TENDER DOCUMENTS
FOR

Construction of 33kV New Line from 132/33kV Ransinghpur OPTCL Grid Substation to IOCL Depot at Jatni, Odisha

Volume – II

Technical Bid

Tender Specification No CESU / 263 /2012-13
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CENTRAL ELECTRICITY SUPPLY UTILITY OF ODISHA

(CESU)

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BID ENQUIRY NO: CESU Hqrs. / P&S / / Dt.
BID DOCUMENTS CONSIST OF THE FOLLOWING VOLUMES

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General
1.0. INTRODUCTION:

The CENTRAL ELECTRICITY SUPPLY UTILITY OF ODISHA,
hereinafter called CESU/OWNER is inviting Bids in respect of Total Turnkey Package for Construction of 33 kV S/C line from Ransinghpur (OPTCL) S/S to IOCL Depot, Jatni, Odisha through a combination of OH D/C NBLS towers and UG Cables (with Spare cable) on total turnkey basis including supply of all Equipments/Materials Erection (including Civil Works), Testing and Commissioning as per the Scope detailed in the Bid Documents.

2.0. NATURE OF WORK:

The work covered by this Specification is for 33kV distribution lines as specified herein and in the attached Schedules. The overhead distribution lines will form a part of the CESU’s distribution System.

3.0. SCOPE:

Construction of 33 KV New Line from Ranasinghpur 132/33 kV S/S to IOCL depot, at Jatni, through a combination of overhead and underground lines.

The work involves:

a) The detailed survey to be got conducted including route map, tower schedule, soil investigation reports.
b) The Tower designs to be done and all the BOQ to be freezeed.
c) The foundation designs to be done for different soil classifications like normal, submerged, hard rock, fissured rock etc and provisional quantities to be indicated in the BOQ.
d) Construction of 33kV S/C line through a combination of Overhead line on double circuit NBLS towers of route length 6.8 km and UG Cable of route length 13.3 km from 132/33kV Ransinghpur grid S/S to IOCL Depot at Jatni.
e) Stringing of 33KV ACSR Panther conductor for a route length of about 6.8kM.
f) Fitting of Insulators & hardware fittings for 33kV line.
g) Construction of foundation (Civil Work) for the towers, 4 poles structure and DPs.
h) Erection of 33 kV Isolator with ear switches (2 nos).
i) Erection of DP structure (2 nos) and 4-Pole structure (1 no) with required Insulators and H/W fittings.
j) Erection of 33 kV Lightning Arrestors (27 nos).
k) Erection of 1 set of HG Fuse unit.
l) Laying of 3core x 400mm2, 33KV XLPE UG Cable with spare (2 runs) for a distance of 9 kM.
m) Laying of 3core x 300mm2, 33KV XLPE, UG Cable with spare (2 runs) for a distance of 21 kM.
n) Straight through Jointing kits of 400mm2 and 300mm2, 33KV XLPE Cable. (120 nos)
o) Jointing of HT cable termination end kit for 400mm2 and 300mm2, 33KV XLPE Cable (20 nos)
p) Erection of rigid PVC pipes of size 200 mm diameter of length 60mtrs.

4.0. Technical specifications for supply of materials:

The supply of all the required materials on TOTAL TURN KEY is in the scope of the contractor. The technical specifications for the major materials are mentioned in different sections of this volume.

5.0. Methodology:

The complete procedures for the execution of the project are explained herewith in details.

5.0.1 SURVEY (detail & check, estimating of quantities & spotting of towers/ Poles).

Walk over survey, Theodolite survey, profile survey (if required) shall have to be carried out to establish the route alignment by the contractor for new 33 KV lines. If the line is passing by any Municipal/ NAC areas, permission from local bodies, NH authority and State high way authority has to be obtained prior to execution of work.

A. CHECK SURVEY

The contractor shall undertake the check survey during execution on the basis of the alignment profile drawing and tower schedule approved by the concerned authority. During check survey, minor changes due to RoW or any other unavoidable constraints, the contractor may have to change the said alignment after obtaining prior approval from the authority.

B. GENERAL:

Preliminary route alignment in respect of the proposed 33KV transmission lines has been fixed by CESU subject to alteration of places due to way leave or other unavoidable constraints. The Right of way shall be solved by the contractor and all expenses there of shall be borne by him. However, CESU shall render all helps in co-ordination with law and order department for solving the same. Involvement of forest land should be restricted as far as possible.

C. Provisional quantities/numbers of different types of tower structures, Length cables, Conductors etc have been estimated and indicated in the BOQ Schedule given. However final quantities for work shall be as determined by the successful bidder, on completion of the detail survey, preparation of route profile drawing and designing of the different items as elaborated in the specification and scope of work.

D. The contractor shall undertake detailed survey on the basis of the tentative alignment fixed by CESU. The said preliminary alignment may, however, change in the interest of economy to avoid forest and hazards in work. While surveying the alternative route the following points shall be taken care of by the contractor.

I. The line is as near as possible to the available roads in the area and the route is
straight and short as far as possible.

II. Good farming areas, religious places, forest, civil and defense installations, aerodromes, public and private premises, ponds, tanks, lakes, gardens, and plantations are avoided as far as practicable.

III. The line should be far away from telecommunication lines as reasonably possible. Parallelism with these lines shall be avoided as far as practicable.

IV. Crossing with permanent objects are minimum but where unavoidable preferably at right angles.

V. Difficult and unsafe approaches are avoided.

VI. The survey shall be conducted along the approved alignment only.

VII. For river crossing/ Crossing of drains : Taking levels at 25 meter interval on bank of river and at 50 meter interval at bed of river so far as to show the true profile of the ground and river bed railway/road bridge, road The levels shall be taken at least 100 m. on either side of the crossing alignment. Both longitudinal and cross sectional shall be drawn preferably to a scale of 1:2000 at horizontal and 1:200 vertical.

VIII. Route of Cable shall be surveyed thoroughly and marked in the drawing for laying of cable in HDD method.

After completing the detailed survey, the contractor shall submit the final profile and tower schedule (with no. of stay or structure) and Cable layout for final approval of CESU. To facilitate checking of the alignment, suitable reference marks shall be provided. For this purpose, concrete pillars of suitable sizes shall be planted at all angle locations and suitable wooden/iron pegs shall be driven firmly at the intermediate points. The contractor shall quote his rate covering these involved jobs.

E. PROFILE PLOTTING AND TOWER SPOTTING:

With the help of sag template, final tower location shall be marked on the profiles and while locating the tower on survey chart, the following shall be kept in mind:

I. SPAN

- The span should be as near as possible to the basic design span so that the minimum ground clearance should not less than 7.0 mts in cross country at maximum sag condition.
- In urban areas minimum in every Half KM one angle tower (Cut point) has to be provided.
- In other areas in every 1.5 KM one angle tower (Cut point) may be provided.

II. WAY-LEAVE AND TREE CUTTING

- Way-leave permission which may be required by the contractor shall be arranged at his cost. While submitting final-survey report for approval, proposals for way-leave right of way shall be submitted by the contractor. CESU may extend help to get the permission within a reasonable time as mutually agreed upon for which due notice shall be given...
by the contractor in such a way so that obtaining permission from appropriate authority
do not hinder the continued and smooth progress of the work.

• CESU shall not be held responsible for any claim on account of damage done by the
contractor or his personnel to trees, crops and other properties.

• The contractor shall take necessary precaution to avoid damage to any ripe and
partially grown crops and in the case of unavoidable damage, the CESU shall be
informed and necessary compensation shall be paid by the contractor.

• All the documents required for application to the statutory authorities must be prepared
by the contractor & submitted to the CESU for submission of the application towards
approval of NH authority, State authority etc. However, the responsibilities lie with the
contractor to get the clearance.

• Trimming of tree branches or cutting of a few trees en-route during survey is
within the scope of survey to be done by the contractor. Contractor shall arrange for
necessary way-leave and compensation in this regard. During erection of the line,
compensation for tree cutting, damage caused to crops, actual cutting and falling of the
tree including way-leave permission for such route clearance shall be arranged by the
contractor at his cost. The contractor will identify the number of trees and detail of
obstructions to be removed for erection of the line and intimate CESU well in advance in
case of any help. Other related works like construction of temporary approach roads, etc.
as required, shall be done by the contractor and the same will lie within the scope of
contractors work and such cost shall be considered to be included in the rates quoted by
him.

III. SUB-SOIL INVESTIGATION
(In case of river crossing locations/other locations where PILLING may be required)

• To ascertain soil parameters in locations where higher tower will be required in order to
get adequate ground clearance (Either 220KV or 132 KV tower normally used in OPTCL)
the contractor shall carry out sub-soil investigation through reputed soil consultant as
approved by the CESU.

IV. TEST BORING

• The boring shall be done at the major locations / crossing of special towers.
• The test boring through different layers of all kinds of soil shall have to be carried out by
the contractor through the approved soil consultant as briefed hereunder.
  a. Method of boring, selection of sampling tubes, sampling, recording of boring,
     protection, handling, leveling of samples shall be done as specified in IS: 1892/1977, if
     any, after obtaining approval from the CESU. The contractor shall furnish in the soil
     report in details, the equipment and method of boring actually adopted.
  b. Depth of boring below ground level shall be normally 15 Mts to 25 Mts., in river
crossing locations.

c. Undisturbed soil samples shall be obtained for the initial 4M depths at every 1.5M interval and at change of strata. After these initial 4M depths, samples shall be obtained preferably at every 3M or where there is a change of strata, or as advised by the CESU.

d. In case collection of undisturbed samples becomes difficult/impossible detailed soil testing on remolded soil samples is to be considered and reported in the soil report.

e. Standard penetration test as per IS: 2131 with latest amendment shall have to be conducted in different strata and recorded properly.

f. The ground water table shall be recorded during boring operation and incorporated in the bore log. If possible, the position of the water table just after monsoon period be ascertained from local people and indicated in the report.

V. LABORATORY TESTS OF SOIL SAMPLES

- The method and procedure of testing of soil sample to be followed shall be as per relevant IS codes. Adequate volume of test samples shall be collected from site.

- Sample shall be properly sealed immediately after recovery as specified in relevant IS code and transported carefully to laboratory for carrying out necessary laboratory tests to find out the following parameters of every samples. Data and time of taking of the sample shall be recorded in the test report.

  a) Natural moisture content, Liquid limit, Plastic limit and Plasticity index.
  b) Bulk, dry and buoyant density of soil.
  c) Void ratio (e-long P curve shall be submitted)
  d) Specific gravity.
  e) Grain size distribution (Sieve analysis and hydrometer analysis)
  f) Tri-axial and consolidation tests (consolidation undrained and consolidated drained as and when application in table, graph and drawing.
  g) Permeability tests
  h) Chemical tests for both water and soil samples at different layers.
  i) Evaluation of safe bearing capacity at different strata for square footings shall be done for a maximum value of 25-mm. settlements.
  j) At depths from 3M to 25 different strata.
  k) Factor of safety shall be considered as 3 for evaluation of safe bearing capacity of soil.
  l) Unconfined compression test for cohesive soil if encountered.
VI. REPORT ON SUB-SOIL INVESTIGATION

- The contractor shall make analysis of soil samples as collected by him in the field and approved by the CESU. A comprehensive report shall have to be prepared by him, finally incorporating all the data collected in proper tabular forms or otherwise along with the analysis.
- Recommendations shall include but not be limited to the following items (a) to (o)
  a) Geological information of the region.
  b) Past observations and historical data, if available, for the area or for other areas with similar profile or for similar structures in the nearby area.
  c) Procedure of investigations employed at field as well as laboratory test results.
  d) Net safe bearing capacity and settlement computation for different types of foundations for various widths and depths of tower and building.
  e) Recommendations regarding stability of slopes, during excavations etc.
  f) Selection of foundation types for towers, transformers and buildings etc.
  g) Bore hole and trial pit logs on standard proforma showing the depths, extent of various soil strata etc.
  h) A set of longitudinal and transverse profiles connecting various boreholes shall be presented in order to give a clear picture of the site, how the soil/rock strata are varying vertically and horizontally.
  i) Modulus of sub grade reaction from plate load test for pressure ranging up to 6 kg/cm². The recommended values shall include the effect of size, shape and depth of foundations.
  j) Deformation modulus from plate load test in various test depth/stratification.
  k) Coefficient of earth pressure at rest.
  l) Depth of ground water table and its effect on foundation design parameters.
  m) Recommendations regarding stability of slopes, during shallow excavation etc.
  n) Whether piles are necessary or not. If piles are necessary, recommendation of depth, diameter and types of piles to be used.
  o) Recommendations for the type of cement to be used and any treatment to the underground concrete structure based on the chemical composition of soil and sub-soil water.
### 6.0 Bill of Quantities (BOQ):

<table>
<thead>
<tr>
<th>Key basis</th>
<th>SI No</th>
<th>Description Of Item</th>
<th>Unit</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>Supply of materials for NBLS Tower which includes Design, fabrication, galvanizing &amp; and all hardware accessories with a provision of 33kV double circuit line.</td>
<td>No</td>
<td>31</td>
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<td>Hx Tower (1.05 MT)</td>
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<td>Hz Tower 2.58 MT</td>
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<td></td>
<td></td>
<td>Hx (Hardware Fittings-0.054 MT)</td>
<td>No</td>
<td>31</td>
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<tr>
<td></td>
<td></td>
<td>Hz (Hardware Fittings-0.149 MT)</td>
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<td></td>
<td>Extension (Hz)-0.757 MT</td>
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<td></td>
<td>Extension (Hardware Fittings-0.024 MT)</td>
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<td>14</td>
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<td>2</td>
<td>2</td>
<td>Supply of materials for NBLS Tower foundation with design, fabrication, galvanizing with all hardware accessories.</td>
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<td>31</td>
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<td></td>
<td></td>
<td>Hx Tower foundation with Stub-0.131 MT</td>
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<td>Hz Tower foundation with Stub-0.526 MT</td>
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<td>35</td>
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<td>Supply of ACSR Panther conductor (as per IS standard) on the NBLS towers for single circuit.</td>
<td>km</td>
<td>22.5</td>
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<tr>
<td>3</td>
<td>3</td>
<td>Supply of materials for 2 nos. of DP structure of Metering Unit at either ends and one no. of 4 Pole structure inside Janla 33/11KV Structure,</td>
<td></td>
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<td></td>
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<td>i) 11mtr R.S. Joist (150mmx150mm)</td>
<td>No</td>
<td>8</td>
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<td></td>
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<td>ii) 11 kV Insulators</td>
<td>No</td>
<td>54</td>
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<td></td>
<td></td>
<td>iii) H/W fittings - As required.</td>
<td>Kg</td>
<td>to be filled up by bidder</td>
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<tr>
<td></td>
<td></td>
<td>iv) Stay sets (2 nos. per DP)</td>
<td>Sets</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>v) MS Channel- As required</td>
<td>Kg</td>
<td>to be filled up by bidder</td>
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<td></td>
<td></td>
<td>vi) Provision of holding two nos. of 400mm² Cable end bottles per DP- 2 nos. and 4 nos. For 4 pole (Cantilever arrangement)</td>
<td>Kg</td>
<td>to be filled up by bidder</td>
</tr>
<tr>
<td></td>
<td></td>
<td>vii) Earthing Materials for each DP and 4 Pole.</td>
<td>No</td>
<td>12</td>
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<td></td>
<td></td>
<td>viii) Lighting Arrestor</td>
<td>No</td>
<td>15</td>
</tr>
<tr>
<td>Item</td>
<td>Description</td>
<td>Quantity</td>
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<td>ix)</td>
<td>Isolator with earth switch for 4 Pole structure</td>
<td>Sets 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>x)</td>
<td>HG Fuse set for 4 pole structure</td>
<td>Sets 1</td>
<td></td>
<td></td>
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<tr>
<td>4</td>
<td><strong>Supply of 3core x 400mm² 33KV XLPE Underground Cabling for a route length of 4.0 kM and Supply of 3core x 300mm² 33KV XLPE Underground Cabling for a route length of 9.3 kM</strong></td>
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</tr>
<tr>
<td>i)</td>
<td>Supply of 3core x 400mm², 33KV XLPE Underground Cable (2 runs)</td>
<td>kM 8</td>
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<tr>
<td>ii)</td>
<td>Supply of 3core x 300mm², 33KV XLPE Underground Cable (2 runs)</td>
<td>kM 18.6</td>
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</tr>
<tr>
<td>iii)</td>
<td>Supply of Cable Jointing kit for 400mm² 33KV XLPE Cable (straight through)</td>
<td>Sets 34</td>
<td></td>
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<td>iv)</td>
<td>Supply of Cable termination end kit for 400mm² 33KV XLPE Cable</td>
<td>Sets 14</td>
<td></td>
<td></td>
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<td>v)</td>
<td>Supply of Cable Jointing kit for 300mm² 33KV XLPE Cable (straight through)</td>
<td>Sets 86</td>
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<td>vi)</td>
<td>Supply of Cable termination end kit for 300mm² 33KV XLPE Cable</td>
<td>Sets 6</td>
<td></td>
<td></td>
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<td>vii)</td>
<td>PVC rigid pipes, 200mm dia.</td>
<td>Mtr. 60</td>
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<tr>
<td>viii)</td>
<td>Earthing Device</td>
<td>Sets 6</td>
<td></td>
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<tr>
<td>ix)</td>
<td>Lighting Arrestor</td>
<td>No 12</td>
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</tbody>
</table>
Section-II

33kV Conductors
TECHNICAL SPECIFICATION FOR 33kV ACSR Panther Conductors

1.0 SCOPE

This section covers design, manufacture, testing before dispatch, packing, supply and delivery F.O.R destination of kMs of "PANTHER" ACSR Conductor of size 30/7/3.00mm.

2.0 STANDARDS

2.1 The Conductor shall also comply in all respects with the IS:398 (Part-II) 1996 with latest amendments unless otherwise stipulated in this specification or any other International Standards which ensure equal or higher quality material.

2.2 The ACSR Conductor shall also conform to the following standards

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Indian Standards</th>
<th>Title</th>
<th>International Standards</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>IS : 209</td>
<td>Specification BS : 3436 for zinc</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>IS : 1778</td>
<td>Reels and BS : 1559 Drums for Bare Conductors</td>
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<tr>
<td>4</td>
<td>IS : 1521</td>
<td>Method of Ten-ISO / R 89 site testing of Steel wire.</td>
<td></td>
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<tr>
<td>5</td>
<td>IS : 2629</td>
<td>Recommended practice for Hot dip galvanising of Iron and Steel.</td>
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<tr>
<td>6</td>
<td>IS : 2633</td>
<td>Method of Testing uniformity of coating of zinc coated articles.</td>
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</tr>
<tr>
<td>7</td>
<td>IS : 4826</td>
<td>Galvanised coating quoting on round steel wire.</td>
<td>ASTM A – 472 729</td>
</tr>
<tr>
<td>8</td>
<td>IS : 6745</td>
<td>Methods of determination of weight of zinc coating of zinc coated iron and steel articles.</td>
<td>BS : 443</td>
</tr>
<tr>
<td>9</td>
<td>IS : 8263</td>
<td>Method of radio Interference tests on high voltage Insulators</td>
<td>IEC:437 NEMA : 107</td>
</tr>
<tr>
<td>10</td>
<td>IS : 1841</td>
<td>EC grade aluminium rod produced by rolling (Second Revision)</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>IS : 5484</td>
<td>EC grade aluminium rod produced by continuous casting and rolling (first revision)</td>
<td></td>
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</tbody>
</table>

2.3 However, in an event where the supplier offers ACSR conductor conforming to standards other than the above, then the salient points of comparison between the standards adopted and the standards quoted herein shall be detailed in relevant schedule with an authenticated English version of such standards referred to.
3.0 GENERAL TECHNICAL REQUIREMENTS

The General Technical Requirements are given in Clause-31.0. The Conductor shall conform to these technical requirements.

3.1 MATERIALS/WORKMANSHIP

3.1.1 The material offered shall be of best quality and workmanship. The steel cored aluminium conductor strands shall consist of hard drawn aluminium wire manufactured from not less than 99.5% pure electrolytic aluminium rods of E.C. grade and copper content not exceeding 0.04%. They shall have the same properties and characteristics as prescribed in IEC:889-1987. The steel wire shall be made from material produced either by the acid or basic open hearth process or by electric furnace process or basic oxygen process. Steel wire drawn from Bessemer Process shall not be used.

3.1.2 The steel wires shall be evenly and uniformly coated with electrolytic high grade, 99.95% purity zinc complying with the latest issue of IS-209 for zinc. The uniformity of zinc coating and the weight of coating shall be in accordance with standard specification and shall be tested and determined according to the latest IS-2633 or any other authoritative standard.

3.1.3 The steel strands shall be hot dip galvanized and shall have a minimum zinc coating of 250 gm/Sq.m after stranding. The coating shall be smooth, continuous, and of uniform thickness, free from imperfections and shall withstand minimum three dips after stranding in standard preece test. The steel strands shall be preformed and postformed in order to prevent spreading of strands in the event of cutting of composite core wire. The properties and characteristics of finished strands and individual wires shall be as prescribed in IEC:888-1987.

4.0 CONDUCTOR PARAMETERS

4.1 The Parameters of individual strands and composite steel cored aluminium conductor, shall be in accordance with the standard specification values.

4.2 Creep in a conductor is attributed partly due to settlement of strands and partly due to non-elastic elongation of metal when subjected to load. The manufacturer of conductor shall furnish the amount of creep which will take place in 10, 20, 30, 40 and 50 years along with the supporting calculations. The calculations should be based on everyday temperature of 32 °C and everyday tension of 25% of UTS of conductor of 33 KV Lines.

5.0 TOLERANCES

5.1 The tolerances on standard diameter of Aluminium and Steel wires shall be as detailed in specific technical requirements.

5.2 The cross-section of any wire shall not depart from circularity by more than an amount corresponding to the tolerance on the standard diameter.
5.3 The details of diameters, lay ratios of Aluminium and steel wires shall be in accordance with the standard specification.

6.0 SURFACE CONDITIONS

6.1 All aluminum and steel strands shall be smooth, and free from all imperfections, spills/and splits. The finished conductor shall be smooth, compact, uniform and free from all imperfections including spills and splits, die marks, scratches, abrasions, scuff marks, kinks (protrusion of wires), dents, pressmarks, cut marks, wire cross-over, over-riding looseness, pressure and/or unusual bangle noise on tapping, material inclusions, white rust, powder formation or black spots (on account of reaction with trapped rain water etc.), dirt, grit, etc. The surface of conductor shall be free from points, sharp edges, abrasions or other departures from smoothness or uniformity of surface contour that would increase radio interference and corona losses. When subjected to tension upto 50% of the ultimate strength of the conductor, the surface shall not depart from the cylindrical form nor any part of the component parts or strands move relative to each other in such a way as to get out of place and disturb the longitudinal smoothness of the conductor.

7.0 JOINTS IN WIRES

7.1 Aluminium wires
7.1.1 During stranding, no aluminium wire welds shall be made for the purpose of achieving the required conductor length.

7.1.2 No joint shall be permitted in the individual aluminium wires in the outer most layer of the finished Conductor. However, joints in the 12 wire & 18 wire inner layer of the conductor are permitted but these joints shall be made by the cold pressure butt welding and shall be such that no two such joints shall be within 15 meters of each other in the complete stranded conductor.

7.2 Steel wires

There shall be no joints in finished steel wires forming the core of the steel reinforced aluminium conductor.

8.0 STRANDING

8.1 The wires used in construction of the stranded conductor, shall, before stranding, satisfy all requirements of IS-398 (Part-II)1996.

8.2 In all constructions, the successive layers shall be stranded in opposite directions. The wires in each layer shall be evenly and closely stranded round the underlying wire or wires. The outer most layer of wires shall have a right hand lay. The lay ratio of the different layers shall be within the limits as per standard specification.

9.0 PACKING

9.1 The conductor shall be supplied in non-returnable strong wooden drums provided with lagging
of adequate strength constructed to protect the conductor against any damage and displacement during transit, storage and subsequent handling and stringing operations in the field. The drums shall generally conform to IS-1778-1980 and latest version except as otherwise specified hereinafter. The conductor drums shall be adequate to wind one standard length of 2500 meters PANTHER ACSR conductor.

9.2 The drums shall be suitable for wheel mounting and for letting off the conductor under a minimum controlled tension of the order of 5KN. The conductor drums shall be provided with necessary clamping arrangements so as to be suitable for tension stringing of power conductor.

9.3 The bidders should submit their drawings of the conductor drums along with the bid. After placement of letter of intent the supplier shall submit four copies of fully dimensioned drawing of the drum for purchaser's approval. After getting approval from the purchaser, supplier shall submit 30 more copies of the approved drawings for further distribution and field use at Board's end.

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

9.5 All flanges shall be 2-ply construction with 64 mm thickness. Each ply shall be nailed and clenched together at approximately 90 degrees. Nails shall be driven from the inside face of the flange, punched and then clenched on the outer face. Flange boards shall not be less than the nominal thickness by more than 2 mm. There shall not be less than 2 nails per board in each circle.

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

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

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

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

9.10 Before reeling, card board or double corrugated or thick bituminised waterproof bamboo paper shall be secured to the drum barrel and inside of flanges of the drum by means of a suitable
commercial adhesive material. The paper should be dried before use. Medium grade kraft paper shall be used in between the layers of the conductor. After reeling the conductor the exposed surface of the outer layer of conductor shall be wrapped with thin polythene sheet across the flanges to preserve the conductor from dirt, grit and damage during transportation and handling and also to prevent ingress of rain water during storage/transport.

9.11 A minimum space of 75 mm shall be provided between the inner surface of the external protective lagging and outer layer of the conductor. Outside the protective lagging, there shall be minimum of two binders consisting of hoop iron/galvanised steel wire. Each protective lagging shall have two recesses to accommodate the binders.

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

9.13 The conductor ends shall be properly sealed and secured with the help of U-nails on one side of the flanges.

9.14 Only one standard length of conductor shall be wound on each drum. The method of lagging to be employed shall be clearly stated in the tender.

9.15 As an alternative to wooden drum Bidder may also supply the conductors in non-returnable painted steel drums. The painting shall conform to IS:9954-1981, reaffirmed in 1992. Wooden/steel drum will be treated at par for evaluation purpose and accordingly the Bidder should quote the package.

10.0 LABELLING AND MARKING

10.1 The drum number shall be branded or gauged or stencilled into the flange. An arrow shall be marked on the sides of the drum, together with the words "Roll this way". Each drum shall have the following information provided on the outside of the flange stencilled with indelible ink.

a) Manufacturer's name and address.

b) Contract/Specification number.

c) Size and type of conductor.

d) Net weight of the conductor.

e) Gross weight of the conductor and drum.

f) Length of the conductor.

g) Position of the conductor end.

h) Drum and lot number.

i) Name and address of the consignee.

j) Month and year of manufacture.

k) The drum may also be marked with standard specification as per which the conductor is manufactured.
11.1 **STANDARD LENGTHS**

11.1 The standard length of the conductor shall be 2500 metres. Bidder shall indicate the standard length of the conductor to be offered by them. A tolerance of plus or minus 5% on the standard length offered by the bidder shall be permitted. All lengths outside this limit of tolerance shall be treated as random lengths.

11.2 Random lengths will be accepted provided no length is less than 70% of the standard length and total quantity of such random length shall not be more than 10% of the total quantity order. When one number random length has been manufactured at any time, five (5) more individual lengths, each equivalent to the above random length with a tolerance of +/-5% shall also be manufactured and all above six random lengths shall be dispatched in the same shipment. At any point, the cumulative quantity supplied including such random lengths shall not be more than 12.5% of the total cumulative quantity supplied including such random lengths. However, the last 20% of the quantity ordered shall be supplied only in standard length as specified.

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

12.0 **QUALITY ASSURANCE PLAN**

A Quality Assurance Plan including customer hold points covering the manufacturing activities of the material shall be required to be submitted by the tenderer to the purchaser along with the tender. The Quality Assurance Plan after the same is found acceptable, will be approved by the purchaser. The contractor shall follow the approved Quality Assurance Plan in true spirit. If desired by the purchaser, he shall give access to all the documents and materials to satisfy the purchaser that the Quality Assurance Plan is being properly followed.

13.0 **TESTING**

13.1 **SELECTION OF TEST SAMPLES FOR TYPE TESTS**

13.1.1 The samples shall be taken from a continuous length of conductor and subjected to all the tests specified in clause 14.

13.2 **SELECTION OF TEST SAMPLES FOR ACCEPTANCE TESTS**

13.2.1 Before dispatch from the works individual wire and finished steel cored aluminium conductor shall be subjected to the tests as specified in IS:398 or any other authoritative standard.

13.2.2 Sample for individual wires for test shall be taken before stranding from outer ends of not
less than ten per cent of the spools in the case of aluminium wire and ten per cent of the wire coils in the case of steel wires. If samples are taken after stranding, they shall be obtained by cutting 1.2 metres from the outer ends of the finished conductor from not more than 10 per cent of the finished reels.

13.2.3 The routine tests shall be same as acceptance test and shall be carried out on each coil.

14.0 TESTS

The following tests shall be carried out on a sample/samples of conductor.

14.1 Type Tests

a) Visual examination
b) Measurement of diameters of individual aluminium and steel wires.
c) Measurement of lay ratio of each layer
d) Breaking load test
e) Ductility test
f) Wrapping test
g) Resistance test on aluminium wires.
h) DC resistance Test on Composite Conductor.
i) Galvanizing test
j) Surface condition test.
k) Stress Strain test
l) Procedure qualification test on welded joint of Aluminium Strands.

NOTE :- The tenderer should submit type test certificates of a standard laboratory alongwith the tender, failing which the tender is liable for rejection.

14.2 Acceptance tests and Routine tests

a) Visual and dimensional check on drum.
b) Visual examination
c) Measurement of diameters of individual aluminium and steel wires.
d) Measurement of lay ratio of each layer
e) Breaking load test
f) Ductility test
g) Wrapping test
h) Resistance test on aluminium wires.
i) DC resistance Test on Composite Conductor.
j) Galvanizing test

14.3 Tests during Manufacture

The following tests during manufacture shall be carried out.
a) Chemical analysis of zinc used for galvanising,
b) Chemical analysis of aluminium used for making aluminium strands,
c) Chemical analysis of steel used for making steel strands,

14.4 Visual examination

The conductor shall be examined visually for good workmanship and general surface finish of the conductor. The conductor drums shall be rewound in the presence of Board's Inspecting Officer. The Inspector will initially check for Scratches, Joints etc., and that the conductor shall generally conform to the requirements of the specifications/IS 398(Part-II)-1996.

14.5 Measurement of diameters of individual Aluminium and Steel Wires.

The diameters of individual Aluminium and Steel Wires shall be checked to ensure that they conform to the requirements of this specification.

14.6 Measurement of lay-ratios

The lay-ratios of each layer of the conductor shall be measured and checked to ensure that they conform to the requirements of this specification and IS:398 (Part-II)-1996.

14.7 Breaking load test

14.7.1 Breaking load test on complete conductor.

Circles perpendicular to the axis of the conductor shall be marked at two places on a sample of conductor of minimum 5m length between fixing arrangement suitably fixed on a tensile testing machine. The load shall be increased at a steady rate upto 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 100% of 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.

14.7.2 Breaking load test on individual Aluminium and Galvanized steel wires.

This test shall be conducted on both Aluminium and Galvanized steel wires. The breaking load of one specimen cut from each of the samples taken shall be determined by means of suitable tensile testing machine. The load shall be applied gradually and the rate of separation of the jaws of the testing machine shall be not less than 25 mm/min. and not greater than 100 mm./ min. The ultimate breaking load of the specimens shall be not less than the values as per standard specification.

14.8 Ductility Test

For the purpose of this test both torsion and elongation tests shall be carried out on galvanized steel wires only.

14.9 Torsion Test
One specimen cut from each of the samples taken shall be gripped in two vices exactly 15 cms. apart. One of the vices shall be made to revolve at a speed not exceeding one revolution per second and the other shall be capable of moving longitudinally to allow for contraction or expansion during testing. A small tensile load not exceeding 2 (two) percent of the breaking load of the wire shall be applied to the samples during testing. The test shall be continued until fracture occurs and the fracture shall show a smooth surface at right angles to the axis of the wire. After fracture, the specimen shall be free from helical splits. The sample shall withstand a number of twists equivalent to not less than 18 on length equal to 100 times the diameter. When twisted after stranding the number of complete twists before fracture occurs shall be not less than 16 on a length equal to 100 times the diameter of the wire. 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 the next higher whole number. The fracture shall show a smooth surface at right angles to the axis of the wire.

14.10 Elongation Test

The elongation of one specimen cut from each of the samples taken shall be determined. The specimen shall be straightened by hand and an original gauge length of 200 mm. shall be marked on the wire. A tensile load shall be applied as described in 1.1.4.6.2.1 and the elongation shall be measured after the fractured ends have been fitted together. If the fracture occurs outside the gauge marks, or within 25 mm. of either mark and the required elongation is not obtained, the test shall be disregarded and another test conducted. When tested before stranding, the elongation shall be not less than 4 percent and when tested after stranding, the elongation shall be not less than 3.5 percent.

14.11 Wrapping Test

This test shall be conducted on both Aluminium and Galvanised steel wires.

14.11.1 Aluminium wires

One specimen cut from each of the samples of aluminium wires shall be wrapped round a wire of its own diameter to form a close helix of 8 turns. Six turns shall then be unwrapped and closely wrapped in the same direction as before. The wire shall not break or show any crack.

14.11.2 Galvanized steel wires

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

14.12 RESISTANCE TEST

This test shall be conducted on aluminium wires only, conforming to procedure as per
IEC:889. The electrical resistance of one specimen of aluminium wire cut from each of the samples taken shall be measured at ambient temperature. The measured resistance shall be corrected to the value corresponding to 20 degrees C. by means of following formula.

\[ R_{20} = \frac{R_T}{1 + \alpha (T - 20)} \]

Where

- \( R_{20} \) = Resistance corrected at 20 degrees C.
- \( R_T \) = Resistance measured at T degrees C.
- \( \alpha \) = Constant mass temperature coefficient of resistance 0.004.
- \( T \) = Ambient temperature during measurement

This resistance calculated to 20 degrees C. shall be not more than the maximum value specified in standard specification.

14.13 GALVANIZING TEST

This test shall be conducted on galvanized steel wires only. The uniformity of Zinc coating and the weight of coating shall be in accordance with IS 4826-1979.

14.14 SURFACE CONDITION TEST

A sample of the finished conductor for use in 33 KV system having a minimum length of 5 meters with compression type dead end clamps compressed on both ends in such manner as to permit the conductor to take its normal straight line shape, shall be subjected to a tension of 50 percent of the UTS of the conductor. The surface shall not depart from its cylindrical shape nor shall the strands move relative to each other so as to get out of place or disturb the longitudinal smoothness of conductor. The measured diameter at any place shall be not less than the sum of the minimum specified diameters of the individual aluminium and steel strands.

14.15 STRESS-STRAIN TEST

The test is contemplated only to collect the creep data of the conductor from the manufacturer. A sample of conductor of minimum 10 meters length shall be suitably compressed with dead end clamps.

15.0 TEST SET-UP

15.1 The test sample shall be supported in a trough over its full length and the trough adjusted so that the conductor will not be lifted by more than 10mm under tension. This shall be ascertained by actual measurement.

15.2 The distance between the clamp and the sleeve mouth shall be monitored with callipers during the test to ensure that, after the test, it does not change by more than 1mm + 0.1mm from the value before the test.
15.3 The conductor strain shall be evaluated from the measured displacements at the two ends of the gauge length of the sample. The gauge reference targets shall be attached to the clamps which lock the steel and aluminium wires together. Target plates may be used with dial gauges or displacement transducers and care shall be taken to position the plates perpendicular to the conductor. Twisting the conductor, lifting it and moving it from side-to-side by the maximum amounts expected during the test should introduce no more than 0.3mm error in the reading.

16.0 Test Loads for Complete Conductor

The loading conditions for repeated stress-strain tests for complete conductor shall be as follows:

16.1 1KN load shall be applied initially to straighten the conductor. The load shall be removed after straightening and then the strain gauges are to be set at zero tension.

16.2 For non-continuous stress-strain data, the strain readings at 1KN intervals at lower tensions and 5 KN intervals above 30% of UTS shall be recorded.

16.3 The sample shall be reloaded to 30% of UTS and held for 1 hour. Readings are to be noted after 5, 10,15, 30, 45 and 60 minutes during the hold period. The load shall be released then after the hold period.

16.4 The sample shall be reloaded to 50% of UTS and held for 1 hour. Readings are to be noted after 5, 10,15, 30, 45 and 60 minutes during the hold period. The load shall be released then after the hold period.

16.5 Reloading upto 70% of UTS shall be done and held for 1 hour. Readings are to be noted after 5, 10,15, 30, 45 and 60 minutes. The load shall be released.

16.6 Reloading upto 85% of UTS shall be done and held for 1 hour. Readings are to be noted after 5, 10, 15, 30, 45 and 60 minutes and the load shall be released then.

16.7 Tension shall be applied again and shall be increased uniformly until the actual breaking strength is reached. Simultaneous readings of tension and elongation shall be recorded upto 90% of UTS at the intervals.

17.0 Test Loads for steel core only

The loading conditions for repeated stress-strain tests for the steel core of ACSR shall be as follows:

17.1 The test shall consist of successive applications of load applied in a manner similar to that for the complete conductor at 30%, 50%, 70% and 85% of UTS.

17.2 The steel core shall be loaded until the elongation at the beginning of each hold period corresponds to that obtained on the complete conductor at 30%, 50%, 70% and 85% of UTS respectively.

18.0 Stress-strain curves

The design stress-strain curve shall be obtained by drawing a smooth curve through the 0.5
and 1 hour points at 30%, 50% and 70% of UTS loadings. The presence of any aluminium slack that can be related to any observed extrusion entering the span from the compression dead ends shall be removed from the lower ends of the design curves. Both the laboratory and standard stress-strain curves shall be submitted to the purchaser along with test results. The stress-strain data obtained during the test shall be corrected to the standard temperature i.e. 20 deg. C.

**19.0 DC RESISTANCE TEST ON COMPOSITE CONDUCTOR**

On a conductor sample of minimum 5m length, two contact clamps shall be fixed with a predetermined bolt torque. The resistance of the sample shall be measured by a Kelvin double bridge by placing the clamps initially zero metre and subsequently one metre apart. The test shall be repeated at least five times and the average value recorded. The value obtained shall be corrected to the value at 20 deg C as per clause no.12.8 of IS:398 (Part-II)-1982/1996. The corrected resistance value at 20 deg.C shall conform to the requirements of this specification.

**20.0 Procedure Qualification test on welded Aluminium Strands.**

Two Aluminium wires shall be welded as per the approved quality plan 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.

**21.0 Chemical Analysis of Aluminium and steel**

Samples taken from the Aluminium and Steel ingots / coils/ strands shall be chemically/ Spectrographically analysed. The same shall be in conformity with the requirements stated in this specification.

**22.0 Chemical Analysis of zinc**

Samples taken from the zinc ingots shall be chemically / spectrographically analysed. The same shall be in conformity with the requirements stated in this specification.

**23.0 Visual and Dimensional check on Drums**

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

**24.0 REJECTION AND RETEST**

24.1 In case of failure in any type test, the supplier is either required to manufacture fresh sample lot and repeat all the tests successfully once or repeat that particular type test three times successfully on the sample selected from the already manufactured lot at his own expenses. In case a fresh lot is manufactured for testing then the lot already manufactured shall be rejected.

24.2 If samples are taken for test after stranding and if any selected reel fails in the retest, the manufacturer may test each and every reel and submit them for further inspection. All
rejected material shall be suitably marked and segregated.

5.0 CHECKING AND VERIFICATION OF LENGTH OF CONDUCTOR

The contractor should arrange for inspection by the representative of the purchaser specially authorized for this purpose. At least 50% of the total number of drums of conductor subject to minimum of two taken at random should be checked to ascertain the length of conductor. Arrangements should be made available in the works of the manufacturer for transferring the conductor from one reel to another at the same time measuring the length of the conductor so transferred by means of a meter.

26.0 ADDITIONAL TESTS

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

27.0 TESTING EXPENSES

27.1 The breakup of the testing charges for the type tests specified shall be indicated separately.

27.2 Bidder shall indicate the laboratories in which they propose to conduct the type test. They shall ensure that adequate facilities are available in the laboratories and the tests can be completed in these laboratories within the time schedule guaranteed by them.

27.3 The entire cost of testing for the acceptance and routine tests and tests during manufacture specified herein shall be treated as included in the quoted unit price of the conductor, except for the expenses of the Inspector/Purchaser's representative.

27.4 In case of failure in any type test, if repeat type tests are required to be conducted then all the expenses for deputation of Inspector/Purchaser's representative shall be deducted from the contract price. Also if on receipt of the supplier's notice of testing, the Purchaser's representative does not find 'plant' to be ready for testing, the expenses incurred by the Purchaser for redeputation shall be deducted from contract price.

28.0 Test Reports

28.1 Copies of type test reports shall be furnished in at least six copies alongwith one original. One copy will be returned duly certified by the Purchaser only after which the commercial production of the material shall start.

28.2 Record of Routine test reports shall be maintained by the supplier at his works during inspection by the Purchaser's representative.

28.3 Test certificates of Tests during manufacture shall be maintained by the supplier. These shall be produced for verification as and when desired by the Purchaser.

29.0 Test Facilities
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 be free of vibrations, jerks etc with traverse laying facilities.

30.0 INSPECTION

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

30.2 The Bidder shall keep the Owner informed in advance of the time of starting and of the progress of manufacture of conductor in its various stages so that arrangements can be made for inspection.

30.3 The contractor will intimate the purchaser about carrying out of the tests at least 15 days in advance of the scheduled date of tests during which the purchaser will arrange to depute his representative/s to be present at the time of carrying out of the tests. Six (6) copies of the test reports shall be submitted.

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

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

30.6 At least 50% of the total number of drums subject to minimum of two in any lot put up for inspection, shall be selected at random to ascertain the length of conductor by the following method: "At the works of the manufacturer of the conductor, the conductor shall be transferred from one drum to another at the same time measuring its length with the help of a graduated pulley and Cyclometer. The difference in the average length thus obtained and as declared by the Bidder in the packing list shall be applied to all the drums if the conductor is found short during checking".
31.0 SCHEDULE OF DEVIATIONS/VARIATIONS

If the tenderer has any exceptions to any of the clause/s laid down in this specification, these should be clearly stated in the schedule of deviations / variations.

SPECIFIC TECHNICAL REQUIREMENTS

System Particulars
a) Line Voltage (kV) 33
b) Highest System Voltage (kV) 36
c) Number of Circuits 1
d) Frequency HZ 50
e) Neutral effectively earthed
j) Short circuit level (KA) 31.8KA

TECHNICAL REQUIREMENTS
k) Conductor : Panther ACSR
l) IS applicable: IS-398 (part-II)1996 latest revision.
m) Wire diameter: Panther

<table>
<thead>
<tr>
<th>Material</th>
<th>Diameter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aluminium (mm)</td>
<td>30/3.00</td>
</tr>
<tr>
<td>Steel (mm)</td>
<td>7/3.00</td>
</tr>
</tbody>
</table>

n) Number of strands:
   Steel centre
   1st steel layer 6
   1st Aluminium layer 12
   2nd Aluminium layer 18

o) Sectional Area of Aluminium (sq. mm.) 212.1

p) Total Sectional 261.5

q) Overall diameter (mm) 21
r) Approximate weight 974 (Kg./Km.)
s) Calculated D.C. resistance: 0.139 at 20 degrees C, maximum. (Ohms/km.)
t) Ultimate tensile strength 89.67(KN)
u) Final modulus of elasticity: 80 (GN/sq.m)
v) Coefficient of Linear 17.8 expansion x 10-6 per ° C
GURANTEED TECHNICAL PARTICULARS FOR
ACSR Panther Conductor

(To be submitted along with offer)

1. Maker's Name, Address & Country:

2. a) Aluminium:
   b) Steel wire:
   c) Complete conductor:

CONDUCTOR:

3. Size & Code:

4. IS/International Standards applicable:

5. Wire diameter in mm:
   Aluminium : Steel :

6. Diameter of complete Conductor in mm:

7. Number of strands: Steel centre:
   1st steel layer:
   1st Aluminium layer:
   2nd Aluminium layer:

8. Sectional Area of Aluminium in mm²:

9. Total Sectional Area in mm²:

10. Overall diameter in mm:

11. Weight in kg:

12. Calculated D.C. resistance at 20 degrees C, maximum:

13. Continuous current rating at 75 degree C (Enclose supporting calculations):

16. Ultimate tensile strength, kg/kN:

17. Final modulus of elasticity:

18. Co-efficient of Linear expansion:

19. Lay-Ratio Maximum Minimum
   Steel core 6 wire layer
   Aluminium
   1st layer
   2nd layer

STRANDS

20. Technical particulars of Steel Aluminium
   Aluminium and steel strands:
   a) Diameter (mm) Standard : Maximum : Minimum :
   b) Cross-sectional area of nominal diameter wire (sqmm):
   c) Weight in Kg/Km. :
   d) Minimum breaking load in Kg/KN Before stranding:
After stranding:

e) Minimum ultimate tensile stress of strand (KG/Sq mm):
f) Co-efficient of linear expansion:

21. D.C. Resistance at 20 degrees C in ohms/Km:

22. Zinc coating of steel wire in gms/m2:
    a) Number of 1 minute dips:
    b) Minimum weight of Zinc Coating:
    c) Process of Galvanizing:
    d) Quality of Zinc:

23. Joints in strands a) Steel:
    b) Aluminium:
    c) Method of making joint:
    d) Ultimate tensile strength of joint:

24. Maximum single length of conductor which can be manufactured in km:

25. Standard length of each piece in Km.:

26. a) Tolerance if any on standard lengths:
    b) Details of random lengths:

27. No. of standard length in one reel:

28. Type of Drums and IS applicable:

29. Dimensions of the Drum in cm. (Drawing shall be enclosed):

30. Weight of the Drum in kg:
    a) with conductor:
    b) empty Drum with lagging:

31. Details of marking on conductor drum:

32. Whether the drums are suitable for use with tension stringing equipment:

33. Standard according to which the conductor will be manufactured and tested:
    a) Certification Mark if any:
    b) Test certificate enclosed: Yes/No

34. Chemical composition of high carbon steel wire:

35. Initial & Final sag and Tension charts Furnished:

36. Stress/Strain data corresponding to different tensions, temperatures and time
    furnished:

37. Curves/tables of creep compensation corresponding to different tensions
    temperatures furnished:

38. Other details if any:
Section-III
NBLS Towers
TECHNICAL SPECIFICATIONS FOR 33kV NBLS Towers

Support Structures shall be of lattice type double circuit. Both suspension and tension poles in case of all 33 KV lines. Suitable extension where ever necessary in case mini base tower is to be used. The total steel structures to be inducted to the existing or as additional features should be galvanized with minimum zinc coating of 610 gms / Sq. Mts. Any new design (approved and tested in any approved test bed) as per the required parameters is also acceptable. The materials must conform to IS: 800. The entire test on materials and fabrication etc will be as per the relevant Indian standards.

In different crossings the contractor shall take into consideration the prevailing regulations of the respective authorities before finalizing type and location of the towers. While carrying out survey work, the contractor has to collect all relevant data, prepare and submit drawings in requisite number for obtaining clearance from road, aviation, railways, and river and forest authorities.

1.0 ERECTION WORK

Erection of transmission line shall include all necessary works before commissioning of the line including but not limited to the following:

- Submission of erection program with bar chart.
- Detailed survey Including location marking.
- Submission of Soil Testing/investigation Report
- Submission of Tower foundation design as per the Soil Test Report for Approval.
- Stub template setting, concreting of stubs, curing and coping.
- Earthing of tower.
- Erection of super structure and accessories.
- Fixing of Insulator and accessories, paving out and stringing of conductors with all accessories, fittings, dampers etc. complete for power conductors.
- Paving out and stringing of earth wire with all accessories, fittings of dampers etc. complete for earth wire.
- Checking and commissioning of the line after completion of all erection works.
- Getting clearance from Chief Electrical Inspector (CEI) Govt. of Orissa.
- Solving all type of ROW problem and payment of compensation at his own cost to make the location free for construction erection and stringing work.
- Payment of all type of crop compensation at his own cost.
- The contractor shall arrange the security for watch and ward for the entire work including the work already done till handing over of the line at his own cost. Engaging own security at own cost till final handing over of the line to CESU.
- Any incidental work not covered in the specification but are required for completion of
the line and commissioning thereof.

- All other materials required for satisfactory construction of Transmission lines such as sand, coarse aggregate, all type of fine aggregates, jelly, explosives, earth pit filling, materials like charcoal and salt etc, form boxes, shutters. Erection tools and works etc. of approved quality shall be inclusive of the cost of such materials and all other expenses incidental to execution of this contract shall be borne by the contractor.

**STANDARDS FOR STRUCTURAL STEEL WORK**

**IS: 800** Code of practice for general construction in steel

**IS: 606** Code of practice for use of steel tubes in general building construction

**IS: 808** Rolled steel beams, Channels and angle sections

**IS: 813** Scheme of symbols for welding

**IS: 814** Covered electrodes for metal arc welding of structural steel

**IS: 816** Code of practice for use of metal arc welding for general construction in mild steel

**IS: 1200** Method of measurement of steel work and iron work (Part 8)

**IS: 1236** Mild steel Tubes

**IS: 1363** Black hexagon bolts, nuts and lock nuts (dia 6 to 30mm) and black hexagon Screws (dia 6 to 24mm)

**IS: 1364** Precision and semi-precision hexagon bolts, screws, nuts and lock nuts (dia range 6 to 39mm)

**IS: 1367** Technical supply conditions for threaded fasteners

**IS: 1730** Dimensions for steel plate, sheet and strip for structural and general engineering purposes

**IS: 1977** Specification for structural steel (ORDINARY QUALITY)

**IS: 2062** Steel for general structural purposes

### 2.0 FABRICATION OF STRUCTURAL STEEL WORKS:

**SCOPE**

This sub-section of the specification concerns the supply, fabrication, testing, surface protection and delivery to site of structural steel work, including the supply of all bolts, nuts, washers, electrodes and other materials and consumables stores required for the fabrication.

**CODES AND STANDARDS**

All work shall conform fully to the requirements of the current version of all relevant Indian standards as determined by the Engineer in charge.

**MATERIALS**

- The materials shall conform to the following requirements. All steel materials to be used in construction within the purview of the specification shall comply with any of the following Indian Standard Specification as may be applicable.
• All bolts shall be property class 5.6 of property class 5.0 and nuts shall be of properly class 5.0 HRH and shall conform to the requirements of Indian standard Specification IS:1367(Part 3)– 1991, IS: 6639-1972 and galvanizing quality shall be as per IS: 538. All bolts and nuts shall be of minimum diameter of 16 mm. unless otherwise stated. All mild steel for bolts and nuts when tested in accordance with the following Indian Standard Specification shall have a tensile strength of not less than 44 kg/sq.mm. and a minimum elongation of 23 percent on a gauge length of 5.6 A, where ‘A’ is the cross sectional area of the test specimen. Washers shall be made of steel conforming to IS: 961 as may be applicable under the provisions of the contract. Zinc reached Epoxy Paints to be used for shop coat of fabricated steel (other than galvanized) under the purview of this contract shall conform to IS: 2074 – Ready mixed paint, red oxide –zinc chromate priming.

MATERIALS TO BE USED

• All steel materials required for the work will be supplied by the Contractor unless otherwise specified elsewhere in the contract. The materials shall be free from all imperfections, mill scale, slag intrusions, laminations, pitting, rusts, etc. that may impair their strength, durability and appearance.

• All materials shall be of tested quality only, test certificates in respect of each consignment of structural steel work delivered to the site shall be submitted to the Engineer.

• Electrodes for manual metal arc welding shall be of approved manufacturer and conforming to the relevant Indian Standard Codes of Practice and Specification. They shall be of the heavily coated type and the thickness of the coating shall be uniform and concentric. With each container of electrodes, the manufacturer shall furnish instructions giving recommended voltage and amperage,(and polarity in the case of direct current supply), for which the electrodes are suitable.

Note: All Iron materials including Joist, Angle, Channel, Cross Arms, Pins, Tower members etc used in this project shall be galvanized of 610gm/mt².

• Electrodes: All electrodes to be used under the Contract shall be of approved manufacturer and shall comply with the relevant Indian Standard Specifications, including but not limited to the following requirements:-

  IS: 814 Covered electrodes for manual metal arc welding of carbon making manganese steel
  IS: 7280 Bare wire electrodes for submerged are welding of structural steels.
• **Mild Steel:** When tested in accordance with the following Indian Standard Specifications all mild steel for bolts and nuts shall have a tensile strength of not less than 44 Kg/mm² and a minimum elongation of 23 percent on a gauge length of 5.6 A, where \( -\frac{\text{\textit{A}}}{\text{\textit{A}}} \) is the cross sectional area of the test specimen:

**IS: 1367** Technical supply conditions for threaded fasteners

**IS: 1608** Method for tensile testing of steel products other than sheet, strip, and wire tube

• **Steel:** All steel materials shall comply with the relevant Indian Standard Specifications, described above. Where imported steel material is used, this shall conform to the relevant international specification which is deemed to be appropriate by the Engineer.

• **Bolts, Nuts and Washers:** All bolts and nuts shall conform fully to the requirements of Indian Standard Specification **IS: 1367.** Materials for bolts and nuts under the purview of this contract shall comply with any of the following Indian Standard Specifications as may be applicable.

• **High Tensile Steel:** The material used for the manufacturer of high tensile steel bolts and nuts shall have the requirements of **IS:1367**

• **Washers:** Washers shall be made of steel conforming to the appropriate Indian Standard Specifications including, but not limited to **IS: 1977, IS: 2062, IS: 6649**

3.0 DESIGN METHOD FOR TOWERS

The stress analysis shall be conducted by any suitable method for all types of steel structures including towers, Line supporting structures, considering following worst case load combinations as applicable for respective structures:

- All possible combinations of dead loads, service loads and on any other applicable Loads as derived.
- Wind induced loads.
- Inertial forces induced due to seismic activities.
- Thermal stresses.
- Any other special loads like short circuit forces (CTC) during service period of structures and during erection stages.

Usage of INHOUSE developed software shall not be permitted. Only standard widely used and tested software’s i.e. STAAD-3, COSMOS, SAP-90 etc shall be used for analysis and design of structure.
ASSUMED WORKING LOADS

- **Wind load:** Wind load on structure trusses, equipment, conductor, insulators, etc. shall be assessed confirming to IS: 802 (Part-I. Sec-I) –1995 for the state of Orissa in coastal district

- **Conductor Tension:** The tension for conductors will be 1000 Kg. And for shielding wire will be 750 kg. Angle of deviation with respect to direction normal to take off structure beam will be 0 deg. to 15 deg.

- **Short Circuit Loading:** Short circuit forces including snatch in the case of bundle conductors shall be considered according to manufacturers specification.

- **Seismic Loads:** The lateral forces shall be established in accordance with recommendations of IS: 1893-1984. A basic horizontal seismic co-efficient of 0.04 shall be used.

- **Dead Load:** Dead weight, loads of conductors, insulators and electrical
  Line shall be taken into Consideration in the design as per data furnished by the manufacturers and conforming to IS: 802 (Part-I/Sec-I) – 1995.

- **Human Load:** A point load of 150 Kg. Anywhere on the structure
  Stress on members shall be checked conforming to IS: 802 (Part-I/Sec-2)- 1992.

COMBINATION OF LOADS

- For the design of the steel structures, simultaneous application of loads as indicated shall be considered. The direction of wind should be assumed such as to produce the maximum Stress in any member for the combination of wind load and wire tensions.

NORMAL CONDITION

Strung Bus Bars

- Wind load on bus bars, shield wires, insulator strings, electrical equipments structure members etc.
- Unbalanced loads due to wire tension.
- Dead loads of wire, insulators, electrical Line and structure members.

ABNORMAL CONDITIONS

- **Short Circuit Conditions:** In addition to the combination of loading excluding the wind loads, earthquake forces as specified shall be considered for the design of structural members.

- **Earthquake Conditions:** In addition to the combination of loading, short circuit forces shall be considered for the design of structural members.

FACTOR OF SAFETY

The factor of safety in the design of members for steel switchyard structures shall be as per

**LIMIT OF EFFECTIVE SLENDERNESS RATIO**
The effective slenderness (L/R) ratio of members shall meet the following limits.

- **Leg members, Gantry chords, main compression:** 120
- **Member and ground wire peaks:**
- **Other members having computed compressive Stress:** 200
- **Tension members:** 400

Where
- **L:** Length of the unsupported panel of member.
- **R:** Radius of gyration of members.

In order to facilitate transportation and hauling, the length of any structural member shall not exceed 6 m.

**MINIMUM THICKNESS AND SIZE OF STEEL MEMBERS**
Minimum thickness of steel members of structures shall be as follows:

- **For leg members and compressive chords in Gantry:** 6 mm
- **For other members without calculated stress:** 5 mm
- **For redundant members without calculated stress:** 5 mm Gusset plates: 6 mm Minimum
- **Bolt diameter for main members:** 16 mm carrying calculated stress
- **Minimum bolt diameter for bracing member:** 12 mm without calculated stress.

In computing the net section of tension members, the diameter of the bolt holes shall be taken as 1.5 mm. greater than the nominal diameter of the bolts.

**4.0 DESIGN DRAWINGS AND CALCULATIONS**
The design drawings shall show the following data and information:
- Tower Foundation by piling method if required along with the calculation based on the soil investigation report discussed above.

**5.0 DETAILING OF TOWER MEMBERS**
Detailing shall be done as per IS: 802 (Part-II)-1978 and as follows:

**General**
Steel structure dimensions, framing, member sizes and length, number, size and length of bolts, thickness of each of the fillers and other necessary details to fabricate each piece
shall be shown on the approved detailed drawings. No subsequent change shall be made without the written approval of CESU.

All web members shall be in one piece where practicable. All double diagonal web system members shall be connected at their point of intersection by at least one bolt.

Step bolts
Step bolts shall be of 16-mm. diameters and shall have round or hexagonal head. Each step bolt shall be provided with two hexagonal nuts. The minimum bolt length and length of unthreaded portion shall be 150 and 100 mm. respectively. Step bolts shall not be used as connection bolts.

The step bolts shall be spread alternately on the inner gauge line on each face of the angle about 40 cm. Centers. They shall be furnished for one leg of each steel structure column from its base elevation.

‘U’ bolts
Detailed drawings shall be complete with sizes and detailed dimensions of all steel structure members. At each joint there shall be the number, size and length of bolts, number and size of fillers and detailed dimensions of gusset plate, if any.

Bill of Material
Bill of Material shall give the size, length and galvanized weight of each member and the total weights of steel structures. It shall also include the number of bolts, nuts and washers per structure.

6.0 QUALITY CONTROL
The contractor shall establish and maintain quality control procedures for different items of work and material to ensure that all work is performed in accordance with the specifications and best modern practice.

In addition to the contractors quality control procedures, materials and workmanship at all times shall be subjected to inspection by the CESU. As far as possible, all inspection by the CESU’s representative shall be made at the Contractor’s fabrication shop whether located at site or elsewhere. The contractor shall co-operate with the CESU in permitting access for inspection to all places where work is being done and in providing free of cost of all necessary help in respect of tools and plants, instrument, labour and material required to carry out the inspection.

Materials or workmanship not in reasonable conformance with the provisions of these specifications maybe rejected at any time during the progress of the work. The quality control procedure shall cover but not be limited to the following items of work:

**Steel:** Quality, manufacturer’s test certificates, test reports of representative samples of
materials from unidentified stocks if permitted to be used.

**Bolts, nuts & washers:** Manufacturer’s certificate, dimension & washers, check, material testing.

**Electrodes:** Manufacturer’s certificate, thickness and quality of flux coating.

**Welds:** Inspection, X-ray, ultrasonic test, and magnetic particle test.

**Paints:** Manufacturer’s certificate, physical inspection reports.

**Galvanizing:** Tests in accordance with IS: 2633 – Methods of testing weight, thickness and uniformity of coating on hot-dipped galvanizing articles.

### 7.0 FABRICATION

#### WORKMANSHIP

All workmanship shall be equal to the best practice in modern structural shop and shall conform to the provisions of IS: 800 – 1984 & IS: 802 (Part II) 1978.

Rolled materials before being laid off or worked, must be clean free from sharp kinks, bends, or swifts and straight within the tolerances allowed by IS: 1852. If straightening is necessary, it may be done by mechanical means or by the application of a limited amount of localized heat not exceeding 600 deg. C.

Cutting shall be affected by shearing, cropping or sawing. Use of mechanically controlled Gas Cutting Torch may be permitted for mild steel only. Gas cutting of high tensile steel may also be permitted provided special care is taken to leave sufficient metal to be removed by machining, so that all metal that has been hardened by flame is removed. To determine the effective size of members, cut by gas, 3 mm. shall be deducted from each cut edge.

The erection clearance for cleared ends of members connecting steel to steel shall preferably be not greater than 2 mm. at each end. The erection clearance at ends of beams without cleats shall not be more than 3 mm. at each end, but where for practical reasons greater clearance is necessary suitably designed clearings shall be used. All members shall consist of rolled steel sections.

Holes for bolts shall not be more than 1.5 mm. large than the diameter of the bolt passing through them. All members shall be cut to jig and all holes shall be punched and drilled to jig. All parts shall be carefully cut and holes accurately located after the members are assembled and tightly clamped or bolted together. Drifting or rimming of holes shall not be allowed. Holes for bolts shall not be formed by gas cutting process. Punching of holes will not be permitted for M.S. members up to 8 mm. thick and in no case shall a hole be punched where the thickness of the material exceed the diameter of the punched hole.

The stress analysis shall be conducted by any suitable method for all types of steel structures. Any computer programmer to be employed shall be prepared of approved by the recognized institute and be submitted to CESU/ Engineer Minimum bolt spacing and
distances from edges for members shall be in accordance with the provisions in the relevant Indian Standard Specification.

Built members shall, when finished, be true and free from all kinds of twists and open joints and the material shall not be defective or strained in anyway.

All bolts shall be galvanized including the threaded portion. The threads of all bolts shall be cleared of smelter by spinning or brushing. A die shall not be used for cleaning the threads unless special approved by the CESU. All nuts shall be galvanized with the exception of the threads, which shall be oiled.

When in position all bolts shall project through the corresponding nuts but not exceeding 10 mm.

The nuts of all bolt attaching insulator sets and earth conductor clamps to the structure shall be carefully positioned as directed by the CESU. Bolts and nuts shall be placed in such a way so that they are accessible by means of an ordinary spanner.

Foundation bolts and tubes shall be fitted with washer plates or anchor angles and flats, nuts, etc and shall be manufactured from mild or special steel.

Washers shall be tapered or otherwise suitably shaped, where necessary to give the heads and nuts of bolts a satisfactory bearing. The threaded portion of each bolt shall project out through the nut at least one thread. In all cases, the bolt shall be provided with a washer of sufficient thickness under the nut to avoid any threaded portion of the bolt being within the washer, one spring washer or lock nut shall be provided for each bolt shall project out through the nut at least one thread. In all cases, the bolt shall be provided with a washer of sufficient thickness under the nut to avoid any threaded portion of the bolt being within the washer, one spring washer or lock nut shall be provided for each bolt for connections subjected to vibrating forces or otherwise as may be specified in the drawings.

8.0 CLEANING AND GALVANIZING

Cleaning

After fabrication as been completed and accepted, all materials shall be clear of rust, loose scale, dirt, oil grease and other foreign substances.

Galvanizing

All materials shall be hot-dip galvanized after fabrication and cleaning. Re- tapping of nuts after galvanizing is not permitted. Galvanizing or structural mild steel products shall meet the requirements of IS: 4759-1984.

All holes in materials shall be free of excess shelter after galvanizing. Galvanizing for fasteners shall meet the requirements of IS: 1367 (Part – 3)-1983. The spring washers shall be electro galvanized as per IS: 1573 – 1986. Finished materials shall be dipped into the solution of dichromate after
Galvanizing for white rust protection during transportation. All galvanizing shall be uniform and of standard quality.

**Mass of zinc Coating**

The mass of zinc coating for different class of materials, as given in Table, shall be followed.

**MASS OF ZINC COATING**

<table>
<thead>
<tr>
<th>Sl.No.</th>
<th>Product</th>
<th>Minimum value of average Mass of coatings Gm/m</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Castings – grey iron, malleable iron</td>
<td>610</td>
</tr>
<tr>
<td>2.</td>
<td>Fabricated steel articles: A. 5 mm thick and over</td>
<td>610</td>
</tr>
<tr>
<td></td>
<td>B. Under 5 mm, but not less than 2 mm.</td>
<td>460</td>
</tr>
<tr>
<td></td>
<td>C. Under 2 mm. but not less than 1.2 mm</td>
<td>340</td>
</tr>
<tr>
<td>3.</td>
<td>Threaded work other than tubes and tube fittings: A. 10 mm. dia. and over</td>
<td>300</td>
</tr>
<tr>
<td></td>
<td>B. Under 10 mm. dia.</td>
<td>270</td>
</tr>
</tbody>
</table>

**Straightening after Galvanizing**

All plates and shapes which have been warped by the galvanizing process shall be straightened by being re rolled or pressed. The materials shall not be hammered or otherwise straightened in a manner that will injure the protective coating. If, in the opinion of CESU the material has been forcibly bent or warped in the process of galvanizing of fabrication such defects shall be cause for rejection.

**Repair of Galvanizing**

Materials on which galvanizing has been damaged shall be acid stripped and regularized, unless, in the opinion of CESU, the damage is local and can be repaired by zinc spraying or by applying a coating of galvanizing repair compound. Where regularizing is required, any member which becomes damaged after having been dipped twice shall be rejected.

**9.0 CONFIRMITY WITH DESIGN**
The contractor shall design the towers including all connection not detailed in the tender Drawings. Full design calculation for the connections shall be submitted with the fabrication drawings for review by the Engineer in Charge.

The Contractor shall design and fit all required lifting lugs or attachments required for erection of the structural steelwork and provide appropriate design and calculations for review. Contractor shall furnish all materials and fabricate all steelwork in accordance with the approved Drawings and/or as instructed by the Engineer keeping in view the maximum utilization of the available sizes and sections of steel materials.

The method of painting, marking, packing and delivery of all fabricated materials shall be strictly in accordance with the provisions of the Specification and/or as approved by the Engineer.

10.0 STORAGE OF MATERIAL

General

All materials shall be as stored as to prevent deterioration and to ensure the preservation of their quality and fitness for the work. Any materials which has deteriorated or has been damaged shall be removed from the Contractors yard immediately, failing which the Engineer shall be at liberty to arrange for removal of the material and the cost incurred thereof shall be realized from the Contractor. The Contractor shall maintain up to date accounts in respect of receipt, use and balance of all sizes and sections of steels and other materials. Where fabrication is carried out in Contractors fabrication shop or site and where fabrication works for their other projects are also carried out, all materials allocated for use on these projects shall be stored separately with easily identifiable marks.

QUALITY CONTROL

The contractor shall establish and maintain quality control procedure for all items of work and material provision to ensure conformity with the requirements of this specification in addition to the Contractors quality control procedures, materials and workmanship shall at all times be subjects to be inspected by the Engineer in charge.

The quality control procedure shall cover but not be limited to the following items of work:-

- Steel Quality Manufacturers test certificates.
- Bolts, Nuts & Manufacturers certificate, dimension checks, material Washers testing.
- Electrodes Manufactures certificate, thickness and quality of flux coating. All inspection by the Engineer shall be carried out at the Contractors fabrication shop unless the Engineer is an agreement with other arrangements being made. The Contractor shall permit access for inspection to all places where work is being
carried out and shall provide, free of cost, all necessary assistance to the Engineer in respect of tools and plant instruments labour and materials required to carry out the inspection.

11.0 EARTH WORK FOR TOWER FOUNDATIONS

General Requirements
The contractor shall provide all tools, plants, instruments, qualified supervisory personnel, labour materials, any temporary workers, consumables, and everything necessary, whether or not such items are specifically stated herein, for completion of the project in accordance with specification requirement. The excavation shall be done in accordance with the design and drawing. This shall also includes, where ever required, proper shoring shuttering to maintain excavations and also the furnishing, erecting and maintaining of substantial barricades around excavated areas and warning lamps at night for ensuring safety of lives and property.

• Scope also includes dumping of excavated materials in regular heaps, bunds, rip rap with regular slope as directed by Engineer-in-charge within the lead specified and leveling the same so as to provide natural drainage. Rock/soil excavated shall be stacked properly. All softer materials shall be laid along the center of the herpes, the harder and more weather resisting materials forming the casing on the sides and the top. Rocks shall be stacked separately.
• The area to be excavated /filled shall be cleared of trees, plants, stumps, bush, vegetation rubbish etc. and other objectionable matter. If any roots or stumps or trees are met during excavation, they shall be removed as directed by Engineer-in-charge.

• Soft/Loose Soil:
These shall include all kinds of soils containing pellets, Sand, Silt and are removable by ordinary pick axes, shovel and spade and which is not classified under “Dense/Compact” “soft dis-integrated” and “Hard Rock” category as defined below:

• Dense/Compact Soil:
Spoil removable by pick-axe, crowbar etc. Moorum or shingle, gravel, clay, loam peat etc.

• Soft & Decomposed / Dis- integrated Rock:
This shall include rock, boulders, shale, chalk, slate, hard mica, schist, laetrite and all other materials which in the opinion of the Engineer-in- charge is rock, does not need blasting and could be removed with picks, hammer, craw bars, wedges and pneumatic breaking work. This shall also include rock boulders not longer than one meter in any direction and not more than 500 mm in any one of the other two directions.
• **Hard Rock**
  This shall include all rock occurring in continuous masses which cannot be removed except by blasting for loosening it. Harder varieties of rock with or without veins and secondary minerals, which in the opinion of the Engineer-in-charge require blasting, shall be considered as hard work.

• **Submerged Soil**
  Where the subsoil water table is encountered within the range of foundation depth, the soil below the water table and that at locations where pumping or bailing out of water is required due to presence of surface water will be treated as wet soil. Soil partially submerged and fully submerged shall also come under this category. In case of pile foundations submerged soil; the required sand filling should be done by the contractor by his own cost.

• Where soil at a tower foundation is of composite nature, classification will be according to the type of soil, which is preponderant in the footing and the rate for the same will apply for the composite foundation. The decision of the CESU Engineer-in-charge shall be final and binding with reference to classification of soils.

• All surplus excavated soil along with left over gradients if any “should be removed from work site and dumped at any suitable place in such a manner that the landowner will not object. A thin layer of nearly 200mm of surplus earthy can be stacked over the excavated pits for future compaction”.

• Standard penetration test to be carried out for long line one in ten support sites.

**Back filling has to be done by borrowed earth if required.**

All organic or other foreign materials shall be removed from back fill earth. The earth shall be deposited in maximum 200mm. Layers, leveled and watered and rammed properly before another layer is deposited.

The back filling should be such that enough moisture would be available for curing of the concrete embedded. Sufficient water shall be poured over the back filled earth for proper consolidation. All surplus excavated soil shall be stacked around the tower legs. In case of wet locations, de-watering, shoring and shuttering etc. if required shall be paid for based on unit rates indicated. The actual quantity shall be as approved by the Engineer-in-charge. The shoring and shuttering is to be done by very good quality planks and supports as approved by Engineer-in-charge.

**Stub-Template setting, concreting of stubs and copping:**

- The stub shall be set correctly in accordance with approved method at the exact location and alignment with the help of stub setting templates as per the standards. The levels and alignment shall be checked and approved by Engineer-in-charge for which
adequate advance intimation shall be given by the contractor. The approval shall not, however, relieve the contractor of his responsibility of correctness of setting.

- The bottom of the pits shall be free from loose earth and shall have about 150mm. Thick layer of sand or a lean concrete [1:4:8] mat, before stubs are set for concreting. The concrete shall be as specified in relevant I.S.S. for such work or as directed by the Engineer-in-charge. It shall be 1:2:4 mix with proper quality of sand, cement and granite chips as stated below: The concreting of stubs shall not be made in parts and it should be a continuous process till completion.

Reinforcement, as per approved drawings. In no case the bottom most portion clits of stub should be more or less than 75mm from the bottom finished level.

**Concreting:**

**Sand—**
The sand to be used for concreting shall be coarse and from available Local River beds free from clay and other undesirable organic & inorganic materials like dust, lump, loam, mica, saline and other deleterious substances.

**Coarse Aggregate—**
The coarse aggregate to be used shall be of broken granite rock varying in size from 20mm. to 40mm. to be approved by the Engineer-in-charge provided the resultant concrete shall meet the requirement of IS:456-1964 M150 quality.

**Water—**
Clear non-saline, free from oils, acids alkalis and organic materials water from river, tank or well shall be used in concreting.

**Concreting—**
The stock position/condition of cement will be subject to inspection by the Engineer-in-charge at any time and at the time of use in the work.

For reconciliation of cement account, consumption of cement shall be considered as under:

- 1:1.5:3 Mix -
- 1:2:4 Mix 330kg/cum
- 1:3:6 Mix 225kg/cum
- 1:5 Cement mortar 87kg/cum
- 1:4:8 Mix 115kg/cum

- Before laying the concrete the stub shall be cleaned of rust, scale, mud etc with a steel wire brush. The method of placement of concrete shall be such as not to result in loss of workability or in segregation of concrete mix.

- In wet locations, the site must be kept completely dewatered, both during the placing of the concrete and for 24 hours thereafter to protect the concrete from water during this period.

**Reinforced Cement Concrete:**
The steel reinforcement bar shall be fabricated and placed in the position while concreting as shown in the approved foundation drawing or as directed by the Engineer-in-charge. Before the steel reinforcement bars are placed in position, the surface of the bars shall be cleared of rust, scale, dirt, grease or other objectionable foreign substance. The bending and fixing of bars for concrete reinforcements shall conform to IS: 2502/1963 and IS: 5525/1969. Sufficient concrete coverage as indicated in the foundation drawing or as per relevant ISS, where not shown in the drawing, should be provided.

- **Copping**
  After completion of back-filling the coping over the top surface of the chimney shall be done as per the approved foundation drawing with 1:2:4 concrete with a slight slope towards the outer edge to drain off any rain water falling on the coping. The coping shall have a smooth and geometrical finish. In no case the height of coping more or less than 350mm above the actual ground level.
  Black Bitumen paint of 2 coat of a length 400mm above the coping should be provided by the contractor by his own cost.

- **Curing**
  Full care should be taken for curing of the concrete exposed over ground by any conventional method. 15 days curing is required depending on weather and location. The concrete underground is expected to be cured from the moisture in the backfill earth.

- **EARTHING**
  Every tower shall be suitably earthed so that the tower footing resistance does not exceed 10 Ohms. Depending on the earth resistively of soil it is to be decided by the Engineer-in-charge whether pipe type Earthing or counterpoise Earthing is to be provided, details of which shall be indicated in the approved drawings. The earth electrode shall be 40mm. dia 3 mtr. Long heavy duty GI pipe. The contractor shall supply 560 kg. of common salt and 50 kg. Charcoal for each earth pit. The contractor is required to take soil resistively reading at each location before start of work.

ERECTION OF SUPER STRUCTURE WITH ACCESSORIES

- The super structure shall be erected as per approved structural drawings to be furnished by the Contractor. All members shall be carefully handled during transport and erection so that the galvanizing is not scratched and the interior steel not exposed. In storage and at tower site all tower steels shall be kept clear of the ground in a clean and dry condition. Contact with brackish water or other substances likely to attach galvanizing shall be avoided. All superficial rust stains, corrosive salts and other corrosive foreign materials deposited prior to or during installation of the tower shall be removed without causing damage to the protective surfaces. Towers shall be erected in a workman like
manner and tower members shall not be strained or deformed during course of erection.

- The method followed for the erection of towers shall ensure the points mentioned below:
  - Straining of the members shall not be permitted for bringing them into position. It may, however, be necessary to match hole positions at joints and to facilitate this, Tommy bars not more than 450 mm. long may be used.
  - Before starting erection of an upper section, the lower section shall be completely braced and all bolts provided in accordance with approved drawings.
  - All plan diagonals relevant to section of tower shall be placed in position before assembly of upper section is taken up.
  - All bolts will have their bolt heads facing outside/inside of the tower as convenient, for horizontal or nearly horizontal bolt connection and upwards for vertical bolt connections.
  - Slings and other works used for picking up members, portions of towers or complete towers, shall be protected in such a manner as to prevent cuttings into the corners of members, damaged the finish or portions of towers shall be raised in such a manner that no dragging on the ground surface or against portions of the towers already erected will occur.

- Normally two version towers will be used viz: “Hx”, and “Hz” type with their extensions.
- The method of erection is left to the contractor subject to his responsibility for any damage done to the materials due to any cause. The erection of towers should not be started earlier than 15 days after back fill of the stubs so that there is no disturbance or damage to the concrete and also to allow it to acquire its full strength. Approval of the Engineer-in-charge to start erection work shall be obtained.

  After the final tightening of bolts and nuts the threads shall be punched so as to prevent loosening under temperature changes or vibrations. The towers must be truly vertical after erection and no straining will be permitted to bring them so. Towers shall be so erected that the vertical axis through the center of the gravity shall not be out of plumb by more than one centimeter for every 500 centimeter of height.

- **TIGHTENING AND PUNCHING OF BOLTS AND NUTS —**

  All nuts shall be tightened properly using correct size spanners or torque wrenches. Before tightening, it shall be seen that filler washers and plates are placed in relevant gaps between members bolts of proper size and length are inserted under each nut and in case of steps bolts, spring washers have been placed under the outer nut. The tightening shall progressively be carried out from the top down wards and checked back from bottom upwards before punching care being taken that all bolts at every level are tightened simultaneously. The minimum 3 thread should be projected after final tightening. After final tightening, the projected thread
should be riveted by using hammer. In the complete tower, the nuts for bolts shall be tightened to the following torque.

**Size of bolts tightening torque**

<table>
<thead>
<tr>
<th>Size of bolts</th>
<th>Torque (kg-m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>12 mm dia</td>
<td>600-800</td>
</tr>
<tr>
<td>16 mm dia</td>
<td>1000-1200</td>
</tr>
<tr>
<td>20 mm dia</td>
<td>1400-1800</td>
</tr>
<tr>
<td>24 mm dia</td>
<td>2000-2500</td>
</tr>
</tbody>
</table>

**• FIXATION OF INSULATORS AND HARDWARES —** Insulators shall be handled carefully in all stages of handling and be individually checked for cracks, damage, and loss of glaze etc. before assembly and erection at site, which shall be according to the drawings approved by CESU. The rigging and hoisting of insulator strings shall be done very carefully so that no damage is caused to the insulators and hardware. Discs with hairline cracks and chips and also those having glazing defects exceeding ½ cm sq. shall not be used. At all major highways, Main River and utility line crossing double string of insulators shall be used.

The entire stringing work of conductor and earth wire shall be carried out by tension stringing technique. The contractor shall indicate in their offer, the sets of tension stringing equipment he is having in his possession and the sets of the stringing equipment he would deploy exclusively for this package which under no circumstance shall be less than the number and capacity requirement indicated in Qualifying Requirements for Bidder.

**Materials:**

The Bidder should have assured access to supply Earth wire, hardware fittings and Conductor & Earth wire accessories from qualified manufacturers. Type test certificate from CPRI/Govt. testing laboratory should be attached with the offer.

- **Earth wire:** Galvanized steel ground wire of size 7/3.15 mm or above from any reputed manufacturer.

- **Hardware Fittings:** 90KN/100KN Hardware fittings of reputed manufacturer.
  
  Type and load test certificates from CPRI/ Govt. testing laboratory.

- **Insulator String Hardware (As may be applicable)**
  
  I. Anchor shackle
  II. Chain Link
  III. Ball Clevis
  IV. Arcing horn holding plate
  V. Yoke plate
  VI. Socket clevis
  VII. Arcing horns
VIII. Corona control ring/grading ring  
IX. Clevis Eye  
X. Free center type/ Amour grip suspension clamp for suspension strings.  
XI. Compression type dead end clamp.  
XII. Sag adjuster.  
XIII. Balancing weight

- **Accessories for Conductor & Earth wire (As may be applicable)**
  - Performed Amour rods
  - Mid Span compression joint
  - Repair Sleeves
  - Flexible copper bonds
  - Bundle spacers
  - Vibration dampers
  - Rigid Spacer
  - Suspension clamp for earth wire.
  - Tension clamp for earth wire

- **Service Conditions:**
  - Equipment/ material to be supplied against this specification shall be suitable for satisfactory continuous operation under tropical conditions as specified below:
    - Maximum ambient temperature (Degree Celsius) : 50
    - Minimum ambient temperature (Degree Celsius) : 0
    - Relative humidity (% range) : 10 – 100
    - Wind zone (as per IS : 875) : 49 m/sec
    - Maximum altitude above mean sea level (Meter) : Up to1000m
    - Isoceraunic level (days/years) : 50
    - Moderately hot and humid tropical climate conducive to rust and fungus growth.

- **General Climatic Conditions:**
  - Climatic conditions shall be of tropical nature having summer period for 8 months and winter period for 4 months in a year. The maximum temperature during summer be of the order of 50 Deg. C and the minimum temperature in the winter shall be of the order 40° C. Normal every day temperature is 32° C.
  - **Working Seasons:**
    - Working season shall be approximately 9 months/year and balance 3 months shall be monsoon period. For this particular work two working seasons shall be
allowed to the contractor.

- **Guaranteed Technical Particulars**

  The Guaranteed Technical Particulars of the various items shall be furnished by the Bidders in one original and one duplicate for Approval from CESU. The data furnished in Guaranteed Technical Particulars should be the minimum or maximum value (Which ever is ruling condition as per the requirement of the specification) required. However, for testing purpose or from performance point of view, the material shall be considered performed successfully if it achieves the minimum/maximum value required, whichever is ruling condition, as per the technical specification. No preference whatsoever shall be given to the bidder offering better/more stringent values than the required as per specification except where stated otherwise.

- **Access to the Line and Right of Way:**

  Right of way and way leave clearance shall be arranged by the Contractor in accordance with work schedules. Owner will secure way leave and Right of way in the Forest area but the contractor shall maintain the same for the entire period of the contract.

- **Clearance from Ground, Building, Trees etc**

  Clearance from ground, buildings, trees and telephone lines shall be provided in conformity with the Indian Electricity Rules, 1956 as amended up to date. The tree cutting shall be the responsibility of the Owner except for that required during survey. However, the Contractor shall count, mark and put proper numbers with suitable quality of paint at his own cost on all the trees that are to be cut by the Owner at the time of actual execution of the work as detailed below. Contractor may please note that Owner shall not pay any compensation for any loss or damage to the properties or for tree cutting due to Contractor’s work.

**STRINGING OF OVERHEAD GROUND WIRE**

- **GENERAL**

  The overhead ground wire(s) shall be strung for the entire length of the transmission line, and shall be attached to the towers in accordance with the details same as for conductor(s). The work, methods, and limitations used for installing the overhead ground wire shall be the same as for installing the conductor.

- **STRINGING OF OVERHEAD GROUND WIRE**

  The overhead ground wire shall be strung in advance of the conductors, and the method shall be the same as for conductor string. The same degree of care shall be exercised to avoid damage or injury of the overhead ground wire. If damaged, the
contractor in a manner approved by the Engineer-in-charge shall replace them.

- **JOINTING OF OVERHEAD GROUND WIRE**
  Compression type joints and clamps shall be installed in accordance with the printed instructions of the manufactures. Galvanized tension sleeves shall, after jointing, be coated effectively with an approved rust preventive paint and shall further be furnished with a repair coat of paint after final passage through snatch blocks.

- **SAGGING OF OVERHEAD GROUND WIRE**
  After being sagged, the overhead ground wire shall be clipped in the same manner as for conductor. Suspension clamps of overhead ground wire shall be installed in such a manner that earthling bond wires shall all face a given direction. The ends of bond wires shall be clamped with terminal clamps in an approved manner. In no case the sagging of the ground wire will be more than the conductor sag. The mid-span clearance between ground wire and power conductor should be more than the clearance near the tower in order to avoid flashover during lightening surge.

- **FIXING OF CONDUCTOR AND GROUND WIRE ACCESSORIES**
  Vibration dampers and other conductor and ground wire accessories shall be installed by the contractor as per the design requirement and as per the respective manufactures instruction. Dampers shall be fastened securely, so that all dampers will hang in vertical planes. Vibration dampers shall be installed within 24 hours after the conductor has been clipped in.

- **FIXING OF TOWER ACCESSORIES**
  All towers accessories such as anti climbing devices phase plate, number plate, danger plate etc. hall be fixed in an approved manner. The bird guard should be fixed in all X arms of tangent tower at the time of erection of tower.

- **SPECIAL WORKS**
  Special works which are not within the scope of this contract but come up during the execution of the works shall be carried out by the contractor at mutually agreed methods and rates to be decided before the commencement of such works. All nuts up to the bottom cross arm shall be welded continuously to the bolt by the contractor using his own welding rod and skilled welder as per schedule of quantity.
Tower Drawings:
Section-IV
R.S. Joist Pole
TECHNICAL SPECIFICATION OF 11 mtr, R.S Joist Pole

1.0 Scope Of Work:
This specification covers design, manufacture, testing and supply of 150x150mm RS Joist 11 Meter long designed for a working load of 306kg. The bidder should enclose Performance Certificates from the above users, issued in favour of the Sub Vendor / manufacturer, as proof of successful operation in field.

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Size</th>
<th>Purpose</th>
<th>Supply Qty(Nos)</th>
<th>Locations</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>11 Mtr</td>
<td>DP</td>
<td>4</td>
<td>1. At Ransinghpur grid</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2. At IOCL Depot</td>
</tr>
<tr>
<td>2</td>
<td>11 Mtr</td>
<td>4-Pole</td>
<td>4</td>
<td>At Janla S/s</td>
</tr>
</tbody>
</table>

Applicable Standards:
This specification covers the manufacturing, testing before dispatch and delivery of following R.S Joists

<table>
<thead>
<tr>
<th>150x150mmRS Joist</th>
</tr>
</thead>
<tbody>
<tr>
<td>150 x 150 mm R.S. Joist length:-11mtr,30.6kg/mtr total weight 336.6kg</td>
</tr>
</tbody>
</table>

2.0 Standards:
The RS JOISTS shall comply with the requirements of latest issue of IS – 2062 Gr – A except where specified otherwise.

3.0 Climatic Conditions:
The climatic conditions at site under which the store shall operate satisfactory, are as follows

- Maximum temperature of air in shade: 45° c
- Maximum temperature of air in shade: 0 c
- Maximum temperature of air in shade: 50° c
- Maximum rain fall per annum: 2000mm
- Maximum temperature of air in shade: 45° c
- Maximum ambient temperature: 45° c
- Maximum humidity: 100%
- Av. No. of thunder storm days per annum: 70%
- Av. No. of dust storm per annum: 20
- Av. Rain fall per annum: 150mm

4.0 Rolled Steel Joists
The Rolled Steel joist (RSJ) support structures shall be fabricated from mild steel, grade A and in lengths dictated by design parameters. The joists, may include, but shall not be limited to the size i.e. 150 X 150 mm;
4.1 Dimensions and Properties

<table>
<thead>
<tr>
<th>RSJ DESIGNATION</th>
<th>150 x 150 mm ISHB</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length of Joist in Mtr with +100mm/- 0% Tolerance</td>
<td>11 mtr</td>
</tr>
<tr>
<td>Weight kg/m with±2.5% Tolerance</td>
<td>30.6</td>
</tr>
<tr>
<td>Sectional Area (cm$^2$)</td>
<td>39.00</td>
</tr>
<tr>
<td>Depth(D) of Section (mm) with +3.0mm/ -2.0mm Tolerance as per IS 1852-1985</td>
<td>150.00</td>
</tr>
<tr>
<td>Width (B)of Flange(mm) with ±2.5mm Tolerance for116 x 100 mm ISMB &amp; ±4.0mm Tolerance for 150 x 150 mm ISHB IS 1852-1985</td>
<td>150.00</td>
</tr>
<tr>
<td>Thickness of Flange(Tf) (mm) with±1.5mm Tolerance</td>
<td>9.00</td>
</tr>
<tr>
<td>Thickness of Web(Tw) (mm) with±1.0mm Tolerance</td>
<td>8.40</td>
</tr>
<tr>
<td>Corner Radius of fillet or root (R1) (mm)</td>
<td>8.00</td>
</tr>
<tr>
<td>Corner Radius of Tow (R2) (mm)</td>
<td>4.00</td>
</tr>
<tr>
<td>Moment of Inertia Ixx (cm 4) Iyy (cm 4)</td>
<td>1540.00 460.00</td>
</tr>
<tr>
<td>Radius of Gyration (cm) Rxx Ryy</td>
<td>6.29 3.44</td>
</tr>
<tr>
<td>Flange Slope(α) in Degree</td>
<td>94.0</td>
</tr>
<tr>
<td>Tolerance in Dimension</td>
<td>As per IS:1852</td>
</tr>
</tbody>
</table>

4.2 MECHANICAL PROPERTIES:

<table>
<thead>
<tr>
<th>Test</th>
<th>Requirement as per IS:2062/1999 Grade-A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yeild Stress(MPa)</td>
<td>Min250</td>
</tr>
<tr>
<td>Tensile Strength(MPa)</td>
<td>Min410</td>
</tr>
<tr>
<td>Lo=(5.65√So)Elongation%</td>
<td>Min23</td>
</tr>
<tr>
<td>Bend Test</td>
<td>Shall not Crack</td>
</tr>
</tbody>
</table>

4.3. CHEMICAL PROPERTIES:

<table>
<thead>
<tr>
<th>Chemical Composition</th>
<th>Requirement as per IS:2062/1999 Grade-A</th>
<th>Permissible variation over the Specified Limit,Percent,Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade</td>
<td>A</td>
<td>-</td>
</tr>
</tbody>
</table>
### Chemical Composition

<table>
<thead>
<tr>
<th>Chemical Name</th>
<th>Fe-410W A</th>
<th>-</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbon(%Max.)</td>
<td>0.23</td>
<td>0.02</td>
</tr>
<tr>
<td>Manganese(%Max.)</td>
<td>1.5</td>
<td>0.05</td>
</tr>
<tr>
<td>Sulphur(%Max.)</td>
<td>0.050</td>
<td>0.005</td>
</tr>
<tr>
<td>Phosphorous(%Max.)</td>
<td>0.050</td>
<td>0.005</td>
</tr>
<tr>
<td>Silicon(%Max.)</td>
<td>0.40</td>
<td>0.03</td>
</tr>
<tr>
<td>Carbon Equivalent(%Max.)</td>
<td>0.42</td>
<td>-</td>
</tr>
</tbody>
</table>

### Deoxidation Mode
- Semi-killed or killed

### Supply Condition
- As rolled

4.4. However, in case of any discrepancy between the above data & the relevant ISS, the values indicated in the IS shall prevail.

4.5. The Acceptance Tests shall be Carried out as per Relevant ISS.

#### 5.2.150x150mm RS Joists:

RS Joists of Specific Weight 30.6kg/mtr with length of each type of pole being 11mtr pole weighing 336.6Kg for specified number of poles with specified weight in MT as given in the NIT table given above shall have to be supplied as per IS:2062;2006 Grade"A", IS:808;1989/2001, IS1608:1995 & IS:12779-1989 and their latest amendment if any complying the required Dimension, Weight, Chemical & Mechanical properties confirming to the relevant IS, as per the Tolerance given Below.

#### 5.3. APPLICABLE TOLERANCES:

2. Length of each pole = + 100mm / - 0 % As per relevant IS: 12779-1989
   (with proportionate change in no of Poles)

3. Specific Weight of RS Joists = ±2.5% As per relevant IS: 1852/1985

4. Weight for whole lot of supply for all categories = ±3.0% As per relevant IS: 12779-1989 for both type of RS Joists.

#### 6.0. EMBOSsing ON EACH R.S JOIST:

Following distinct non-erasable embossing is to be made on each R.S Joists.

a) Name & Logo of the Manufacturer.

b) B.I.S Logo(ISI Mark) if applicable.

c) Size of the R.S Joist
### GUARANTEED TECHNICAL PARTICULARS FOR
(ROJOISTS of sizes 150x150mm)
(To be submitted along with offer)

#### 1.1. Dimensions and Properties:

<table>
<thead>
<tr>
<th>PARTICULARS</th>
<th>150 x 150 mm ISHB</th>
<th>Manufacturer’s Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length of Joist in Mtr with +100mm/-0% Tolerance</td>
<td>11mtr</td>
<td></td>
</tr>
<tr>
<td>Weight kg/m with±2.5% Tolerance</td>
<td>30.6</td>
<td></td>
</tr>
<tr>
<td>Sectional Area (cm$^2$)</td>
<td>39.00</td>
<td></td>
</tr>
<tr>
<td>Depth(D) of Section (mm) with ±3.0mm/ -2.0mm Tolerance as per IS 1852-1985</td>
<td>150.00</td>
<td></td>
</tr>
<tr>
<td>Width (B) of Flange (mm) with ±2.5mm Tolerance for 116 x 100 mm ISMB &amp; ±4.0mm Tolerance for 150 x 150 mm ISHB IS 1852-1985</td>
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</tr>
<tr>
<td>Corner Radius of Tow (R2) (mm)</td>
<td>4.00</td>
<td></td>
</tr>
<tr>
<td>Moment of Inertia Ixx (cm$^4$)</td>
<td>1540.00</td>
<td></td>
</tr>
<tr>
<td>Iyy (cm$^4$)</td>
<td>460.00</td>
<td></td>
</tr>
<tr>
<td>Radius of Gyration (cm)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rxx</td>
<td>6.29</td>
<td></td>
</tr>
<tr>
<td>Ryy</td>
<td>3.44</td>
<td></td>
</tr>
<tr>
<td>Modulus of Section Zxx(cm$^3$)</td>
<td>205</td>
<td></td>
</tr>
<tr>
<td>Zyy(cm$^3$)</td>
<td>60.2</td>
<td></td>
</tr>
<tr>
<td>Flange Slope(α) in Degree</td>
<td>94.0</td>
<td></td>
</tr>
<tr>
<td>Tolerance in Dimension</td>
<td>As per IS:1852</td>
<td></td>
</tr>
<tr>
<td>Distinct Non-Erasable Embossings to be made on each R.S. Joist</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a) Name &amp; Logo of the Manufacturer.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b) B.I.S Logo(ISI Mark) if applicable.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>c) Size</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
1.2. Chemical Properties:

<table>
<thead>
<tr>
<th>Tensile Test</th>
<th>Requirement as per IS:2062/ 1999 Grade-A</th>
<th>Manufacturer’s Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yeild Stress(MPa)</td>
<td>Min250</td>
<td></td>
</tr>
<tr>
<td>Tensile Strength(MPa)</td>
<td>Min410</td>
<td></td>
</tr>
<tr>
<td>Lo=(5.65√So)Elongation%</td>
<td>Min23</td>
<td></td>
</tr>
<tr>
<td>Bend Test</td>
<td>Shall not Crack</td>
<td></td>
</tr>
</tbody>
</table>

1.3. Mechanical Properties:

<table>
<thead>
<tr>
<th>Chemical Composition</th>
<th>Requirement as per IS:2062/ 1999 Grade-A</th>
<th>Permissible variation over the Specified Limit, Percent, Max</th>
<th>Manufacturer’s Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade</td>
<td>A</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Chemical Name</td>
<td>Fe-410W A</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Carbon(%Max.)</td>
<td>0.23</td>
<td>0.02</td>
<td></td>
</tr>
<tr>
<td>Manganese(%Max.)</td>
<td>1.5</td>
<td>0.05</td>
<td></td>
</tr>
<tr>
<td>Sulphur(%Max.)</td>
<td>0.050</td>
<td>0.005</td>
<td></td>
</tr>
<tr>
<td>Phosphorous(%Max.)</td>
<td>0.050</td>
<td>0.005</td>
<td></td>
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<td>Silicon(%Max.)</td>
<td>0.40</td>
<td>0.03</td>
<td></td>
</tr>
<tr>
<td>Carbon Equivalent(%Max.)</td>
<td>0.42</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Deoxidation Mode</td>
<td>Semi-killed or killed</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Supply condition</td>
<td>As rolled</td>
<td>-</td>
<td></td>
</tr>
</tbody>
</table>

However, in case of any discrepancy between the above data & the relevant ISS, the values indicated in the IS shall prevail.

The Acceptance Tests shall be Carried out as per Relevant ISS. The RS Joists shall be manufactured confirming to the relevant IS with Manufacturer’s name/logo & B.I.S Logo if applicable embossed on it.
Section-V
Insulators & Hardware fittings
TECHNICAL SPECIFICATION OF 33 kV INSULATORS AND HARDWARE FITTINGS

This Specification covers design, engineering, manufacture, assembly, stage testing, inspection & testing before supply and delivery at site of the following:

- 33 KV Disc Insulator
- 33 KV Pin Insulator

1.0 Specific Parameters & Layout Conditions

Performance Guarantee

The equipment along with all accessories shall be capable of performing intended duties under specified conditions. The manufacturer shall guarantee the reliability and performance of the individual equipment as well as of the complete system as specified in the bid documents.

2.0 Design and Construction

The material shall conform in all respect to the relevant Indian standards with latest amendments indicated below:

<table>
<thead>
<tr>
<th>Indian Standards</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIS:731/1976</td>
<td>Porcelain insulators for overhead power lines with a nominal voltage greater than 1000V</td>
</tr>
<tr>
<td>BIS:2486(Part-1 to Part-4)</td>
<td>Metal fittings of insulators for overhead power lines with nominal voltage greater than 1000V</td>
</tr>
<tr>
<td>BIS:7935-1975</td>
<td>Porcelain insulators for overhead power lines with a nominal voltage up to and including 1000V</td>
</tr>
<tr>
<td>REC SPEC : 3/1971</td>
<td>33 KV Porcelain insulators and fittings</td>
</tr>
<tr>
<td>REC SPEC : 21/1981</td>
<td>Guy Insulator (Stay Insulator)</td>
</tr>
</tbody>
</table>

3.0 General Requirements for 33 KV Pin and Disc Insulator

All insulators for 33KV shall conform to Type B of latest version of IS: 731. Insulator shall be as per enclosed drawing. Pin insulator shall consist of a single piece of porcelain, intended to be mounted rigidly on supporting structure by a pin, which passes up inside the insulator. The pin type insulator shall have a top groove and shall be threaded to take mild steel pins. The profile of threads shall be as per IS: 1445. The strain insulator shall be of Ball and Socket (B & S) type with details.

4.0 General requirement for Stay Insulators

These insulators shall generally comply with latest version of IS: 1445, REC Specification No.4/1972 and fittings with IS: 7935-1975 or the latest version thereof.

Guy strain insulators shall conform to designation C as per IS: 5300.

5.0 Specific Requirements for Insulators

The insulators shall confirm to the following specific conditions of respective IS given in the table below:
<table>
<thead>
<tr>
<th>Insulator</th>
<th>Designation</th>
<th>Minimum mechanical failing load</th>
<th>Minimum Creepage distance</th>
</tr>
</thead>
<tbody>
<tr>
<td>33 KV</td>
<td>Pin</td>
<td>10 KN</td>
<td>320 mm</td>
</tr>
<tr>
<td>33 KV</td>
<td>Pin</td>
<td>10 KN</td>
<td>580 mm</td>
</tr>
<tr>
<td>33 KV</td>
<td>Disc</td>
<td>70 KN (for B &amp; S type)</td>
<td>320 mm</td>
</tr>
<tr>
<td>33 KV</td>
<td>Stay</td>
<td>88 KN</td>
<td>57 mm</td>
</tr>
</tbody>
</table>

### 6.0 Insulator Materials

#### 6.1 Porcelain:
The porcelain used in the manufacture of shells shall be sound, free from defects thoroughly vitrified and smoothly glazed. It should not engage directly with hard metal.

#### 6.2 Glaze:
The finished porcelain shall be glazed in brown colour. The glaze shall cover all exposed parts of the insulator and shall have a good lustre, smooth surface and good performance under the extreme weather conditions of a tropical climate. It shall not crack or chip by ageing under the normal service conditions. The glaze shall have the same co-efficient of expansion as if the porcelain body throughout the working temperature range. The insulator shall be so designed that the stresses due to expansion and contraction in any part of the insulator shall not lead to deterioration.

#### 6.3 Cement:
Cement used in the manufacture of the insulator shall not cause fracture by expansion or loosening by contraction. The cement shall not give rise to chemical reaction with metal fittings and its thickness shall be as small and uniform as possible. Proper care shall be taken to correctly centre and locate individual parts during cementing.

### 7.0 QUALITY ASSURANCE AND TESTING

#### 7.1 Type Tests:
Reports of the following type tests conducted in any NABL accredited laboratory, shall have to be submitted along with the bid.

- Visual examination
- Verification of dimensions
- Visible Discharge test (dry)
- Impulse voltage withstand and flashover test (dry)
- Power frequency voltage withstands and flashover test (i) dry (ii) wet
- Temperature Cycle test
- Mechanical failing Load Test (for pin insulator only) to be carried out as per procedure described at Sub-clause 12.2.5 below
- 24 hour Mechanical Strength Test for Strain Insulator
- Puncture Test
- Porosity Test
- Galvanizing Test
- Electro-mechanical failing test (for Strain Insulator only) to be carried out.
- Thermal mechanical performance test (for Strain insulators only) to be carried out.
Note: Type test reports shall be submitted for acceptance which should not be more than five (05) years old as on date of bid opening.

7.2 Acceptance Tests:

The following tests shall be conducted at the works of the manufacturer on a suitable number of individual insulators.

Verification of dimensions
Temperature cycle test
Electro-mechanical failing test (for Strain Insulator only) to be carried out.
Puncture Test
Porosity Test
Galvanizing Test

7.3 Routine Test:

The manufacturer should have facilities to conduct following routine tests at their works.

a. Visual Inspection
b. Mechanical routine test (for Strain Insulator only)
c. Electrical routine test (for Strain Insulator only)
d. Hydraulic Internal Pressure on Shells (for strain insulators only).

The bidder shall have to submit the list testing and measuring equipments along with bid documents.

7.4 Test during Manufacture:

On all components as applicable.

a. Chemical analysis of zinc used for Galvanizing
b. Chemical analysis, mechanical metallographic test and magnetic particle inspection for malleable castings.
c. Chemical analysis hardness tests and magnetic particle inspection for forgings.
d. Hydraulic Internal Pressure tests on disc insulator shells as per relevant BIS Clause.

7.5 Hydraulic (For Disc Insulators Internal Pressure Test on Shells)

The test shall be carried out as per relevant BIS Clause.

Thermal Mechanical Performance Test (if applicable)

Thermal Mechanical Performance Test shall be performed in accordance with IEC-383-1-1993:

1. The applied mechanical load during this test shall be 70% of the rated electromechanical or mechanical value.
2. The acceptance criteria shall be:

   a) \( X \) greater than or equal to \( R + 3S \)
   Where,
   \( X \) Mean value of the individual mechanical failing load.
   \( R \) Rated electro-mechanical/mechanical failing load
   \( S \) Standard deviation.
The minimum sample size shall be taken as 20 for disc insulator units.

The individual elect mechanical failing load shall be at least equal to the rate value. Also puncture shall not occur before the ultimate fracture.

7.6 Electromechanical/Mechanical Failing Load Test.

This test shall be performed in accordance of IEC 383 with the following acceptance.

\[ X \geq R + 3S \]

Where,
- \( X \) Mean value of the electro-mechanical/mechanical/failing load
- \( R \) Rated electro-mechanical/mechanical failing load
- \( S \) Standard deviation.

The minimum sample size shall be taken as 20 for disc insulators units. However, for larger lot size, IEC 591 shall be applicable.

The individual electro-mechanical/mechanical failing load shall be at least equal to the rated value. Also electrical puncture shall not occur before the ultimate fracture.

**Note:** The purchaser had right to waive any type/special test if the supplier produces the test report for such tests conducted on identical Insulators.

8.0 Packing and Marking

Each insulator shall be visibly and indelibly marked as following:
- Name and Trademark of manufacturer
- Month / Year of manufacturer
- Minimum failing load in KN

Marking on porcelain shall be printed / engraved and shall be applied before firing.

All insulators shall be packed in strong seasoned wooden crates. The gross weight of the crates along with the material shall not normally exceed 200 Kg to avoid handling problem.

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

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

All 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 dispatched on account of faulty packing and faulty or illegible markings. Each wooden case/crate shall have all the markings stenciled on it in indelible ink.
### Guaranteed Technical Particulars for 33KV Disc Insulators

(To be submitted along with offer)

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Description</th>
<th>Unit</th>
<th>Bidder’s offer</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Disc Diameter</td>
<td>mm</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Disc spacing</td>
<td>mm</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Creepage distance</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(a) Total</td>
<td>mm</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(b) Protected</td>
<td>mm</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Combined electromechanical strength.</td>
<td>Kgs.</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Dry one minute power frequency</td>
<td>Kv</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Wet one minute power frequency</td>
<td>Kv</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Dry power frequency flashover.</td>
<td>Kv</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Wet power frequency flashover.</td>
<td>Kv</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Dry impulse withstand positive &amp; negative.</td>
<td>Kv (Peak)</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Impulse flashover 1 x 50 microsecond (Positive)</td>
<td>Kv (Peak)</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Impulse flashover 1 x 50 microsecond (Negative)</td>
<td>Kv (Peak)</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Power frequency puncture voltage</td>
<td>Kv</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>High system voltage.</td>
<td>Kv</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Visible Discharge voltage.</td>
<td>Kv</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>Weight/Unit.</td>
<td>Kg.</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>Marking :--</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Each insulator will be legibly marked to show the following :</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(a) Name of the Purchaser :--</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(b) Name or trademark :--</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(c) Month &amp; year of manufactureing :--</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(d) Minimum failing load.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Packing:** All insulators shall be packed suitably for easy but rough handling & acceptable for road transport. Where more than one insulator is packed in a crate, separator shall be fixed between the insulators to keep individual insulator in position without movement in the crate.
**GURANTEED TECHNICAL PARTICULARS FOR 33 KV PIN INSULATORS**

(To be submitted along with offer)

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Description</th>
<th>Bidders offer</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Normal working voltage</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>High system voltage</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Visible Discharge voltage dry PF.</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>1 Minute withstand voltage wet PF.</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>1 Minute withstand voltage..........</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>PF puncture withstand voltage.</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Impulse withstand voltage :</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Impulse flashover voltage :</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Minimum failing load.</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Minimum creepage distance.</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Colour of glaze.</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Weight per unit.</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Size of insulator. (Height)</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Material of thimble.</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>Steel head.</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>Standard.</td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>Tolerance.</td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>Marking :--</td>
<td>Each insulator will be legibly marked to show the following :</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(a) Name of the Purchaser :-- IOCL</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(a) Name or trademark :--</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(c) Month &amp; year of manufacturing :--</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(d) Minimum failing load.</td>
</tr>
</tbody>
</table>

**PACKING:** All insulators shall be packed in wooden crates suitable for easy but rough handling & acceptable for road transport. Where more than one insulator are packed in a crate, separator shall be fixed between the insulators to keep individual insulator in position.
DRAWINGS:

[Diagram of porcelain insulator with dimensions and specifications]

- Specification: IS: 731 - 1971
- Creepage Distance: 320 mm.
- Electro-Mech. Failing Load: 70 KN
- Drawing No.: RI-Disc/001/70
9.0 TECHNICAL SPECIFICATIONS OF HARDWARE FITTING FOR 33kV DISC INSULATOR & 33 kV GI PIN INSULATOR

9.1 SCOPE:
This Specification covers design, engineering, manufacture, assembly, stage testing, inspection & testing before supply and delivery at site

Hardware fittings for 33 KV Disc Insulators and 33 KV Gi Pins.

9.2 APPLICABLE STANDARD:
I. Fittings for Disc insulators shall comply with the requirements of IS : 2486 and REC specification No. 3/1971, 4/1972.
II. 33 kV Gi shall comply with the requirements of IS : 2486.

9.3 GENERAL REQUIREMENTS:
I. Fittings for Disc Insulators:
Cross arm strap confirming to IS 2486 (Part II)
Forged Steel ball eye for attaching the socket end of the Disc insulator to the cross arm strap. Forging shall be made of steel as per IS : 2004 Grade 4.
Aluminium alloy thimble socket made out of permanent high strength aluminum alloy for attaching the disc insulator at one end and for accommodating the loop of conductor (Panther ACSR) at the other end. The thimble socket shall be attached to the disc insulator with the help of locking pin as per the dimensions given in IS:2486 (Part II).
The tension hardware with four bolts strain hardware shall have minimum slip strength not less than 95% of the strength of respective conductor.
Failing load shall be minimum 70 KN.

II. 33 kV Gi Pin:
The pins shall be of single piece obtained by the process of forging. They will not be made by any process using more than one piece of material. The pin will have good finish, free from flaws and other defects. The finish of the collar shall be such that a sharp angle between the collar and the shank is avoided. All ferrous pins, nuts and washers, except those made of stainless steel shall be galvanized by hot dip process. Other fittings, i.,e flat washers and spring washers may be electro-galvalised as per IS:2486. The threads of nuts, and toped holes, when cut after galvanization shall be well oiled or greased.
The pins shall be as per relevant figure indicated in IS 2486 (part II) having stalk length of 165 mm and shank length of 150 mm with minimum failing load of 10 KN with small heads and shall match with the pin type insulators with cemented zinc thimble having similar threads.

9.4 TESTS:
The hardware fittings and pins shall be tested as per IS: 2486 (part-1):1993
I. Type Test:
The bidder has to enclose the reports of the following type tests carried out in any gov't. recognized laboratory along with the bid documents.

a) Checking of Threads on Heads
b) Galvanizing Test
c) Visual Examination
d) Mechanical Test.

II. Acceptance Tests:
Following tests shall be carried out at the works of the manufacturer before dispatch.

a) Checking of Threads on Heads
b) Galvanizing Test
c) Visual Examination
d) Mechanical Test.

10.0 TECHNICAL SPECIFICATIONS OF NUTS & BOLTS

10.1 SCOPE:
This specification covers manufacture, testing and supply of ISI Marked bolts and nuts made of black mild steel. 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. The half thread GI nuts and bolts with 1 plane washer and 1 spring 1 washer completes 1 set. The assorted sizes are as following:

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Size</th>
<th>Appx. Quantity (In Kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>M 16 x 40 mm (Full Thread)</td>
<td>As per actual</td>
</tr>
<tr>
<td>2</td>
<td>M 16 x 65 mm</td>
<td>-do-</td>
</tr>
<tr>
<td>3</td>
<td>M 16 x 125 mm</td>
<td>-do-</td>
</tr>
<tr>
<td>4</td>
<td>M 16 x 150 mm</td>
<td>-do-</td>
</tr>
<tr>
<td>5</td>
<td>M 16 x 225 mm</td>
<td>-do-</td>
</tr>
<tr>
<td>6</td>
<td>M 16 x 250 mm</td>
<td>-do-</td>
</tr>
<tr>
<td>7</td>
<td>M 16 x 300 mm</td>
<td>-do-</td>
</tr>
<tr>
<td>8</td>
<td>M 16 x 325 mm</td>
<td>-do-</td>
</tr>
<tr>
<td>9</td>
<td>M 10 x 50 mm</td>
<td>-do-</td>
</tr>
</tbody>
</table>

10.2 APPLICABLE STANDARDS
The Bolts & Nuts shall conform to IS: 6639 and galvanized as per IS: 1367 (Part-13)/ IS-2629.

10.3 GENERAL REQUIREMENTS
a) Bolts upto M16 and having length up to 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-2427. Bolts should be provided with washer face in accordance with IS: 1363 Part-I to ensure proper bearing.
b) Nuts should be double chamfered as per the requirement of IS: 1363 Part-III-1984. The manufacturer should ensure that nuts should not be over tapped beyond 0.4 mm oversize on effective diameter for size up to M16.

c) 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. 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 protruded 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.

d) 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. The bidder 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.

e) To obviate bending stress in bolt, it shall not connect aggregate thickness more than three time its diameter. Bolts at the joints shall be so staggered that nuts may be tightened with spanners without fouling.

f) 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 agency should also have proper Quality Assurance system which shall be in line with the requirement of this specification and IS: 14000 services Quality System standard. Fasteners of grade higher than 8.8 shall not to be used.

10.4 Raw Materials

MS round 16mm/12mm used shall be tested for quality as per IS: 2062 Gr."A".

The dimensions of the bolts & nuts and tolerances shall conform to IS: 1363 with their latest amendments in all respect. The eccentricity and angular errors of various elements shall be within specified limits as per IS: 1367/1967 with its latest amendments. The bolts & nuts shall be free from forging and threading defects such as cuts, splits, burns, bulging, taper, eccentricity, loose fill etc., which may affect their serviceability.

The bolt heads and nuts shall be chamfered on one face only and other face shall be machined made. Mechanical property requirement of tester shall conform to IS: 1367 (Part-III)-1979 property class 4.6 for bolts and property class-5 for nuts as per IS: 1367 (Part-VI)-1980. The bolts and nuts shall be supplied in well-cleaned conditions and suitably protected against corrosion in individual bags of 50kgs.

10.5 GALVANISING

It is required for galvanizing the Stay Clamps as following:
a) All galvanizing shall be carried out by the hot dip process, in accordance with Specification IS 2629. However, high tensile steel nuts, bolts and spring washer shall be electro galvanized to Service Condition 4. The zinc coating shall be smooth, continuous and uniform. It shall be free from acid spot and shall not scale, blister or be removable by handling or packing. There shall be no impurities in the zinc or additives to the galvanic bath which could have a detrimental effect on the durability of the zinc coating.

b) Before picking, all welding, drilling, cutting, grinding and other finishing operations must be completed and all grease, paints, varnish, oil, welding slag and other foreign matter completely removed. All protuberances which would affect the life of galvanizing shall also be removed.

c) The weight of zinc deposited shall be in accordance with that stated in Standard IS 2629 and shall not less than 0.61kg/m² with a minimum thickness of 86 microns for items of thickness more than 5mm, 0.46kg/m² (64 microns) for items of thickness between 2mm and 5mm and 0.33kg/m² (47 microns) for items less than 2mm thick.

d) Parts shall not be galvanized if their shapes are such that the pickling solutions cannot be removed with certainty or if galvanizing would be unsatisfactory or if their mechanical strength would be reduced. Surfaces in contact with oil shall not be galvanized unless they are subsequently coated with an oil resistant varnish or paint.

e) In the event of damage to the galvanizing the method used for repair shall be subject to the approval of the Project Manager or that of his representative.

f) Repair of galvanizing on site will generally not be permitted.

g) The threads of all galvanized bolts and screwed rods shall be cleared of spelter by spinning or brushing. A die shall not be used for cleaning the threads unless specifically approved by the Project Manager. All nuts shall be galvanized. The threads of nuts shall be cleaned with a tap and the threads oiled.

h) Partial immersion of the work shall not be permitted and the galvanizing tank must therefore be sufficiently large to permit galvanizing to be carried out by one immersion.

i) After galvanizing no drilling or welding shall be performed on the galvanized parts of the equipment excepting that nuts may be threaded after galvanizing. To avoid the formation of white rust galvanized materials shall be stacked during transport and stored in such a manner as to permit adequate ventilation. Sodium dichromate treatment shall be provided to avoid formation of white rust after hot dip galvanization.

j) The galvanized steel shall be subjected to test as per IS-2633.

10.6 TESTS

10.6.1 Acceptance Tests

The bidder shall furnish test certificate from his own/recognized Govt. Laboratory giving
the results of tests as per IS: 1367 (Part-III)-1979 & IS: 1367 (Part-VI) 1980 witnessed by owners inspecting officer for each lot under inspection. The test certificate shall be in respect of the following for all sizes of both bolts & nuts as applicable given below:-

a) Dimensional particulars (Sampling in accordance with IS: 2614 for both bolts & nuts (tolerance as per drawing).

b) Tensile strength test on full size (for bolts minimum 400 N/Sq. mm and for Nuts Proof Stress test Min 610 N/Sq.mm).

c) Power load test on full size bolts and M-12-51400 N for 15 Sec. d) Head soundness tests for bolts (no fracture). e) Brinell hardness tests or Rockwell Hardness or Vickers’s Hardness tests for bolts min. 114 and max. 209 or min.67 & max. 95 or min.120 & max.220 respectively. For nuts Vicker’s Hardness min. 130 & max. 302.

10.6.2 PRE-DESPATCH INSEPCTION

The bidder shall arrange to carryout acceptance tests in presence of owner’s inspecting officer in his own laboratory. In case testing facilities are not available at his works he will make necessary arrangements for carrying out these tests at a Govt. recognized lab at his own expenses(s) and will provide all testing arrangement for Owner’s representative to witness the tests.

10.6.3 MARKINGS

On the bolt head, there shall be identification marking of the manufacturer as well as property class “4.6”. If possible property calls “5” shall be marked on Nuts also. Further “ISI” mark shall be marked on Sunny Bags for proper identifications.

GURANTEED TECHNICAL PARTICULARS FOR NUTS & BOLTS
(To be submitted along with offer)

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Particulars</th>
<th>Bidder’s Offer</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Length of Bolt (in MM)</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Dia of Bolt (In MM)</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Pitch of Thread (In MM)</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Full Thread or Half Thread</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Dimension of Head</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Size &amp; Thickness of Plain Washer</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Size &amp; Thickness of Spring Washer</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Thickness of GI Coating</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Weight of one complete set</td>
<td></td>
</tr>
</tbody>
</table>
11.0 TECHNICAL SPECIFICATIONS OF DANGER BOARD

11.1 SCOPE:
This Specification covers manufacture, testing and supply to the owner’s stores of Danger Notice Plates to be displayed in accordance with Rule no.35 of Indian Electricity Rules, 1956.

11.2 APPLICABLE STANDARDS
The danger Notice Plates shall comply with IS: 2551-1982 and REC Spec. No. 57/1993 or the latest version thereof.

11.3 DIMENSIONS
The size of Danger Notice shall be as following:

For display at 33 KV installations – 250 x 200mm
The corner of the plate shall be rounded off.
The locations of fixing holes as shown in Fig. 1 to 4 is provisional and can be modified to suit the requirement of the purchaser.

11.4 LETTERINGS
All letterings shall certainly spaced. The dimension of the letters, figures and their respective position shall be as per standard. The size of letters in the words in each languages and spacing earmarked for them.

11.5 LANGUAGES
Under Rule No.35 of Indian Electricity Rules, 1956, the owner of every medium high and extra high voltage installation is required to affix permanently in a conspicuous position a danger notice in Hindi or English and, in addition, in the local languages, with the sign of skull and bones.

The type and sizes of lettering to be done in Odia is indicated in the specimen danger notice plates.

Adequate space has been provided in the specimen danger notice for having the letterings in local languages for the equivalent of ‘Danger’: “33000” and “volts”.

11.6 MATERIAL AND FINISH
The plates shall be made from mild steel sheet of at least 1.6 mm thick and vitreous enameled white, with letters, figures and conventional skull and cross bones in signal red colour (refers IS:5-1978) on the front side. The rear side of the plate shall also be enameled.

11.7 TESTS
The following tests shall be carried out: Visual examination as per IS: 2551-1982. Dimensional check as per IS:2551-1982.
Test for weather proofness as per IS:8709-1977 (or its latest version)

11.8 MARKING

Maker’s name and trade mark and the purchaser’s name shall be marked in such a manner and position on the plates that it does not interfere with the other information.

11.9 PACKING

The plates shall be packed in wooden crates suitable for rough handling and acceptable for rail/road transport.

### GUARANTEED TECHNICAL PARTICULARS FOR DANGER BOARD

(To be submitted along with offer)

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>GENERAL TECHNICAL PARTICULARS</th>
<th>Bidder’s Offer</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Size of the danger board</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Size of the letter</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Size of the Skull</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Detail of painting</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Whether detailed drawing is enclosed</td>
<td></td>
</tr>
</tbody>
</table>

12.0 TECHNICAL SPECIFICATIONS OF BARBED WIRE

12.1 SCOPE:

The scope covers manufacture, testing and supply of two ply barbed wires as per IS:278,1978.

12.2 MATERIALS:

The galvanised barbed wires, (Type A) shall be manufactured from hot dipped galvanised mild steel wire confirming to IS:280, 1972. Diameter of line and point wire shall be 2.5 mm. Distance between the barbs shall be 75 mm.

12.3 COILING & PACKING:

Each reel of barbed wire shall be wound and fastened compactly and of weight of 50 Kg approximately.

12.4 TESTING:

Routine and Acceptance test will be carried out at the works of the manufacturer as per IS:278.
**GURANTEED TECHNICAL PARTICULARS FOR BARBED WIRE**  
(To be submitted along with offer)

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>GENERAL TECHNICAL PARTICULARS</th>
<th>Bidder’s Offer</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Nominal diameter of line wire</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Nominal diameter of point wire</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Distance between the barbs</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Tensile strength</td>
<td></td>
</tr>
<tr>
<td>a</td>
<td>Min. N/mm²</td>
<td></td>
</tr>
<tr>
<td>b</td>
<td>Max. N/mm²</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Minimum breaking load (KN)</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Type of coating Heavy/Medium/Light</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Weight of Zinc coating (Gms/Sq. Mtr.) Min.</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>No. of dips the coating is able to withstand as 18 ± 20ºC</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Chemical composition the MS Wire used shall not</td>
<td></td>
</tr>
<tr>
<td>a</td>
<td>Sulphur 0.060%</td>
<td></td>
</tr>
<tr>
<td>b</td>
<td>Phosphorous 0.065%</td>
<td></td>
</tr>
</tbody>
</table>
Section-VI
33kV Isolator
TECHNICAL SPECIFICATION OF 33 KV AIR BREAK ISOLATOR

1.00 SCOPE

1.01 This specification covers design, manufacture, testing and supply of. Manually operated 33 KV, 800 Amps Upright mounting type with manually operated with earth switch Isolators.

1.02 The isolator shall be of the manual operated type with earthing switches and shall complete with all parts and accessories including insulator operating rods, mounting attachments, necessary for their efficient operation.

1.04 It is not intent to specify completely herein, all details of the design and construction of equipments, however the equipment shall confirm in all respect to high standards of engineering mentioned in clause No. 4.0 design and workmanship and shall capable of performing in continuous commercial operation up to the suppliers guarantee in a manner acceptable to the purchaser, who will interpret the meanings of drawing and specification and shall have the powers to reject any work or material which, in his judgment, is not in accordance therewith. The equipment offered shall be complete with all components necessary for its effective and trouble free operation along with associated equipments, interlock, protection schemes, etc. Such components shall be deemed to be within the scope of bidder's supply irrespective of whether those are specifically brought out in this specification or not. All similar parts particularly removable ones shall be interchangeable.

2.00 LOCATION

The isolators are required to be provided at interconnection points of UG Cable on 4-Pole structure at Janla 33/11kV S/s.

3.00 SERVICE CONDITIONS:

3.01 The 33 kV triple pole air break isolators are intended to be used primarily for sectionalizing 33 kV UG cable portion of the line with 33 kV over head portion of the line.

3.03 ATMOSPHERIC CONDITIONS

Please refer to meteorological data furnished elsewhere in this document.

4.0 GOVERNING SPECIFICATION:

4.01 The isolator shall unless otherwise specified, generally conform the IS : 9921 (Part I to IV) - 1985, which shall be applied in the manner altered, amended or supplemented by this specification, the latest Indian Electricity Rules wherever applicable.

4.02 Any deviation from this specification offered to improvement performance, utility and efficiency of equipment proposed by the bidder will be given due consideration, provided full particular with justification thereof are furnished.

4.03 In the preparation of this specification, details have been taken from IEC 600 - 129 "alternating current disconnects (Isolators) and earthing switches", and IS 9921 (Part-I to IV) "Specification for alternating current disconnects (isolators) and earthing switches for voltages above 1000V".

4.04 Equipment meeting with the stipulations of equivalent IEC, ANSI, CSA, DIN standards which ensure equal or better quality than the standards listed in Clause No. 4.05, shall also be acceptable. In such case the bidder should submit along with this offer, two copies of such
standards, in authentic English translation, if the language of the standard is other than English. In case of dispute, the stipulations in English translation, submitted by the bidder shall prevail. Further, in the event of conflict between the stipulations of the standard adopted be the bidder, corresponding Indian Standard specification shall prevail.

4.05 In this specification reference has been made to the following Indian standard and other specifications:

<table>
<thead>
<tr>
<th>Sl No</th>
<th>Standards</th>
<th>Particulars</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>IS : 9921-85 Part-I, II, III &amp; IV)</td>
<td>Specification for alternating current Disconnects (isolators) and earthing switches for voltages above 1000V</td>
</tr>
<tr>
<td>3</td>
<td>IS : 7608</td>
<td>Phosphor bronze wires (for general engineering purposes)</td>
</tr>
<tr>
<td>4</td>
<td>IS : 2108-1977</td>
<td>Black hard malleable iron castings</td>
</tr>
<tr>
<td>5</td>
<td>IS : 1570 Part - IQ- 1979</td>
<td>Carbon steel (unalloyed steels)</td>
</tr>
<tr>
<td>6</td>
<td>IS : 2071  (Part-I &amp; II)-1974</td>
<td>General definitions, test requirements &amp; test procedures</td>
</tr>
<tr>
<td>7</td>
<td>IEC: 600129</td>
<td>Alternating current disconnects (isolators) and earthing switches</td>
</tr>
<tr>
<td>8</td>
<td>IS : 7906 (Part-III)-1975</td>
<td>Helical compression springs</td>
</tr>
<tr>
<td>9</td>
<td>IS: 5561 – 1970</td>
<td>Electric power connectors</td>
</tr>
<tr>
<td>10</td>
<td>IS: 5358-1969</td>
<td>Galvanizing of ferrous parts</td>
</tr>
<tr>
<td>11</td>
<td>IS : 2633</td>
<td>Method of testing conformity of coating of zinc coated article</td>
</tr>
</tbody>
</table>
5.00 RATING AND OTHER PARTICULARS

5.01 The isolators shall be designed for the following rating and other particulars:

<table>
<thead>
<tr>
<th>Sl.No.</th>
<th>Particulars</th>
<th>33KV</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Type</td>
<td>Manually operated Double break, upright mounting with the movement of the blade in a horizontal plane suitable for outdoor installation</td>
</tr>
<tr>
<td>2</td>
<td>No. of poles (Phases)</td>
<td>Three</td>
</tr>
<tr>
<td>3</td>
<td>Rated Voltage</td>
<td>36KV</td>
</tr>
<tr>
<td>4</td>
<td>Rated normal current</td>
<td>800A</td>
</tr>
<tr>
<td>5</td>
<td>Rated frequency</td>
<td>50 Hz</td>
</tr>
<tr>
<td>6</td>
<td>System neutral earthing</td>
<td>effectively earthed…</td>
</tr>
<tr>
<td>7</td>
<td>Rated short time withstand current of <strong>main switch</strong></td>
<td>25 KA (rms for 3secs)</td>
</tr>
<tr>
<td>8</td>
<td>Rated peak withstand current</td>
<td>2.5 times the rated short time withstand current</td>
</tr>
<tr>
<td>9</td>
<td>Rated 1.2/50 micro second impulse withstand voltage (peak)</td>
<td></td>
</tr>
<tr>
<td>a)</td>
<td>to earth</td>
<td>170 kV</td>
</tr>
<tr>
<td>b)</td>
<td>across isolating distance</td>
<td>195 kV</td>
</tr>
<tr>
<td>10</td>
<td>Temperature rise</td>
<td>Max.Temp deg.C</td>
</tr>
<tr>
<td>a)</td>
<td>a. Copper contacts in air</td>
<td></td>
</tr>
<tr>
<td>i</td>
<td>Silver faced Copper</td>
<td>105</td>
</tr>
<tr>
<td>ii</td>
<td>Bare copper</td>
<td>75</td>
</tr>
<tr>
<td>b)</td>
<td>Terminal of isolator to be connected to external conductors by bolts</td>
<td></td>
</tr>
<tr>
<td>i</td>
<td>Silver faced copper</td>
<td>105</td>
</tr>
<tr>
<td>ii</td>
<td>Bare copper</td>
<td>90</td>
</tr>
<tr>
<td>c)</td>
<td>Metal parts acting as springs</td>
<td>The temperature shall not exceed a value, where the elasticity of the materials is impaired. For</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>11</td>
<td>Safe duration of over load</td>
<td></td>
</tr>
<tr>
<td>a)</td>
<td>150% of rated current</td>
<td>5 minutes</td>
</tr>
<tr>
<td>b)</td>
<td>120% of rated current</td>
<td>30 minutes</td>
</tr>
<tr>
<td>12</td>
<td>Minimum creep age distance (mm)</td>
<td>840</td>
</tr>
<tr>
<td>13</td>
<td>Rated mechanical terminal load</td>
<td></td>
</tr>
<tr>
<td>a)</td>
<td>Straight load (Kgf)</td>
<td>35</td>
</tr>
<tr>
<td>b)</td>
<td>Across load (Kgf)</td>
<td>13.26</td>
</tr>
<tr>
<td>14</td>
<td>Phase to Phase spacing for installation (mm)</td>
<td>1500</td>
</tr>
<tr>
<td>15</td>
<td>Height of center line of terminal pad above ground level (mm)</td>
<td>4000</td>
</tr>
</tbody>
</table>

5.02 The isolator are required to be closed or interrupt the 33 kV line & UG cable line charging current. Hence isolators should be capable of closing or interrupting a current of magnitude indicated in 5.01 (iv) above.

5.04 CLEARANCE:

5.04.01 The clearance between live parts and ground structure shall not be less than those specified in the IS – 10118, part – Ill, 1982. The length of break in full open position should be such that there is absolutely, no possibility of arc over from the live parts to the de-energized parts on which any maintenance work have to be done. The speed of opening or closing the switch shall be designed to ensure that the arcing during the operation is reduced to the minimum.

6.0. GENERAL TECHNICAL REQUIREMENTS

6.01. TYPE OF ISOLATORS:

The ISOLATORS shall be of three phase gang operated horizontal, double break type with turn and twist type moving blades.

6.02. CURRENT DENSITY:

Current density, to be adopted, for all parts of isolator and terminal connector & shall not exceed the following limits.

a) Hollow tube sections – Copper - 2.0 A / Sq. mm
- Aluminium -1.25 A/Sq. mm
b) Other sections and terminal connectors

- Copper: 1.6 A/Sq. mm
- Aluminium: 1.0 A/Sq. mm

6.03. Designs & Drawings

The full particulars of design, manufacture, template and quality control devices developed for manufacture of the equipments - offered in respect of the following items shall be furnished with drawings and descriptions.

<table>
<thead>
<tr>
<th>SI No</th>
<th>Particulars</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Contacts, Material etc.,</td>
</tr>
<tr>
<td>2</td>
<td>Design of contact pressure.</td>
</tr>
<tr>
<td>3</td>
<td>Contacts support and fixing arrangement on insulators</td>
</tr>
<tr>
<td>4</td>
<td>Turn and twist mechanism, clamps, locks, etc.</td>
</tr>
<tr>
<td>5</td>
<td>Bearings, housing of bearing, bushes, etc.</td>
</tr>
<tr>
<td>6</td>
<td>Balancing of heights.</td>
</tr>
<tr>
<td>7</td>
<td>Coupling pipes, joints, connection adjustments.</td>
</tr>
<tr>
<td>8</td>
<td>Base plates.</td>
</tr>
<tr>
<td>9</td>
<td>Down pipe, guides joints.</td>
</tr>
<tr>
<td>10</td>
<td>Brass bushes and bearings at various joints</td>
</tr>
<tr>
<td>11</td>
<td>Operating mechanism, type of gear, size and thickness of box, degree of protection. Gland plate, gland, etc.</td>
</tr>
<tr>
<td>12</td>
<td>Nuts, bolts and fasteners</td>
</tr>
</tbody>
</table>

6.04 TYPE AND CONSTRUCTION:

The design of the isolators shall be such that the switch can be changed to right or left hand control without excessive labour and with a minimum change of parts. The live parts shall be of non-rusting, non-corroding metal. Current carrying parts shall be nonferrous. Bolts, screws and pins shall be provided with lock washers, keys or other equipment locking facilities. Current carrying parts shall be made of copper alloy or equivalent material. The switch shall not require lubrication of any part, at frequent intervals.

The isolator shall be suitable for mounting in upright position (with the blades moving in horizontal plane) on steel / fabricated steel structures. The heights at which the isolators will be
mounted along with phase to phase dimensions are as per clause 5.00, Part - I. Any change in dimensions, will be intimated to successful bidder. Necessary lengths of operating rod as required shall be supplied..

6.05: OPERATING MECHANISM FOR MANUALLY OPERATED ISOLATOR:

a) Manual operating mechanism, gang operated through crank & reduction gear shall be provided for main switch.

b) The design of the operating mechanism shall be Such that minimum energy is required for operation and one person shall be able to operate the switch without undue effort. The blades shall be in positive continuous control throughout tile entire cycle of operation. Suitable reduction gear to achieve above aspects may be provided, for main switch and shall close or open with about 20 revolutions of the crank.

c) The operating pipes and rods shall be sufficiently rigid to maintain positive control without tension or compression & there shall also be capable of withstanding all torsional and bending stresses due to operation of the disconnecting switch. It shall not be possible, after final adjustment has been made for any part of the mechanism to be displaced at any point in the travel sufficiently to allow improper functioning of the switch, when the switch is opened or closed at any speed. All holes, ill crank, linkages, etc., having moving pins, shall be drilled to accurate fit, so as to maintain the minimum amount of slack and lost motion. The operating mechanism and its controls shall be so designed that under no circumstances the switch blades travel is interrupted before it reaches the fully close or open position. The operating mechanism shall be suitable to hold the main switch or earth switch in closed or opened position to prevent operation by gravity, wind, short circuit, seismic acceleration, vibration, shock, accidental touching etc.

6.06. CONTROL CABINET:

The operating mechanism mid all accessories shall be enclosed in a weather, dust and vermin proof cabinet. The control cabinet of each operating mechanism shall be made out of 12 SWG (2.64 mm thick) steel sheet. or 10mm thick aluminum in the form plate or casting. Control cabinet shall be provided with hinged doors along with padlocking arrangement. Sloping rain hood shall be provided to cover all sides. 15 mm thick neoprene or better type gasket shall be provided to ensure degree of protection atleast IP 55 as per S : 2147.

The motor operating mechanism / manually operating mechanism shall be mounted on the base supporting structures or on a separate Support- structure at a height of 300 mm from the ground level. Operating or lever for manual operation shall be at a convenient height of 1000 mm above ground level for easy operation. The unsupported length of the operating rod shall not. exceed 3 meters. Guide bearings shall be provided at suitable intervals. All brackets angles or other members mid accessories necessary for fixing the operating mechanism to switch supporting structure. and the bearing for operating rods shall be supplied. Rust proof pins and bearings of the bronze bushing, ball or roller type shall be provided. All ball and roller bearings shall be protected from weather by means of covers and grease retainers. Bearing pressures shall be kept low to ensure long life.

6.06 GEAR:

The disconnect may be required to operate occasionally with considerably long idle intervals. Special care shall be taken for selection of material for gear and lubrication of gears to meet
these requirements. The gears shall be made of bronze or any other better material and lubricated for life with graphite or better quality non-draining or non-hardening grease. Complete details of components, materials, self-lubricating arrangement, grade of lubricant, details of jigs, fixtures and devices used for quality check shall be furnished in the bid.

6.07 CONSTRUCTIONAL FEATURES:

6.07.01 FIXED AND MOVING CONTACTS:

a) The isolator shall have heavy-duty self-aligning high pressure - contacts of modem design. The contact shall be made of high grade, high conductivity, and heat resisting material. The main contacts shall be made of hard drawn electrolytic copper and the surface shall be silver plated. Arcing contacts wherever provided shall close first and open last.

b) The isolators blades / arms shall be made preferably from tubular section of hard drawn electrolytic copper having suitable diameter and shell thickness, and the contact surface shall be heavily silver plated.

c) The surface of the contacts shall be liberally designed to withstand safely the-highest short circuit current of the system as specified in the clause 05.01 (vii) - (viii) of part - I.

d) The male and female contact assembly and blades shall ensure
   i. Electro dynamic withstand ability during short circuit without any risk of repulsion of contacts.
   ii. Thermal withstand ability during short circuits.
   iii. Constant contact pressure even when the live parts of the insulators stacks are subjected to tensile stresses the insulators stacks are subjected to tensile stresses due to linear expansion of connected bus - bars, flexible conductors either because of temperature variation or strong winds.
   iv. Self - wiping action during closing and opening (preferably twisting type contacts). The surface shall be wiped during closing and opening operation to remove any film, oxide coating, etc. wiping action shall not cause scouring or abrasion of surfaces.
   v. Self - wiping ensuring smooth closing of the switch. The temperature rise of the contacts and other current carrying parts shall not be more than 45 °C over an ambient air temperature of 45°C, while carrying the rated current continuously. The temperature rise due to passage of rated short-circuit current for a period of 3 seconds shall not cause annealing or welding of contacts.

e) Fixed guides shall be provided so that proper seating of contacts will be obtained by closing even when a blade is out of alignment by 2.5 min or less.

f) All movable pars which may be in the current path shall be shunted by flexible copper conductors to prevent breaking due to repeated bending.

g) Fabrication shall be made with suitable jig to avoid deviation during production. Details of size and shape of contact, springs, back plate, fixing arrangements, design of contact pressure, life of contacts, limit of temperature rise etc., shall be furnished along with the tender.

6.08 MOUNTING OF CONTACTS:

Fixed contacts shall be mounted on a block or channel welded to 10 mm thick M.S. plate with holes for fixing on insulators. Slots shall be provided for marginal adjustment of height of contacts. The contacts shall rest on a brass block and with initial tension. Suitable device shall be provided to prevent dashing. Fabrication, welding etc. shall be done in suitable jig to avoid deviation during production.

6.09 TURN AND TWIST MECHANISM:

Turn and twist mechanism shall be provided with adequate locking to avoid opening or loosening by wind, short circuit force etc., on moving blade. The springs shall be made out of stainless steel or phosphor bronze or any other better material to have adequate strength and resilience and shall be encased with grease to avoid exposure to rain. The clamps and plates be made out
of at least 10 mm thick M.S. plate or flat. Fasteners with unlock nuts shall be used wherever necessary. Vulnerable parts shall be fabricated by tubular gas cutting and milling. The entire-mechanism shall be fabricated in suitable jig and template to avoid deviations during production.

6.10. All lives parts shall be designed to have smooth surfaces without any sharp points, edges and other corona producing surfaces so as to eliminate corona at specified extinction voltage or at 1.1 x rated voltage, if extinction voltage is not specified.

6.11. FASTNERS:

Nuts, bolts and washers of M-16 and higher size shall be hot-dip galvanized. The bolts used on tapped holes of insulators cap shall be galvanized by centrifuge process to avoid excess deposition of zinc on threads. Nuts, bolts and washers of less than M-16 size shall be of stainless steel when used on live parts and nickel plated brass in other parts.

6.12. BEARINGS

a) The design and construction of the various bearings should embody all the features required to withstand the climatic conditions specified to ensure dependable and effective operation, even after long period of inaction. All bearings in the current path except those specially designed as high pressure contact should be shunted by flexible copper housing having adequate cross section.

b) Rotating insulator shall be mounted on a housing with bearings. The housing shall be made of gravity die cast metal with smooth surfaces and suitably machined for seating the bearings. Two nos. of bearings with adequate shaft diameter and distance between the bearings shall be provided to avoid wobbling during operations. The bearings shall be of at least 75 mm internal diameter. The bearings shall be of reputed make and lubricated for life. All other friction locations shall be provided with suitable bearings or stainless or brass bushes. The bearings, bushes, joints, springs, etc., shall be so designed that no lubrication shall be required during the service. Complete details of bearings, bushes housing greasing, etc., shall be furnished with tender.

6.13. TANDEM AND DOWN PIPE:

a) The operating down pipe mid tandem pipe shall be of heavy duty GI pipe of the following sixes (Bore dia) for different KV class

i. Bore dia of tandem pipe ------ 32 mm.

ii. Bore dia of down operating pipe – 50 mm

b) The outside diameter and thickness of pipe shall be as follows

as per table - 3 of IS : 1239 (Part - 1) 1990. Mild steel tubes. -

<table>
<thead>
<tr>
<th>S1.</th>
<th>Nominal No.</th>
<th>outer dia Maximum (mm)</th>
<th>outer dia Minimum(mm)</th>
<th>Minimum thickness</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>32</td>
<td>42.9</td>
<td>42</td>
<td>4</td>
</tr>
<tr>
<td>2.</td>
<td>40</td>
<td>48.8</td>
<td>47.9</td>
<td>4</td>
</tr>
<tr>
<td>3.</td>
<td>50</td>
<td>60.8</td>
<td>59.7</td>
<td>4.5</td>
</tr>
</tbody>
</table>
6.14 **Tandem pipe:**

a) Two Nos. of tandem pipe shall be used for phase coupling of double break isolator. Base plate of insulators for connection of tandem pipe shall be made out of one piece of at least 10 mm thick MS plate. Bolt and shackle device shall be used to connect tandem pipe to the base plate. Wherever unavoidable, sliding clamps may be used. These clamps shall be made out of at least 10 mm thick MS plate with four(4) nos. of nuts and bolts. A grub screw shall be provided for securing connection of tandem pipes.

b) The pipe shall be terminated into a suitable swivel or universal type joint between the insulator bottom bearing of the operating mechanism to take cares of marginal angular misalignment at site. All brackets, guides, etc., shall be mounted on the base of the isolator. Arrangement of mounting any guide, bracket, mechanism and the base shall not be accepted, for upright mounting type isolator.

6.15 **BASE :**

Each pole of the isolator shall be provided with hot dip galvanized rolled steel base provided with holes for mounting bolts and designed for mounting on a steel structure. The bases shall be rigid and self supporting and shall require the guying or cross bracing between phases other than the supporting structure. The composite frame of the base shall be made of single channel of 150 x 75 x 6 / 8 mm.

6.16 **INSULATORS:**

6.16.01. The isolator shall be provided with solid core insulators.

a) These shall be of stacking type to be used. The dimensions and other parameters unless otherwise specified shall generally conform to IS - 5350-Part-11 & IEC 273.

b) The cylindrical type post insulators shall be of solid core type. Insulators of similar type shall be interchangeable. The mechanical strength class for outdoor cylindrical post insulators shall be of strength class 6, corresponding mechanical strength in tension, compression and torsional shall be as per IS : 53550 Part - II. When operated at maximum system voltage, there shall be no electrical discharge. Shielding rings, if necessary shall be provided.

c) The parameters of the insulators required shall conform to IS : 0350 - Part - II - 1973 or IEC 273.

d) The cylindrical post insulators shall consist of single unit only.

e) The insulator shall be provided with a completely galvanized steel base designed for mounting on the support. The base and mounting arrangement shall be such that the insulator shall be rigid and self supporting and no guying or cross bracing between phase shall be necessary.

6.16.02. **Porcelain** of the isolator:

a) The porcelain used for the manufacture of the insulators shall be homogenous, free from laminations and other flaws or imperfections that might effect the mechanical or dielectric. quality and shall be thorough vitrified, tough and impervious to moisture. The glazing of the porcelain shall be uniform brown colour, with a smooth surface arranged to shade away rain water and free from blisters, burns and other similar defects. Insulators shall be inter-changeable.
b) The porcelain and metal parts shall be assembled in such a manner and with such materials that any differential thermal expansion between the metal and porcelain parts throughout the operating temperature range will not loosen the parts or electrical strength or rigidity. The assembly shall not have excessive concentration of electrical stress in any section or across leakage surfaces. The cement used shall not give rise to chemical reaction with metal fittings. The insulator shall be suitable for water washing by rains or artificial means in service conditions. Further the insulators to be supplied shall be of high-quality and should not result in mismatch and misalignment of stacks during erection and operation.

c) Each cap shall be of a high-grade cast iron or malleable steel casting or steel forging. Cap and base insulators shall be interchangeable with each other. The insulator shall conform to the requirement of the latest edition of IS: 2544, or any other equivalent standard. The bidder should furnish the characteristics of insulators.

6.16.03 All the ferrous metal part shall be hot dip galvanized smoothly as per IS: 3638 (as amended up to date), IS: 2623 or any other equivalent authoritative standard. The material shall be galvanized only after shop operations upon it have been completed. The metal parts for galvanization should be thoroughly cleaned of any paint, grease, rust, scales or alkalies or any foreign deposit which are likely to come in the way of galvanization process. The metal parts coating shall withstand minimum four one minute dips in copper sulphate solution as per IEC - 168.

The insulator unit shall be assembled in a suitable jig to ensure correct positioning of the top and bottom metal fittings relative to one another. The phases of the metal fitting shall be parallel and at right angle to the axis of the insulator and corresponding holes in the top and bottom metal fittings shall be in a vertical plane containing the axis of the insulator.

It shall be sole responsibility of the supplier to carry out thorough inspection and quality checks on the insulators at the insulator supplier works before offering the insulators for purchaser’s inspection.

6.17 PADLOCKING DEVICE:

The isolator shall be provided with padlocking device to permit locking of the isolator in both fully open and fully closed positions.

6.18 EARTHING:

The frame of each disconnect shall be provided with two reliable earthing terminals for connection to the earthing conductor / flat also clamping screw suitable for carrying specified short time current. The diameter of clamping screw shall be at least 12 mm. The connecting point shall be marked with earth symbol.

6.19 TERMINAL CONNECTORS

a) The disconnecting switches shall be provided with high conductivity bimetallic terminal connectors and suitable for Aluminium pipes (BS 1600 schedule 40) and 100 mm AAA conductors & 120 sqmm U.G. cable, the size of which will be indicated to successful bidder. The connector shall be rigid in respect of AAA conductors & flexible for UG Cable connections. The terminal connectors shall be expansion type in respect of Aluminium pipes. The terminal connector shall conform to IS: 5561 1970.

b) Further the terminal connectors shall be suitable for both horizontal or vertical take off.
c) For bimetallic type of connectors, necessary steps shall be taken by the manufacturers to ensure that there is no adverse effect on the connector and the connected equipment due to bimetallic action.

6.20. SUPPORTING STRUCTURE:

These galvanized support structures shall be fabricated as per the requirement.

6.21. ASSEMBLY

The disconnect shall be fully assembled at the works of the bidder. Typical operation shall be carried out on each type of fully assembled disconnect to ascertain that all parts fit correctly and function satisfactorily.

6.22. PAINTING, GALVANIZING AND CLIMATE PROOFING:

a) All interiors and exteriors of enclosures, cabinets mid other metal parts shall be thoroughly cleaned to remove all rust scales, corrosions, grease and other adhering foreign matter and surfaces treated by recognized phosphating (Eg. Seven tank phosphating sequence), After such preparation of surfaces tow coats of zinc oxide primer shall be given by suitable stoving and air-drying, etc., before final paint.

b) Colour of the final paint shall be of shade No. 631 of IS-5, i.e., epoxy light grey. The final painted cubicle shall present aesthetically pleasing appearance free from any dent of uneven surface Paint inside the metallic housing shall be of anti-condensation type and the paint on outside surfaces shall be suitable for outdoor installation.

c) All ferrous parts not suitable for painting such as structural steel, pipes, rods, levers, linkages, nuts and bolts used in other than current path etc., and also supporting structures shall be hot dip galvanized. Galvanization shall be done after completion of fabrication which shall be capable to prevent corrosion in view of the severe climatic conditions.

d) Thickness of zinc coating shall not be less than 610 gm of zinc per sq. meter of surface. Zinc coating shall be smooth clean and of uniform thickness and free from defect. Preparation of galvanizing and the galvanizing itself shall not adversely effect the mechanical properties of the coated material, The quality shall be established by tests per IS : 2633. Galvanizing of nuts and bolts shall be carried out by centrifugal or suitable process so that the bolts will easily fit into the tapped holes / nuts.

e) All components shall be given adequate treatment of climate proofing as per IS : 3202 so as to withstand corrosion and severe conditions.

7.00 TESTS :

7.01 Type tests :

a) The equipment offered, shall be fully type tested. The type test reports shall not be older than 5 years on the day of bid opening. The type tests are to conducted again if the reports are older than 5 years on the day of bid opening at no extra cost to owner.

b) During the type test the disconnect shall be mounted on its own support structure or equivalent support structure and installed with its own operating mechanism to make the type test representative. Drawing of equivalent support structure if any and mounting arrangement made for type tests shall be furnished for purchaser's approval before conducting the type tests.

c) The type tests shall be conducted on the disconnect along with approved insulators and terminal connectors.

d) Mechanical endurance test shall be conducted on the main switch.
e) **LIST OF TYPE TESTS:**

List of type tests to be carried out as per IS : 9921 Part - VI 1985, are as given below.

i. Visual examination of components,
ii. Dimensional verification of parts.
iii. Assembly, interchangeability and verification of critical dimensions.
iv. Measurement of resist-circuit of main circuit and earth circuit (before and after mechanical endurance test)
v. Temperature rise test (before and after mechanical endurance test)
vi. Mechanical endurance test.
vii. Short time withstand current and peak withstand current tests.
viii. One minute power frequency voltage wet withstand tests across the isolating distances and to earth.
ix. Standard lightning impulse voltage withstand tests on auxiliary and control circuits and auxiliary switches.
x. One minute power frequency, withstand voltage test on auxiliary and control circuits and auxiliary switch.
xi. Verification of operation during application of rated mechanical terminal loads.
xii. Galvanization tests.
xiii. Chemical composition of contact material, springs and fasteners and bushes.
xiv. Physical tests on springs and fasteners and copper strip / tubes.

7.02. **ACCEPTANCE AND ROUTING TESTS:**

a) All acceptance and routine tests as stipulated in the relevant standards shall be carried out by the supplier in presence of purchaser's representative.

b) Mechanical operation tests (routine test) shall be conducted on the complete disconnect (man switch and earth switch) at supplier's works and a certified test report be furnished to the purchaser. Alternatively the bidder may offer to conduct this test at purchaser's sub-station in which case the purchaser shall make necessary arrangement to erect the disconnect at his sub-station site under supervision of bidders representatives for supervision shall not be borne by the purchaser.

c) The test report of power frequency voltage withstand test conducted on the insulator shall be furnished for purchaser's acceptance in lieu of conducting the power frequency (dry) test on main circuit (routine test).

d) **LIST OF ROUTING TESTS:**

List. of routine test to be carried out as per IS : 9921, Part - IV - 1985 are as given below:

i. Visual examination of components.
ii. Assembly, interchangeability and verification of critical dimensions.
iii. One minute power frequency voltage dry withstand tests across the isolating distance and to earth.
iv. Measurement of resistance of isolator contacts and between terminals of the main circuits.
v. Power frequency voltage withstand tests on auxiliary and control circuits and auxiliary switches at 2 KV (rms) for one minute.
vi. Mechanical operation tests.
7.03 SPECIAL TESTS

Special tests listed below shall be carried out in presence of purchaser's representative.

a) Test on insulators – Conforming to IS - 2544 
b) Test on insulators – Conforming to IEC - 168 
c) Test on terminal connecters – IS : 5561 
d) Operation tests on operating mechanism - IS : 2623.
e) Test certificates and documents of the following items shall be furnished at the time of routine tests.
   
   - Chemical analysis of copper.
   - Bearings
   - Fasteners
   - Universal/ swivel joint coupling.
   - Insulators.
   - Gears

8.00 INSPECTION

The inspection may be carried out by the purchaser at any stage of manufacture. The successful bidder shall grant free access to the purchaser's representative at a reasonable time when the work is in progress. Inspection and acceptance of any equipment under this specification by the purchaser, shall not relieve the supplier of his obligation of furnishing equipment in accordance with the specification and shall not prevent subsequent rejection if the equipment is found to be defective. The supplier shall keep the purchaser informed in advance, about the manufacturing programme so that arrangement can be made for inspection. The purchaser reserves the light to insist for witnessing the acceptance / routine testing of the bought out items.

9.0 DOCUMENTATION:

All drawings shall conform to International Standard Organization (ISO) ' A ' series of drawing sheet / Indian standards specification IS : 656. All drawings shall be in ink and suitable for microfilming. All dimensions and data shall be in system international units.

10.0 LIST OF DRAWINGS AND DOCUMENTS:

The bidder shall furnish the following drawings along with his offer:

a) General outline and assembly drawings of the disconnect, operating mechanism, structure, insulator and terminal connector.

b) Sectional views and descriptive details of items such as moving blades, contacts arms, contact springs, contact support, turn and twist mechanism, bearing, housing of bearing, bushes, balancing of heights, phase coupling pipes, base plate, operating shaft, guides, swivel -joint operating mechanism and its components, etc.

a) Loading diagram.
b) Drawings with structure for the purpose of type test
c) Name plate
d) Schematic drawing
e) Type test reports in case the equipment has already been type tested
f) Test reports, literature, pamphlets of the bought out items and raw material.
11.0. INSTRUCTION MANUALS

The two copies of the erection, operation and maintenance manuals in English shall be supplied one month prior to dispatch of the equipment. The manual shall be bound volume and shall contain all drawings and information required for erection, Operation and maintenance of the disconnect including but not limited to the following particulars.

a) Marked erection prints identify the component parts of the disconnect as shipped with - assembly drawings.

b) Detailed dimensions and description of all auxiliaries.

c) Detailed views of the insulator stacks, metallics, operating mechanism, structure etc.

12.0. LIST OF MANUFACTURERS:

a) SWITCHGEAR & STRUCTURAL,
b) MULAR,
c) CGL ,
d) GR POWER ,
e) AREVA,
f) SIEMENS

The bidders can only offer the above manufacturer’s equipments.
Section-VII
Lightning Arrestor
TECHNICAL SPECIFICATION OF 33 KV LIGHTNING ARRESTOR
(VOLTAGE CLASS SURGE ARRESTORS)

The specification covers the design, manufacture, shop & laboratory testing before despatch, supply delivery of 33 KV, Station class heavy duty, gapless metal oxide Surge Arrestors, insulating base, clamps, complete fittings & accessories suitable for 33 KV transformers/feeders including arrester’s electrode earthing.

1.0 STANDARDS

The design, manufacture and performance of Surge Arrestors shall comply with IS: 3070 Part-3 and other specific requirement stipulated in the specification Unless otherwise specified, the equipment, material and processes shall conform to the latest applicable Indian/International Standards as listed hereunder:

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>IS: 2071-1974 (Part-2)</td>
<td>Test Procedures</td>
</tr>
<tr>
<td>IS: 6209-1982</td>
<td>Methods of Partial discharge measurement.</td>
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<tr>
<td>IS: 6745-1980</td>
<td>Methods for determination of mass of zinc coating on zinc coated iron and steel articles.</td>
</tr>
<tr>
<td>IEC:TC-37</td>
<td>Test Procedures.</td>
</tr>
<tr>
<td>IEE-99-4</td>
<td>Surge Arrestors.</td>
</tr>
</tbody>
</table>

The equipment complying with any other internationally accepted standards shall also be considered if it ensures performance equivalent to or superior to the India Standards.

2.0 GENERAL REQUIREMENT

2.1 The Metal Oxide gap less Surge Arrester without any series or shunt gap shall be suitable for protection of 33 KV power transformers, associated equipment and 33 KV lines from voltage surges resulting from natural disturbance like lightening as well as system disturbances.

2.2 The surge arrester shall draw negligible current at operating voltage and at the same time offer least resistance during the flow of surge current.
2.3 The surge arrester shall consist of non-linear resistor elements placed in series and housed in electrical grade porcelain housing/silicon polymeric of specified creepage distance.

2.4 The assembly shall be hermetically sealed with suitable rubber gaskets with effective sealing system arrangement to prevent ingress of moisture.

2.5 The surge arrester shall be provided with line suitable for ACSR 'Panther' Conductor for vertical and horizontal take off. The earth terminals shall be provided of suitable size. The groundsie terminal of surge arrester shall be connected with 50x6mm- galvanized strip, one end connected to the surge arrester and second end to a separate ground electrode (Electrode type of earthing). The contractor shall also recommend the procedure which shall be followed in providing the earthing/system to the Surge Arrester.

2.6 The surge arrester shall not operate under power frequency and temporary over voltage conditions but under surge conditions, the surge arrester shall change over to the conducting mode.

2.7 Surge arrester shall have a suitable pressure relief system to avoid damage to the porcelain/silicon polymeric housing and providing path for flow of rated fault currents in the event of arrester failure.

2.8 The reference current of the arrester shall be high enough to eliminate the influence of grading and stray capacitance on the measured reference voltage.

2.9 The surge arrester shall be thermally stable and the contractor shall furnish a copy of thermal stability test with the bid.

2.10 The arrestors for 33 KV system shall be suitable for mounting on transformers as well as in the yard. The supplier shall furnish the drawing indicating the dimensions, weight etc. of the surge arrestors for the design of mounting brackets.

2.11 The arrester shall be capable of handling terminal energy for high surges, external pollution and transient over voltage and have low losses at operating voltage.

3.0 ARRESTER HOUSING

3.1 The arrester housing shall be made up of porcelain/silicon polymeric housing and shall be homogenous, free from laminations, cavities and other flaws of imperfections that might affect the mechanical and dielectric quality. The housing shall be uniform brown colour, free from blisters, burrs and other similar defects. Arrestors shall be complete with insulating cases, fasteners for stacking units together and terminal connectors.

3.2 The housing shall be so coordinated that external flashover shall not occur due to application of any impulse or switching surge voltage upto the maximum design value for arrester. The arrestors shall not fail due to contamination. The 33 KV arrestors housing shall be designed for pressure relief class as given in Technical Parameters of the specification.

3.3 Sealed housing shall exhibit no measurable leakage.

4.0 TESTS
4.1 Test on Surge Arrestors

The Surge Arrestors offered shall be type tested not earlier than 5 years before the date of opening of this tender. The surge arrestors shall be subjected to routine and acceptance tests in accordance with IS: 3070(Part3)-1993. In addition, the suitability of the Surge Arrestors shall also be established for the following:

* Residual voltage test
* Reference voltage test
* Leakage current at M.C.O.V.
* P.D. Test
* Sealing test
* Thermal stability test
* Aging and Energy capability test
* Watt loss test

Each metal oxide block shall be tested for guaranteed specific energy capability in addition to routine/acceptance test as per IEC/IS.

4.2 The maximum residual voltages corresponding to nominal discharge current of 10KA for steep current, impulse residual voltage test, lightning impulse protection level and switching impulse level shall generally conform to Annexure-K of IEC-99-4.

4.3 The bidder shall furnish the copies of the type tests and the characteristics curves between the residual voltage and nominal discharge current of the offered surge arrestor and power frequency voltage V/s time characteristic of the surge arrestor subsequent to impulse energy consumption as per clause 6.6 of IS: 3070 (Part-3) offered along with the bid.

4.4 The surge arrestors housing shall also be type tested and shall be subjected to routine and acceptance tests in accordance with IS: 2071.

4.5 Galvanization Test

All Ferrous parts exposed to atmospheric condition shall have passed the type test and be subjected to routine and acceptance test in accordance with IS: 2633 & IS: 6745.

5.0 NAME PLATE

5.1 The nameplate attached to the arrestors shall carry the following information: -

* Manufacturing Trade Mark
* Year of Manufacture
* Rated Voltage
* Continuous Operation Voltage
* Pressure relief rated current
* Name of Client-
* Purchase Order Number along with date.

6.0 INSPECTION

6.1 All tests and inspection shall be made in the manufacturer’s works unless
otherwise specifically agreed upon by the manufacturer and purchaser at the time of placement of purchase order. The manufacturer shall afford to the inspector representing the purchaser, all reasonable facilities, without charge to satisfy him that the material being furnished is in accordance with these specifications. The purchaser reserves the right to get an component/material being used by the manufacturer of the Surge Arrestor tested from any recognized test house.

6.2 The inspection by the purchaser or his authorized representative shall not relieve the contractor of his obligation of furnishing equipment in accordance with the specifications.

7.0 DRAWING AND INSTRUCTION MANUALS

Within 15 days of receipt of the order, the successful tenderer shall furnish to the purchaser the following drawings and literature for approval:

a. Outline dimensional drawings of Surge Arrestor and all accessories. b.

Assembly drawings and weights of main component parts.

c. Instructions manual
d. Drawing showing details of pressure relief value
e. Volt-time characteristics of surge arrestors.
f. Detailed dimensional drawing of porcelain housing/ Silicon polymeric i.e. internal diameter, external diameter, thickness, height profile, creepage distance, dry arching distance etc.
## Guaranteed Technical Particulars for 33kV Lightning Arrestor

(To be submitted along with offer)

<table>
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<th>Sl. No.</th>
<th>Particulars</th>
<th>Bidder’s Offer</th>
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<td>1.</td>
<td>Name of manufacturer.</td>
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<td>2.</td>
<td>Type Designation</td>
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<td>4.</td>
<td>Applicable Standard</td>
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<td>5.</td>
<td>No. of units per Arrestors</td>
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<td>6.</td>
<td>Rated Voltage</td>
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<td>7.</td>
<td>Nominal discharge current 8/20 micro second wave (KA)</td>
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<td>8.</td>
<td>Maximum continuous operating Voltage</td>
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<td>Insulation withstand voltage power frequency</td>
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<td>10.</td>
<td>Maximum Lightning Impulse Residual voltage (8/20 micro second wave)</td>
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<tr>
<td></td>
<td>i) 5000 A KV Peak</td>
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<td></td>
<td>ii) 10000 A KV Peak</td>
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<td>11.</td>
<td>Maximum steep current Impulse Residual voltage at 10 KA of micro second front time.</td>
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<td>12.</td>
<td>Maximum Switching Impulse Residual voltage 50 x 100 micro seconds at 500 Amps.</td>
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<td>13.</td>
<td>Current Impulse withstand capability.</td>
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<td></td>
<td>i) Long duration discharge class.</td>
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<td>ii) Minimum energy discharge capability</td>
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<td>16.</td>
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<tr>
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<td>i) High current</td>
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<td>Reference current of the arresters Ambient</td>
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<td>Current at M.C.O.V. (Maximum Continuous)</td>
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<td>18.</td>
<td>i) Resistive Current IR</td>
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<td>ii) Capacitive voltage IC</td>
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<td>19. Temporary over voltage capability</td>
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<td></td>
<td>i) 0.1 second</td>
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<td>ii) 1.0 Second</td>
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<td>iii) 10.0 Second</td>
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<td>20.</td>
<td>a) Total Creepage Distance</td>
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<td>b) Protected Creepage Distance</td>
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<td>Over all dimensions</td>
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<td>i) Height</td>
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<td>ii) Diameter</td>
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<td>Cantilever strength KG-M</td>
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<td>23.</td>
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<td>24.</td>
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<td></td>
<td>i) Between Arrestors</td>
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<td>ii) Arrestor and adjoining - objects</td>
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Section-VIII

HG Fuse Unit
TECHNICAL SPECIFICATIONS FOR 33kV HG Fuse Unit

1.0 SCOPE
1.1 This specification covers the manufacture, testing and supply of 33KV, 800 Amps, H.G. Fuse sets
1.2 The 33 KV H.G. Fuses shall be suitable for outdoor operation under the climatic conditions specified. It shall be of the following ratings :-

1. Number of Poles 3
2. No. of insulator per pole 4 nos. 22 KV/24 KV, Post insulators per phase.
3. Nominal system voltage 33kV
4. Highest system voltage 36kV
5. Rated frequency 50Hz
6. System Earthing Effectively earthed
7. Rated normal current 800 Amps.
8. Altitude of installation Not exceeding 1000 M.

The Post insulator used in the H.G.Fuse set shall have the following ratings :-

1. Power frequency withstand voltage (dry) 95 KV (RMS)
2. Power frequency withstand voltage (wet) 75 KV (RMS)
3. Impulse withstand voltage (dry) 170 KV (Peak)
4. Power frequency puncture withstand voltage 1.3 times the actual dry flashover voltage of the unit.

2.0 STANDARDS
The H.G. Fuse set shall conform to the following standards.

IS- 5792 – 1973 ( for high voltage expulsion fuses and similar fuses ).
IS- 2544 – 1973 ( for porecelain post insulators or its latest amendments if any.

INSULATOR MAKE :- 22/24 KV post insulator complete with pedestal cap duly cemented to be used in 33 KV H.G. Fuse sets confirming to IS-2544/1973.
The tender shall furnish type test certificate of the post insulators from their manufacturer for reference.

3.0 TECHNICAL DETAILS
The H.G. Fuse shall have adjustable arcing horns made of solid copper rod having 8.23mm dia. The horns shall be fitted with screwing devices with fly nut for fixing and tightening the fuse wire. It shall have robust terminal connectors of size80mm x 50 mm x 8mm made of copper casting (95% minimum copper composition) duly silver plated with two numbers of 12mm dia brass bolts and double nuts with flat brass washers. The connector should be capable of connecting crimpable conductor with bimetallic solderless sockets. The H.G. Fuse set shall be suitable for horizontal mounting. The minimum clearance between the adjacent phases of the fuse set shall be 1200 mm and the centre to centre ( distance between two post insulators of the same phase ) shall be 760 mm. All metal (ferrous) parts shall be galvanized and polished. Only post insulator (original
cemented and not pin insulators shall be used for the H.G. Fuse set).

4.0 TESTS & TEST CERTIFICATE

Certificate for the following type test conducted within 5 years preceding to the date of opening of Tender on a prototype set of H.G. Fuse set in a Govt. approved Testing Laboratory preferably at CPRI, Bangalore shall have to be submitted for Reference & Scrutiny.

a) Dielectric test (impulse & one minute wet power frequency withstand voltage test.

b) Temperature rise test (for terminals).

c) Mechanical strength test for the post insulator as per IS-2544/1973.

d) Test for galvanization of metal (ferrous) parts.

5.0 ROUTINE TESTS

The following routine tests shall have to be conducted on each test and results are to be furnished for consideration for acceptance of deputing inspecting Officer for inspection & conducting testing of the materials.

1. Power frequency voltage dry test.

2. Dimension check.


6.0 GUARANTEED TECHNICAL PARTICULARS

The tenderers are required to furnish the guaranteed technical particulars duly filled in the proforma given along with the tender.

7.0 COMPLETENESS OF EQUIPMENT

Any fittings accessories or apparatus which may not have been specifically mentioned in this specification but which are usually necessary in equipment of similar plant shall be deemed to be included in the specification and shall be supplied by the Tenderer without extra charge. All plant and equipment shall be complete in all details whether such details are mentioned in the specification or not.

8.0 INSPECTION

Routine and acceptance test shall be conducted at the place of manufacturer. The tenders are requested to furnish details of equipment which will be used for testing along with tender. The tenders of these manufacturers who do not have adequate testing facilities for conducting routine and acceptance test are liable for cancellation. The successful bidder has to furnish routine test certificate and guarantee certificate for each consignment of materials to be inspected at the time of offer of materials for inspection.
Section-IX

33kV HT UG Cable
TECHNICAL SPECIFICATIONS FOR 33kV XLPE INSULATED UNDERGROUND CABLES

1.0 SCOPE:

1.1 The scope of this specification covers the design, manufacture, stage inspection at works, inspection and testing the finished cables 33kV aluminum conductor. Three Core 400 square millimeter and 300 square millimeter XLPE insulated screened, DRY CURED Power cables for use with effectively earthed urban distribution system at manufacturer’s works. One portion from Janla 33/11kV s/s to IOCL depot Jatni is proposed for 3 core ,300 sqmm XLPE insulated Cable and the rest cable portion is proposed for 3 core ,400 sqmm XLPE insulated as per the SLD given herewith.

2.0 RATED VOLTAGE

2.1 The rated voltage of the cable shall be 33000 Volts AC with the highest system voltage of 36000 Volts between phases of the effectively earthed three phase-distribution system.

3.0 APPLICABLE STANDARDS:

3.1 Unless otherwise stipulated in the specifications, the latest version of the following Standards shall be applicable.

   a. IS 8130 – Conductors for Insulated electrical cables and flexible cords, H4 Grade Aluminium Conductor, Stranded compacted Circular.
   b. IS 10810 (series) – Methods of tests for cables.
   c. IS 10418 – Drums for electrical cables.
   d. IS 7098 (Part 2) – Cross – linked Polyethylene Insulation for Cables.
   e. IS 3975 – Specification for mild steel wires, strips and tapes for armoring of cables.
   f. IS 5831 – Specification for PVC insulation sheath for electric cables.
       Dimensions of protective coverings of cables
       Part 1 – Elastomeric and thermoplastic insulated cables.

3.2 The Cables manufactured to any other Internal Standards like BSS, IEC or equivalent standards not less stringent than Indian Standards are also acceptable. In such cases, the Bidders shall enclose a copy of the equivalent international standard, in English language, along with the bid.

4.0 CLIMATIC CONDITIONS:

- Maximum temperature of air in shade : 50 Degree C
- Minimum temperature of air in shade : 15 Degree C
- Maximum temperature of air in sun : 65 Degree C
- Maximum humidity : 87%
- Average No. of thunder storm days per annum : 50
- Average No. of dust storm days per annum : 10
- Maximum rainfall per annum : 3000 mm
• Average rainfall per annum: 925 mm
• Limits of ambient temperature over a period of 24 hours: 47 Deg. C and 27 Deg. C in summer and 30 Deg. and 7.5 Deg. C during winter
• Maximum wind pressure: 260 Kg/Sq.mm
• Altitude: 1000 M above MSL

5.0 PRINCIPAL PARAMETERS:

• The Power cable shall be 33 KV grade high conductivity stranded, compacted, aluminum shaped conductor of flexibility grade-2, 3 core dry cured XLPE insulated, extruded inner PVC sheathed, galvanized steel strip armored, with separate extruded PVC outer sheathed overall, conforming generally to IS:7098 (Part-II/1985) or any latest amendment there of suitable for 33 KV / 11 KV 3 Phase 50 C/S earthed system.

CONDUCTOR:
The cable conductor shall be made from stranded aluminum to form compact shaped conductor having resistance within the limits specified in IS: 8130/1984 and any amendment thereof. The wires shall be laid up together with a suitable right hand lay.

CONDUCTOR SHIELD:
The conductor having a non-magnetic semi-conducting screen shall ensure perfectly smooth profile and avoid stress concentration. This conductor screen shall be extruded in the same operation as the insulation; the semi-conducting polymer shall be cross linked.

INSULATION:
The XLPE insulation should be suitable for specified 33 KV system voltages. The curing process of XLPE insulation should be dry cured. The manufacturing process shall ensure that insulations shall be free from voids. The insulation shall withstand mechanical and thermal stresses under steady state and transient operating conditions. The extrusion method should give very smooth interface between semi-conducting screen and insulation. The insulation of the cable shall be high stranded quality, specified in IS:7098 (Part-II/1985).

INSULATION SHIELD:
To confine electrical field to the insulation, non-magnetic semiconducting shield shall be put over the insulation. The insulation shield shall be extruded in the same operation as the conductor shield and the insulation by triple extrusion process. The XLPE insulation shield should be strippable. Metallic screening shall be provided.

SHEATH:
The sheath shall be suitable to withstand the site conditions and the desired temperature. It should be of adequate thickness, consistent quality and free from all defects. The PVC sheath shall be extruded as per IS: 7098 Part-II/1985.
• **ARMOUR:** Armoring shall be applied over the inner sheath with single galvanized steel wire/strip complying with the requirements of IS: 3975/1979. The dimensions of the galvanized wire/strip shall be as specified in table 4 of the IS: 7098/Part-II/1985. The armour wire/strip shall be applied as closely as practicable. The direction of the lay of the armour shall be left hand. The joints in armour wire/strip shall be made by brazing or welding and the surface irregularities shall be removed. A joint in any wire/strip shall be at least 300mm from the nearest joint in any other armour wire/strip in the complete cable.

• **OUTER SHEATH:** Extruded PVC outer sheath as per IS:5831/1984, shall be applied over armouring with suitable additives to prevent attack by rodents and termites. Outer sheathing shall be designed to offer high degree of mechanical protection and shall also be heat, oils, chemicals, abrasion and weather resistant. Common acids, alkalis, saline solutions etc., shall not have adverse effects on the PVC sheathing material used. The cable shall be suitable for laying in covered trenches and/or buried underground to meet the outdoor application purposes.

• **Conductor Screening:** Extruded, cross-linked, semi-conducting compound of 1.0mm thickness for 33 KV

### 6.0 CONSTRUCTION:

• The cable shall have suitable PVC fillers laid up with insulation cores to provide substantially circular cross section before the inner sheath is applied. The fillers should be suitable for the operating temperature of the cable and compatible with the insulating material.

• All materials used in the manufacture of cable shall be new, unused and of finest quality. All materials should comply with the applicable provisions of the tests of the specification, IS, Indian Electricity Rules, Indian Electricity Act and any other applicable statutory provisions, rules and regulations.

• The PVC material used in the manufacture of cable should be of reputed manufacturer. No recycling of the PVC is permissible. The purchaser reserves the right to ask for documentary proof of the purchase of various materials to be used for the manufacture of cable and to check that the conductor is complying with quality control.

• Maximum Permissible emergency overload temp. at 25% overload to 100 hrs. per year or 500 hrs. in life of cable :1300°C for 1 hour.

Maximum Permissible short circuit temperature : 2500°C for 1 hour.

### 7.0 CURRENT RATING:
The cables will have current ratings and derating factors as per relevant Indian Standards. The one second short circuit current rating values shall be furnished and shall be subject to the purchaser's approval. The current ratings shall be based on maximum conductor temperature of 90Deg.C with ambient site condition specified for continuous operating at the rated current. The Short circuit current rating should be 28.2 KA for 1 sec for 33 KV, 300 mm2 and 37.6 KA for 1 sec. for 33 KV, 400 mm2, XLPE UG Cable.

8.0 OPERATION

Cables shall be capable of satisfactory operation, under a power supply system frequency variation of plus or minus 3 Hz., voltage variation of plus or minus 10% and combined frequency voltage variation of 10% (absolute sum). Cable shall be suitable for laying in ducts or buried under ground. Cable shall have heat and moisture resistance properties. These shall be of type and design with proven record on Distribution Network services.

9.0 LENGTHS:

The cables shall be supplied in standard drum lengths of 250Mtr. ±5% for 33 KV Cables.

10.0 IDENTIFICATION:

For identification of individual cores, colored tape of red, yellow and blue colors respectively shall be used on the cores on frequent intervals to identify phase conductors as per IS:7098/Part-II/1985.

- **MARKING ON THE DRUM**: The following information either stenciled on the reel or drum or contained in a label attached to it shall be carried by the cable.
  - Reference : IS:7098/Part-II
  - Manufacturers Name, Brand name or Trade mark
  - Type of cable and voltage grade
  - Number of cores
  - Nominal cross sectional area of conductor
  - Cable code
  - Length of cable on the reel or drum
  - Number of lengths on the reel or drum
  - Direction of rotation of drum (by means of arrow)
  - Approximate gross weight
  - Year of manufacture
  - The reel, drum, or label may be marked with IS Certification mark
  - The drum shall be marked –Name of Bayer – CESU, Orissa.
  - Purchase Order number and date.

- **EMBOSSING ON THE OUTER SHEATH OF CABLE**:
Each cable shall have the range of non-erasable distinct markings listed below legibly printed on its outer sheath at one meter intervals.

- ISI Mark with B.I.S License No. & ISS No. Applicable legibly embossed on the insulation.
- Buyer’s name: “CESU, Odisha”
- Manufacturer’s Name with trademark identification.
- Year of manufacture: last two digits are sufficient:
- Size of Cable
- Rated voltage class:
- Sequential marking of length.
- The height of the printed lettering shall be not less than 20% of the overall diameter of the conductor

11.0 TESTS
The following tests shall be carried out in accordance with IS:8130/1984, IS:3975/1979 (Armouring), IS:5831/1984, IS:10810 (Methods of test for cables), IS:7098/Part-II/1985.

- **TYPE TESTS**: The following shall constitute the type tests:
  - Tensile test (for aluminum) in accordance with IS:8130/1984.
  - Wrapping test (for aluminum) in accordance with IS:8130/1984.
  - Conductor resistance tests (in accordance with IS:8130/1984)
  - Test for thickness of insulation and sheath (in accordance with IS:10810)
  - Physical test for insulation and sheath (in accordance with IS:10810 and IS:5831/1984).
  - Test for bleeding and blooming of pigments (in accordance with IS:5831/1984)
  - Insulation resistance test (in accordance with IS:5831/1984)
  - High voltage test (water immersion test) in accordance with IS:10810.

- **ACCEPTANCE TESTS**: The following shall constitute the acceptance tests:
  - Tensile test (for aluminum) : IS:8130/1984
  - Wrapping test (for aluminum) : IS:8130/1984
  - Conductor resistance test : IS:8130/1984
  - Test for thickness of insulation : IS:5831/1970 & IS:10810
• ROUTINE TESTS: The following shall constitute routine tests:
  ✓ Conductor resistance test (in accordance with IS: 8130/1984)
  ✓ High voltage test or spark test (in accordance with IS: 10810)

12.0 INSPECTION

All acceptance tests shall be conducted at the time of inspection and inspection shall be
made at the place of manufacture unless and otherwise specifically agreed upon by the
manufacturer and purchaser at the time of purchase. The manufacturer shall afford the
inspector representing the purchaser all reasonable facilities, without charges to satisfy him
that the material is being furnished in accordance with the specification. The purchaser has
the right to have the test carried out at his own cost by an independent agency whenever
there is dispute regarding the quality of supply.

13.0 PACKING

The cable shall be either wound on reels or drums, the packing shall be robust enough for
rough handling that is occasioned during transportation by Rail/Road.

14.0 GUARANTEED TECHNICAL PARTICULARS:

Guaranteed technical particulars of the cables to be furnished with the Bid are enclosed.

15.0 DRAWING & LITERATURE

15.1 The following shall be furnished along with the tender
  a) Cross sectional drawings of the cables, giving dimensional details for each size of
cable.
  b) An illustrated literature on the cable, giving technical technical information, on
current ratings, cable constants, short circuit ratings, derating factors, for different
types of installation, packing date, weights and other relevant information.

16.0 Schedule of Requirement, Desired deliveries and Prices

The schedule of requirement and desired deliveries etc. are indicated in the GTP.

17.0 INSTALLATION CONDITIONS

The cables are laid directly buried in ground, in the bores formed by horizontal boring
method. The Nominal depth of laying is up to 2000 mm (from top, of ground to centre of
cable). However, in trenchless horizontal bore method, the bore can go up to a depth of a
maximum of 2 meter. Nature of soil is heterogeneous, sandy, Soil resistivity varies between
18 to 100 ohmmeter and the Thermal resistivity is around 1200 to 1500 C/ Cm/w. Only firm
prices shall be quoted.

18.0 QUANTITY

Tenderer may quote the quantity that they can offer immediately within a month of the issue
of purchase order and the minimum time required to supply the full quantity.

- **ISI CERTIFICATION:** Tenderer having ISI certification marking will only be considered.

- **DRAWING & LITERATURE:** The following shall be furnished along with the tender
  
  ✓ Cross sectional drawings of the cables, giving dimensional details for each size of cable.
  
  ✓ An illustrated literature on the cable, giving technical information, on current ratings, cable constants, short circuit ratings, de-rating factors, for different types of installation, packing date, weights and other relevant information.

### 19.0 LIST OF MANUFACTURERS:

a) NICO  
b) GLUSTER  
c) POLYCAP  
d) DIMOND  
e) FINOLEX  
f) KEI  

The bidders can only offer the above cable manufacturer’s equipments. However manufacturers other than the above list may be considered based on their previous experience and approval of CESU.
GURANTEED TECHNICAL PARTICULARS TO BE

FURNISHED BY THE BIDDER

1. CABLES
   a) Manufacturer
   b) Trade Name

2. Type of Cable

3. Applicable specification & Standards

4. Voltage Class

5. Whether suitable for extrusion technique is employed in the manufacture of conductor screen

6. Whether triple extrusion technique is employed in the manufacture of conductor screen

7. Permissible voltage and frequency variation for satisfactory operation

8. Continuous Current Rating for standard conditions indicated in specifications:
   c) Air (45°C Ambient)
   d) In Ground (35°C)
   e) In Duct
   f) In Trench

9. De-rating factors for various laying conditions

10. Conductor
    a) Material
    b) Shape of conductor
    c) Nominal area of cross section
    d) Number of strands per core
    e) Diameter of Wire (before compacting and stranding)
    f) Diameter and size of conductor

11. Conductor Screening
    a) Type
    b) Material
    c) Nominal thickness
    d) Continuous working temperature
    e) Maximum allowable temperature at the termination of short circuit

12. Insulation
    a) Material
    b) Thickness of Insulation
    c) Thickness of Insulation between cores
    d) Thickness of Insulation between cores and inner sheath
    e) Tolerance of thickness in insulation
    f) Diameter of core over insulation

13. Specific Insulation Resistance at 90°C

14. Process of curing

15. Whether XLPE Insulation filled or unfilled

16. Insulation Screening:
    a) Material
    b) Thickness
    c) Thickness of semi conducting part
    d) Thickness of metallic part
    e) Size of copper tape
    f) Whether overlapping provided
    g) Current carrying capacity for continuous rating
    h) Current carrying capacity for short circuit rating for 1 minutes
    i) Diameter of cable over screening
    j) Whether insulation screen is removable without the application of heat

17. Inner Sheath
    a) Material
    b) Extruded or wrapped
    c) Minimum thickness
    d) Diameter of cable over inner sheath
18. Armouring:
   a) Material
   b) Type of Armouring
   c) Diameter of wire
   d) Whether galvanized
   e) Diameter of cable over Armouring
   f) Current carrying capacity of Armor

19. Outer Sheath:
   a) Material
   b) Minimum thickness of sheath
   c) Tolerance over thickness of sheath
   d) Overall diameter of cable

20. Scheme for identification of cable

21. Allowable/attainable maximum conductor temperature when carrying rated current continuously

22. Cable constants:
   a) DC Resistance per core $20^\circ C$
   b) AC Resistance per core at operating temperature
   c) Reactance
   d) Capacitance
   e) Insulation Resistance at $27^\circ C$
   f) Loss tangent
   g) Dielectric constant – Maximum cable charging current at normal operating voltage

23. Factory Tests (Enumerate in detail for each type of cable)

24. Is the offered cable guaranteed to safely withstand continuous conductor temperature at $90^\circ C$ and also safely withstand temperature upto $130^\circ C$ for a duration of one hundred hours per year.

25. Are the offered Three core cable guaranteed to perform satisfactorily under installation conditions specified? If ‘Yes’ furnish relevant calculations in support including the following data:
   a) Induced voltage in the Armour when a 500 mtr long cable is carrying current
   b) Induced voltage and the circulating current in the copper tape

TENDERER.
Section-X
HT cable joints and terminals
TECHNICAL SPECIFICATIONS FOR HEAT SHRINKABLE CABLE JOINT KITS FOR CABLE TERMINATIONS AND JOINTS

1.0 GENERAL:
1.1 The term heat shrink refers to extruded or molded polymeric materials which are cross linked to develop elastic memory and supplied in expanded or deformed size or shape. The manufacturer of kits besides stating the properties of each component of the kit as indicated below and as per the detailed specifications should also state the source of origin of each component viz; whether locally manufactured or imported in raw material form and processed. The manufacturing activity carried out on each component should be stated. Also, in case the kit is assembled with components imported from two or more foreign suppliers, the manufacturers should give documentary proof supported by the foreign manufacturers confirming that the kit assembled utilizing components of different suppliers are guaranteed by them.

2.0 QUALIFYING EXPERIENCE:
2.1. The kits should have satisfactory performance record in India in excess of 5 years supported with proof of customers having had satisfactory use of these kits in excess of 5 years.

3.0 HEAT SHRINKABLE MATERIAL:
3.1. The heat shrinkable material component used in the joint shall have been produced in a systematic procedure as follows:
   a) The required materials shall be mixed and extruded into the required shape and then cross-linked by irradiation or any other appropriate chemical process. The components are then warmed and stretched by a predetermined amount and allowed to cool in the extruded shape. The cross-linking shall create a memory and when heated again, the same shall come back to its original shape at which it was cross-linked. Heat shrinkable tubes can be reduced to 30% of its expanded dimension by heating.
   b) The volume resistivity of the sleeves shall be $10^8$ ohm-cm and the dielectric constant of around 15 to 30. The limiting temperature shall not be less than 100°C for longer duration and 250°C for one minute.

4.0 TYPE TEST REPORTS:
The Joints and terminations should have been subjected to all the type tests and type test reports not later than 5 years on the day of Bid opening shall be furnished for verification.

5.0 ELECTRICAL CLEARANCES:
The electrical clearances required for a Indoor/Outdoor termination and a straight through joint is shall be as per standards

6.0 COMPRESSION TYPE TUBULAR TERMINAL ENDS:
The materials used in the terminals shall be Aluminum of grade 19501 conforming to IS 5082 - Specifications for wrought aluminum and aluminum alloys bars, rods, tubes and sections for electrical purposes. The finish inside the barrel shall either be suitably roughened throughout the crimping length of terminal end or provided with suitable grease
based compound with abrasive action. Edges and corners shall be free from burrs and sharp edges. The terminals shall meet the requirements of IS 8309 - Specification for Compression type tubular terminal ends for aluminum conductors of insulated cables.

7.0 JOINT KITS:
The requirements contained in a typical joint Kit are as follows:

a) Heat shrinkable or push-on or Tapex or cold shrinkable type clear insulating tubes
b) Stress control tubing where necessary
c) Ferrule insulating tubing for joints.
d) Conductive cable break outs for terminations, non tracking, erosion and 
e) Weather resistant tubing both outer / inner
f) Non tracking erosions and weather resistant outdoor sheds in case of terminations
g) High permittivity mastic wedge Insulating mastic.
h) Aluminum crimping lugs of ISI specification.
i) Tinned copper braids
j) Wrap around mechanical protection for joints.
k) Cleaning solvents, abrasive strips.
l) Plumbing metal.
m) Binding wire etc. adequate in quantity and dimensions to meet the service and test conditions.
n) The kit shall contain a leaflet consisting of detailed installation instructions and shall be properly packed with shelf life of over 3 years.

8.0 LIST OF MANUFACTURERS:
a) RECHEM
b) FRONTECH
c) 3M

The bidders can only offer the above manufacturer’s equipments.
ANNEXURE - I

SPECIFICATIONS FOR MATERIAL PROPERTIES AND OTHER TECHNICAL REQUIREMENTS FOR HEAT SHRINKABLE CABLE TERMINATIONS AND JOINTS SUITABLE FOR 33 kV SCREENED CABLES/XLPE CABLES

1.0 GENERAL:

The term heat shrink refers to extruded or molded polymeric materials which are cross linked to develop elastic memory and supplied in expanded or deformed size or shape. The subsequent heating results in shrinking down to original size and shape. The manufacturer of kits besides stating the properties of each component of the kit as indicated below and as per the detailed specifications given in Enclosures-I(A), I(B) & I(C) should also state the source of origin of each component viz; whether locally manufactured or imported in raw material form and processed. The manufacturing activity carried out on each component should be stated. Also, in case the kit is assembled with components imported from two or more foreign suppliers, the manufacturers should give documentary proof supported by the foreign manufacturers confirming that the kit assembled utilizing components of different suppliers are guaranteed by them.

2.0 QUALIFYING EXPERIENCE:

The kits should have satisfactory performance record in India in excess of 5 years supported with proof of customers having had satisfactory use of these kits in excess of 5 years.

3.0 PERFORMANCE TESTING AT CPRI, BANGALORE:

The successful contractor/bidder should undertake the testing of termination and jointing kits at CPRI in the presence of CESU Engineers as per the performance type test sequence given below. For this purpose, the kit shall be selected by CESU Engineers in the manufacturer’s premises and sealed by the Engineer before taking it to CPRI, Bangalore.

<table>
<thead>
<tr>
<th>Sl No</th>
<th>Particulars</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Amb. Temperature</td>
<td>Maximum 45°C</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Minimum 10°C</td>
</tr>
<tr>
<td>2</td>
<td>Atmospheric pressure</td>
<td>963 to 987 m. bar</td>
</tr>
<tr>
<td>3</td>
<td>Relative Humidity</td>
<td>50 – 90 %</td>
</tr>
</tbody>
</table>
### Test sequence

<table>
<thead>
<tr>
<th>Sl No</th>
<th>Test Sequence</th>
<th>Test Voltage</th>
<th>Test results shall be as follows</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Impact a wedge shaped weight of 4 kg having a 90° angle with a 2 mm radius shall be dropped freely 6 times from a height of 2.0M. On to the sample. The drops shall be distributed over the length of the joint and at right angles to the axis of the joint. (Electricity Council Engg. C.81)</td>
<td>No visual damage</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>AC voltage withstand (IEC Pub 60)</td>
<td>35 kV</td>
<td>Shall withstand satisfactorily</td>
</tr>
<tr>
<td>3</td>
<td>Impulse voltage withstand test (IEC Pub 60 &amp; 230)</td>
<td>95 kV</td>
<td>-do-</td>
</tr>
<tr>
<td>4</td>
<td>Load Cycling</td>
<td>15 kV</td>
<td>-do-</td>
</tr>
<tr>
<td>5</td>
<td>Thermal short circuit</td>
<td>Indoor -75 kV</td>
<td>-do-</td>
</tr>
<tr>
<td>6</td>
<td>Load Cycling</td>
<td>15 kV</td>
<td>-do-</td>
</tr>
<tr>
<td>7</td>
<td>A/C voltage withstand</td>
<td>24 kV</td>
<td>-do-</td>
</tr>
<tr>
<td>8</td>
<td>Impulse voltage withstand</td>
<td>Outdoor 95 kV</td>
<td>-do-</td>
</tr>
<tr>
<td>9</td>
<td>D/C voltage withstand</td>
<td>48 kV</td>
<td>-do-</td>
</tr>
<tr>
<td>10</td>
<td>Humidity indoor termination</td>
<td>Conductivity 800 S/Cm., 100 hrs spray rate 0.41/Cu.</td>
<td>7.5 kV</td>
</tr>
</tbody>
</table>
ENCLOSURE – I (A)

MATERIAL SPECIFICATION FOR HEAT SHRINKABLE TUBING

<table>
<thead>
<tr>
<th>Test</th>
<th>Test Method</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Non-Tracking Tubing</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Stress Control Tubing</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ferrule insulating tubing</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Clear insulating tubing</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Inner tubing for Joint</td>
</tr>
<tr>
<td>Tensile Strength</td>
<td>ISO 37</td>
<td>8 N/mm² Min.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>14 N/mm² Min.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>10 N/mm² Min.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>12 N/mm² Min.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>14 MPa Min.</td>
</tr>
<tr>
<td>Ultimate Elongation</td>
<td>ISO 37</td>
<td>300 % Min.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>250 % Min.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>300 % Min.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>200 % Min.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>500 % Min.</td>
</tr>
<tr>
<td>Accelerated Ageing 168 Hrs. at 120°C</td>
<td>ISO 188</td>
<td>-</td>
</tr>
<tr>
<td>-Tensile Strength</td>
<td>ISO 37 Min.</td>
<td>7.5 N/mm² Min.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>13 N/mm² Min.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>10 N/mm² Min.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>12 N/mm² Min.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>14 MPa Min.</td>
</tr>
<tr>
<td>- Ultimate Elongation</td>
<td>ISO 37 Min.</td>
<td>200 % Min.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>130 % Min.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>300 % Min.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>200 % Min.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>300 % Min.</td>
</tr>
<tr>
<td>Thermal Endurance</td>
<td>IEC 216</td>
<td>110°C Min.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>90°C Min.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>105°C Min.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>110°C Min.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>120°C Min.</td>
</tr>
<tr>
<td>Electric Strength</td>
<td>IEC 243</td>
<td>Wall Elec. Thkn. Strn. (Normal) KV/CM</td>
</tr>
<tr>
<td></td>
<td>Volume</td>
<td>IEC 93 1 × 10⁸ OHM-CM Min.</td>
</tr>
<tr>
<td>-------------------------</td>
<td>--------------------------</td>
<td>-----------------------------</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3.0 mm.</td>
</tr>
<tr>
<td>Dielectric</td>
<td>IEC 250</td>
<td>5.0 Max.</td>
</tr>
<tr>
<td>Tracking and</td>
<td></td>
<td></td>
</tr>
<tr>
<td>erosion resistance</td>
<td>ASTM D2303</td>
<td>No tracking erosion to top surface or flame failure after:</td>
</tr>
<tr>
<td>Water absorption</td>
<td>ISO/R 62 Procedure A</td>
<td>1 % Max. AFT. 14 days at (23 ± 2)°C</td>
</tr>
<tr>
<td>Resistance to liquids</td>
<td>ISO 1817</td>
<td></td>
</tr>
<tr>
<td>- Transformer oil to VDE 0370 immersion &amp; days at (23 ± 2)°C</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Tensile Strength</td>
<td>ISO 37</td>
<td>5 N/mm² Min.</td>
</tr>
<tr>
<td>- Ultimate Elongation</td>
<td>ISO 37</td>
<td>250 % Min.</td>
</tr>
</tbody>
</table>
### MATERIAL SPECIFICATION FOR HEAT SHRINKABLE MOULDED PARTS

<table>
<thead>
<tr>
<th>Sl No</th>
<th>Test</th>
<th>Test Method</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Sheds</td>
</tr>
<tr>
<td>1</td>
<td>Tensile Strength</td>
<td>ISO 37</td>
<td>8 N/mm²</td>
</tr>
<tr>
<td>2</td>
<td>Ultimate Elongation</td>
<td>ISO 37</td>
<td>300 % Minimum.</td>
</tr>
<tr>
<td>3</td>
<td>Accelerated Ageing 168 Hrs. at 120ºC</td>
<td>ISO 188</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Tensile Strength</td>
<td>ISO 37</td>
<td>7.5 N/mm² Minimum.</td>
</tr>
<tr>
<td>5</td>
<td>Ultimate Elongation</td>
<td>ISO 37</td>
<td>200 % Minimum.</td>
</tr>
<tr>
<td>6</td>
<td>Thermal Endurance</td>
<td>IEC 216</td>
<td>110ºC Minimum.</td>
</tr>
<tr>
<td>7</td>
<td>Electric Strength</td>
<td>IEC 243</td>
<td>Wall Elec. Thkn. Strn. (Normal) KV/CM&lt;3.0 100 mm. Minimum.</td>
</tr>
<tr>
<td>8</td>
<td>Volume Resistivity</td>
<td>IEC 93</td>
<td>1 × 10¹³ OHM-CM Minimum.</td>
</tr>
<tr>
<td>9</td>
<td>Dielectric constant</td>
<td>IEC 250</td>
<td>5.0 Maximum.</td>
</tr>
<tr>
<td>10</td>
<td>Tracking and erosion resistance</td>
<td>ASTM D2303</td>
<td>No tracking erosion to top surface or flame failure after: 1 HR at 2.5 kV 1 HR at 2.75 kV 1 HR at 3.0 kV 20 Mins. at 3.25 kV</td>
</tr>
<tr>
<td>11</td>
<td>Water absorption</td>
<td>ISO/R 62 Procedure A</td>
<td>1 % Max. AFTER, 14 days at (23 ± 2)ºC</td>
</tr>
<tr>
<td>12</td>
<td>Resistance to liquids</td>
<td>ISO 1817</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Transformer oil to VDE 0370 immersion &amp; days at (23 ± 2)ºC</td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Tensile Strength</td>
<td>ISO 37</td>
<td>5 N/mm² Minimum.</td>
</tr>
<tr>
<td></td>
<td>Ultimate Elongation</td>
<td>ISO 37</td>
<td>250 % Minimum.</td>
</tr>
</tbody>
</table>

Central Electricity Supply Utility of Orissa
ENCLOSURE- I(C)

MATERIAL SPECIFICATION FOR HEAT SHRINKABLE ADHESIVE/SEALANTS

<table>
<thead>
<tr>
<th>Test</th>
<th>Test Method</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Black Insulator Mastic</td>
<td></td>
<td>Sealant break-out and sheds</td>
</tr>
<tr>
<td>Softening Point</td>
<td>ASTM E28</td>
<td>(115 ± 10)° C</td>
</tr>
<tr>
<td>Electric Strength</td>
<td>IEC 243</td>
<td>130 kV/CM Min.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>80 kV/CM Min.</td>
</tr>
<tr>
<td>Volume resistivity</td>
<td>IEC 93</td>
<td>$1 \times 10^{14}$ OHM-CM</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Min.</td>
</tr>
<tr>
<td>Water absorption</td>
<td>ISO/R 62 Procedure A</td>
<td>1 % Max. AFT. 1 day at (23 ± 2)° C</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 % Max. AFT. 1 day at (23 ± 2)° C</td>
</tr>
<tr>
<td>Corrosive effect 16 Hrs.</td>
<td>ASTM D2671 Method-B</td>
<td>No corrosion</td>
</tr>
<tr>
<td>at 121° C</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adhesive peel strength</td>
<td>as detailed in master Spec.</td>
<td>-</td>
</tr>
<tr>
<td>substrate 2/1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Materia</td>
<td>Requirement</td>
<td>Test Method</td>
</tr>
<tr>
<td>---------</td>
<td>-------------</td>
<td>-------------</td>
</tr>
<tr>
<td>NTR/ NTR</td>
<td>25N/25 mm Min.</td>
<td>-</td>
</tr>
<tr>
<td>NTR/ CON</td>
<td>20N/25 mm Min.</td>
<td>-</td>
</tr>
<tr>
<td>NTR/ AL</td>
<td>20N/25 mm Min.</td>
<td>-</td>
</tr>
<tr>
<td>NTR/ Pb</td>
<td>20N/25 mm Min.</td>
<td>-</td>
</tr>
<tr>
<td>T.E.R.T</td>
<td>ASTM D2303</td>
<td>No tracking erosion to top surface or flame failure after: 1 HR at 2.0 kV, 1 HR at 2.5 kV, 1 HR at 2.75 kV</td>
</tr>
</tbody>
</table>

**ANNEXURE – I(D)**

**CLASSIFICATION OF SOIL STRATA**

1.00 **Ordinary Soil:**

This shall comprise of vegetable or organic soil, turf, sand, sandy soil, silt, loam, clay, mud, red earth, suede, peat, black cotton soil, soft shale, loose murrum, mud debris, concrete below ground level, a mixture of all these and similar material which yields to the ordinary application of pick, shovel, rake or other ordinary digging implement. Removal of gravel or any other modular material having diameter in any one direction not exceeding 75 mm, such occurring strata shall be deemed to be covered under this category.

2.00 **Hard Soil:**

This shall include:

1) Stiff heavy clay, hard shale or compact murrum requiring grifting tool or pick or both and shovel closely applied.
2) Gravel, soft laterite, kankar and cobble stone having maximum diameter in any one direction between 75 mm and 300 mm.
3) Soliding of road paths, etc., and hard core.
4) Macadam surfaces such as water bound and bitumen/tar bound.
5) Lime concrete, stone masonry in lime/cement mortar below ground level.
6) Soft conglomerate, where the stones may be detached from the matrix with picks.
7) Generally any material which requires the close application of picks or sacrifiers to loosen and not affording resistance to digging greater than hardest of any soil mentioned in item (1) to (6) above.

3.00 Ordinary Rock:

1) Ordinary rock comprising of lime stone, sand stone, hard laterite, fissured rock, conglomerate or other soft or disintegrated rock which may be quarried or split with crow bars.
2) Unreinforced cement concrete which may be broken up with crow bars or picks and stone masonry in cement mortar below ground level.
3) Boulders which do not require blasting having maximum diameter in any direction of more than 300 mm found lying loose on the surface or embedded in river bed, soil, talus slope wash and terrace material of dissimilar origin.

   NOTE: Hard laterite does not require blasting. It is to be classified under ordinary rock which does not require blasting.

4.00 Hard Rock:

This shall comprise:

1) Any rock or cement concrete or RCC for the excavation of which the use of mechanical plant or blasting is required.
Section-XI

Cable Laying Methodology
GENERAL INFORMATION AND SCOPE OF WORK FOR LAYING UG CABLES

CABLE LAYING

1.0. Notwithstanding anything stated in these specifications, CESU reserves the right to assess the bidder’s capability to fulfill the scope of the bid, should the circumstances warrant such assessment.

2.0. DESIGN – WORKMANSHIP AND INTERPRETATION OF CLAUSES:

2.1 The design and quality of goods supplied and the workmanship shall be in accordance with the best engineering practice to ensure satisfactory performance of the system throughout the service life.

2.2 The goods and accessories offered shall be complete in all respects. Any material and/or component thought not specifically stated in this specification but is necessary for trouble free and successful operation shall be deemed to be included. All such components, accessories, etc., shall be supplied at no extra cost.
2.3  The goods supplied shall be such that components, accessories of the same type shall be interchangeable. Likewise similar or corresponding parts, components / accessories shall also be interchangeable.

2.4  Wherever and whenever a material or article is specified or described by the name of a particular brand, manufacturer, vendor, the specific item mentioned shall be understood as establishing type, function, quality and not as limiting competition. However bidders may offer other similar components / accessories provided they meet with the required standards, design, duties and performance.

2.5  Goods and accessories so offered shall conform to type test and shall also be subjected to acceptance and routine tests in accordance with the requirements stipulated in this specification. The CESU reserves the right for repeating any or all of the type tests to be conducted on the goods supplied.

3.0.  STANDARDS

3.1.  Except as modified by this specification all materials to be supplied shall conform to the requirements of the latest editions of the following standards:

a)  IS 1255 Code of practice for Installation and maintenance of power cables up to and including 33 KV rating
b)  IS 7098 (Part 2 ) Cross – linked Polyethylene PVC sheathed cables.
c)  IEC 332 Tests on erected cables
d)  IEC 1329 Allied steel, tubes, tubular and other rough iron fittings.
e)  IEC 2629 Recommended practice for hot dip galvanizing of iron & steel.
f)  ASTM-D : 2671 Standard method of testing heat shrinkable or push on Tapex or cold type tubing for electrical use.
g)  ASTM-D 3111 Flexibility determination of hot melt adhesives by mandrel bend test method.
h)  IEC 60 High Voltage test
i)  IS 3043 Code of practice for Earthing
j)  IS 8309 Compression type tubular terminals for aluminum conductors of insulated cable.

4.0.  DEVIATION IN SPECIFICATION:

4.1.  All deviations in specification shall be brought out by the bidder and detailed clause by clause in appropriate annexure form.

4.2.  Deviations brought out elsewhere or in any other format will not be considered and are liable for rejection. The CESU in such an event shall also deem that the bidder has conformed to the clauses in this specification scrupulously.
4.3. Deviation in specification shall if possible be quoted with reference to standards. The bidder shall then furnish an authentic English version of such standards.

5.0. LOCAL CONDITIONS:

5.1. It will be imperative on each bidder to fully inform himself of the local conditions and factors which may have any effect on the execution of the supply and services covered under these documents and specification.

5.2. It shall be understood and agreed that such factors will have been properly investigated and considered in any bid that is submitted. The purchaser will entertain no claim for financial adjustment to the contract awarded under these specifications and documents. No change in the time schedule of the contract, or any financial adjustment arising thereof that are based on incorrect information, or its effect on the cost of the contract to the bidder shall be permitted by the Purchaser.

5.3. Bidders are advised to visit the various areas where the U.G. cables are access, road /drain / footpath crossings to enable them to make proper costing and then quote accordingly.

6.0. DETAILS OF WORK:

a) The scope of work involves Supply and laying, testing and commissioning of 33KV, 3 Core, 400/300 Sq.mm XLPE UG cable.

b) Laying of 3 core, 33 kV, 400 and 300 sqmm UG Cables by trenchless technology adopting horizontal Boring (HDD) by machines with adequate drawing capacity.

6.1. The contract will be on the turnkey basis and all the required materials as per specifications are to be procured by the contractor himself. The specifications for the major equipment to be procured are as follows:

a) XLPE Cables of above size as per specifications enclosed.

b) Cable jointing termination and straight through kits as per specifications enclosed.

6.2. All the other materials like coarse and fine aggregate sand, joint markers, sealing, route markers, cable support clamps, terminals and inline connectors, sealing compounds etc., whether specifically mentioned or not in these specifications are deemed to have been included in the scope of supply and installation. Similarly, the contractor has to arrange for all the tools and plants required for the works at his own cost.

7.0. SERVICE CONDITIONS:

7.1. The cables are being laid in the Khurda district, Odisha, where temperature, humidity effect is heavily experienced.

7.2. The climatic conditions are prone to wide variations in ambient temperature, humidity etc., and the accessories offered shall be suitable for installation under the above
tropical conditions, where moderately hot and humid conditions conducive to dust, rust and fungi growth, prevail at site.

7.3. The underground cables are to be laid along NH-5, where other utility services like telephone and EHT lines are encountered.

### 8.0. CLIMATIC CONDITIONS

<table>
<thead>
<tr>
<th>Sl No</th>
<th>Particulars</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Location</td>
<td>Bhubaneswar – Jatani in Orissa</td>
</tr>
<tr>
<td>2</td>
<td>Altitude</td>
<td>Not exceed 100 M above MSL- Almost at the Sea level</td>
</tr>
<tr>
<td>3</td>
<td>Max. Ambient air temperature :</td>
<td>45º C</td>
</tr>
<tr>
<td>4</td>
<td>Max. Daily average air temp :</td>
<td>38 º C</td>
</tr>
<tr>
<td>5</td>
<td>Minimum ambient air temp :</td>
<td>10 º C (Max)  5 º C (Min)</td>
</tr>
<tr>
<td>6</td>
<td>Ground temperature at depth of laying assumed :</td>
<td>35 º C (Max)</td>
</tr>
<tr>
<td>7</td>
<td>Isoceraunic level :</td>
<td>45</td>
</tr>
<tr>
<td>8</td>
<td>Avg. annual rainfall :</td>
<td>1450 mm</td>
</tr>
<tr>
<td>9</td>
<td>Avg. number of rainy days per annum</td>
<td>60</td>
</tr>
<tr>
<td>10</td>
<td>Climate :</td>
<td>The climate in the coastal city of Bhubaneswar is Tropical moderately hot and humid. sub- soil water at certain location at depth of burial of cables may be anticipated.</td>
</tr>
<tr>
<td>11</td>
<td>Soil :</td>
<td>Normally dry</td>
</tr>
</tbody>
</table>

### 9.0. COMPLIANCE WITH REGULATIONS:

9.1. All services carried out by the bidder / sub contractor shall be as per the requirements of the I.E.Act-2003 & Indian electricity Rules – 1956, OERC and all other applicable statutory laws governing the services in the state of Odisha.

9.2. Particular attention is drawn to the necessity of consulting the local authorities and the administrative heads concerned with the operation and maintenance of roads, railways, telegraph and telephone services, water supply and sewerage and other public utilities.

9.3. The CESU will assist in obtaining permission from civil authorities for boring in the Roads, cutting roads. However the necessary charges shall be paid by the bidder sufficiently in advance. CESU will also co-ordinate with the traffic police authorities for regulation of traffic during cutting of roads.
10.0. INSPECTION BY ELECTRICAL INSPECTOR

10.1. All Electrical installations and equipments are to be inspected and approved by the Chief Electrical Inspector to the Government of Odisha, before commissioning.

10.2. The Contractor will arrange for the payment of the necessary fees for inspection.

10.3. Any defects pointed out by the Electrical Inspector, shall be corrected or attended by the bidder /subcontractor at his own cost and he shall pay, for subsequent inspection charges to the Electrical Inspector, for obtaining approval.

11.0. INSTALLATION OF U.G. CABLES

11.1. Method Of Ug Cable Laying: Laying 33 kV HT UG cables at a depth not more than 3 Mtrs, by trenchless technology, adopting horizontal boring using appropriate standard machines. Boring & Drawing of cable including preparation at site.

11.2. ROUTE PLANS: Tentative cable route plans will be furnished to the contractors, indicating the roads road crossings, findings by excavating trial holes by the contractor /sub contractor. The work should be taken upon only after CESU Engineers approve the final route. The CESU reserves the right to change, alter deviate the route on technical reasons.

11.3. TRIAL PITS: The bidder shall excavate trial pits, for alignment purpose at appropriate distance apart as warranted by the local conditions, keep a record of the findings and close the trial holes properly to avoid hindrance/accidents to pedestrian traffic. The final route/alignment of the cables shall be decided based on the finding of the trial holes.

11.4. It is the responsibility of the bidder to maintain as far as possible the required statutory clearances from other utility services.

11.5. Any damage caused, inadvertently to any utility services shall be the sole responsibility of the contractor.

12.0. STATUTORY NOTICES AND WAY LEAVES

12.1. The Contractor shall arrange the necessary way leaves from the concerned public utility authorities and CESU shall give the required assistance to the contractor in completing the project.

13.0. LAYING OF CABLES

13.1. 33 kV H.T 3 core HT UG cables: Laying 33 kV HT UG cables by trenchless technology by adopting horizontal boring at a depth not more than 3 Mtrs using appropriate standard machines.

14.0. LAYING OUT THE CABLE :
14.1. **33 kV H.T 3 core HT UG cables:**

The cable shall be pulled / drawn smoothly in the bored holes by the horizontal boring machine itself. The excavated cable trench shall be drained of all water and bed surface shall be smooth, uniform and fairly hard before laying out the cable. The cable shall be pulled in the trench only on cable rollers spaced out at uniform intervals to prevent damage to cable. The laying out process shall be smooth and steady, without subjecting the cable abnormal tension. The cable laid out shall be smoothly and evenly transferred to the ground after providing sand cushion and shall never be dropped. All the snake bends in the cable shall be straightened out.

14.2. **Loop Cable:** One complete loop of the cable has to be kept at each jointing point and termination point.

15.0. **FLAKING**

15.1. Wherever it is not possible to lay of the entire cable drum length, the cable should be cut and properly sealed and if it is necessary to remove the cable from the drum, it should be properly flaked. Such cable lengths should be properly stored at site.

16.0. **CABLES AND OVER BRIDGES:**

16.1. Wherever the cable route crosses bridges the cable shall be laid in the ducts, if provided, by removing and replacing the R.C.C. covers and filled with sand cushion.

16.2. In the absence of the cable ducts over bridges, the cable shall be laid in suitable size steel/G.I. pipes or as directed by the engineer-In-charge and the pipe covered by cement concrete if necessary to protect from direct sunrays.

17.0. **CABLE CROSSING OPEN DRAINS WITH LONG SPAN:**

17.1. Wherever the cable to cross open drains with a long span, the cable shall be laid in suitable size G.I. pipe, properly jointed with suitable collars. The GI pipe shall be firmly supported on pillars, columns, or suitable support of R.C.C. foundation with stone masonry in cement mortar 1:4

17.2. Wherever the U.G. cable has to cross the sewerage or water supply line the U.G. cable has to be taken below them maintaining adequate clearance. Further wherever the U.G. cable runs parallel to the telephone cable a separation distance of at east 300-mm shall be maintained.

17.3. The cables shall be laid in stoneware pipe wherever the cable and trench crosses private roads, gates, etc. In order to avoid inconvenience the stoneware pipe should be laid first after excavation and excavated trench shall be back filled, compacted and surface properly redone to restore that original condition.
18.0. CABLE AND JOINT MARKERS

18.1. Permanent means of indicating the positions of joints on site should be provided. During the course of permanent reinstatement cable and joint markers, should be laid directly above the route of the cable and the position of the joint respectively.

18.2. Wherever it is not possible to place the marker directly over the cable route or joint the marker should be suitably placed near the cable route or joint on which the distance of the cable route or joint at right angles to and parallel to the marker should be clearly indicated.

18.3. The position of fixing the markers will be at the discretion of the Engineer-In-charge.

19.0. JOINTING OF CABLES

19.1. **GENERAL:** It shall be noted that the U.G. cables are of XLPE insulation and needs special care in jointing. The cable jointer and his assistant shall have experience in making joints / terminations. Jointing work should commence as soon as two or three lengths of cables have been laid. All care should be taken to protect the factory-plumbed cap/seal by laying the end solid in bitumen until such time as the jointing is commenced.

19.2. Jointing of cables in carriage ways, drives, under costly paving, under concrete or asphalt surfaces and in proximity to telephone cables and water mains, should be avoided whenever possible.

19.3. **JOINT PITS:** The joint pits should be sufficient dimensions as to allow jointers to work with as much freedom of movement and comfort as cables proposed to be jointed. The sides of the pit should be draped with tarpaulin sheet to prevent loose earth from falling on the joint during the course of making. The pit should be well shored with timber, if necessary. An overlap of about 1.0 mtr of the cables to be jointed may be kept, for allowance to adjust the position of the joint. When two or more cables are laid together the joints shall be arranged to be staggered by 2 to 2.5 mtr.

19.4. **SUMP PITS:** When jointing cables in water logged ground or under monsoon conditions, a sump pit should be excavated at one end of the joint pit in such a position so that the accumulating water can be pumped or bailed out by buckets without causing interference to the jointing operation.

19.5. **TENTS:** A tent should be used in all circumstances wherever jointing work is carried out in the open irrespective of the weather conditions. The tent should be so covered as to have only one entrance and the back facing the direction of the wind. The tent cover should be properly weighted or tied down on the sides.
19.6. **MEASUREMENT OF INSULATION RESISTANCE:** Before jointing is commenced the insulation resistance of both sections of the cable to be jointed should be checked by insulation resistance testing instrument. An insulation resistance – testing instrument of 2.5/5 kV shall be used. The Insulation Resistance values, between phases and phase to earth shall be recorded. The actual jointing operation shall start only after the approval of the engineer in charge of works.

19.7. **PRECAUTIONS BEFORE MAKING A JOINT OR CUTTING A CABLE.**

The cable end seals should not be opened until all necessary precautions have been taken to prevent circumstances arising out of rainy/inclement weather conditions, which might become uncontrollable. The cable seals should be examined to ascertain if they are intact and also that the cable ends are not damaged, if the seals are found broken or the lead sheath punctured, the cable ends should not be jointed until after due examination and testing by the engineer-in-charge of the works.

19.8. **PRECAUTIONS TO BE TAKEN ON LIVE CABLES IN SERVICE**

Sometimes it becomes necessary that a H.V. cable, which is in service, be cut for making a straight joint with a new cable. In such cases work on joint should start only after the in service cable is properly identified, isolated, discharged, tested and effectively earthed. Search coils interrupters or cable-identifying instruments should be used for this purpose.

19.9. **IDENTIFICATION NUMBERS / COLOURS AND PHASING:** The cables should be laid and jointed number to number or colour to colour shown on the core identifying marks and prevent cross jointing. In all cases, the cables should be tested and phased out, and more particularly so when the cable terminates at Ring Main Unit / Sub-station.

19.10. **MAKING A JOINT:** The Heat shrinkable joints used shall be conform to the specification vide Annexe 2. Alternatively push-on or Tapex or cold shrinkable type can be used with the approval of CESU. The contractor should furnish all the technical particulars of these joints and obtain approval only in case they are found superior to the heat shrinkable joints. Epoxy based joints are not permitted. Comprehensive jointing instructions obtained from the manufacturer of joint kits shall be meticulously followed. The connection of the earth wires should be done using flexible bonds connected to cable sheath using clips or soldering. Aluminum conductor strands shall be joined be joined by mechanical compression method, using suitable die and sleeve with a good quality tool. The joints shall conform to specification as per IS 13573-1992.

19.11. **TRANSITION JOINTS:** Wherever straight through joints will have to be made with existing cables under the following conditions, the contractor shall arrange such type of joints and execute them with skilled jointers.
(1) Between cables having two different types of insulation viz., paper and XLPE
(2) Between cables having two different types of conductor material, viz. copper and aluminum.
(3) Or a combination of the above

The transition joints shall conform to IS 13705 – Transition joints for cables for working voltages from 11 KV upto and including 33 KV – performance requirements and type tests.

19.12. **CABLE TERMINATIONS:** Cable terminations required are both indoor and outdoor type and invariably be of heat shrinkable type conforming to the specifications vide Annexe 2. Alternatively push-on or Tapex or cold shrinkable type can be used with the approval of CESU with appropriate sheds for rainwater in case of outdoor terminations. All the technical particulars to establish the superiority in the performance of these joints shall be furnished while seeking approval. The terminations shall conform to specifications as per IS 13573 – 1992. The instructions furnished by the manufacturer of termination boxes/kits should strictly be followed.

19.13. Whenever a cable raised from the trench to end in termination, to be finally connected to an overhead line or transformer, the following instructions should be complied with –

(i) One coil to made and left in the ground for future needs
(ii) The rise of cable, immediately from the ground level should be enclosed in suitable diameter GI pipe to height of 2 mt.
(iii) The balance portion of the cable should be neatly curved, in ‘S’ shape.
(iv) The cable and pipe should be properly fastened by using appropriate clamps/support. The hardware of clamps shall be painted with red oxide and enamel paint or galvanized.
(v) The lugs on the termination shall be compressed with a suitable compression tool.

20.0. **EARTHING AND BONDING**

20.1. The metal sheath and Armour should be efficiently bonded and earthed at all terminals to earth electrodes provided. The cross sectional area of the bond shall be such that the resistance of each bond connection shall not exceed the combined resistance of an equal length of the metal sheath and Armour of the cable.

21.0. **TESTING AFTER LAYING AND JOINTING**

21.1. All cables after laying and jointing works are completed should be tested systematically and insulation and pressure tests should be made on all underground cables.

21.2. All test results should be recorded in tabular form in logbooks kept for the purpose
21.3. The cable cores should be tested for :-
   (i) Continuity
   (ii) Absence of cross phasing
   (iii) Insulation resistance to earth; insulation resistance between conductors.

22.0. H.V. TESTS

22.1. After the laying and jointing work is completed, a high voltage test should be applied to the cable to ensure that the cable has not been damaged during or after the laying operations and there is not defect in the joining.

22.2. The high voltage tests should be as per IS 1255 or as per international standards. The H.V. testing instruments shall be brought by the turn key contractor.

23.0. TESTING AND RECORD OF CABLE CONSTANTS:

23.1. When the cable is ready, just before commissioning, the cable constants viz, the resistance, capacitance and inductance of each conductor should be determined and recorded, along with frequency at which the values of capacitance and inductance are determined.

24.0. GUARANTEE

24.1. All the cable joints / termination done by the contractor shall be guaranteed for 12 months from the date of energisation of the complete cable. In the event of failure during the guarantee period, the restoration work shall be done free of cost by the contractor within 24 hours of giving notice or else the expenditure incurred by CESU to re-do the joint / termination will be recovered from the performance guarantee amount held with the CESU.

25.0. CABLE RECORDS

25.1. Accurate neat plans / sketches, drawn to suitable scale (1 cm = 10M) should be prepared and furnished by the contractor after the completion of each work.

25.2. All relevant information should be collected at site, during the progress of work and preserved for preparation of drawings.

25.3. The following essential data should be incorporated on all drawings
   a) Size, type of cable or cables.
   b) Location of the cable in relation to prominent land mark property, Kerb-line etc., with depths.
   c) The cross section showing where cables are laid in piper or ducts, giving their sizes, type and depths.
   d) Position and type of all joints
   e) Location of other cables which run alongside or across the cable route.
f) Position and depths of all pipers, ducts, etc., which are met as obstruction to the cable route.

g) Accurate lengths from joint to joint

h) Manufacturers name and drum number of the cable, between sections / joint to joint.

Two transparencies and six blue print copies of the cable records prepared as above shall be given to the CESU’s engineer as a part of the contract as soon as the cable is charged.
Section-XII
Proposed Route Map with GPS drawing