2nd Corrigendum to tender call notice No: 69/ 2011-12.

For and on behalf of ODISHA POWER TRANSMISSION CORPORATION LIMITED, the last date of receipt & opening of tender notice No: 69/2011-12 & Tender specification No.78/2011-12 is extended to date 05/06/2012 up to 1P.M & to be opened on date 05/06/2012 at 3.30 P.M. The interested manufacturers/authorized supplier of HTLS conductor may visit our web site http://www.optcl.co.in, for detail amendments to the specification.

Senior General Manager (CPC)

Clarifications to the Pre bid conference.

1) 6.1 m ground clearance is required by OPTCL at 800A continuous flow at span length of 320 m. The tension & sag at different conditions are specified at clause No. 2.2.3 (sag tension requirement) of technical specification

2) Line profiles are available with OPTCL .The bidders can collect the approved hard copies of the profile from the office of the Sr. GM (CPC).

3) The circuit kilometer of the lines where ACSR conductor will be replaced is 99.70 KM. Chandaka- Mancheswar line is drawn over single circuit towers & double circuit towers. Hot line stringing will be required where double circuit towers are used, as detailed in the tower schedule.

4) Training will be imparted to four batches of three days duration to each batch.

5) Wind Speed at stand still-0.6 m/sec.

9) Mid-span joints will be allowed if section length between tension towers is more than 1500 meters.

6) High temperature endurance & creep test –Being the generic test, previous test reports of similar size or higher size of same technology product shall be accepted.

7) Annexure –10, is not required, as no JV agreement is required by OPTCL.

8) Authorized Indian manufacturer must have manufacturing facility of aluminum conductor, aluminum alloy conductor, & must have manufactured these conductors of quantity not less than 35% of the tendered quantity within last five years from the date of opening of the bid.

Or

50% of the tendered quantity as indicated in the package in two orders.

Or

60% of the tendered quantity as indicated in the package in three orders

9) Thermal stability test of core for continuous operating temperature of 180 deg is to be submitted.

10) In the event OPTCL receives only one technically approved bid, OPTCL will consider it.

11) In the price schedule for erection portion Sl.No. 3 “Dismantling of existing ACSR Panther Conductor with hardware fittings in 132kV Chandaka-Ranasinghpur Line & handing over the same at OPTCL store” quantity may please be read as 24.25 KM instead of 57.25 KM.

AMMENDED CLAUSES

Clause-2. Of Instruction to Bidders (ITB).MINIMUM QUALIFYING REQUIREMENTS OF BIDDERS

2.1 This bidding is open to any Indian manufacturer of aluminium or aluminium alloy conductor with or without having facility to manufacture HTLS conductor. In case manufacturer not having facility to manufacture HTLS conductor, they can have authorization from principal manufacturer to import & supply the HTLS conductor. In case Indian manufacturer is having the HTLS manufacturing facility, he is having the option either to import the entire conductor or to import core from the principal manufacturer of HTLS conductor & manufacture the conductor at his factory and supply the same. In all such cases the experience of principal manufacturer as per clause No. 2.1.1, 2.1.2, 2.1.3 & 2.1.4 shall be taken in to consideration.

The authorization of the principal manufacturer should be valid as on the date of opening of the techno commercial bid & is to be extended up to the completion of the project.

In case of Indian manufacturer imports the conductor / core, the following documents to be furnished before inspection of materials in India.

(i) Invoice of the supplier.
(ii) Mill’s test certificates.
(iii) Packing list.
(iv) Bill of lading.
(v) Bill of entry certificates by customs.

2.1.1 The bidder or his principal manufacturer of HTLS conductor should have supplied not less than 35% of the tendered quantity as indicated in the respective packages in a single order. or

50% of the tendered quantity as indicated in the package in two orders.

or

60% of the tendered quantity as indicated in the package in three orders

2.1.2 The above supply should have been completed during last five years from the date of opening of the tender.

2.1.3 The above supplied material should be in successful operation for a minimum period of one year, as on the date of submission of bid. The performance certificate of user utilities should be furnished along with the bid.

2.1.4 Type tests carried out on the proposed conductor or on higher size conductor of the same technology within last five years are to be submitted with the bid, in line with the relevant National / International standards (Copy of the standards to be submitted with the bid). In case the bidder is a authorized manufacturer of the principal manufacturer, the type test of the similar conductor being manufactured by the principal manufacturer will also be considered valid

Clause No.13 of section-III of SCC (Special condition of contract) The delivery & completion period has been extended as follows.

Time Schedule:

Name of the package.	Name of the line	Delivery at owner's store	Erection, testing & commissioning
Package-I.	1. 132 Kv Chandaka – Mancheswar ckt-II (5.88 Km)	130 days from the date of placement of letter of award	150 days from the date of placement of letter of award
	2. . 132 Kv Tarkera – Chhend line (2X 6.16 Km)	130 days from the date of placement of letter of award	180 days from the date of placement of letter of award
Package-II.	1. 132 Kv Chandaka – Nimapara line (57.25 Km)	180 days from the date of placement of letter of award	360 days from the date of placement of letter of award
	2. 132 Kv Chandaka – Ranasingpur line (24.25 Km)	180 days from the date of placement of letter of award	240 days from the date of placement of letter of award

3. Amended technical specification is enclosed.

SENIOR GENERAL MANAGER (CPC).

SECTION-V

AMMENDED

TECHNICAL SPECIFICATION

FOR REPLACEMENT OF

ACSR PANTHER CONDUCTOR BY

HTLS CONDUCTOR (Except GAP conductor).

1 .132 KV CHANDAKA-MANCHESWAR CKT-II.

2 .132 KV CHANDAKA-RANASINGPUR LINE.

3 .132 KV CHANDAKA NIMAPARA LINE.

4 **132 KV TARKERA CHHEND LINE.**

INDEX

1.GENERAL INFORMATION AND SCOPE

1.1 Scope

1.1.1 The turnkey work involves replacement of ACSR conductor in 132KV Chandaka-Mancheswar circuit-II (route length 5.88Km) ,132KV Chandaka-Ranasingpur line (route length 24.25Km), 132kV Chandaka-Nimapara Line (route length 57.25 Km) & 132kV Tarkera-Chhend D/C Line (route length 6.16 Km) by HTLS conductors **except GAP conductor** with current carrying capacity of minimum 800A. This includes replacement of conductor of the transmission lines from gantry to gantry, at both ends of the lines.

The work involves dismantling of existing ACSR Panther Conductor, supply of HTLS conductor of minimum 800 A capacity corresponding to 180ºC & with unit weight equal to or less than that of ACSR Panther conductor and associated conductor hard ware fittings, clamps & vibration dampers and stringing of the HTLS conductor on existing 132KV transmission line structure and disc insulators after survey of the lines & delivery of the dismantled materials at the nearest stores of the owner, training to OPTCL employees & other personnel as identified by the owner, on stringing of HTLS conductors. . ROW, if any for execution of work & approach to work site shall be resolved by the contractor at his cost. However, OPTCL will provide necessary assistance. **Shut down will be allowed form 5 AM to 5 PM on daily basis for the replacement work.** The contractor has to do the stringing within this interval so that line can be charged at 5 PM every day. **However the guaranteed shut down period for each day is eight hours.**

1.1.2 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.

1.1.3 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.

1.1.4 The entire stringing work of HTLS conductor shall be carried out by tension stringing machine 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 bidder shall indicate in the 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.

1.1.5 In 132KV Chandaka-Mancheswar circuit-II, all locations will be provided with double insulator strings at both suspension and tension points. In case of other lines, only 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.

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

1.1.7 One conductor-manufacturing engineer should remain present on the site during erection process.

1.1.8 Award has been placed for under ground cable from gantry of Chandaka Grid Sub station to location No.3 of Chandaka –Mancheswar Ckt-II (Length-0.352 Km), gantry of Chandaka Grid Sub station to location No.4 of Chandaka –Nimapara line (length-0.305 Km) & gantry of Chandaka Grid Sub station to location No.4 of Chandaka – Ransinghpur line (length-0.305 Km) . If the cabling work is complete before manufacture of HTLS conductor, the conductor, & accessories quantity will be reduced accordingly. But the offer to be made for the entire route length for evaluation purpose.

1.1.9 The project scope is split in to two packages.

I) Package-I, 132 KV Chandaka- Mancheswar & Tarkera- Chhend (D/C Line).

II) Package-II, 132 Kv Chandaka- Nimapara & Chandaka- Ransingpur.

Intending bidders can either participate in package-I, or in package-II, or in both package-I & II.

EMD for package-I =Rs 36.4 Lakhs.
EMD for package-II=Rs 1.63 Crore.
EMD for package-I & II (Combining)=Rs 1.994 Crore.

In the event of an eligible bidder becoming L1 in both the packages, they will be considered for award of both the packages provided they meet the combined eligibility criteria as per clause 2.1, 2.1.1 to 2.1.4 of section-I (ITB). Otherwise they will be awarded only one package out of the two at the discretion of OPTCL considering the least cost to OPTCL.

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 conductor	Not exceeding 21mm ± 5%
Approx. mass of complete	Less than or equal to 974 kg/km

conductor (kg/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.

2.2 Climatic & 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.

Ambient temperature: 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 of 180°C and no wind corresponding to 50 Hz alternating current of 800 Amperes per conductor under ambient conditions specified above = 6.4 m .Initial (erection) tension to be 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
Sag at maximum continuous operating temp (corresponding to 800 amperes and no wind.	≤ 6.4 meters
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-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 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.

2.5 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.

2.6 Tolerances

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

2.7 Materials

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

2.8 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. **Fully annealed type (0 tempered) aluminium / alloy strand shall not be accepted owing to its lower abrasion resistance.**

2.9 Core

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.

2.10 Conductor 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, III & IV.

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 Employer 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 conducted in last five year.

(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

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.

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)	
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 Alloy strands	: 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 Employer'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 Employer.

6.6 Inspection

6.6.1 The Employer'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 Employer 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 Employer 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 : 1778-1980	Reels and Drums for Bare Conductors	BS:1559-1949
5.	IS : 1521-1991	Method of Tensile Testing of Steel Wire	ISO 6892-1984
6.	IS : 2629-1990	Recommended Practice for Hot Dip Galvanising of Iron and Steel	
7.	IS : 2633-1992	Method of Testing Uniformity of Coating on Zinc Coated Articles	
8.	IS : 4826-1992	Galvanised Coating on Round Steel Wires	IEC : 888-1987 BS:443-1969
9..	IS : 6745-1990	Methods of Determination of Weight of Zinc Coating of Zinc Coated Iron and Steel Articles	BS:433-1969 ISO 1460 -1973
10.	IS : 9997-1988	Aluminium Alloy Redraw Rods	IEC 104 -1987
11.		Zinc Coated steel wires for stranded Conductors	IEC : 888-1987
12.		Hard drawn Aluminium wire for overhead line conductors	IEC : 889-1987
13.	IS:398 (Part-IV)	Aluminium Alloy stranded conductor	IEC : 208-1966 BS-3242-1970
14.		Aluminium clad steel wires	IEC:1232
15.		Method of measurement of resistivity of metallic materials	IEC:468
16		Ampacity	IEEE738
17.		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. Manak Bhavan, 9, Bahadur Shah Zafar Marg, 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.

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 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

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

8. Complete conductor

8.1 UTS of Conductor KN

8.2 Lay ratio of conductor Maximum Minimum

a) 1st layer (outer most layer)

b) 2nd Layer

c) 3rd Layer

d) 4th Layer

8.3 Maximum permissible conductor temperature for continuous operation Deg C

8.4 Maximum permissible conductor temperature for short term operation Deg C

8.5 Permissible duration of above

short term operation Minutes

8.6 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

8.7 DC resistance of conductor at 20ºC Ohm/km

8.8 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

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

8.10 Sag Tension Calculation

8.10.1 Sag Tension Calculation enclosed Yes/No

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

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

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

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

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

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

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

8.11 Tolerance on standard length of conductor %

8.12 Direction of lay for outside layer

8.13 Linear mass of the Conductor

a) Standard Kg/Km

b) Minimum Kg/Km

c) Maximum Kg/Km

8.14 Standard length of conductor KM

8.15 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.

9.1 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.

9.1.1 Technical Description of Hardware Fittings

9.1.2 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.

9.1.3 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.

9.1.4 **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.

9.1.5 **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.

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

9.1.7 **Suspension Assembly**

9.1.7.1 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.

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

9.1.7.3 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.

9.1.7.4 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 8% to 15% of the UTS of the conductor.

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

9.1.7.6 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.

9.1.7.7 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.

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

9.1.8 **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.

9.1.9 **Standard Preformed Armour Rod Set**

9.1.9.1 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.

9.1.9.2 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.

9.1.9.3 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.

9.1.9.4 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.

9.1.9.5 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.

9.1.9.6 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).

9.1.10 **Armour Grip Suspension Clamp**

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

9.1.10.2 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.

9.1.10.3 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.

9.1.11 **Dead end Assembly**

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

9.1.11.2 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.

9.1.11.3 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.

9.1.11.4 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.

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

9.1.12.1 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.

9.1.12.2 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.

9.1.12.3 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.

9.1.12.4 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.

9.1.12.5 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.

9.1.12.6 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.

9.1.12.7 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.

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

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

9.1.12.10 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.

9.1.12.11 Fasteners of grade higher than 8.8 are not to be used and minimum grade for bolt shall be 5.6.

9.1.13 **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.

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

9.1.14 **Workmanship**

9.1.14.1 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.

9.1.14.2 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.

9.1.14.3 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.

9.1.14.4 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.

9.1.14.5 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.

9.1.14.6 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.

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

9.1.14.8 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.

9.1.14.9 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.

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

9.1.14.11 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.

9.1.15 **Bid Drawings**

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

9.1.15.2 Fully dimensioned drawings of the hardwares and their component parts shall be furnished in three (3) copies along with 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.

9.1.15.3 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	

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9.2 **Accessories For the HTLS Conductor**

9.2.1 **General**

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

9.2.2 2.5% extra fasteners, filler plugs and retaining rods shall be provided.

9.2.3 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.

9.2.4 **Mid Span Compression Joint**

9.2.4.1 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.

9.2.4.2 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.

9.2.5 **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 20 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.

9.2.6 **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.

9.2.7 **Vibration Damper**

9.2.7.1 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.

9.2.7.2 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 alongwith the 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 machanical impedence 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 .

9.2.7.3 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.

9.2.7.4 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 droop of weight and to maintain consistent flexural stiffness of the cable in service.The messenger cable other than stainless steel shall be hot dip galvanised in accordance with the recommendations of IS:4826 for heavily coated wires.

9.2.7.5 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.

9.2.7.6 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.

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

9.2.7.8 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.

9.2.7.9 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.

9.2.7.10 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.

9.2.7.11 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 (viz Free centre type/Armour grip type etc.)

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

9.2.8 **Material and Workmanship**

9.2.8.1 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.

9.2.8.2 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.

9.2.8.3 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.

9.2.8.4 All ferrous parts shall be hot dip galvanised, 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.

9.2.8.5 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.

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

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

9.2.8.8 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.

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

9.2.8.10 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.

9.2.9 **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.

9.2.10 **Bid Drawings**

9.2.10.1 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.

9.2.10.2 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

9.2.10.3 Placement charts for spacer/spacer damper and damper

9.2.10.4 The above drawings shall be submitted with all the details as stated abcve alongwith 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, 10 (ten) more sets of drawings shall be submitted to Owner for further distribution and field use at Owner's end.

9.2.11 **Tests and Standards**

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

9.2.11.1 **On Suspension Clamp**

a)	Magnetic power loss test	: As per Annexure-B
b)	Clamp slip strength Vs torque test	: As per Annexure-B

9.2.11.2 **On Dead end Tension Assembly**

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

9.2.11.3 **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

9.2.11.4 **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

9.2.11.5 **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

9.2.11.6 **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 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.

9.2.12 **Acceptance Tests**

9.2.12.1 **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

9.2.12.2 **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

9.2.12.3 **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

9.2.12.4 **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

9.2.12.5 **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

9.2.12.6 **Repair Sleeve for Conductor**

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

9.2.12.7 **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.

9.2.13 **Routine Tests**

9.2.13.1 **For Hardware Fittings**

a)	Visual examination	IS:2486-(Part-I)

b) Proof Load Test : As per Annexure-B

9.2.13.2 **For conductor accessories**

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

9.2.13.3 **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.

9.2.14 **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.

9.2.15 **Inspection**

9.2.15.1 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.

9.2.15.2 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.

9.2.15.4 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.

9.2.15.5 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.

9.2.16 **Packing and Marking**

9.2.16.1 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.

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

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

9.2.16.4 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.

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

9.2.16.6 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.

9.2.17 **Standards**

9.2.17.1 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.

9.2.17.2 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 1573	Electroplated Coating of Zinc on iron and Steel	
3.	IS : 2121 (Part-II)	Specification for Conductor and Earthwire Accessories for Overhead Power lines: Mid-span Joints and Repair Sleeves for Conductors	
4.	IS:2486 (Part-I)	Specification for Insulator Fittings for Overhead power Lines with Nominal Voltage greater than 1000 V: General Requirements and Tests	
5.	IS:2629	Recommended Practice for Hot Dip Galvanising of Iron and Steel	
6.	IS:2633	Method of Testing Uniformity of Coating on Zinc Coated Articles	
7.		Tests on insulators of Ceramic material or glass for overhead lines with a nominal voltage greater than 1000V	IEC:383-1993
8.	IS:4826	Galvanised Coating on Round Steel Wires	ASTM A472729 BS:443-1969
9.	IS:6745	Methods of Determination of Weight of Zinc Coating of Zinc Coated Iron and Steel Articles	BS:433 ISO : 1460 (E)
10.	IS:8263	Method of Radio Interference Tests on High Voltage Insulators	IEC:437 NEMA:107 CISPR
11.	IS:6639	Hexagonal Bolts for Steel Structures	ISO/R-272
12.	IS:9708	Specification for Stock	
13.	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. Manak Bhavan, 9, Bahadur Shah Zafar Marg, 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.

10. EXECUTION OF WORK

10.1 The erection works consist of

a. Dismantling of existing ACSR Panther Conductor , hardware, accessories and crediting at OPTCL store. These material will be reused by OPTCL in other works. Hence the materials are to be returned in good form.

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

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.

11.4 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 Chandaka-Mancheswar circuit-II.

16.2. Appendix-II: - Tower schedule showing individual span length, ruling span lengths, and existing ground clearance of 132KV Chandaka-Ranasingpur line.

16.3. Appendix-III: - Tower schedule showing individual span length, ruling span lengths, and existing ground clearance of 132KV Chandaka-Nimapara line.

16.4 Appendix-IV: - Tower schedule showing individual span length, ruling span lengths, and existing ground clearance of 132KV Tarkera-Chhend (D/C) line.

16.5 Appendix-V: - Spare list suitable for the offered HTLS conductor.

16.6 Appendix-VI: - List of rate contract holder firms of OPTCL.

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 20ºC 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 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 1.4 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 Employer. The Employer 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 Employer'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 Alloy wire 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 vice. The viced 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 will be cut at the bending point. There should be no separation of core and aluminium at the bending point after this operation.

1.17 Aluminium conductivity test on aluminium clad strand

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

1.18 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.

1.19 Stress-strain test at elevated temperature

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

1.20 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.

1.21 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 1% of the RTS (Rated tensile strength). The curve for load vs time shall be recorded and recorded load of failure for core shall not be less than UTS of core.

1.22 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

1.23 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.

1.24 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.

ANNEXURE - B

1.0 Tests on Hardware Fittings

1.1 Magnetic Power Loss Test for Suspension Assembly

Two hollow aluminium tubes of 22 mm diameter for the conductor. An alternating current over the range of 600 to 960 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 800 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.

1.4 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 07 kN but less than 14 kN.

1.5 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 iniiternationally recognised 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.**

(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 along with the jumper terminal The load shall be increased gradually till breaking of welded joint occurs. The breaking load should be above 30 kN.

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 recognized procedures for these tests. The, sampling will be based on heat number and heat treatment batch. The details regarding test will be as discussed and mutually agreed to by the 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 Owner in 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) 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.

(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.

APPENDIX- I

132KV Chandaka-Mancheswar circuit-II

Loc No	Type of tower	DC/SC	Normal / Angle type	Span length in meters	Sectional length in meters	Ruling span in meters	Existing Ground clearance in meters
0	Gantry at Chandaka			0	0	0	
1	PC	**DC**	Angle	74	74	74	12
2	PC	**DC**	Angle	138	138	138	9.8
3	PC	**DC**	Angle	140	140	140	9.7
4	NZE+3	SC	Angle	266	266	266	9.8
5	A	SC	Normal	292		302.03	7.16
6	A	SC	Normal	294		302.03	5.86
7	B	SC	Angle	318	904	302.03	4.96
8	A	SC	Normal	336		319.43	5.96
9	A	SC	Normal	306		319.43	5.98
10	A	SC	Normal	314		319.43	6.51
11	B	SC	Angle	316	1272	319.43	5.96
12	A	SC	Normal	304		303.34	6.1
13	A	SC	Normal	304		303.34	6.1
14A	PC+3	**DC**	Angle	302	910	303.34	7.5
15	OC+3	**DC**	Angle	86	86	86	16
16	PC	**DC**	Angle	222	222	222	11.2
16A	PC	**DC**	Angle	138	138	138	12
16B	PB+6	**DC**	Angle	202	202	202	12
16C	PC	**DC**	Angle	232	232	232	8
17	C	SC	Angle	208	208	208	8.2
18	A	SC	Normal	254		256.02	8.5
19	C	SC	Angle	258	512	256.02	8.6
20	Gantry at Mancheswar			96	96	96	12.6

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

APPENDIX- II (Page 1/3)

132KV Chandaka-Ranasingpur line.

Loc No	Type of tower	DC/SC	Normal / Angle type	Span length in meters	Sectional length in meters	Ruling span in meters	Existing Ground clearance in meters
0	Gantry at Chandaka			0	0		
1	PC	**DC**	Angle	60	60	60	
2	PC	**DC**	Angle	100	100	100	8
3	PC	**DC**	Angle	60	60	60	7.9
4	PB	**DC**	Angle	100	100	100	6.09
5	PB	**DC**	Angle	280	280	280	5.35
6	PC	**DC**	Angle	140	140	140	6
7	PA	**DC**	Normal	280		270.08	6.9
8	PA	**DC**	Normal	240		270.08	5.4
9	PA	**DC**	Normal	290		270.08	7
10	PA	**DC**	Normal	250		270.08	6.9
11	PB	**DC**	Angle	280	1340	270.08	7.2
12	PA	**DC**	Normal	230		240.62	7.6
13	PC	**DC**	Angle	250	480	240.62	8.9
14	PC	**DC**	Angle	150	150	150	8.6
15	PC	**DC**	Angle	230	230	230	8.2
16	PC	**DC**	Angle	250	250	250	5.85
17	PC	**DC**	Angle	190	190	190	7.1
18	PA	**DC**	Normal	260		260	8.3
19	PB	**DC**	Angle	260	520	260	6.1
20	PA	**DC**	Normal	220		220	8.4
21	PB	**DC**	Angle	220	440	220	9
22	PA	**DC**	Normal	360		327.41	8.9
23	PC	**DC**	Angle	280	640	327.41	9
24	PC	**DC**	Angle	180	180	180	7.5
25	PC	**DC**	Angle	290	290	290	7.1
26	PC	**DC**	Angle	250	250	250	8.1
27	PC	**DC**	Angle	170	170	170	8.2
28	PA	**DC**	Normal	230		271.84	8
29	PC	**DC**	Angle	300	530	271.84	8.1
30	PB	**DC**	Angle	220	220	220	8
31	PA	**DC**	Normal	360		317.04	6.9
32	PA	**DC**	Normal	300		317.04	6.2
33	PA	**DC**	Normal	300		317.04	7
34	PA	**DC**	Normal	320		317.04	6.4
35	PB	**DC**	Angle	290	1570	317.04	8.1

APPENDIX- II (Continued)(Page 2/3)

132KV Chandaka-Ranasingpur line.

Loc No	Type of tower	DC/SC	Normal / Angle type	Span length in meters	Sectional length in meters	Ruling span in meters	Existing Ground clearance in meters
36	PA	● DC	Normal	250		272.21	7.9
37	PC	DC	Angle	290	540	272.21	8
38	PC	DC	Angle	150	150	150	7.9
39	PC	DC	Angle	200	200	200	8
40	PA	DC	Normal	270		240.2	7.2
41	PB	DC	Angle	190	460	240.2	7
42	PC	DC	Angle	160	160	160	8.1
43	PB	DC	Angle	60	60	60	7.8
44	PB	DC	Angle	290	290	290	7.1
45	PA	DC	Normal	310		338.22	8.3
46	PA+3	DC	Normal	350		338.22	8.1
47	PB	DC	Angle	350	1010	338.22	8
48	PA	DC	Normal	300		313.76	7.9
49	PA	DC	Normal	320		313.76	8.1
50	PB	DC	Angle	320	940	313.76	8.2
51	PA+3	DC	Normal	330		340.41	7.9
52	PC	DC	Angle	350	680	340.41	8.55
53	PB	DC	Angle	200	200	200	8.05
54	PA	DC	Normal	280		275.4	8
55	PA	DC	Normal	280		275.4	7.9
56	PA	DC	Normal	280		275.4	7.5
57	PC	DC	Angle	260	1100	275.4	8.3
58	PA	DC	Normal	300		290.51	7.1
59	PB	DC	Angle	280	580	290.51	7.5
60	PA	DC	Normal	310		312.84	7.4
61	PA	DC	Normal	330		312.84	7.7
62	PA	DC	Normal	320		312.84	7.2
63	PA	DC	Normal	290		312.84	8
64	PB	DC	Angle	310	1560	312.84	7.1
65	PA	DC	Normal	310		322.38	7.15
66	PA	DC	Normal	310		322.38	6.9
67	PA+3	DC	Normal	340		322.38	7
68	PA	DC	Normal	360		322.38	6.9
69	PA	DC	Normal	300		322.38	7.2
70	PB	DC	Angle	300	1920	322.38	8

APPENDIX- II (Continued)(Page3/3)

132KV Chandaka-Ranasingpur line.

Loc No	Type of tower	DC/SC	Normal / Angle type	Span length in meters	Sectional length in meters	Ruling span in meters	Existing Ground clearance in meters
71	PA	**DC**	Normal	300		300	7.7
72	PA	**DC**	Normal	300		300	7.5
73	PC	**DC**	Angle	300	900	300	7.2
74	PA	**DC**	Normal	290		290	7.5
75	PC	**DC**	Angle	290	580	290	6.6
76	PC	**DC**	Angle	150	150	150	7.6
77	PA	**DC**	Normal	220		286.34	8
78	PA	**DC**	Normal	310		286.34	5.85
79	PA	**DC**	Normal	290		286.34	5.95
80	PC	**DC**	Angle	300	1120	286.34	7.1
81	PA	**DC**	Normal	290		290	7.6
82	PA	**DC**	Normal	290		290	5.97
83	PC	**DC**	Angle	290	870	290	6.3
84	PA	**DC**	Normal	280		278.08	5.5
85	PA	**DC**	Normal	280		278.08	6
86	PA	**DC**	Normal	270		278.08	6.2
87	PA	**DC**	Normal	280		278.08	6.3
88	PB	**DC**	Angle	280	1390	278.08	5.9
88A	DD1	**DC**	Angle	20	20	20	7.1
88B	DC1	**DC**	Angle	240	240	240	7.9
88C	DD 1	**DC**	Angle	100	100	100	8
88D	DB 1+3	**DC**	Angle	280	280	280	7.8
88E	DD 1+3	**DC**	Angle	300	300	300	8
88F	DD 1	**DC**	Angle	190	190	190	7.9
88G	DD 1	**DC**	Angle	130	130	130	8.05
89	Gantry at Ranasingpur			130	130	130	12.6

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

APPENDIX- III

Name of EHT Line : 132kV Chandaka - Nimapara					
Route Length : 57.250 kms					
Location	**Tower Type**	**Angle of Deviation**	**SC / DC**	**Span Length (mtrs)**	**Crossings**
Chandaka	***Gantry***				
1	PC		DC	60	Grid Boundary
2	PC		DC	104	
3	PC		DC	37	
4	PB		DC	104	Grid Boundary (3-4)
5	PB		DC	292	220kV Line, 11kV Line (4-5)
6	PC		DC	140	Tar Road, 11kV Line (5-6)
7	PA		DC	284	11kV Line (6-7)
8	PA		DC	250	
9	PA		DC	290	
10	PA		DC	248	Morum Road (9-10)
11	PB		DC	298	Tar Road (10-11)
12	PA		DC	230	Morum Road (11-12)
13	PC		DC	210	
14	PC		DC	156	Tar Road, 11kV & 33kV Lines (13-14)
15	PC		DC	230	Morum Road (14-15)
16	PC		DC	250	
17	PC		DC	196	Tar Road (16-17)
18	PA		DC	240	11kV Line (17-18)
19	PB		DC	240	11kV Line (18-19)
20	PA		DC	220	
21	PB		DC	220	Tar Road (20-21)
22	PA		DC	364	Concrete Road (21-22)
23	PC		DC	286	
24	PC		DC	180	Morum Road (23-24)
25	PC		DC	294	Morum Road (24-25)
26	PC		DC	250	
27	PC		DC	180	
28	PA		DC	250	Hilly Area (27-28)
29	PC		DC	300	Tar Road, Hilly Area (28-29)
30	PB		DC	220	Tar Road (29-30)
31	PA		DC	335	Reserve Forest (30-31)

32	PA		DC	330	
33	PA		DC	310	
34	PA		DC	320	Tar Road, 33kV Line (33-34)
35	PB		DC	320	Tar / Metal Road, 33kV Line (34-35)
36	PA		DC	268	Metal Road (35-36)
37	PC		DC	296	Tribal Basti, 11kV Line (36-37)
38	PC		DC	158	
39	PC		DC	200	
40	PA		DC	290	Tar / Morum Road, Park (39-40)
41	PB		DC	160	Tar Road, Regional Park (40-41)
42	PC		DC	160	Tar Road, 11kV & 33kV Lines (41-42)
43	PB		DC	60	
44	PB		DC	294	Tar Road, 11kV Line (43-44)
45	PA		DC	310	Reserve Forest (44-51)
46	PA+3		DC	350	
47	PB		DC	330	
48	PA		DC	310	
49	PA		DC	330	Reserve Forest (44-51)
50	PB		DC	320	
51	PA+3		DC	334	
52	PC		DC	366	Reserve Forest, Tar Road, 11kV Line (51-52)
53	PB		DC	200	Tar Road (52-53)
54	PA		DC	280	11kV Line (53-54)
55	PA		DC	284	
56	PA		DC	296	
57	PC		DC	260	Tar Road (56-57)
58	PA		DC	300	Sum Hospital (57-58)
59	PB		DC	280	Tar Road (58-59)
60	PA		DC	326	
61	PA		DC	330	
62	PA		DC	320	Tar Road (61-62)
63	PA		DC	290	
64	PB		DC	294	
65	PA		DC	300	Tar Road (64-65)
66	PA		DC	300	
67	PA+3		DC	322	
68	PA		DC	360	
69	PA		DC	290	
70	PB		DC	310	
71	PA		DC	235	LT Line, Park (70-71)
72	PA		DC	220	
73	PC		DC	220	Tar Road (72-73)
74	PA		DC	290	
75	PC		DC	290	Tar Road (74-75)
76	PC		DC	150	National Highway-5 (75-76)
77	PA		DC	220	11kV Line, Pond (76-77)
78	PA		DC	314	Paddy Field (77-78)

79	PA		DC	298	11kV Line, Paddy Field (78-79)
80	PC		DC	300	Paddy Field (79-88)
81	PA		DC	294	
82	PA		DC	312	
83	PC		DC	294	
84	PA		DC	280	
85	PA		DC	280	
86	PA		DC	270	
87	PA		DC	280	
88	PB		DC	280	
89	PA		DC	280	
90	PA		DC	280	
91	PA		DC	280	
92	OB+6		DC	300	Paddy Field
93	OB+6		DC	170	Canal, Railway Crossing
94	PA		DC	330	
95	PA		DC	300	
96	PA		DC	300	
97	PA		DC	300	
98	PA		DC	300	
99	PB		DC	300	
100	PA+3		DC	320	
101	PA+6		DC	260	Canal, Road & 11kV Line
102	PA		DC	320	
103	PA		DC	300	Canal
104	PA		DC	300	
105	PA		DC	300	
106	PA		DC	300	
107	PB		DC	300	
108	PA		DC	300	
109	PA		DC	300	
110	PA+3		DC	280	
111	PA		DC	300	
112	PA		DC	300	River Crossing
113	PA		DC	300	11kV Line, Paddy Field
114	PA+6		DC	320	River Crossing, Paddy Field
115	PA+3		DC	340	Canal, Paddy Field
116	PC		DC	240	
117	PA		DC	305	
118	PA		DC	270	
119	PA		DC	270	
120	PA		DC	300	
121	PA		DC	300	
122	PA		DC	300	
123	PA		DC	310	Village Road, Barren Land, Paddy Field
124	PA		DC	290	

125	PB		DC	300	
126	PA		DC	320	
127	PA+3		DC	300	
128	PA		DC	320	
129	PA+3		DC	300	BBSR - Puri NH-5
130	PA		DC	280	
131	PA+3		DC	320	
132	PA		DC	300	
133	PA		DC	290	Village Road
134	PB		DC	290	
135	PA+6		DC	345	Morum Road, Paddy Field
136	PA		DC	350	
137	PA		DC	340	
138	PA		DC	270	
139	PA		DC	280	
140	PA		DC	260	
141	OA+6		DC	350	Road
142	OA+6		DC	460	Canal, Road
143	PB		DC	250	Canal, Road, River
144	PA+3		DC	345	
145	PA+3		DC	300	11kV Line, Paddy Field
146	PA		DC	340	
147	PA		DC	300	
148	PB		DC	300	
149	PA		DC	305	
150	PA		DC	220	
151	PA+3		DC	310	
152	PA		DC	320	
153	PC		DC	310	Pipili - Konark State Highway
154	PA		DC	287	
155	PA		DC	310	Village Road
156	PA		DC	270	
157	PC		DC	300	
158	PA+3		DC	330	
159	PA+6		DC	370	Village Road
160	PB+3		DC	350	
161	PA+3		DC	325	
162	PA		DC	340	Road
163	PA		DC	300	
164	PA+3		DC	330	
165	PA		DC	320	River Crossing (Dhanua)
166	PB		DC	260	
167	PA		DC	280	
168	PA		DC	240	Canal Bank, Village Road
169	PA		DC	300	
170	PA		DC	280	
171	PA		DC	300	Kajipatna - Balanga Road

172	PA		DC	300	
173	PA		DC	290	
174	PA		DC	290	
175	PA+6		DC	340	
176	PB		DC	360	
177	PA		DC	292	
178	PA		DC	290	
179	PA		DC	300	
180	PA		DC	300	
181	PA		DC	300	
182	PA+3		DC	320	
183	PA		DC	300	
184	PA		DC	290	
185	PB		DC	290	
186	PA		DC	295	
187	PA+6		DC	370	
188	PA		DC	350	Nimapara - Balanga Road Crossing
189	PA+3		DC	300	
190	PB		DC	290	
191	PA		DC	300	
192	PA+6		DC	350	
193	PA		DC	330	
194	PB		DC	200	
195	PA		DC	270	
196	PA		DC	280	Road
197	PA		DC	280	
198	PB+6		DC	300	
199	PA+3		DC	375	
200	PA		DC	260	Canal, Road, River Crossing
201	PB		DC	280	
202	PC		DC	140	
Nimapara	***Gantry***			43	

APPENDIX _IV

Name of EHT Line : 132kV Tarkera - Chhend DC Line					
Route Length : 6.165 kms					
Location	**Tower Type**	**Angle of Deviation**	**SC / DC**	**Span Length (mtrs)**	**Crossings**
Tarkera	***Gantry***				
1	DD		DC	50	
2	DA		DC	250	
3	DA		DC	290	
4	DA		DC	220	
5	DD	44° 0' 0" L	DC	220	
6	DA+3		DC	260	
7	DB+6		DC	220	
8	DD+3	47° 0' 0" L	DC	300	Ring Road & Bye-pass (7-8)
9	DA		DC	270	Panposh Road (8-9)
10	OC+6	28° 5' 0" L	DC	240	
11	UR+6	54° 40' 0" R	DC	150	Ring Road (10-11)
12	OC+6	28° 10' 0" R	DC	170	Railway Crossing (11-12)
13	DC+3	25° 10' 0" L	DC	380	
14	DA		DC	260	Ring Road (13-14)
15	DA		DC	250	Basanti Road (14-15)
16	PC	32° 40' 0" L	DC	240	
17	DA+3		DC	280	
18	DD	53° 40' 0" L	DC	195	
19	DA		DC	260	
20	DA		DC	220	
21	DA		DC	260	
22	DD+3	42° 20' 0" R	DC	200	Ring Road (21-22)
23	DA		DC	250	
24	DA		DC	230	
25	DD+6	30° 5' 0" L	DC	190	
26	DD	30° 0' 0" R	DC	100	
27	DD	0°	DC	110	
28	DD	0°	DC	65	
Chhend	***Gantry***			35	

APPENDIX- V

SPARE LIST SUITABLE FOR THE OFFERED HTLS CONDUCTOR.

Sl. No.	DESCRIPTION	QTY.	REMARK
1	Single Tension hardware fitting	20	
2	Double Tension hardware fitting	10	
3	Single suspension hardware fitting	20	
4	Double suspension hardware fitting	10	
5	Vibration damper	20	
6	Mid span joint	10	
7	Repair sleeve	10	
8	Performed armored rod	10	

APPENDIX-VI

RATE CONTRACT HOLDER FIRM OF OPTCL.(Which may change at the time of execution of work).

1) M/s S.B. Electrostructural,
A/78, Saheed Nagar, Bhubaneswar
Ph No- 0674-6532924, Fax- Nil

2) M/s Engineering & Allied Services(P) Ltd,
294, Saheednagar, Bhubaneswar-751007
Ph No – 0674-2544351

3) M/s KBS EL-CONS
Plot No -18, Madhusudannagar,
Unit-IV, Bhubaneswar-751001

4) M/s Apurba Construction,
Infront of F-41/7,Burla-768017
Sambalpur.
Ph No – 0663-2431897

5) M/s Jagamohan Pradhan,
At/PO/Via- -Rengali damsite
Dist- Anugul-759105
Ph No- 06760-277277, Fax No- 06760-277167

6) M/s A.K.Das, Associates Ltd,
H-1, Satyanagar, Bhubaneswar—751007
Ph No- 0674-2543732, Fax No- 0674-2544019

7) M/s Manoranjan Enterprises,
C/O- Subash ch Singh, At- Nuahate
Via- Banarpal, Anugul.(Ph No- 06764-229825, Fax-NIL)

8) M/s J.D.Construction,
Bhaskargang-B, Near Muni Samaj
Sahadevkhunta, Balesore.
Ph No- 9437148055

9) M/s Jagabandhu Enterprisers(P) Ltd,
Plot No- 35/B,Sector-A,
Mancheswar Industrial Estate-751010
Ph No- 0674-2582290,Fax No-0674-2582179

ANNEXURE – XX

PROFORMA BANK GUARANTEE FOR ADVANCE PAYMENT
(To be stamped in accordance with Stamp Act)

Ref No:- ……

Bank Guarantee No. ……

Date:- ……..

(Name and address of the Owner)

……

……

Dear Sir,

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

Whereas in accordance with the terms of the said Contract, the Employer has agreed to paid to the Contractor an Advance payment in the amount of _____ (amount of foreign currency in works) _____ (_____) (Amount in Figures) and (Amount of local currency in words) _____ (_____) (Amount in figures) and (Amount of local currency in words) _____ (_____) (Amount in figures)

By this letter we, the undersigned……(Name of the Bank), a bank organized under the laws of ……..and having its registered / principal office at ……do hereby jointly and severally with the Contractor irrevocably argument in the event that the contractor fails to commence or fulfill its obligations under the terms of the said advance payment to the Employer.

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

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

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

Yours truly,
Name of the Bank
Authorized signature

Signature of witness_____
Name_____
Address_____

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

Note:

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

ANNEXURE – XXI

FORM OF UNDER TAKING

(To be submitted along with the Price Bid & a copy of the same in the Techno-Commercial Bid)

To

The Sr. G.M (CPC)
OPTCL, Bhubaneswar

Ref: (i) Tender Notice No. ……
(ii) Tender Specification No. ……..

Having read the Clause No.36 (a to f) procedure for evaluation of the price bid of instruction to Bidders, I/we understand & hereby declared and undertake that

(i) any item/ items, which is/are completely missed / omitted / replaced with an irrelevant content or left blank (price not quoted) in our price bid, the same shall be evaluated by incorporating the highest quoted price of said item from amongst all other qualified bidders. The bid price so evaluated shall fix the relative position of the bidders for evaluation purpose only. AND

(ii) the said item/ items which is/are completely missed / omitted / replaced with an irrelevant content or left blank (price not quoted) in our price bid, shall be supplied /erected & installed by us, free of cost, in the event, the contract is awarded in our favour, irrespective of any financial involvement on us and without any financial liability to OPTCL.

I/we further undertake that we shall abide by this declaration/ undertaking & shall not raise any dispute whatsoever, in future, as regards our price and the basis of evaluation of our price bid.

I/we hereby declare that this under taking is given at my / our free will and volition without being influenced, coerced or persuaded any manner.

Date:
(Signature)……
Place: (Printed Name)
……..…….
(Designation)
…….
(Common Seal)