding to these maximum temperatures. The supplier shall submit relevant type/ performance test certificates as per applicable standards/product specifications tp confirm suitability of the offered material.

2.5.8.4 All ferrous parts shall be hot dipgalvanised, after all machining has been completed. Nuts may, however, be tapped (threaded) after galvanising and the threads oiled. Spring washers shall be electro galvanised as per grade 4 of IS-1573. The bolt threads shall be undercut to take care of increase in diameter due to galvanising. Galvanising shall be'done in accordance with IS:2629/ IS-1367 (Part-13) and satisfy the tests mentioned in IS-2633. Fasteners shall withstand four dips while spring washers shall withstand three dips. Other galvanised materials shall have a minimum average coating of Zinc equivalent to 600 gm/sq.m and shall be guaranteed to withstand at least six dips each lasting one minute under the standard Preece test for galvanising unless otherwise specified.

2.5.8.5 The zinc coating shall be perfectly adherent, of uniform thickness, smooth, reasonably bright, continuous and free from imperfections such as flux, ash, rust stains, bulky white deposits and blisters. The zinc used for galvanising shall be of grade Zn 99.95 as per IS:209.

2.5.8.6 In case of castings, the same shall be free from all internal defects like shrinkage, inclusion, blow holes, cracks etc.

2.5.8.7 All current carrying parts shall be so designed and manufactured that contact resistance is reduced to minimum and localised heating phenomenon is averted.

2.5.8.8 No equipment shall have sharp ends or edges, abrasions or projections and shall not cause any damage to the conductor in any way during erection or during continuous operation which would produce high electrical and mechanical stresses in normal working. The design of adjacent metal parts and mating surfaces shall be such as to prevent corrosion of the contact surface and to maintain good electrical contact under all service conditions.

2.5.8.9 Particular care shall be taken during manufacture and subsequent handling to ensure smooth surface free from abrasion or cuts.

2.5.8.10 The fasteners shall conform to the requirements of IS:6639-1972. All fasteners and clamps shall have corona free locking arrangement to guard against vibration loosening.

2.5.9 **Compression Markings**

Die compression areas shall be clearly marked on each equipment designed for continuous die compressions and shall bear the words 'COMPRESS FIRST' 'suitably inscribed on each equipment where the compression begins. If the equipment is designed for intermittent die compressions, it shall bear the identification marks 'COMPRESSION ZONE' and 'NON-COMPRESSION ZONE' distinctly with arrow marks showing the direction of compression and knurling marks showing the end of the zones. The letters, number and other markings on finished equipment shall be distinct and legible.

2.5.10 **Bid Drawings**

2.5.10.1 The Bidder shall furnish detailed dimensioned drawings of the equipments and all component parts. Each drawing shall be identified by a drawing number and Contract number. All drawings shall be neatly arranged. All drafting and lettering shall be legible. The minimum size of lettering shall be 3 mm. All dimensions and dimensional tolerances shall be mentioned in mm.

2.5.10.2 The drawings shall include

(i) Dimensions and dimensional tolerances

(ii) Material. fabrication details including any weld details and any specified finishes and coatings. Regarding material, designations and reference of standards are to be indicated.

(iii) Catalogue No.

(iv) Marking

(v) Weight of assembly

(vi) Installation instructions

(vii) Design installation torque for the bolt or cap screw

(viii) Withstand torque that may be applied to the bolt or cap screw without failure of component parts

(ix) The compression die number with recommended compression pressure.

(x) All other relevant technical details

2.5.10.3 Placement charts for spacer/spacer damper and damper

2.5.10.4 The above drawings shall be submitted with all the details as stated abcvealongwith the bid document. After the placement of award.the Contractor shall again submit the drawings in three copies to the Owner for approval. After Owner's approval and successful completion of all type tests, 20 (twenty) more sets of drawings shall be submitted to Owner for further distribution and field use at Owner's end.

2.5.11 **Tests and Standards**

Type Tests (Type tests should have been completed during last five years)

All the specified type tests on Hardware Fittings and Accessories for HTLS Conductors offered by the bidder shall not be required to be carried out if valid test certificate is available i.e., tests conducted within last five years from the date of bid opening in an accredited laboratory or witnessed by the representative (s) of a Utility.
In the event of any discrepancy in the test report (i.e., any test report not applicable due to any design / material/manufacturing process change including substitution of components or due to non compliance with the requirement stipulated in the Technical Specification) the tests shall be conducted by the Contractor at no extra cost to the OPTCL.
NB. In case the bidder do not have valid type test report at the time of bidding & intent to carry out the type test after becoming the successful bidder, they can do so provided they give an undertaking while bidding that to save time they will supply the material, pending the type test result. However, the payment against supply will be released only after receipt of successful type test result or against 100% bank guarantee till the type test result is receipt. In case the material fails in type test they have to lift it back after which above bank guarantee will be released & performance bank guarantee will be encashed.

2.5.11.1 **On Suspension Clamp**

a) Magnetic power loss test : As per Annexure-B

b) Clamp slip strength Vs torque test : As per Annexure-B

c) Ozone Test on elastomer : As per Annexure-B

2.5.11.2 **On Dead end Tension Assembly**

a) Electrical resistance test for dead end : As per IS:2486-

		Assembly	(Part-I)
	b)	Heating cycle test for dead end Assembly	: As per IS:2486-(Part-I)
	c)	Slip strength test for dead end assembly	: As per IS:2486-(Part-I)
	d)	Ageing test on filler (if applicable)	: As per Annexure-B
2.5.11.3	**Mid Span Compression Joint for Conductor**		
	a)	Chemical analysis of materials	: As per Annexure-B
	b)	Electrical resistance test	:As per IS:2121 (Part-II)
	c)	Heating cycle test	:As per IS:2121 (Part-II)
	d)	Slip strength test	: As per Annexure-B
	e)	Corona extinction voltage test (dry)	: As per Annexure-B
	f)	Radio interference voltage test (dry)	: As per Annexure-B
2.5.11.4	**Repair Sleeve for Conductor**		
	a)	Chemical analysis of materials	: As per Annexure-B
	b)	Corona extinction voltage test (dry)	: As per Annexure-B
	c)	Radio interference voltage test (dry)	: As per Annexure-B
2.5.11.5	**Connector for Conductor**		
	a)	Chemical analysis of materials	: As per Annexure-B
	b)	Electrical resistance test	:As per IS:2121 (Part-II) Clause 6.5 & 6.6
	c)	Heating cycle test	:As per IS:2121 (Part-II)
	d)	Axial tensile load test on welded portion	: As per Annexure-B
	e)	Corona extinction voltage test (dry)	: As per Annexure-B
	f)	Radio interference voltage test (dry)	: As per Annexure-B
2.5.11.6	**Vibration Damper for Conductor**		
	a)	Chemical analysis of materials	: As per Annexure-B
	b)	Dynamic characteristics test*	: As per Annexure-B

c)	Vibration analysis	: As per Annexure-B
d)	Clamp slip test	: As per Annexure-B
e)	Fatigue tests	: As per Annexure-B
f)	Magnetic power loss test	: As per Annexure-B
g)	Corona extinction voltage test (dry)	: As per Annexure-B
h)	Radio interference voltage test (dry)	: As per Annexure-B
i)	Damper efficiency test	: As per IS:9708

* Applicable for 4 R stock bridge dampers. For alternate type of vibration dampers (permitted as per clause 2.5.2), as an alternative to dynamic characteristic test, damper efficiency test as per IEEE-664 Power Manual may be proposed / carried out by the supplier.

2.5.12 **Acceptance Tests**

2.5.12.1 **On Both Suspension Clamp and Tension Assembly**

a)	Visual Examination	: As per IS:2486-(Part-I)
b)	Verification of dimensions	: As per IS:2486-(Part-I)
c)	Galvanising/Electroplating test	: As per IS:2486-(Part-I)
d)	Mechanical strength test of each component	: As per Annexure-B
e)	Mechanical Strength test of welded joint	: As per Annexure-B
f)	Chemical analysis, hardness tests, grain size, inclusion rating & magnetic particle inspection for forgings/castings	: As per Annexure-B

2.5.12.2 **On Suspension Clamp only**

a)	Clamp Slip strength Vs Torque test for suspension clamp	: As per Annexure-B
b)	Shore hardness test of elastomer cushion for AG suspension clamp	: As per Annexure-B
c)	Bend test for armour rod set	: As per IS:2121(Part-I), Clause 7.5,7,10 &7.11

	d)	Resilience test for armour rod set	: As per IS:2121(Part-I), Clause 7.5,7,10 & 7.11
	e)	Conductivity test for armour rods set	: As per IS:2121(Part-I), Clause 7.5,7,10 & 7.11

2.5.12.3 **On Tension Hardware Fittings only**

	a)	Slip strength test for dead end assembly	: As per IS:2486 (Part-I) Clause 5.4
	d)	Ageing test on filler (if applicable)	: As per Annexure-C

2.5.12.4 **On Mid Span Compression Joint for Conductor**

	a)	Visual examination and dimensional verification	: As per IS:2121 (Part-II), Clause 6.2, 6.3 7 6.7
	b)	Galvanising test	: As per Annexure-C
	c)	Hardness test	: As per Annexure-C
	d)	Ageing test on filler (if applicable)	: As per Annexure-C

2.5.12.5 **Connector for Conductor**

	a)	Visual examination and dimensional verification	: As per IS:2121 (Part-II)
	b)	Axial tensile load test for welded portion	: As per Annexure-B

2.5.12.6 **Repair Sleeve for Conductor**

	a)	Visual examination and dimensional verification	: As per IS:2121(Part-II) Clause 6.2, 6.3

2.5.12.7 **Vibration Damper for Conductor**

	a)	Visual examination and dimensional verification	: As per IS:2121(Part-II) Clause 6.2, 6.3 7 6.7

b)	Galvanising test		: As per Annexure-C
	(i) On damper masses		: As per Annexure-C
	ii) On messenger cable		: As per Annexure-C
c)	Verification of resonance frequencies		: As per Annexure-C
d)	Clamp slip test		: As per Annexure-C
e)	Clamp bolt torque test		: As per Annexure-C
f)	Strength of the messenger cable		: As per Annexure-C
g)	Mass pull off test		: As per Annexure-C
h)	Dynamic characteristics test*		: As per Annexure-C

* Applicable for 4 R stockbridge dampers. For alternate type of vibration dampers (permitted as per clause 2.5.2), as an alternative to dynamic characteristic test, damper efficiency test as per IEEE-664 Power Manual may be proposed / carried out by the supplier.

2.5.13 **Routine Tests**

2.5.13.1 **For Hardware Fittings**

a)	Visual examination		IS:2486-(Part-I)
b)	Proof Load Test		: As per Annexure-B

2.5.13.2 **For conductor accessories**

a)	Visual examination and dimensional verification		: As per IS:2121(Part-II) Clause 6.2, 6.3 7 6.7

2.5.13.3 **Tests During Manufacture on all components as applicable**

a)	Chemical analysis of Zinc used for galvanising		IS:2486-(Part-I)
b)	Chemical analysis mechanical metallographic test and magnetic particle inspection for malleable castings		: As per Annexure-B
c)	Chemical analysis, hardness tests and magnetic particle inspection for forging		: As per Annexure-B

If any of the above type tests have not been made, the supplier should furnish an undertaking with the bid that the test reports to be furnished

before offering call for acceptance test. Otherwise the EMD will be forfeited, the bidder will not be eligible to participate in future tenders of OPTCL.

2.5.14 **Co-ordination for testing**

The Contractors shall have to co-ordinate testing of their hardware fittings with insulators to be supplied by other Supplier to the *Owner* and shall have to also guarantee overall satisfactory performance of the hardware fittings with the insulators.

2.5.15 **Inspection**

2.5.15.1 The Owner's representative shall at all times be entitled to have access to the works and all places of manufacture, where the material and/or its component parts shall be manufactured and the representatives shall have full facilities for unrestricted inspection of the Contractor's, sub-Contractor's works raw materials. manufacturer's of all the material and for conducting necessary tests as detailed herein.

2.5.15.2 The material for final inspection shall be offered by the Contractor only under packed condition as detailed in clause 4.11 of this part of the Specification. The engineer shall select samples at random from the packed lot for carrying out acceptance tests.

2.5.15.3 The Contractor shall keep the Owner informed in advance of the time of starting and of the progress of manufacture of material in its various stages so that arrangements could be made for inspection.

2.5.15.4 Material shall not be despatched from its point of manufacture before it has been satisfactorily inspected and tested unless the inspection is waived off by the Owner in writing. In the latter case also the material shall be despatched only after all tests specified herein have been satisfactorily completed.

2.5.15.5 The acceptance of any quantity of material shall in no way relieve the Contractor of his responsibility for meeting all the requirements of the Specification, and shall not prevent subsequent rejection, if such material are later found to be defective.

2.5.16 **Packing and Marking**

2.5.16.1 All material shall be packed in strong and weather resistant wooden cases/crates. The gross weight of the packing shall not normally exceed 200 Kg to avoid handling problems.

2.5.16.2 The packing shall be of sufficient strength to withstand rough handling during transit, storage at site and subsequent handling in the field.

2.5.16.3 Suitable cushioning, protective padding, dunnage or spacers shall be provided to prevent damage or deformation during transit and handling.

2.5.16.4 Bolts, nuts, washers, cotter pins, security clips and split pins etc. shall be packed duly installed and assembled with the respective parts and suitable measures shall be used to prevent their loss.

2.5.16.5 Each component part shall be legibly and indelibly marked with trade mark of the manufacturer and year of manufacture.

2.5.16.6 All the packing cases shall be marked legibly and correctly so as to ensure safe arrival at their destination and to 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 stencilled on it in indelible ink.

2.5.17 **Standards**

2.5.17.1 The Hardware fittings; conductor and earthwire accessories shall conform to the following Indian/International Standards which shall mean latest revisions, with amendments/changes adopted and published, unless specifically stated otherwise in the Specification.

2.5.17.2 In the event of the supply of hardware fittings; conductor and earthwire accessories conforming to standards other than specified, the Bidder shall confirm in his bid that these standards are equivalent to those specified. In case of award, salient features of comparison between the Standards proposed by the Contractor and those specified in this document will be provided by the Contractor to establish their equivalence.

Sl. No.	**Indian Standard**	**Title**	**International Standard**
1.	IS: 209-1992	Specification for zinc	BS:3436-1986
2.	IS:398-1992 Part-V	Aluminum Conductor Galvanised Steel- Reinforced For Extra High Voltage (400 KV) and above	IEC:1089-1991 BS:215-1970
3.	IS 1573	Electroplated Coating of Zinc on iron and Steel	
4.	IS : 2121 (Part-II)	Specification for Conductor and Earthwire Accessories for Overhead Power lines: Mid-span Joints and Repair Sleeves for Conductors	
5.	IS:2486 (Part-I)	Specification for Insulator Fittings for Overhead power Lines with Nominal Voltage greater than 1000 V: General Requirements and Tests	
6.	IS:2629	Recommended Practice for Hot Dip Galvanising of Iron and Steel	
7.	IS:2633	Method of Testing Uniformity of Coating on Zinc Coated Articles	
8.		Ozone test on Elastomer	ASTM- D1171

9.		Tests on insulators of Ceramic material or glass for overhead lines with a nominal voltage greater than 1000V	IEC:383-1993
10.	IS:4826	Galvanised Coating on Round Steel Wires	ASTM A 472729 BS:443-1969
11.	IS:6745	Methods of Determination of Weight of Zinc Coating of Zinc Coated Iron and Steel Articles	BS:433 ISO : 1460 (E)
12.	IS:8263	Method of Radio Interference Tests on High Voltage Insulators	IEC:437 NEMA:107 CISPR
13.	IS:6639	Hexagonal Bolts for Steel Structures	ISO/R-272
14.	IS:9708	Specification for Stock	
15.	IS:10162	Specification for Spacers Dampers for Twin Horizontal Bundle Conductors	

The standards mentioned above are available from:

Reference Abbreviation	**Name and Address**
BS	British Standards, British Standards Institution 101, Pentonvile Road, N - 19-ND UK
IEC/CISPR	International Electro technical Commission, Bureau Central de la Commission, electro Technique international, 1 Rue de verembe, Geneva SWITZERLAND
BIS/IS	Beureau Of Indian Standards. ManakBhavan, 9, Bahadur Shah ZafarMarg, New Delhi - 110001. INDIA

ISO	International Organisation for Standardization. Danish Board of Standardization Danish Standardizing Sraat, Aurehoegvej-12 DK-2900, Heeleprup, DENMARK.
NEMA	National Electric Manufacture Association, 155, East 44th Street. New York, NY 10017 U.S.A.

2.6 Workmanship

i) All the conductor strands shall be smooth, uniform and free from all imperfections, such as spills and splits, cracks, die marks, scratches, abrasions, rust etc.

ii) The finished conductor shall be smooth, compact, uniform and free from all imperfections including kinks (protrusion of wires), wire cross over, over riding, looseness (wire being dislocated by finger/hand pressure and / or unusual bangle noise on tapping), material inclusions, white rust, powder formation or black spot (on account of reaction with trapped rain water etc),dirt, grit etc.

2.7 Joints in wires

a)Aluminum OR Aluminum Alloy Wires

During stranding no Aluminum/ aluminium Alloy welds shall be made for the purpose of achieving the required conductor length.

b)Core Wires

There shall be no joint of any kind in the finished wire entering into the manufacture of the strand. There shall also be no joints or splices in any length of the completed stranded core.

2.8Tolerances

Manufacturing tolerances on the dimensions to the extent of one percent shall be permitted for individual strands and the complete conductor.

2.9Materials

The materials used for construction of the conductor shall be such that the conductor meets the specified technical and the performance requirements.

2.10 Outer Layer

(i) The material of outer layer of HTLS conductor shall be of high temperature resistant aluminum/ aluminum alloy added with zirconium or any other suitable elements to electrolytic aluminum having purity not less than 99.5% and a copper content not exceeding 0.04%. Bidder shall guarantee the chemical composition in the schedule GTP and also furnish description of the manufacturing process in the bid.

(ii) Annealed conductor will be accepted for Package-I.

2.11Core

The stranded core shall be used. Solid core is also acceptable. The core wire strands may be of any composite materials or special steel and shall have properties conforming to the technical performance requirements of the finished conductor. Bidder shall furnish properties and composition of the core wire strands in the GTP schedule. The composite material for core shall be of such proven quality that its properties are not deteriorated by the normal operating conditions of 132KV transmission line in tropical environment conditions as experienced by the existing lines. The Bidder shall provide adequate details including specifications / test reports / operating experience details / performance certificates etc. in support of the suitability of the offered materials. Care to be taken for internal friction due to different material having different thermal co efficient of expansion.

2.12Conductor Length

The Bidder after his survey of the existing line shall determine the most appropriate individual conductor lengths to be manufactured & supplied keeping in view of the tower schedules, section lengths, special crossings etc. The drum drawing as per IS 1778 or any international standard shall be submitted to purchaser for review and approval. The Bidder shall also indicate the maximum single length of conductor that they can manufacture, in the GTP. The tower schedule and individual span lengths of the existing lines are given in Appendix-I & II.

3. STANDARDS

The conductors & accessories shall comply in all respects to the clauses of this specification as indicated above & with the standards noted in Appendix-V, Appendix-VI.

4. STRANDING

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

5. Packing

5.1 The conductor shall be supplied in non-returnable, strong, wooden/painted steel/hybrid (painted steel cum wood) drums provided with lagging of adequate strength, constructed to protect the conductor against all damage and displacement during transit, storage and subsequent handling and stringing operations in the field. The Supplier shall select suitable drums for supply of conductor and shall be responsible for any loss or damage to conductor and/or drum during transportation handling and storage due to improper selection of drum or packing.

5.2 The drums shall be suitable for wheel mounting and for letting off the conductor under a minimum controlled tension of the order of 5000 Kgf.

5.3 The Bidder should submit their proposed drum drawings along with the bid.

5.4 One conductor length only shall be wound on each drum.

5.5 The conductor ends shall be properly sealed and secured on the side of one of the flanges to avoid loosening of the conductor layers during transit and handling.

5.6 **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 meters

(g) Arrow marking for unwinding

(h) Position of the conductor ends

(i) Distance between outer-most Layer of conductor and the inner surface of lagging.

(k) Barrel diameter at three locations & an arrow marking at the location of the measurement.

(l) Number of turns in the outer most layer.

(m) Gross weight of drum after putting lagging.

(n) Tear weight of the drum without lagging.

(o) Net weight of the conductor in the drum.

(p) Dispatch instruction.

The above should be indicated in the packing list also.

5.7 Verification of Conductor Length

The Owner reserves the right to verify the length of conductor after unreeling at least ten (10) percent of the drums in a lot offered for inspection.

6. Tests and Standards

6.1 Type Tests

Type Tests on Stranded Conductor/ Stranded wire

The following tests should have been conducted in last five year for which offer is made.

All the specified type tests on HTLS Conductors offered by the bidder shall not be required to be carried out if valid test certificate is available i.e., tests conducted within last five years from the date of bid opening in an accredited laboratory or witnessed by the representative (s) of a Utility.
In the event of any discrepancy in the test report (i.e., any test report not applicable due to any design/ material/manufacturing process change including substitution of components or due to non compliance with the requirement stipulated in the Technical Specification) the tests shall be conducted by the Contractor at no extra cost to the OPTCL.

NB. In case the bidder do not have valid type test report at the time of bidding & intent to carry out the type test after becoming the successful bidder, they can do so provided they give an undertaking while bidding that to save time they will supply the material, pending the type test result. However, the payment against supply will be released only after receipt of successful type test result or against 100% bank guarantee till the type test result is receipt. In case the material fails in type test they have to lift it back after which above bank guarantee will be released & performance bank guarantee will be encashed.

(i) **On complete Conductor**

a) DC resistance test on stranded conductor : As per Annexure-A

b)	UTS test on stranded conductor	: As per Annexure-A
c)	Stress- Strain test on stranded conductor and core at room temperature	: IEC 1089
d)	Stress-strain test on stranded conductor and core at elevated temperature	As per Annexure-A
e)	High temperature endurance & creep test on stranded conductor	: As per Annexure-A
f)	Sheaves Test	: As per Annexure-A
g)	Axial Impact Test	: As per Annexure-A
h)	Crush Strength Test	: As per Annexure-A
i)	Torsional Ductility Test	: As per Annexure-A
(ii)	**On Conductor Strand/core**	
a)	Heat resistance test on Aluminium Alloy strands	: As per Annexure-A
b)	Bending test on core	: As per Annexure-A
c)	Compression test on core	: As per Annexure-A
d)	Coefficient of linear expansion on core/ core strands	: As per Annexure-A

6.2 Acceptance Tests

a)	Visual and dimensional check on drum	: As per Annexure-A
b)	Visual check for joints scratches etc. and length measurement of conductor by rewinding	: As per Annexure-A
c)	Dimensional check on core strands/composite core and Aluminium Alloy strands	: As per Annexure-A
d)	Check for lay-ratios of various layers	: As per Annexure-A
e)	Galvanising test on core strands (if applicable)	: As per Annexure-A
f)	aluminum thickness on aluminium clad wires (if applicable)	
g)	Torsion and Elongation tests on core strands/composite core	: As per Annexure-A
h)	Breaking load test on core strands and Aluminium / Aluminium Alloy strands	: As per Annexure-A
i)	Wrap test on core strands and conductor.	: As per IEC:888 & IES:889

j)	Minimum conductivity test on conductor strands.	: As per IEC : 889
k)	Heat resistance test on Aluminium Alloy strands	: As per Annexure-A
l)	Ageing test on filler (if applicable)	: As per Annexure-A
m)	Minimum conductivity test on core strands(if applicable)	: As per Annexure-A
n)	Dimentional check on conductor	

Note: All the above tests except (j) shall be carried out on Aluminium / Aluminium Alloy and core strands after stranding only.

6.3 Routine Test

a) Check to ensure that the joints are as per Specification

b) Check that there are no cuts, fins etc., on the strands.

c) Check that drums are as per Specification

d) All acceptance tests as mentioned above to be carried out on each coil

6.4 Tests During Manufacture

a)	Chemical analysis of zinc used for galvanizing (if applicable)	: As per Annexure-A
b)	Chemical analysis of Aluminium alloy used for making Aluminium Alloystrands	: As per Annexure-A
c)	Chemical analysis of core strands/composite core	: As per Annexure-A

6.5 Test Reports

6.5.1 Record of routine test reports shall be maintained by the Supplier at his works for periodic inspection by the Owner's representative.

6.5.2 Test Certificates of tests during manufacture shall be maintained by the Supplier. These shall be produced for verification as and when desired by the Owner.

6.6 Inspection

6.6.1 The Owner'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 representative shall have full facilities for unrestricted inspection of the Supplier's works, raw materials and process of manufacture for conducting necessary tests as detailed herein.

6.6.2 The Supplier shall keep the Owner 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.

6.6.3 No material shall be dispatched from its point of manufacture before it has been satisfactorily inspected and tested, unless the inspection is waived off by the Owner in writing. In the latter case also the conductor shall be

dispatched only after satisfactory testing for all tests specified herein have been completed.

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

6.7 Test Facilities

6.7.1 The following additional test facilities shall be available at the Supplier's works:

a) Calibration of various testing and measuring equipment including tensile testing machine, resistance measurement facilities, burette, thermometer, barometer etc.

b) Standard resistance for calibration of resistance bridges.

c) Finished conductor shall be checked for length verification and surface finish on separate rewinding machine at reduced speed (variable from 8 to 16 meters per minute). The rewinding facilities shall have appropriate clutch system and free of vibrations, jerks etc. with traverse laying facilities.

6.8 Standards

6.8.1 The conductor shall conform to the following Indian/International Standards, which shall mean latest revisions, with amendments/changes adopted and published, unless specifically stated otherwise in the Specification.

6.8.2 In the event of the supply of conductor conforming to standards other than specified, the Bidder shall confirm in his bid that these standards are equivalent to those specified. In case of award, salient features of comparison between the standards proposed by the Supplier and those specified in this document will be provided by the Supplier to establish their equivalence.

Sl. No.	Indian Standard	Title	International Standard
1.	IS: 209-1992	Specification for zinc	BS:3436-1986
2.	IS: 398-1982	Specification for Aluminium Conductors for Overhead Transmission Purposes	IEC:1089-1991 BS:215-1970
3.	IS:398-1990 Part-II	Aluminum Conductor Galvanised Steel Reinforced	BS;215-1970 IEC:1089-1991
4.	IS:398-1992 Part-V	Aluminum Conductor Galvanised Steel- Reinforced For Extra High Voltage (400 KV) and above	IEC:1089-1991 BS:215-1970
5.	IS : 1778-1980	Reels and Drums for Bare Conductors	BS:1559-1949
6.	IS : 1521-1991	Method of Tensile Testing of Steel Wire	ISO 6892-1984
7.	IS : 2629-1990	Recommended Practice for Hot Dip Galvanising of Iron and Steel	
8.	IS : 2633-1992	Method of Testing Uniformity of Coating on Zinc Coated Articles	
9.	IS : 4826-1992	Galvanised Coating on Round Steel Wires	IEC : 888-1987 BS:443-1969
10.	IS : 6745-1990	Methods of Determination of Weight of Zinc Coating of Zinc Coated Iron and Steel Articles	BS:433-1969 ISO 1460 - 1973
11.	IS : 8263-1990	Method of Radio Interference Tests on High Voltage Insulators	IEC:437-1973 NEMA:107-1964 CISPR
12.	IS : 9997-1988	Aluminium Alloy Redraw Rods	IEC 104 - 1987
13.		Zinc Coated steel wires for stranded Conductors	IEC : 888-1987
14.		Hard drawn Aluminium wire for overhead line conductors	IEC : 889-1987
15.	IS:398 (Part-IV)	Aluminium Alloy stranded conductor	IEC : 208-1966 BS-3242-1970
16.		Aluminium clad steel wires	IEC:1232
17.		Method of measurement of resistivity of metallic materials	IEC:468
18		Ampacity	IEEE738
19.		Creep	

The standards mentioned above are available from:

Reference Abbreviation	Name and Address
BS	British Standards, British Standards Institution 101, Pentonvile Road, N - 19-ND UK
IEC/CISPR	International Electro technical Commission, Bureau Central de la Commission, electro Technique international, 1 Rue de verembe, Geneva SWITZERLAND
BIS/IS	Beureau Of Indian Standards. ManakBhavan, 9, Bahadur Shah ZafarMarg, New Delhi - 110001. INDIA
ISO	International Organisation for Standardization. Danish Board of Standardization Danish Standardizing Sraat, Aurehoegvej-12 DK-2900, Heeleprup, DENMARK.
NEMA	National Electric Manufacture Association, 155, East 44th Street. New York, NY 10017 U.S.A.

ANNEXURE-A

1. Tests on Conductor

1.1 UTS Test on Stranded Conductor

Circles perpendicular to the axis of the conductor shall be marked at two places on a sample of conductor of minimum 5 m length between fixing arrangement suitably fixed by appropriate fittings on a tensile testing machine. The load shall be increased at a steady rate up to 50% of minimum specified UTS and held for one minute. The circles drawn shall not be distorted due to relative movement of strands. Thereafter the load shall be increased at steady rate to minimum UTS and held for one minute. The Conductor sample shall not fail during this period. The applied load shall then be increased until the failing load is reached and the value recorded.

1.2 D.C. Resistance Test on Stranded Conductor

On a conductor sample of minimum 5m length two contact-clamps shall be fixed with a predetermined bolt torque. The resistance shall be measured by a Kelvin double bridge or using micro ohm meter of suitable accuracy by placing the clamps initially zero metre and subsequently one metre apart. The test shall be repeated at least five times and the average value recorded. The value obtained shall be corrected to the value at 20^0C as per IS:398-(Part-IV)/(Part-V). The resistance corrected at 20deg C shall conform to the requirements of this Specification.

1.3 Coefficient of linear expansion for core/core strands

The temperature and elongation on a sample shall be continuously measured and recorded at interval of approximately 15 degree C from 15 degree C to maximum continuous operating temperature corresponding to rated current(800 A) by changing the temperature by suitable means. Coefficient of linear expansion shall be determined from the measured results.

1.4.1 Breaking load test on Aluminium Alloy & Core strands and D.C Resistance test on Aluminium Alloy wire

The above tests shall be carried out as per IEC: 888/889 and the results shall meet the requirements of the specification.

1.5 Wrap test on Core strand

The wrap test on steel strands shall be meet the requirements of IEC: 888. In case of aluminium clad core wire, the same shall be wraped around a mandel of diameter of five times that of the strand to form a helix of eight turns. The strand shall be unwrapped. No breakage of strand shall occurred.

1.6 Heat Resistance test on Aluminium Alloy wire

Breaking load test as per clause 1.5 above shall be carried out before and after heating the sample in uniform heat furnace at 280 degC (+5/-3 degC) temperature

for one hour. The breaking strength of the wire after heating shall not be less than the 90% of the breaking strength before heating.

1.7 Chemical Analysis of Aluminium Alloy and Core

Samples taken from the Aluminium and core coils/strands shall be chemically/spectrographically analysed. The same shall be in conformity to the particulars guaranteed by the bidder so as to meet the requirements stated in this Specification.

1.8 Visual and Dimensional Check on Drums

The drums shall be visually and dimensionally checked to ensure that they conform to the approved drawings.

1.9 Visual Check for Joints, Scratches etc.

Conductor drums shall be rewound in the presence of the Owner. The Owner shall visually check for scratches, joints etc. and that the conductor generally conform to the requirements of this Specification. Ten percent (10%) drums from each lot shall be rewound in the presence of the Owner's representative.

1.10 Dimensional Check on Core Strands and Aluminium Alloy Strands

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

1.11 Check for Lay-ratios of Various Layers

The lay-ratios of various layers shall be checked to ensure that they conform to the guaranteed values furnished by the Contractor.

1.12 Procedure Qualification test on welded Aluminium Alloy strands.

Two Aluminium Alloywire shall be welded as per the approved qualityplan and shall be subjected to tensile load. The breaking strength of the welded joint of the wire shall not be less than the guaranteed breaking strength of individual strands.

1.13 Chemical Analysis of Zinc

Samples taken from the zinc ingots shall be chemically/ spectrographically analyzed. The same shall be in conformity to the requirements stated in the Specification.

1.14 Galvanizing Test

The test procedure shall be as specified in IEC : 888. The material shall conform to the requirements of this Specification. The adherence of zinc shall be checked by wrapping around a mandrel four times the diameter of steel wire.

1.15 Torsion and Elongation Tests on Core Strands

The test procedures shall be as per clause No. 10.3 of IEC 888. 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 stranded diameter of the strand, the minimum number of twists will be proportioned 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 1.5% for a gauge length of 250 mm.

1.16 Bending test on conductor core strand

A sample of conductor core strand measuring 30 cm in length shall be subject to bending with help of a vise. The vised length of wire should be 5 cm and radius of bend 4.8 mm. The bending should be first 90 degrees left and 90 degree right. After this operation the strand should cut at the bending point. There should be no separation of core and aluminium at the bending point after this operation.

1.17 Compression test on aluminium clad strand

A sample of aluminium clad core strand 10 mm in length is to be compressed by a plate with a load of 3600 kgs. The aluminium and core strand should not break.

1.18 Aluminium conductivity test on aluminium clad strand

Resistivity test as per IEC-468 shall be conducted to confirm minimum conductivity as per specification requirement.

1.19.1 Minimum conductivity test on thermal resistant aluminium alloy strands

Resistivity test as per IEC-468/IEC 889 shall be conducted to confirm minimum conductivity as per specification requirement.

1.20 Stress-strain test at elevated temperature

Stress-strain test as per IEC-1089 shall be conducted keeping conductor temperature at designed maximum temperature.

1.21 High Temperature endurance & creep test

A conductor sample of at least 20 m length shall be strung at tension equal to 25 % of conductor UTS. The conductor temperature shall be increased to designed maximum temperature in steps of 20 deg. C and thermal elongation of the conductor sample shall be measured & recorded at each step. Further, the temperature of the conductor shall be maintained at maximum continuous operating temperature ($\pm$10 Deg. C) for 1000 hours. The elongation/creep strain of the conductor during this period shall be measured and recorded at end of 1 hour, 10 hour, 100 hour and subsequently every 100 hour upto 1000 hours time period. After completion of the above, the conductor sample shall be subjected to UTS test as mentioned above at clause 1.1 of Annexure-A.

The supplier shall furnish details of creep characteristic in respect of the conducted based on laboratory test and other laboratory investigations/ experimental conducted on similar type of conductor and shall indicate creep strain values corresponding to 1 month, 6 month, 1 year, 10 year & 20 year creep at everyday tension & continuous designed temperature.

1.22 Axial Impact Test

The conductor sample shall be suspended vertically and load applied by dropping a 650 Kg from an elevation of 4 meters above the sample. The impact velocity shall be not be less than 8 m/sec. with an initial pre-tension of 200 kgs. The curve for load vs time shall be recorded and recorded load of failure for core shall not be less than UTS of core.

1.23 Crush Strength Test

A section of conductor is to be crushed between two six inch steel platens. Load shall be held at 350 Kgs for 1 minute and then released. All the strands shall be subsequently disassembled and tensile tested. All the strands shall exhibit full strength retention

1.24 Torsional Ductility Test

After removing the outer layer aluminium/ aluminium alloy strands, the conductor shall be loaded to 25% of UTS and than loaded in increasing steps of +/-180 deg, the core shall withstand atleast 16 such rotation.

1.25 Sheaves Test (if required)

The conductor sample of minimum length of 35 meter shall be tensioned at 22 % of the UTS and shall be passed through pulleys having diameter of 32 times that of the conductor with angle of 20 deg. between the pulleys. The conductor shall be passed over the pulleys 36 times a speed of 2 m/sec. After this test UTS test on the conductor shall be carried out.

1.0 **Tests on Hardware Fittings**

1.1 **Magnetic Power Loss Test for Suspension Assembly**

Two hollow aluminium tubes of 32 mm diameter for the conductor shall be placed 450 mm apart respectively. An alternating current over the range of 1500 to 2000 amps shall be passed through each tube. The reading of the wattmeter with and without suspension assemblies alongwith line side yoke plate, clevis eye shall be recorded. Not less than three suspension assemblies shall be tested. The average power loss for suspension assembly.shall be plotted for each value of current. The value of the loss corresponding to 2456 amperes per phase shall be read off from the graph and the same shall not be more than the value guaranteed by the supplier.

1.2 **Galvanising/Electroplating Test**

The test shall be carried out as per Clause no. 5.9 of IS:2486-(Part-1) except that both uniformity of zinc coating and standard preecee test shall be carried out and the results obtained shall satisfy the requirements of this specification.

1.3 **Mechanical Strength Test of Each Component**

Each component shall be subjected to a load equal to the specified minimum ultimate tensile strength (UTS) which shall be increased at a steady rate to 67% of the minimum UTS specified. The load shall be held for five minutes and then removed. The component shall then again be loaded to 50% of UTS and the load shall be further increased at a steady rate till the specified UTS and held for one

minute. No fracture should occur. The applied load shall then be increased until the failing load is reached and the value recorded.

1.5 **Clamp Slip Strength Vs Torque Test for Suspension Clamp**

The suspension assembly shall be vertically suspended by means of a flexible attachment. A suitable length of conductor shall be fixed in the clamp. The clamp slip strength at various tightening torques shall be obtained by gradually applying the load at one end of the conductor. The Clamp slip strength vs torque curve shall be drawn. The above procedure is applicable only for free centre type suspension clamp. For AG suspension clamp only clamp slip strength after assembly shall be found out. The clamp slip strength at the recommended tightening torque shall be more than 20 kN but less than 29 kN.

1.6 **Heating Cycle Test**

Heating cycle test shall be performed in accordance with IS 2486 (Part-I) with following modifications:-

i) Temperature of conductor during each cycle: 40 deg. C above designed maximum operating temperature of the conductor.

ii) Number of cycle: 100

Slip strength test shall also be carried out after heating cycle test.

1.8 **Shore Hardness Test for Elastomer Cushion for AG Suspension Assembly**

The shore hardness at various points on the surface of the elastomer cushion shall be measured by a shore hardness meter and the shore hardness number shall be between 65 to 80.

1.9 **Proof Load Test**

Each component shall be subjected to a load equal to 50% of the specified minimum ultimate tensile strength which shall be increased at a steady rate to 67% of the UTS specified. The load shall be held for one minute and then removed. After removal of the load the component shall not show any visual deformation.

1.10 **Tests for Forging Casting and Fabricated Hardware**

The chemical analysis, hardness test, grain size, inclusion rating and magnetic particle inspection for forging, castings and chemical analysis and proof load test for fabricated hardware shall be as per the iniiternationallyrecognised procedures for these tests. The sampling will be based on heat number and heat treatment batch. The details regarding test will be as in the Quality Assurance programme.

2.0 Tests on Accessories for Conductor

2.1 **Mid Span Compression Joint for Conductor and Earthwire**

(a) Slip Strength Test

The fitting compressed on conductor shall not be less than one metre in length. The test shall be carried out as per IS:2121 (Part-ii)-1981 clause 6-4 except that the load shall be steadily increased to 95% of minimum ultimate tensile strength of conductor/earthwire and retained for one minute at this load. There

shall be no movement of the conductor/ earthwire relative to the fittings and no failure of the fit tings during this one minute period.

2.2 **Connector for Conductor**

Axial Tensile Load Test for Welded Portion

The sleeve portion of the T-Connector shall be compressed on conductor. The compressed portion shall be held rigidly on some fixtures and axial load shall be applied alongwith the jumper terminal The load shall be increased gradually till breaking of welded joint occurs. The breaking load should be above 30 kN.

Vibration damper for conductor.

Clamp Slip and Fatigue Tests

(i) Test Set Up

The clamp slip and fatigue tests shall be conducted on a laboratory set up with a minimum effective span length of 30 m. The conductor shall be tensioned at tension corresponding to 0 deg& no wind condition and ruling span 400 from sag –tension calculation and shall not be equipped with protective armour rods at any point. Constant tension shall be maintained within the span by means of lever arm arrangement. After the conductor has been tensioned, clamps shall be installed to support the conductor at both ends and thus influence of connecting hardware fittings are eliminated from the free span. The clamps shall not be used for holding the tension on the conductor. There shall be no loose parts, such as suspension clamps, U bolts on the test span supported between clamps mentioned above. The span shall be equipped with vibration inducing equipment suitable for producing steady standing vibration. The inducing equipment shall have facilities for stepless speed control as well as stepless amplitude arrangement. Equipment shall be available for measuring the frequency, cumulative number of cycles and amplitude of vibration at any point along the span.

(ii) Clamp Slip test

The vibration damper shall be installed on the test span. The damper clamp, after lightning with the manufacturer's specified tightening torque, when subjected to a longitudinal pull of 2.5 kN parallel to the axis of conductor for a minimum duration of one minute shall not slip i.e. the permanent displacement between conductor and clamp measured after removal of the load shall not exceed 1.0 mm. The load shall be further increased till the clamp starts slipping. The load at which the clamp slips shall not be more than 5 kN.

3.0 **Tests on All components (As applicable)**

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

Samples taken from the zinc ingot shall be chemically analysed as per IS-209-1979. The purity of zinc shall not be less than 99.95%.

3.2 **Tests for Forgings**

The chemical analysis hardness tests and magnetic particle inspection for forgings, will be as per the internationally recognised procedures for these tests. The, sampling will be based on heat number and heat treatment batch. The details regarding test will be as discussed and mutually agreed to by the Contractor and Owner in Quality Assurance Programme.

3.3 **Tests on Castings**

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

Acceptance Tests **ANNEXURE-C**

1 Mid Span Compression Joint for Conductor

(a) Hardness Test

The Brinnel hardness at various points on the steel sleeve of conductor core and tension clamp shall be measured.

2. Connector for Conductor

(a) Axial Tensile Load Test for Welded Portion

Same as clause 2.2 of Annexure - B .

3. Vibration Damper for Conductor

(a)Verification of Resonance Frequencies

The damper shall be mounted on a shaker table and vibrate at damper clamp displacement of +/-0.5 mm to determine the resonance frequencies. The resonance shall be visually identified as the frequency at which damper mass vibrates with maximum displacement on itself. The resonance frequency thus identified shall be compared with the guaranteed value. A tolerance of ± 1 Hz at a frequency lower than 15 Hz and ± 2 Hz at a frequency higher than 15 Hz only shall be allowed.

(b) Clamp Slip Test

(c) Same as Clause 2.4 (c) (ii) of Annexure - B.

(c) Clamp Bolt Torque Test

The clamp shall be attached to a section of the conductor/earthwire. A torque of 150 percent of the manufacturer's specified torque shall be applied to the bolt. There shall be no failure of component parts. The test set up is as described in Clause 2.4 (c) (i), Annexure-B.

(d) Strength of the Messenger Cable

The messenger cable shall be fixed in a suitable tensile testing machine and the tensile load shall be gradually applied until yield point is reached. Alternatively, each strand of messenger cable may be fixed in a suitable tensile testing machine and the tensile load shall be gradually applied until yield point is reached. In such a case, the 95% of yield strength of each wire shall be added to get the total strength of the cable. The load shall be not less than the value guaranteed by the Contractor

(e) Mass Pull off Test

Each mass shall be pulled off in turn by fixing the mass in one jaw and the clamp in the other of a suitable tensile testing machine. The longitudinal pull shall be applied gradually until the mass begins to pull out of the messenger cable. The pull off loads shall not be less than the value guaranteed by the Contractor.

7. GUARANTEED TECHNICAL PARTICULARS

The bidder shall fill in the guaranteed technical particulars in the Performa below and submit the same with his tender, without which bid will not be considered.

GUARANTEED TECHNICAL PARTICULARS OF HTLS CONDUCTOR

Sl.	Description	Unit	Value guaranteed by the Bidder
1.	Name of Manufacturer		
2.	Address of Manufacturer		
3.	Name of the conductor		
4.	Construction of conductor / Designation of conductor as per IEC:61089		
5.	Particulars of Raw Material		
5.1	Outer Layers		
	a) Type of conductor strand.		
	b) Chemical composition of Conductor strand .		
	i) ----------	%	
	ii) ----------	%	
	iii) ----------	%	
	iv) ---------	%	
	v) ---------	%	
5.2	Inner Core		
	a) Material of core		
	b) Chemical composition of core		
	i) ----------	%	
	ii) ----------	%	
	iii) ----------	%	

iv) --------- %

v) --------- %

vi) -------- %

6. Outer Aluminium / Aluminium Alloy Strand after Stranding

6.1 Number of outer layers Nos.

6.2 Diameter mm

a) Nominal mm

b) Maximum mm

c) Minimum mm

6.3 Minimum Breaking load of strand

a) Before stranding KN

b) After stranding KN

6.4 Resistance of 1m length of strand at 20 deg. C. Ohm

6.5 Modulus of elasticity (kg/mm^2)
a) At 32°C
b) Below Knee point
c) Above Knee point
d) At maximum operating tempt.

6.6 Co-efficient of linear expansion (/ °C)
a) At 32°C
b) Below Knee point
c) Above Knee point
d) At maximum operating tempt.

7. Inner core strands/inner core after stranding

7.1 Number of layers in inner core No

7.2 Diameter mm

a) Nominal mm

b) Maximum mm

c) Minimum mm

7.3 Minimum Breaking load of strand/Core

a) Before stranding KN

b) After stranding KN

7.4 Min. no. of twists which a single strand shall withstand during torsion test for a length equal to 100times dia of wire after stranding. Nos

7.4 Modulus of elasticity (kg/mm^2)

a) At 32°C
b) Below Knee point
c) Above Knee point
d) At maximum operating tempt.

7.5 Co-efficient of linear expansion (/ °C)
a) At 32°C
b) Below Knee point
c) Above Knee point
d) At maximum operating tempt.

8. Complete conductor

8.1 Diameter (mm)
a) Nominal
b) Maximum
c) Minimum

8.2 Area of conductor (mm^2)
a) Total cross sectional area
b) Effective Aluminium area
c) Effective core area

8.3 Modulus of elasticity (kg/mm^2)
a) At 32°C
b) Below Knee point
c) Above Knee point
d) At maximum operating tempt.

8.4 Co-efficient of linear expansion (/ °C)
a) At 32°C
b) Below Knee point
c) Above Knee point
d) At maximum operating tempt.

8.5 UTS of Conductor KN

8.6 Lay ratio of conductor	Maximum	Minimum
a) 1st layer (outer most layer)		
b) 2nd Layer		
c) 3rd Layer		
d) 4th Layer		

8.7 Maximum permissible conductor temperature for continuous operationDeg C

8.8 Maximum permissible conductor temperature for short term operationDeg C

8.9 Permissible duration of above

short term operation Minutes

8.10 Steady state conductor temperature at conductor current of min.800 A at 50ºC ambient conditions & zero wind as detailed in Technical Specification at 2.1 Deg C

8.11 DC resistance of conductor at 20ºC Ohm/km

8.12 AC resistance at maximum continuous operating temperature corresponding to specified maximum operating current (Minimum 800 A under maximum ambient conditions and zero wind as per Technical Specification at 2.1) Ohm/km

8.13 Details of Creep characteristic for conductor enclosed (as per Technical Specification) Yes/No

8.14 Sag Tension Calculation

8.14.1 Sag Tension Calculation enclosed Yes/No

8.14.2 Sag& tension at 32 deg. C & no wind Meters & KN

8.14.3 Sag& tension at 32 deg. C & full wind Meters & KN

8.14.4 Sag& tension at 05 deg. C & 2/3rd wind Meters & KN

8.14.5 Sag& tension at 65 deg. C & no wind Meters & KN

8.14.6 Sag & tension at continous current Carrying 800A. C & no wind (The corresponding Temperature to be mentioned) Meters & KN

8.14.7 Sag& tension at maximum operating temperature & no wind Meters & KN

8.14.8 Sag& tension at emergency temperature & no wind Meters & KN

8.15 Tolerance on standard length of conductor %

8.16 Direction of lay for outside layer

8.17 Linear mass of the Conductor
a) Standard Kg/Km
b) Minimum Kg/Km
c) Maximum Kg/Km

8.18 Standard length of conductor KM

8.19 Maximum length of conductor
that can be offered as single length KM

9.0 Drum is as per specification Yes / No

10.0 Accessories as per specification / standards Yes / No

Date: (Signature).....

Place: (Printed Name).....

(Designation).....

(Common Seal).....

8. SAG TENSION CHARTS AND SAG TEMPLATES

The contractor shall supply six copies of sag tension charts and sag templates each in respect of the conductor. The contractor shall also supply sag template in celluloid, which shall be subject to the approval by the owner and without involving any extra charges. The sag template will be used for changing the tower positions in future.

9. ACCESSORIES

The Bidder after his survey of the existing line shall determine the quantity and type of the accessories required for the turnkey job, which are to be supplied by them. These accessories should be suitable for the supplied conductor for its entire operating range without degradation of mechanical, metallurgical and electrical properties. The steady state temperature of hardware and accessories must not exceed 90°C during no wind and 50°C ambient temperature at minimum 800Amp load. The contractor shall be responsible for satisfactory performance of complete conductor, hardware and accessories, offered by him, for continuous operation at temperatures corresponding to various conditions stipulated at 2.2 of this technical specification.

10. EXECUTION OF WORK

10.1 The erection works consist of

a. Dismantling of existing ACSR Panther Conductor , hardware, accessories and crediting at

b. Transportation, delivery of conductor, hardware, accessories etc. at erection site and keeping in safe custody.

PTCL store.

c. Insurance of materials during storage-cum-erection.

d. Distribution of materials at erection site,

e. Stringing of conductor up to both ends of the lines, with the help of tensioner and puller machine and if required, manually with the approval of the owner.

f. Guarantee of all the activities carried out from (a) to (e) and submission of FQP for carrying out of all above activities.

g. Other items not specifically mentioned in this Specification and are required for the successful erection and commissioning of the transmission lines, unless specifically excluded in the Specification.

10.2 All works shall be carried out in accordance with the revised and latest provisions under Indian Electricity Act and Rules made there under.

10.3 All the erection tools required during erection of lines shall be arranged by the Contractor at his own cost. The Contractor shall also be responsible for any damage to and / or loss of his erection tools.

10.4 In case of any deviation in quantities from the tendered quantity, payment will be made with the approval from the corporate office of the owner.

10.5 It will be the Contractor's sole responsibility to take the materials up to the location. Any pathway, temporary road, temporary bridge required for the work, same will be provided by the contractor at his cost. If, for any reasons the above is not feasible, the contractor at his own cost shall have to arrange transportation by head loads.

11. STRINGING

The stringing work shall be carried with the help of tensioner and puller machines. Wherever it is not possible to install the tensioner, it can be done manually with the approval of site engineer of the owner. Stringing shall mean, the activities of paying, jointing, tensioning, clamping with armor-rod, providing dampers and fixing the conductor at tension hardware and jumpering etc.

11.1 Stringing of conductor shall be done up to gantry at both ends of the individual lines.

11.2 The stringing work should be planned in such a manner in consultation with the Engineer in charge of the Owner that minimum shut down of power line crossings are required. Revenue loss due to any undue shut down due to contractor's irresponsibility shall be recoverable from the contractor.

11.3 Before commencing of stringing work, Contractor shall obtain approval of sag tension charts showing final sag and tension for various temperature and spans.

The Contractor shall be responsible and will take care of proper handling of conductor drums. Sufficient numbers of aluminum snatch blocks shall be used for paying out the Conductors. Necessary precautions shall be taken to avoid conductor rubbing on the ground by providing adequate ground roller, rollers on supports. Additional rollers shall also be provided to cross thorny hedges, tower footing and other obstructions to avoid scratching of conductor. The conductor shall be made to sag correctly as per stringing charts, before they are finally transferred to the hardware and clamps . No mid span joint shall be made at less than 30 meters from the tower end and no mid span joint shall be permitted in road and other important crossings spans. There shall not be more than one joint in the same span of individual conductor. The sag shall be adjusted to suit the sag indicated against actual temperature. The thermometer shall be provided at the conductor point during the stringing work. Dynamo meters shall be used in tensioning the conductors. All conductors shall be stressed to their load at the time of stringing, as per approved stringing charts.

11.5 The minimum clearance between the lowest point of conductor and ground shall not be less than as specified in the chart. All compression joints should be carefully made and a record of initial and final lengths of the joints, jointly signed by contractor and OPTCL representatives shall be maintained. Check for sag should also be made at intervals when conductors are drawn up. Over stressing, causing damage to towers must be avoided. Care should be exercised not to over tension the conductor.

To avoid contact with the ground or any object above ground level the conductors shall be pulled by the controlled tension methods using neoprene lined double pulled wheel type tension stringing equipments. The equipment shall be capable of maintaining continuous tension of not less than of 3000 kg. per conductor.

11.6 When the conductor is on the stringing rollers before sagging-in, it shall be ensured that the conductor is not damaged due to wind, vibration, vehicles or other causes. Scaffolding should be used to cross the important road crossings for minimum interruption to traffic.

11.7 The conductor shall be pulled up to desired sag and left in serial stringing sheaves for at least one hour after which the sag shall be rechecked and adjusted, if necessary, before clipping in and transferring the conductors from the serial stringing sheaves to the suspension clamps.

11.8 The stringing rollers, when suspended on the transmission structure for supporting conductors, shall be so adjusted that the conductor will be on the rollers at the same height as the suspension clamp to which it is to be secured.

11.9 Armour rods and vibration dampers shall be fitted at each suspension and tension tower before final clamping of conductor with Insulator strings. Vibration dampers are to be fixed with clamping bolt and in correct vertical position in relation to conductor.

11.10 Compression type joints are to be used for jointing of conductors. Each part connected with joints shall be perfectly cleaned & precautionary measures taken before final compression. All the joints of conductors shall be made with the best workmanship and shall be perfectly straight and having maximum possible strength.

11.11 Proper guys shall be provided to counter balance the paying out tension of conductor at the tension locations, to avoid damage to towers and/or accident.

12. FIELD QUALITY PLAN (FQP)

Bidder shall invariably submit the FQP along with Technical Bid for erection of line including all the activities such as dismantling, stringing etc. with detailed checklist to be referred.

13. WASTAGE

13.1 The maximum permitted ceiling for wastages for conductor permitted is 0.5% (maximum) which takes into account the additional length for sag & jumpers.

13.2 No wastage is allowed for any material except the percentage limit mentioned for Conductor here in above in Clause No. 13.1

14. LOSSES In the event of any material used for transmission line found broken or damaged or received short during transit or failed during the erection / testing at site before commissioning of line, the contractor shall replace the same free of cost.

15. COMMISSIONING

15.1 The contractor shall ensure that at the end of each sub-activity the surplus material is immediately removed from the work-site to avoid loss and injury to the public.

15.2 The contractor has to make reconciliation of material account and to settle final bill including signature in all relevant papers required for passing of final bill within three months from the date of charging / commissioning of line.

16. DRAWINGS AND SPECIFICATIONS

16.1. Appendix-I: - Tower schedule showing individual span length,ruling span lengths & existing ground clearance of 132KV Joda-Barbil.

16.2. Appendix-II: - Tower schedule showing individual span length, ruling span lengths, and existing ground clearance of 132KV Mendhasal -Khurda D/C line.

16.5 Appendix-III: - List of rate contract holder firms of OPTCL

APPENDIX- I (132 KV JODA- BARBIL LINE).

TOWER SCHEDULE FOR 132 KV JODA - RKL S/C LINE UPTO LOC. 271 AND BOLANI LILO D/C LINE UPTO PROPOSED BARBIL S/S (LOC. 26)

Sl. No.	Loc. No.	Type of Tower	Span Length in Mtr.	AP. No.	Angle of Deviation	Stretch Length in Mtr.	WEIGHT SPAN			WIND SPAN			Remarks Crossing details
							Left	Right	Total	Left	Right	Total	
1	2	3	4	5	6	7	8	9	10	11	12	13	14
132KV JODA - RKL S/C LINE UP TO LOC. 271													
1	Gantry							0	0		31	31	Gantry of Joda Grid S/S
			62										33 KV. LINE
2	298	PC+6		Loc. 298	11º-04'-20" LT	62	62	160	222	31	78	109	
			156										2 NOS. 33 KV. LINE, GRID BOUNDARY WALL, 2 NOS. BUILDING
3	297	NZ		Loc. 297	03º-23'-18" RT	156	-4	132	128	78	114	192	
			228										3 NOS. BUILDIND, TAR ROAD, BOUNDARY WALL, CONCRETE ROAD
4	296	NX					96	146	242	114	150	264	
			300										2 NOS. BUILDING, 3 NOS. NALA
5	295	NX					154	124	278	150	125	275	
			250										2 NOS. TAR ROAD, MARKET BUILDING, BOUNDARY WALL, 33 KV. LINE, 11 KV. LINE
6	294	NZ		Loc. 294	21º-22'-14" LT	778	126	80	206	125	133	258	
			266										132 KV. LINE, TAR ROAD, 11 KV. LINE
7	293	NY		Loc. 293		266	186	-188	-2	133	118	251	
			236										CONCRETE ROAD
8	292	NY		Loc. 292		236	424	28	452	118	136	254	
			272										
9	291	NX					244	31	275	136	156	292	
			312										
10	290	NX+3					281	162	443	156	157	313	
			314										
11	289	NX					152	80	232	157	165	322	
			330										
12	288	NX					250	226	476	165	162	327	
			324										
13	287	NX					98	252	350	162	170	332	
			340										
14	286	NX					88	126	214	170	163	333	
			326										
15	285	NX+3					200	156	356	163	127	290	

			254										2 NOS. 33 KV. LINE, TAR ROAD
16	284	NX					98	240	338	127	154	281	
			308										33 KV. LINE
17	283	NX					68	144	212	154	152	306	
			304										MORUM ROAD
18	382	NX					160	150	310	152	132	284	
			264										
19	281	NX					114	356	470	132	178	310	
			356										BASTI AREA, MORUM ROAD
20	280	NX					0	180	180	178	165	343	
			330										2 NOS. BOUNDARY WALL, 11 KV. LINE
21	279	NX					150	154	304	165	177	342	
			354										
22	278	NX+3					200	232	432	177	134	311	
			268										3 NOS. 11 KV. LINE, TAR ROAD
23	277	NX		Loc. 277	30º-12'-20" RT	4656	36	127	163	134	163	297	
			326										BOUNDARY WALL, 11 KV. LINE
24	276	NX+3					199	238	437	163	160	323	
			320										LT LINE, 2 NOS. BOUNDARY WALL, 2 NOS. TAR ROAD, 3 NOS. 11 KV. LINE
25	275	NX					82	96	178	160	171	331	
			342										HOUSE
26	274	NX+3					246	194	440	171	166	337	
			332										TAR ROAD
27	273	NX					138	54	192	166	105	271	
			210										11 KV. LINE, TAR ROAD
28	272	NX					156	186	342	105	109	214	
			218										
29	271	NX					32	90	122	109	83	192	
			166										
30	31	PC					76	58	134	83	87	170	LILO TO BOLANI
132KV BOLANI LILO D/C LINE UP TO PROPOSED BARBIL S/S (LOC. 26)													
1	31	PC		Loc. 31			0	82	82	0	21	21	
			42										
2	30	PC		Loc. 30		42	-40	88	48	21	110	131	
			220										MARKET COMPLEX, 11 KV. LINE, TAR ROAD
3	29	PB+6		Loc. 29		220	108	150	258	110	119	229	
			238										2 NOS. 11 KV. LINE, 33 KV. LINE
4	28	PA+3					88	80	168	119	112	231	
			224										11 KV. LINE
5	27	PA					144	138	282	112	161	273	
6	26	PC		Loc.		784	184	272	456	161	126	287	LILO TO

				26									PROPOSED BARBIL S/S

The bottom cross arm height of angle tower is 12.1 meters.

APPENDIX- II

132KV MENDHASAL-KHURDA line.

TOWER SCHEDULE FOR 132KV CHANDAKA - KHURDA S/C LINE (LOC. 69 TO KHURDA GANTRY) AND PROPOSED 132KV LILO D/C LINE UP TO MENDHASAL													
Sl No	Location No.	Type of Tower	Height of tower	Angle of Deviation	Span length in mtrs	Stretch length in mtrs	Weight span in mtrs			Wind span in mtrs			Details of crossing
							Left	Right	Total	Left	Right	Total	
1	2	3	4	5	6	7	8	9	10	11	12	13	14
132KV CHANDAKA - KHURDA S/C LINE (LOC. 69 UP TO KHURDA GANTRY)													
1	69	A	11.8				136	124	260	130	150	280	
					300								
2	70	A	11.6				176	184	360	150	193	343	
					386								
3	71	A	13				202	96	298	193	80	273	
					160								
4	72	B	11.6	29°30'RT		2886	64	106	170	80	125	205	
					250								
5	73	A	12				144	146	290	125	130	255	
					260								
6	74	A	12				114	166	280	130	170	300	
					340								
7	75	A	12				174	152	326	170	155	325	
					310								Paddy Field
8	76	A	12				158	102	260	155	120	275	
					240								Paddy Field
9	77	A	12				138	192	330	120	175	295	
					350								Paddy Field
10	78	A	11.4				128	124	252	175	140	315	
					280								Paddy Field
11	79	A	12.6				156	140	296	140	130	270	
					260								Nala
12	80	A	11.4				120	140	260	130	160	290	
					320								Paddy Field
13	81	A	11.8				180	134	314	160	150	310	
					300								Tar Road ,11KV line ,Temple Boundary
14	82	A	11.6				166	142	308	150	140	290	
					280								2nos LT line and 2nos Road
15	83	A	12				138	160	298	140	140	280	
					280								
16	84	A	11.6				120	144	264	140	135	275	
					270								Barren Land
17	85	A	12				126	170	296	135	155	290	
					310								Paddy Field
18	86	B	12	16°0		4050	140	160	300	155	125	280	

				0'LT									
					250								Paddy Field
19	87	A	11.2				90	168	258	125	155	280	
					300								Paddy Field
20	88	A	13.8				142	182	324	155	165	320	
					330								11KV line
21	89	A	13				148	168	316	165	170	335	
					340								Paddy Field
22	90	A	12				172	158	330	170	150	320	
					300								Tar Road 11KV line
23	91	A	12				142	142	284	150	170	320	
					340								11KV line
24	92	A	13				198	154	352	170	150	320	
					300								Barren Land
25	93	A	11.8				146	150	296	150	155	305	
					310								Tar Road,11KV line ,Morrum Road
26	94	A	11.2				160	150	310	155	150	305	
					300								College area
27	95	A	13.4				150	162	312	150	150	300	
					300								College Boundary
28	96	C	10.2	38°0 0'RT		3070	138	160	298	150	160	310	
					320								33KV line
29	97	A	11.6				160	134	294	160	160	320	
					320								Barren Land
30	98	A	11.8				186	160	346	160	185	345	
					370								Barren Land
31	99	A	12				210	182	392	185	155	340	
					310								Forest area
32	100	A	12				128	164	292	155	150	305	
					300								Forest area
33	101	A	12.5				136	162	298	150	140	290	
					280								Forest area
34	102	A	12				118	140	258	140	140	280	
					280								Forest area
35	103	A	11.8				140	154	294	140	140	280	
					280								Forest area
36	104	A	12.4				126	150	276	140	140	280	
					280								
37	105	A	12.4				130	178	308	140	150	290	
					300								Cashew Field
38	106	A	12.4				122	184	306	150	150	300	
					300								Cashew Field
39	107	B	11.6	21°0 0'RT		3340	116	174	290	150	155	305	
					310								Cashew Field
40	108	A	11.8				136	180	316	155	175	330	
					350								
41	109	A	13.6				170	166	336	175	130	305	
					260								Nala
42	110	A	11.6				94	134	228	130	140	270	
					280								
43	111	A	11.8				146	160	306	140	160	300	
					320								220KV DC line

44	112	A	12				160	164	324	160	155	315	
					310								
45	113	A	12				146	134	280	155	145	300	
					290								Morrum Road - Nuagaon-Khurda
46	114	A	11.6				156	140	296	145	165	310	
					330								
47	115	A	12				190	132	322	165	145	310	
					290								Tar Road Khurda-Haladia
48	116	A	12				158	142	300	145	165	310	
					330								
49	117	C	13	54°0 0'LT		3070	188	164	352	165	150	315	
					300								Paddy Field
50	118	A	12.6				136	182	318	150	155	305	
					310								Paddy Field
51	119	A	11.8				128	182	310	155	150	305	
					300								Paddy Field
52	120	A	12.6				118	126	244	150	145	295	
					290								
53	121	A	13				164	140	304	145	155	300	
					310								Tar Road Khurda-Nayagarh
54	122	A	12.6				170	138	308	155	165	320	
					330								
55	123	C	13	LT		1840	192	82	274	165	41	206	
					82								
56	Gantry					82	0		0	41		41	Gantry of Khurda Grid S/S
PROPOSED 132KV LILO D/C LINE UP TO MENDHASAL (IN BETWEEN LOC. 70 & 72 OF 132KV CHANDKA -KHURDA S/C LINE)													
	Existing Loc. 72 (Chandaka-Khurda S/C Line)												
					160								
1	Prop. 1	PC+6	18.8				162	0	162	80	0	80	
					48								Tar Road
2	Prop. 2	PC	12.8	10° 00' 02" LT		48	-142	64	-78	24	115	139	
					230								220kV Line Crossing (2 Nos.)
3	Prop. 3	PC	12.8	33° 48' 03" LT		230	166	74	240	115	80	195	
					160								Grid Boundary wall
4	Prop. 4	PC	12.8	42° 37' 40" RT		160	86	26	112	80	31	111	
					62								
5	Prop. 5	PC	12.8	50° 57' 48" RT		62	34	48	82	31	15	46	
					30								
6	Prop. 6	PC+3	15.8	26° 22' 36" RT		30	-18	56	38	15	28	43	
					56								
7	Gantry					56				0	28	28	Gantry of Mendhasala

													Grid

The bottom cross arm height of angle tower is 13 meters.

APPENDIX-III

RATE CONTRACT HOLDER FIRM OF OPTCL.

1) M/s Krishna Power Construction(P) Ltd, Anandanagar, Hakimpada, Anugul
2) M/s Abhisekcontech India(P) Ltd, M-4/42, AcharyaVihar, Bhubaneswar-751013
3) M/s Apurba Construction Engineers & Erectors, In front of F41/7, Burl – 768017, Sambalpur
4) M/s Engineering and Allied Services(P) Ltd, A/104,Sahidnagar, Bhubaneswar-751007
5) M/s VELCRO Electrical Manufacturers PvtLtd,Flat No 301-302, MadhavVihar Apart, Cuttackroad,Bomikhal, Bhubaneswar-751010.
6) M/s S.B.Electrostructural, A/78, Saheed Nagar, Bhubaneswar
7) M/sJ.D.Construction, Bhaskarganj-B, Near Muni Samaj, Sahadevkhunta, Balesore
8) M/s JagamohanPradhan, At/PO- Rengali Dam site, Dist- Angul- 759105.
9) M/s A.K.Das Associates Ltd, H/1, Satyanagar, , Bhubaneswar-751007
10) .M/s Jagabandhu Enterprisers, Plot No 35/B, Sector-A, Mancheswar Industrial Estate, Bhubaneswar-751010
11) M/s KBS-ELCONS, Plot No 18, Bhubaneswar
12) M/s SR Associates Infrastructure Pvt Ltd, S-2/40, Mancheswar Industrial Estate, Bhubaneswar-751010.
13) M/s Eastern Piling & Construction Pvt Ltd, Badambadi, Kamalpur, Cuttack-753012
14) M/s OM Industries, Mayur Complex, Salipur, Cuttack-754202.
15) M/s AAY BEE ELECTRICAL , A/65 Sahid Nagar, Bhubaneswar-751001
16) M/s Omkar Construction , Janardanpur,Baripada, Mayurbhanj.
17) M/s Subash Chandra Dhal, Suldia, BTM, PO-Industrial Estate, Jharsuguda

The contractor may engage experience installer with special skill for the correct installation of the HTLS conductor for supervision in addition to engagement of OPTCLs rate contract holder.