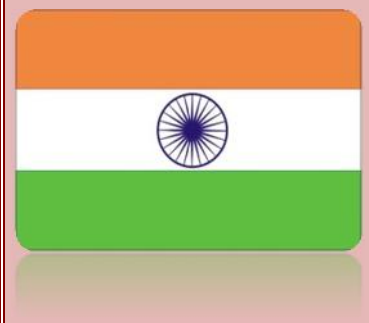
# GOVERNMENT OF INDIA
# MINISTRY OF EXTERNAL AFFAIRS



# GENERAL CONDITIONS OF CONTRACT

# OF

# 132 kV TRANSMISSION LINES

# FOR

# STRENGTHENING OF INDIA-NEPAL POWER TRANSMISSION INTERCONNECTION

## VOLUME-1

**Consultants:**


**WAPCOS LIMITED**
**(A Govt. of India Undertaking)**
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**SECTOR-18, INSTITUTIONAL AREA**
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**CENTRAL ELECTRICITY AUTHORITY,**
**SEWA BHAWAN ,**
**R.K.PURAM,**
**NEW DELHI-01**


**June, 2014**

**BIDDING DOCUMENT FOR**
**ENGINEERING, PROCUREMENT AND CONSTRUCTION ON**
**TURNKEY BASIS OF 132 kV S/C TRANSMISSION LINES ON D/C TOWERS IN INDIA & NEPAL**

# GENERAL CONDITIONS OF CONTRACT
# OF
# TRANSMISSION LINES

## VOLUME - 1

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# SECTION-1

## INFORMATION AND INSTRUCTIONS

## A. GENERAL

### 1.1 Scope of Work

**1.1.1** The Director (DPA), Ministry of External Affairs (MEA), on behalf of President of India hereinafter called the Purchaser for Strengthening the India-Nepal Power Transmission Interconnection Project invites sealed bids in two parts from the eligible bidders for the complete work related to design, supply, construction, testing and commissioning of the following 132 kV S/C Transmission lines on D/C towers. The brief description of the works is as follows:-

i) 132 kV S/C line on D/C Towers from Kataiya (India) – Kusaha (Nepal) with Panther Conductor, (16 km approx.)

ii) 132 kV S/C line on D/C Towers from Raxaul (India) – Parwanipur (Nepal) with Panther Conductor, (22 km approx.)

iii) Above lines shall be constructed on self-supporting latticed steel towers as per designs as approved by WAPCOS. The lines shall be constructed involving supply of towers with bolts, nuts & washers, power conductors, earthwire and their accessories, insulator and hardwares etc. and erection, testing & commissioning thereof.

iv) The Scope of Works comprises design, fabrication, testing before dispatch, packing, supply, delivery for project site in India/ Nepal, insurance, storage at contractor's store and transportation of materials to the work sites of 132 kV Single Circuit Transmission Line on D/C Towers, including accessories complete in all respects, disc insulators power conductors, ground wires, insulator hardwares, bolts, nuts, flat and spring washers, caution and danger plates, number plates, phase plates, anti-climbing device, anti- bird device, tower earthing flats and electrodes, counterpoise earthing and the earth bonds etc and performing

detailed and check survey, erection including all civil works for the foundations of transmission towers, testing and commissioning of the above transmission line and all other equipments necessary for completion of works.

v) Detailed survey, tower spotting, check survey, erection of towers, excavations for foundations, stub assembly, stub setting, concreting, back filling and curing of foundations, sorting of tower parts, assembly and tack welding of tower bolts and nuts wherever necessary, payout of single panther ACSR conductor per phase and one groundwire, loose dead assembly of conductors/ground wires, sagging and tensioning of conductors/ground wires, clipping, fixing of tower accessories etc., as per Detailed Technical Specification Volume-II, Chapter 1 to 6 including final checking , line testing, commissioning and handing over etc.

### 1.1.2 Design & Supply of Towers and Bolts & Nuts :

The work under this contract include Design, supply, fabrication, galvanizing, delivery of towers complete with towers accessories as mentioned in clause 1.1.1. The contractor shall have to develop shop drawings. Necessary quantities of steel, zinc and other material required for fabrication and galvanizing of towers shall have to be arranged by the contractor. WAPCOS will not accept any responsibility/liability in this connection.

The specification also covers supply of Step Bolts, Bolts, Nuts & Washers for towers & tower accessories.

### 1.1.3 Supply of Line Material :

Supply of following line materials as per provisions laid down in the relevant IS codes and their specifications mentioned hereinafter:-

**a) Power Conductor**

'PANTHER' ACSR Conductor

'BEAR' ACSR Conductor

**b) Ground Wire :**

7/3.15mm Galvanised Stranded Steel Groundwire

**c) Insulators :**

Ball and Socket antifog type 70 kN & 90 kN EMS Insulator Discs

**d) Hardwares Suitable For panther Conductor**

- Single suspension fittings
- Single Tension fittings
- Double Suspension fittings
- Double Tension fittings

**e) Conductor Accessories**

Suitable for 'PANTHER' & 'BEAR' Conductor

- Vibration Dampers
- Repair Sleeves
- Mid span compression joints

**f) Groundwire Accessories**

Suitable for 7/3.15 mm G.S.S. Earthwire

- Suspension Clamps
- Tension Clamps
- Mid span compression joints
- Vibration Dampers
- Earth copper bonds

All materials, labour, plant, equipment, materials and services necessary for accomplishing the work shall be provided by the contractor.

The bidders shall be required to offer their rates and prices for the entire package indicated above.

**1.1.4** The successful bidder will be expected to complete the works within 6 months including mobilization time of one month from the date of the signing of Contract Agreement.

## 1.2 Eligible Bidders

1.2.1 The reputed, experienced and financially sound Indian

manufactures/firms/contractors/joint ventures fulfilling the eligibility qualification requirements specified herein below shall be eligible to bid for supplies of equipment & materials and services under the Contract.

a) The bidder shall have annual turnover more than ₹ 100 million during each of the last three financial years.

b) Bidder shall have experience in design, engineering, supply, erection, testing and commissioning of at least 2 (Two) transmission line works of 66 kV of 23 km length each or 1 no. higher than 66 kV voltage line of each of 23 km length including all civil works in the last 10 years. The lines should be in operation at least for 2 years.

1.2.2 The Bidder shall furnish latest Income Tax/Corporate Tax Clearance Certificates. In case such clearance certificate is not issued by concerned authority, authenticated photocopy of the latest income tax return shall be submitted.

1.2.3 The bidder shall submit the above details with documentary evidence including copies of the annual reports, performance certificates from end users, list of past supplies, details of manufacturing and testing facilities available, copies of type test reports etc. in support of their fulfilling the eligibility requirements.

1.2.4 The purchase of Bidding Documents will not entitle the Bidder (s) to qualify the eligibility criteria set for the bidder. The details furnished by the Bidder along with the bid will be examined in details as per the requirements of Bidding Documents and accordingly his eligibility will be established.

**1.3 Qualification of the Bidders**

1.3.1 To be qualified for award of Contract, Bidders shall submit a written "Power of Attorney" authorising the signatory of the Bid to commit the Bidder specifically for "**Strengthening of India-Nepal Power Transmission Interconnection Project"** with its validity.

1.3.2 Bidders shall also submit proposals of work methods and schedules, in sufficient details to demonstrate the adequacy of the Bidder's proposal to meet the Technical Specifications and the completion time.

## 1.4 One Bid per Bidder

1.4.1 Each Bidder shall submit only one Bid. A Bidder who submits or participates in more than one bid will be disqualified.

## 1.5 Cost of Bidding

1.5.1 The Bidder shall bear all costs associated with the preparation and submission of his Bid and the Purchaser will in no case be responsible or liable for those costs, regardless of the conduct or outcome of the Bidding process.

## 1.6 Site Visit and Local Conditions

1.6.1 The Bidder shall visit and examine sites of Works & its surroundings and obtain for himself on his own responsibility all information that may be necessary for preparing the Bid and entering into a Contract for the works. The costs of visiting the site shall be at the Bidder's own expense.

The Bidder shall acquaint himself with the actual local conditions and requirements thereof, including the transportation, communication facilities, utility and labour conditions and shall not claim at any time after the submission of the Bid or subsequent execution of the Contract that there was any misunderstanding with regard to the conditions specified in the

Contract or prevailing at site.

1.6.2 The Bidder and any of his personnel or agents will be granted permission by the Purchaser to enter upon its premises and lands for the purpose of such inspection, but only upon the express condition that the Bidder, his personnel or agents, shall release and indemnify the Purchaser and its personnel and agents from and against all liability in respect thereof and shall be responsible for personal injury (whether fatal or otherwise), loss of or damage to property and any other loss, damage, costs and expenses however caused, which, but for the exercise of such permission would not have arisen.

**1.6.3 Transportation Equipment**

All necessary transportation equipment including lifting and handling equipment shall be provided and/ or hired by the Contractor at his own cost.

1.6.4 In their own interest, the Bidders are required to familiarise themselves with the Income Tax Act, prevailing labour laws and other related Act and laws prevalent in Nepal & India. Further, the Bidders are required to comply with these laws/Acts and other relevant provisions particularly with reference to the requirement of taking insurance for equipment during transportation, storage, erection, testing and commissioning until defects liability period.

1.6.5 The Bidder shall familiarise themselves especially with the rules & regulations applicable to the foreign firms for carrying out business in Nepal.

1.6.6 The Bidder shall be deemed to have carefully examined all the Bidding Documents and also to have satisfied himself as to the nature and character of the work to be executed and where necessary of the site conditions and other relevant matters/details.

## B. BIDDING DOCUMENTS

### 1.7 Content of Bidding Documents

1.7.1 The Bidding Documents together with any Addenda/Corrigenda thereto, issued in accordance with **Clause 1.9** hereof and any minutes of pre-bid meeting issued in accordance with **Clause 1.18** hereof will include the following:

| | | |
|---|---|---|
| **Volume-1** | **-** | **General Conditions of Contract** |
| **Volume-2** | **-** | **Technical Specifications** |
| **Volume-3** | **-** | **Guaranteed Technical Particulars** |
| **Volume-4** | **-** | **Price Schedules** |

1.7.2 The Bidder is expected to examine all instructions, conditions, Proformae, terms, specifications and drawings in the Bidding Documents. Failure to comply with the requirements of bid submission will be at the bidder's own risk. Pursuant to **Clause 1.26** hereof, bids which are not substantially responsive to the requirements of the Bidding Documents will be rejected, for which WAPCOS/ MEA, Govt. of India shall have no liability whatsoever.

### 1.8 Clarification of Bidding Documents

1.8.1 A prospective bidder requiring any clarification of the Bidding Documents may notify the Purchaser in writing or by Fax followed by the post confirmation copy at the Purchaser's mailing address indicated in the Invitation for bids. The Purchaser will respond in writing to any request for clarification on the Bidding Documents, which it receives not later than 10 days before the **Pre-Bid Meeting**. Written copies of the Purchaser's response (including a description of the queries but without identifying the source of queries) will be sent to all prospective bidders who have purchased the Bidding Documents.

## 1.9 Amendment of Bidding Documents

1.9.1 At any time prior to the deadline for submission of bids, the Purchaser may, for any reason, whether at its own initiative or in response to a clarification requested by a prospective bidder, modify the Bidding Documents by issuance of an Addendum/Corrigendum.

1.9.2 The Addendum/Corrigendum shall be notified in writing or by Fax (followed by post confirmation copy) to all prospective bidders who have purchased the Bidding Documents and will be binding on them. Bidder shall acknowledge receipt of each Addendum/Corrigendum in writing or by Fax (followed by a post confirmation copy) to the Purchaser.

1.9.3 In order to afford prospective bidders, reasonable time in which to take the Addendum/Corrigendum into account in preparing their bids, the Purchaser may, at its discretion, extend the deadline for the submission of bids.

# C. PREPARATION OF BID

## 1.10 Language of Bid

1.10.1 The bid prepared by the bidder and all correspondence & documents relating to the bid exchanged by the bidder and the Purchaser, shall be written in the English language. Any supporting documents or printed literature furnished by the bidder in another language shall be accompanied by an English translation of its pertinent passages. For the purpose of interpretation of bid, the English translation shall prevail.

## 1.11 Documents Comprising the Bid

1.11.1 The Bid prepared by the Bidder shall include the following documents:

**(I) Bid Document:**

i) The Proformae of **Bid document** and Price Schedules completed in accordance with **Clauses 1.12, 1.13** and **1.14**.

ii) Filled in Guaranteed & Technical Particulars Schedules & other schedules appended with the Bidding Documents.

iii) Documentary evidence establishing bidder's eligibility and qualification in accordance with **Clauses 1.2**, **1.3** and **1.15** that the bidder is eligible to bid and is qualified to perform the Contract.

iv) Bid Security furnished in accordance with **Clause 1.16**.

v) Names of manufacturers or Sub-suppliers from whom the supplier proposes/intends to procure/buy various components required for completion of works.

vi) A statement of deviations and exceptions to the provisions of the Bidding Documents in the format furnished in the Technical Specifications and a Clause-by-Clause justification on the deviations demonstrating that the deviations sought are either substantially responsive or are better than the Purchaser's specifications.

vii) Filled in Proformae of requirement of Power Load.

viii) Filled in Proformae indicating requirement of space for storage of equipment, offices, etc.

ix) Power of Attorney of authorizing signatory for signing of bid.

1.11.2 All blank spaces on the Proformae and schedules of the Bidding Documents for completion by the bidder shall be filled in with the required information, and where not applicable to the bid, a horizontal line shall be drawn. Any tender received with blank spaces is liable to be rejected.

1.11.3 The bid shall be accompanied by drawings, data, curves, supplier's/ manufacturer's illustrated literature & catalogues and any other relevant information as required in the specifications or deemed necessary by the bidder to illustrate his bid.

1.11.4 No alteration shall be made to any Proformae or to any schedule. Any correction of prices or other data must be re-written in ink both in figures and words and duly signed by the bidder.

**1.12 Performa of Bid**

1.12.1 The bidder shall complete the Performa of bid and Performa for Bank Guarantee for Bid Security to be issued by a Nationalized Bank in the format (Annex-I, IA & II) and the appropriate Price Schedule furnished in the Bidding Documents.

**1.13 Bid Prices**

1.13.1 The Bidder shall indicate on the Price Schedules, Volume-4 of the Bidding Documents, the unit prices and total Bid prices of the goods/ services to be supplied/ performed under the Contract. The format of Price Schedules (Volume-4 of Bidding Documents) shall be strictly adhered to by the Bidder.

1.13.2 Break-up of prices shall be submitted as required in the Price Schedule.

**1.13.3 Price Adjustment.**

Prices quoted by the bidder shall be "FIRM" during the execution of the Contract.

**1.14 Currencies of Bid**

1.14.1 The unit rates and prices shall be offered in entirely in Indian Rupees. All the payments due under the contract shall be made in

Indian Rupees.

## 1.15 Documents Establishing Bidder's Eligibility and Qualifications

1.15.1 Pursuant to **Clause 1.11**, the Bidder shall furnish, as part of his Bid, documents establishing the Bidder's eligibility to Bid and his qualifications to perform the Contract.

1.15.2 The Bidder shall furnish a brief write-up, backed with adequate data, explaining available capacity for manufacture at the works of manufacturer and to supply of the required equipment within the specified time of completion, after meeting all his current commitments.

1.15.3 The bidder shall confirm that all the facilities exist at the works of manufacturer for inspection and testing and the same shall be demonstrated to the Purchaser or his representative at the time of inspection and witnessing of tests.

1.15.4 Reports on financial standing of the bidder such as profit and loss statements, balance sheets and auditor's report of the past three years, banker's solvency certificate, and other related documents shall also be submitted with the bid.

1.15.5 The bidder shall furnish information regarding current litigation, if any, in which the Bidder is involved.

1.15.6 Bidders may note that they are subject to be disqualified, if they have made misleading or false presentation in the Proformae, statements and attachments submitted in proof of the qualification requirements or have record of poor performance such as abandoning the work, not properly completing the Contract, inordinate delays in completion, or financial failure etc.

**1.16 Bid Security**

1.16.1 Pursuant to **Clause 1.11**, the Bidder shall furnish, as part of his Bid, Bid Security amounting to ₹ **17 Lacs.**

1.16.2 The Bid Security is required to protect the Purchaser against risk of Bidder's conduct, which would warrant the security's forfeiture, pursuant to **Clause 1.16.8**.

1.16.3 The Bid Security shall be denominated in Rupees Favouring **Pay & Accounts Officer, Ministry of External Affairs, Govt. of India** and shall be in one of the following forms:

a) An irrevocable Bank Guarantee acceptable to the Purchaser issued by a **Nationalized Bank** located in India, in the proforma provided in the Bidding Documents (Annex-II) and valid for **45 days** beyond the validity of the Bid subject to extension from time to time.

Or

b) Crossed Demand Draft/pay Order for an amount of ₹ **17 Lacs** drawn on any Nationalized Bank of India in favour of the **Pay & Accounts Officer, Ministry of External Affairs, Govt. of India** payable at New Delhi.

1.16.4 Any Bid not accompanied by an acceptable Bid Security will be rejected by the Purchaser as non-responsive.

1.16.5 The Bid Securities of unsuccessful Bidders will be discharged/ returned as promptly as possible but not later than 30 days after the expiry of the period of Bid validity (including extension thereof if any) prescribed by the Purchaser, pursuant to **Clause 1.17**.

1.16.6 Bid security of the successful Bidder will be discharged by the Purchaser after signing the Contract Agreement, pursuant to

**Clause 1.36**, and furnishing the acceptable performance security, pursuant to **Clause 1.35**.

1.16.7 No interest shall be paid by the Purchaser on the Bid Security.

1.16.8 The Bid security may be forfeited:

a) If a Bidder withdraws or modifies his Bid during the period of bid validity or extension thereof; or

b) If the Bidder does not accept the correction of his Bid price, pursuant to **Clause 1.27** hereof;

c) In case of a successful Bidder, if he fails within the specified time limit to:

i) Furnish performance security in accordance with **clause 1.35**;

or

ii) Sign the contract in accordance with **Clause 1.36**.

**1.17 Period of Validity of Bids**

1.17.1 Bids shall remain valid for acceptance for a period of 180 days from the date of opening of Technical bid prescribed by the Purchaser, pursuant to **Clause 1.24**. A bid valid for a shorter period may be rejected by the Purchaser as non-responsive.

1.17.2 In exceptional circumstances, prior to expiry of the original bid validity period, the Purchaser may solicit the Bidder's consent to an extension of the period of validity. The request and the responses thereto shall be made in writing or by Fax followed by a post confirmation copy. The validity period of bid security provided by the bidder under **Clause 1.16** shall also be accordingly extended. A Bidder may refuse the request for extension of period of bid validity without forfeiting his bid

security. A Bidder agreeing to the request of the Purchaser will neither be required nor permitted to modify his bid, but will be required to extend the validity of his bid security correspondingly. The provision of **Clause 1.16** regarding discharge and forfeiture of bid security shall continue to apply during the extended period of bid validity.

**1.18 Pre-Bid Meeting**

a) A pre-bid meeting, open to all prospective bidders who have purchased the Bidding Documents, will be on 25.07.2014 at 1500 hrs.

b) The purpose of the meeting will be to clarify issues/queries sent by the prospective Bidders on the Bidding Documents and to answer questions on any matter that may be raised at that stage.

c) The Bidder is required to submit any questions in writing or by fax followed by a post confirmation copy so as to reach the Purchaser not later than ten days before the meeting.

d) Minutes of meeting, including text of the questions raised and responses given, will be furnished expeditiously to all those attending the meeting and subsequently to all those who had purchased the Bidding Documents. Any modification of the Bidding Documents which may become necessary as a result of the pre-bid meeting shall be made by the Purchaser exclusively through the issuance of an Addendum/ Corrigendum pursuant to **Clause 1.9** and not through the minutes of the pre-bid meeting.

e) Non-attendance of the pre-bid meeting will not be a cause for disqualification of a bidder.

## 1.19 Format and Signing of Bid

1.19.1 The bidder shall prepare and submit one original and 3 (three) copies of the documents comprising the Bid/Offer as described in **Clause 1.11** hereof, bound with the volume containing the Bid Proformae, and clearly marked "ORIGINAL" and "COPY" as appropriate. In the event of discrepancy between them, the original shall prevail.

1.19.2 The original and all copies of the bid shall be typed or written in indelible ink (in case of copies, photocopies are also acceptable).

1.19.3 The bid shall be signed by a person or persons duly authorized by way of Power of Attorney (on stamp paper) to sign on behalf of the bidder with company seal, pursuant to **Clauses 1.3**. The bid shall contain the details such as name, official address and place of business of person(s) authorised to sign the bid. All pages of the bid including entries or amendments which have been made, shall be signed by authorised signatory.

1.19.4 The bid shall contain no alterations, omissions or additions, except those to comply with instructions issued by the Purchaser or as necessary to correct errors made by the bidder, in which case such alternations/omissions/additions/corrections shall be initialed with date by the person or persons signing the bid.

## D. SUBMISSION OF BIDS

## 1.20 Sealing and Marking of Bids

1.20.1 The Bidders shall submit bids for Construction of 132 kV Transmission lines on D/c towers with all associated works in three (3) separate sealed covers as under;

| | |
|---|---|
| Part-I | Techno-Commercial Bid |
| Part-II | Price Bid |

| | |
|---|---|
| Part-III | Bid Security |

Each part shall contain all the documents required but not limited to the following:

| Part No | Name | Numbers to be submitted | |
|---|---|---|---|
| | | **Original** | **Copy of original** |
| **I** | **Techno-Commercial Bid** | **1** | **3** |
| I.1 | Proforma of Bid (Techno-commercial) | 1 | 3 |
| I.2 | "Addenda/Corrigenda" if any | 1 | 3 |
| I.3 | Documents establishing Bidder's eligibility and qualification (refer **Clauses 1.2, 1.3 & 1.15**) | 1 | 3 |
| I.4 | Power of Attorney (authorising the signatory of Bid to commit the Bidder)<br>(Refer Clause 1.3) | 1 | 3 |
| I.5 | Other Schedules of Technical Specification Volume-3 | 1 | 3 |
| I.6 | Schedule of Guaranteed & other Technical particulars as per proforma given in Volume-3. | 1 | 3 |
| I.7 | PERT-Chart for completion of works | 1 | 3 |
| I.8 | Original set of Volume 1, 2 & 3 of Bid Documents including Corrigenda/ Addenda to Bid Document duly signed with company seal on each page | 1 | 3 |
| **II** | **Price Bid (Volume-4)** | **1** | **3** |
| II.1 | Proforma of Bid (Price) | 1 | 3 |
| II.2 | Price Schedules | 1 | 3 |

| | | | |
|---|---|---|---|
| **III** | **Bid Security** | **1** | **-** |

1.20.2 The original and each copy of the bid shall be separately sealed in an inner & an outer envelope, duly marking the envelope such as "Original-Part I; Techno Commercial Offer" & "Copy: Part-I; Techno Commercial Offer" and "Original-Part II; Price Bid" & "Copy: Part-II; Price Bid". The inner and outer envelope of bid security shall be duly marked as "Part-III; Bid Security".

1.20.3 The inner & outer envelopes shall be addressed to the Purchaser at the following address:

**Chief (E&M)**
**WAPCOS Limited**
**Institutional Area, 76-C, Sector 18,**
**Gurgaon. Haryana -122 015, (India)**
**Telephone No. – +91-124 – 2349433**
**Fax No. – +91-124 – 2349184/2349189**
**E-mail: em@wapcos.gov.in**

and bear the project name, the Notice Inviting Tender (NIT) and Contract Package No. and the words **"Do not open before 1600 hours on 11.08.2014".**

1.20.4 The inner & outer envelope shall indicate the name and address of the Bidder to enable the bid to be returned unopened in case; it is declared "late" pursuant to **Clause 1.22**.

1.20.5 If the outer envelope is not sealed and marked as required by **Clause 1.20.2**, the Purchaser shall not assume any responsibility for the misplacement or premature opening of the bid.

## 1.21 Deadline for Submission of Bids

1.21.1 The bids must be received by the Purchaser in the office of

**Chief (E&M)**
**WAPCOS Limited**
**Institutional Area, 76-C, Sector 18,**
**Gurgaon. Haryana -122 015, (India)**
**Telephone No. – +91-124 – 2349433**
**Fax No. – +91-124 – 2349184/2349189**
**E-mail: em@wapcos.gov.in**

**Not later than 1500 hours on 11.08.2014.**

1.21.2 The Purchaser may, at its discretion, extend the deadline for submission of bids by issuing an amendment in accordance with **Clause 1.9** hereof, in which case all rights and obligations of the Purchaser and bidders previously subject to the original deadline shall thereafter be subject to the new deadline as extended.

1.21.3 The bid shall be submitted in person or through courier service at the address indicated in **Para 1.21.1**. Bid submitted through fax or e-mail shall not be accepted.

## 1.22 Late Bids

1.22.1 Any bid received by the Purchaser after the deadline for submission of bids prescribed by the Purchaser, pursuant to **Clause 1.21**, will be returned unopened to the bidder.

## 1.23 Modification and Withdrawal of Bids

1.23.1 The bidder may modify or withdraw his bid after the bid submission, provided that a written notice of the modification or withdrawal is received by the Purchaser prior to the deadline prescribed for submission of bids.

1.23.2 The bidders' modification or withdrawal notice shall be prepared, sealed, marked and delivered in accordance with the provisions of **Clause 1.20** hereof for the submission of bids, with the outer and inner envelopes additionally marked "Modification" or

"Withdrawal" as appropriate.

1.23.3 Subject to **Clause 1.25** hereof, no bid may be modified after the deadline for submission of bids.

1.23.4 No bid shall be withdrawn in the interval between the deadline for submission of bids and the expiry of the period of the bid validity specified in the proforma of bid. Withdrawal of a bid during this interval shall result in the forfeiture of the bid security, pursuant to **Clause 1.16.8**.

## E. BID OPENING AND EVALUATION

### 1.24 Bid Opening

1.24.1 The Purchaser shall open the Techno-commercial offer including modifications made pursuant to **Clause 1.23** and Bid Security in the presence of bidders' authorised representatives (not more than two) who may wish to attend on **11.08.2014 at 1600 hours** at the following location.

**Chief (E&M)**
**WAPCOS Limited**
**Institutional Area, 76-C, Sector 18,**
**Gurgaon. Haryana -122 015, (India)**
**Telephone No. – +91-124 – 2349433**
**Fax No. – +91-124 – 2349184/2349189**
**E-mail: em@wapcos.gov.in**

The bidders' authorised representatives, who are present during opening of bids, shall sign a register evidencing their attendance.

Envelopes marked "Withdrawal" shall be opened and read out first. Bids for which an acceptable notice of withdrawal has been submitted pursuant to **Clause 1.23** hereof shall not be opened.

The envelope marked "Part-III; Bid Security" will be opened after that. A bid will be rejected outright if bid security does not satisfy the requirement set forth in **Clause 1.16** hereof.

The "Techno-commercial Offer" i.e. Part-I shall be opened only of those bidders who have submitted the Bid Security in line with the Bidding Documents. The "Price Bid" i.e. Part-II shall be kept in the safe custody of the Purchaser and will be opened at a later date to be notified separately. The price bids of only those bidders will be opened whose techno-commercial bids have been ascertained to be responsive.

1.24.2 The bidder's names, written notifications of bid, modifications and withdrawals, if any, the presence or absence of the requisite bid security and such other details as the Purchaser, at its discretion, may consider appropriate will be announced at the time of bid opening.

**1.25 Clarification of Bids**

1.25.1 To assist in the examination, evaluation and comparison of bids, the Purchaser may, at its discretion, ask any bidder for clarification of his bid. The request for clarification and the response shall be in writing and no change in price or substance of the bid shall be sought, offered or permitted except as required to confirm the correction of arithmetic errors discovered by the Purchaser during the evaluation of the bids in accordance with of **Clause 1.27** hereof.

**1.26 Examination of Bids and Determination of Responsiveness**

1.26.1 Prior to the detailed evaluation of bids, the Purchaser will determine whether each Bid

i) Meets with the required eligibility and qualification requirements;

ii) Has been properly signed;

iii) Is complete and accompanied by the acceptable Bid Security;

iv) Is substantially responsive to the requirements of the Bidding Documents;

v) Provides any clarification and/or substantiation that the Purchaser may require.

1.26.2 For purposes of this Clause, a substantially responsive bid is one, which conforms to all the terms, conditions and specification of the Bidding Documents without material deviation or reservation. A material deviation or reservation is one

i) Which affects in any substantial way the scope, quality or performance of the Works;

ii) Which limits in any substantial way, inconsistent with Bidding Documents, the Purchaser's rights or the bidder's obligations under the Contract;

iii) Whose rectification would affect unfairly the competitive position of other bidders presenting substantially responsive bids;

iv) Which is incomplete or does not include all the Works covered by the Specification.

The Purchaser's determination of a bid's responsiveness shall be based on the contents of the bid itself without recourse to extrinsic evidence.

1.26.3 If a bid is not substantially responsive, the same shall be rejected by the Purchaser, and may not subsequently be made responsive by correction or withdrawal of non-conforming deviation or

reservation. Any bid which is incomplete, obscure or irregular or only for a part of the schedule is liable for rejection.

1.26.4 The Purchaser may waive any minor informality or non-conformity or irregularity in a bid which does not constitute a material deviation, provided such a waiver does not prejudice or affect the relative ranking of any bidder.

1.26.5 Price Bids of only techno-commercially acceptable and responsive bidders shall be opened by the Purchaser.

**1.27 Correction of Errors**

1.27.1 The price bids shall be checked by the Purchaser for any arithmetic errors in computation and summation. Errors will be corrected by the Purchaser as follows:

i) Where there is discrepancy between amounts in figures and in words, the amounts in words will govern, and

ii) Where there is discrepancy between the unit rate and the total amount derived from the multiplication of unit rate and the quantity, the unit rate as quoted will govern unless in the opinion of the Purchaser, there is an obviously gross misplacement of decimal point in the unit rate, in which case, the total of line item as quoted will govern and unit rate will be corrected accordingly.

iii) In case prices for some items are given by a bidder as lump sum where unit rates are required, the Purchaser reserves the right to arrive at unit rate on the basis of dividing the entered lump sum amount by the specified quantity.

1.27.2 The amount stated in the Proformae of Bid will be adjusted by the Purchaser in accordance with the above procedure for the correction of errors and shall be considered as binding upon the

bidder. If the bidder does not accept the corrected amount of bid, his bid will be rejected and the Bid Security will be forfeited in accordance with **Sub-Clause 1.16.8 (b)** hereof.

## 1.28 Evaluation and Comparison of Bids

1.28.1 General

The bids will be evaluated & compared by the Purchaser from the Technical & Financial points of views so as to make a selection for the complete Work covered under the Bidding Documents.

1.28.2 Procedure for Evaluation

The Purchaser shall evaluate the bids in the following steps:

a) Step-1: Substantial responsiveness

The Purchaser shall evaluate and compare only the bids determined to be substantially responsive in accordance with **Clause 1.26** hereof.

b) Step-2: Techno-Commercial Evaluation

Detailed Techno-commercial Evaluation of only substantially responsive bids will be done. Techno-Commercial proposal including time schedule for supply and erection submitted by the Bidder shall conform to the conditions set forth in the Bidding Documents.

c) Step-3: Price Evaluation

Price bids of only techno-commercially responsive Bidders will be opened and evaluated by the Purchaser.

1.28.3 The Purchaser's evaluation of a bid shall exclude and not take into account:

a) The taxes, levies/duties that are in force from time to time in India, however not applicable.

b) Central Excise Duty as exempted by Government of India will be excluded for evaluation.

c) Any allowance for price adjustment during the period of execution of the Contract, if provided in the bid.

d) Cost of those maintenance tools and spares recommended by the Bidder over and above the mandatory tools & spares specified by the Purchaser in Technical Specification.

e) Cost of optional items.

1.28.4 For evaluation of bids, the following shall be considered:

a) Prices FOR project site inclusive of packing, forwarding, transportation, storage & preservation at site including intermediate storage, if any, and transportation from storage site to work site.

b) The cost of complete works of site assembly, erection, testing, commissioning & handing over of equipments and insurance from Ex-works upto the expiry of defects liability period.

c) Loading, if any, specified in the Technical Specifications to bring the bids at par with respect to technical performance.

d) Making any correction for errors pursuant to **Clause 1.27** hereof.

e) Making an appropriate adjustment for any other acceptable

quantifiable variations or deviations not reflected in the Bid price or in the above mentioned other adjustments.

f) Unconditional discount offered by the Bidder, which is not violative of the conditions of Contract.

**1.29 Process to be Confidential**

1.29.1 After the opening of the bids, information relating to the examination, clarifications, evaluation & comparison of bids and recommendations concerning the award of Contract shall not be disclosed to the Bidders or other persons not officially concerned with such process.

1.29.2 Any effort by the bidder to influence the Purchaser in the process of examination, clarification, evaluation and comparison of bids, and in the decision concerning Award of Contract, may result in the rejection of his bid.

1.29.3 The bidder shall not communicate or use in advertising, publicity or in any other medium, photographs of the Works under this Contract, or description of the site, dimension, quantity, quality or other information, concerning the Works unless prior written permission has been obtained from the Purchaser.

1.29.4 All documents, correspondence, decisions and other matters concerning the Contract shall be considered of confidential and restricted nature by the bidder and he shall not divulge or allow access thereto by any unauthorised persons.

**F. AWARD OF CONTRACT**

**1.30 Post-qualification**

1.30.1 The Purchaser will determine to its satisfaction whether the bidder selected, as having submitted the lowest evaluated responsive bid,

is qualified to satisfactorily perform the Contract.

1.30.2 The determination will take into account the bidder's financial, technical and production capabilities. It will be based upon the examination of the documentary evidence of the bidder's qualifications submitted by the bidder, pursuant to **Clause 1.15**, as well as such other information as the Purchaser deems necessary and appropriate.

1.30.3 An affirmative determination will be a prerequisite for award of the Contract to the bidder. A negative determination will result in rejection of the bidder's bid, in which event the Purchaser will proceed to the next lowest evaluated bid to make a similar determination of the bidder's capabilities to perform the Contract satisfactorily.

**1.31 Award Criteria**

1.31.1 Subject to provisions of **Clause 1.33** hereof, the Purchaser will award the Contract to the bidder whose bid has been determined to be substantially responsive and has been determined as the lowest evaluated bid, provided further that the requisite assessment of the bidder has been made to perform the Contract satisfactorily.

**1.32 Purchaser's Right to Vary Quantities**

1.32.1 The Purchaser reserves the right to increase or decrease the quantity of goods including services upto twenty five (25) percent of the Contract Price without any change in unit rates or other terms and conditions during the execution of the Contract. However, the variation limit shall not apply to the quantities of civil works for the foundations of towers.

## 1.33 Purchaser's right to accept any Bid and to reject any or all Bids

1.33.1 The Purchaser reserves the right to accept or reject any bid, and to annul the bidding process and reject all bids, at any time prior to Award of Contract, without thereby incurring any liability to the affected bidder or bidders or any obligation to inform the affected bidder or bidders of the grounds for the Purchaser's action.

## 1.34 Notification of Award

1.34.1 Prior to the expiration of the period of bid validity, with its extension if any, the Purchaser will notify the successful bidder in writing or by Fax followed by confirmation copy that his bid has been accepted. This letter (hereinafter and in the condition of contract called 'Letter of Award') shall indicate the sum (hereinafter called the 'Contract Price'), which the MEA, Govt. of India will pay to the Contractor in consideration of the execution of this Contract.

1.34.2 The notification of award will constitute the formation of the Contract.

1.34.3 Upon the successful bidder's furnishing of performance security pursuant to **Clause 1.35**, the Purchaser will promptly notify each unsuccessful bidder and will discharge their Bid Security, pursuant to **Clause 1.16**.

## 1.35 Performance Security

1.35.1 Within thirty (30) days of the receipt of Letter of Award from the Purchaser but not later than the date of signing of Contract Agreement, the successful bidder shall furnish to the MEA a performance security in the form of a Bank Guarantee from a Nationalized Bank for an amount equal to 10% (Ten Percent) of the Contract price in accordance with the conditions of Contract.

1.35.2 The Performance security provided by the successful bidder in the form of an irrevocable Bank Guarantee shall be in favour of MEA issued by Nationalized Bank located in India. The Bank Guarantee shall be on the proforma attached as Annex-IV hereof and shall remain valid upto thirty (30) days after the date of issue of last Defects Liability Certificate.

**1.36 Signing of Agreement**

1.36.1 Within thirty (30) days of receipt of the Letter of Award, or a date and time mutually agreed upon, the successful bidder or his authorised representative shall attend the office of MEA, Govt. of India for signing of the Agreement. The proforma for Agreement is attached at **Annex-III** provided in the bidding Document. The cost for preparing the Final Contract Agreement (two original plus 10 copies) will be done by the Contractor. The legal stamp duties applicable to the Agreement shall be shared equally between the Employer and the Contractor. A copy of signed Contract Agreement will be forwarded to MEA for its reference.

1.36.2 Failure on the part of the successful bidder to comply with the requirement of **Clause 1.35** or **Clause 1.36** hereof shall constitute sufficient grounds for the annulment of the award and forfeiture of the bid security, in which event the Purchaser may either award the Work to the next lowest evaluated bidder or call for new bids.

# SECTION-2

# GENERAL CONDITIONS OF CONTRACT

## CONTENTS

# SECTION-2

# GENERAL CONDITIONS OF CONTRACT

## CLAUSE-1: DEFINITIONS

In the Contract, as hereinafter defined, the following words and expressions shall have the meanings hereby assigned to them, except where the context otherwise requires:

i) The Director (DPA), Ministry of External Affairs (MEA), on behalf of President of India & legal successor in title is Purchaser, who will employ the contractor for Strengthening the India-Nepal Power Transmission Interconnection Project.

ii) 'Contractor/Supplier' means the person who has been awarded the work by the MEA and includes the Contractor's personnel, representatives, successors and permitted assigns.

iii) 'Engineer-in-Charge' means the Engineer-in-Charge appointed from time to time by the MEA and notified in writing to the Contractor to act as the Engineer-in-Charge for the purpose of the Contract.

iv) 'Engineer-in-Charge's Representative' means person(s) designated from time to time by the MEA or the Engineer-in-Charge to perform the duties set forth in **Clause-2** hereof, whose authority shall be notified in writing to the Contractor by the Engineer-in-Charge.

v) "Works" shall include both permanent Works and Temporary Works or either of them as appropriate and shall mean supply of Goods and Services.

vi) "Temporary Works" means all temporary Works of every kind other than Contractor's plant, equipment and machinery required in or about the execution and completion of the Works and remedying of any defects therein.

vii) "Permanent Works" means the permanent Works to be executed in accordance with the Contract.

viii) The 'Goods' means all the equipment, machinery and/or other materials, which the Contractor is required to supply to MEA, Govt. of India under the Contract.

ix) 'Services' means services ancillary to the supply of Goods such as but not limited to transportation, insurance from Ex-works till defect liability period, handling, storage and preservation at store/ site, erection, painting, testing and commissioning of Goods, training and other such obligations of the Contractor covered under the Contract.

x) 'Contract' means the agreement entered into between MEA and the Contractor as recorded in the Form of Agreement, signed by both the parties including all attachments and appendices thereto and all documents incorporated by reference there in.

xi) 'Contract Price' means the sum as stated in the Letter of Award payable to the Contractor under the Contract for full and proper performance of his contractual obligations i.e. providing goods and services and remedying any defects therein in accordance with the provisions of the Contract.

xii) 'Plant and Equipment' or 'Machinery' means and include plant, equipment, machinery, tools, appliances, other implements of all description or things of whatsoever nature other than the Temporary Works, required in or about the execution and completion of the Works and remedying of any defects therein but does not include materials or other things intended to form or forming part of the Permanent Works.

xiii) 'Specifications' means the specifications of Works included in the Contract and any modification thereof or addition thereto or

deduction there from as may, from time to time, decided by MEA and/or submitted by the Contractor and approved in writing by the Engineer-in-Charge.

xiv) 'Drawings' means the drawings referred to in the Specifications and any modification of such drawings approved in writing by the Engineer-in-Charge and such drawings, as may, from time to time, be furnished by MEA and/or the Contractor and approved in writing by the Engineer-in-Charge.

xv) 'Site' means the places where the Works are to be executed and any other places as may be specifically designated in the Contract as forming part of Site.

xvi) 'Store' means the place where the goods supplied under this Contract are stored by the Contractor near to the Project site. Such place will be treated as forming part of site.

xvii) 'Approved' means approved in writing, including subsequent written confirmation of previous verbal approval and 'approval' means approval in writing, including as aforesaid.

xviii) 'Consultant' means WAPCOS Limited/CEA, India,its legal successors or permitted assigns.

xix) 'Chief Engineer' means the Chief Engineer-in-Charge of the Works or his successor and to whom the Engineer-in-Charge reports.

xx) 'GoI' means The Government of India.

xxi) 'Sub-Contractor' means the party or parties having direct contract with the Contractor and to whom any part of the Works has been sublet by the Contractor with the consent, in writing, of the Engineer-in-Charge and the legal successors in title to such person, but not any assignee of any such person.

xxii) 'Manufacturer' means the party proposing to design and/or manufacture the Goods as specified, complete or in part.

xxiii) 'Letter of Award' means the letter from MEA or its representative conveying award of Works subject to such reservations as may have been stated therein.

xxiv) 'Tests on Completion' means the tests specified in the Contract or otherwise agreed to by MEA and the Contractor to be performed before the Works are taken over by MEA.

xxv) 'Day' means a day from midnight to midnight.

xxvi) 'Month' means period from the beginning of a given date of a calendar month to the end of the preceding date of the next calendar month.

xxvii) 'Week' means seven consecutive days.

xxviii) 'Quarter' means a period of three consecutive months starting from January, April, July and October i.e. January to March, April to June, July to September and October to December.

xxix) 'C.E.A.' means Central Electricity Authority.

xxx) 'Rupees' means Rupees in Indian Currency.

xxxi) Words in singular number shall include the plural number and vice versa where the context so requires. 'He' shall include 'She' and vice versa.

xxxii) 'IS' means Bureau of Indian Standard Specifications with latest amendments or revision as currently in force at the time of execution of the Works.

xxxiii) 'Bill of Quantities'/Price Schedule' means the priced and completed bill of quantities.

xxxiv) 'Project Manager' means the person appointed from time to time by the Contractor and notified in writing to the MEA to act as the in-charge for the purpose of the Contract.

## CLAUSE-2: DUTIES AND POWERS OF ENGINEER-IN-CHARGE AND ENGINEER-IN-CHARGE'S REPRESENTATIVE

i) The Engineer-in-Charge shall carry out the duties specified in the Contract.

ii) The Engineer-in-Charge may exercise the authority specified in or necessarily to be implied from the Contract, provided however, that if the Engineer-in-Charge is required to obtain the specific approval from a Competent Authority before exercising any such authority, he will do so and convey the decision to the Contractor.

iii) The Engineer-in-Charge's Representative will be appointed by and be responsible to the Engineer-in-Charge and will carry out such duties and exercise such authority as may be delegated to him by the Engineer-in-Charge under **Sub-Clause (iv)** of this Clause. He shall have no authority to relieve the Contractor of any of his duties or obligations under the Contract except as expressly provided hereunder or elsewhere in the Contract, nor to order any work involving delay or any extra payment by the MEA, nor to make any variation in the Works.

iv) The Engineer-in-Charge may, from time to time delegate to the Engineer-in-Charge's Representative any of the powers and authorities vested in the Engineer-in-Charge and he may at any time revoke such delegation. Any communication issued by the Engineer-in-Charge's Representative to the Contractor in accordance with

such delegation shall have the same effect as though it had been issued by the Engineer-in-Charge. Provided that:

a) Any failure of the Engineer-in-Charge's Representative to disapprove any work or materials shall not prejudice the authority of the Engineer-in-Charge thereafter to disapprove such work or materials and to give instructions for the removal or for the rectification thereof.

b) If the Contractor questions any communication of the Engineer-in-Charge's Representative, he may refer the matter to the Engineer-in-Charge who will confirm, reverse or vary the contents of such communication.

v) The Engineer-in-Charge or the Engineer-in-Charge's Representative may appoint any number of persons to assist the Engineer-in-Charge's Representative in the carrying out of his duties. Such assistants shall have no authority to issue any instructions to the Contractor save in so far as such instructions may be necessary to enable them to carry out their duties and to secure their acceptance of materials, plant, equipment and machinery or workmanship as being in accordance with the Contract, and any instructions given by any of them for those purposes shall be deemed to have been given by the Engineer-in-Charge's Representative.

vi) Instructions given by the Engineer-in-charge shall be in writing, provided that if for any reason the Engineer-in-charge considers it necessary to give any such instruction orally, the contractor shall comply with such instruction. Confirmation in writing of such oral instruction given by the Engineer-in-Charge, whether before or after the carrying out of the instruction, shall be deemed to be an instruction within the meaning of this sub-clause. Provided further that if the Contractor, within seven days, confirms in writing to the Engineer-in-Charge any oral instructions of the Engineer-in-Charge and such confirmation is not contradicted in writing within seven

days by the Engineer-in-Charge, it shall be deemed to be an instruction of the Engineer-in-Charge. The provisions of this Sub-Clause shall equally apply to instructions given by the Engineer-in-Charge's Representative and any assistants of the Engineer-in-Charge or the Engineer-in-Charge's Representative appointed pursuant to **Sub-Clause v)**.

vii) The Employer/Engineer-in-Charge may require the Contractor's representative to attend any management meetings held at New Delhi/Gurgaon during the course of Contract, in order to review and access the progress & the arrangements for future work. This is an obligatory requirement in part of the Contract to depute his authorized representative to attend the meetings. Employer/Engineer-in-charge shall record the business of management meetings and supply copies of the record to those attending the meeting. In the record, responsibilities for any actions to be taken shall be in accordance with the Contract.

**CLAUSE-3: ASSIGNMENT OF CONTRACT**

The Contractor shall not, without the prior consent of the MEA, assign the Contract or any part thereof, or any benefit or interest therein or there under, otherwise than by:

i) A charge in favour of the Contractor's bankers of any monies due or to become due under the Contract, or

ii) Assignment to the Contractor's insurers (in cases where the insurers have discharged the Contractor's loss or liability) of the Contractor's right to obtain relief against any other party liable.

**CLAUSE-4: SUBLETTING**

i) The Contractor shall not sublet the whole of the Works. Except where otherwise provided by the Contract, the Contractor shall not

sublet any part of the Works without the prior written consent of the Engineer-in-Charge. However, any such consent shall not relieve the Contractor from any liability or obligation under the Contract and he shall be responsible for the acts, defaults and neglects of any sub-contractor, his agents, servants or workmen as fully as if they were the acts, defaults or neglects of the Contractor, his own agents, servants or workmen. Provided that the Contractor shall not be required to obtain such consent for:

a) The provision of labour, or

b) The purchase of materials which are in accordance with the standards specified in the Contract, or

c) The subletting of any part of the Works for which the Sub-contractor is named in the Contract.

ii) The Contractor shall furnish unpriced copies of the major sub-contracts (costing more than ₹ **3.0 million**) to MEA, wherever these are executed. This action would, however, not involve MEA in any complications arising between the Contractor and his sub-contractor(s) or any other liabilities. This action would also be without prejudice to the provision under this **Clause**.

iii) In the event of a sub-contractor having undertaken towards the Contractor in respect of the work executed or the goods, materials, plant, equipment and machinery or services supplied by such Sub-contractor, any continuing obligation extending for a period exceeding that of the Defects Liability Period or its extension under the Contract, the Contractor shall at any time, after the expiration of such period, assign to the MEA, at the MEA's request and cost, the benefit of such obligation for the unexpired duration thereof.

**CLAUSE-5: LANGUAGE (S) AND LAW**

i) a) The Contract Documents shall be drawn up in English. All correspondence and documents relating to the Contract, exchanged by the Contractor and MEA, shall be submitted in the prescribed form in English. All supporting documents and printed literature in connection with the Contract shall be preferably in English. In case the supporting documents and printed literature are in any other language, these shall be accompanied by an appropriate translation in English and in that case, for the purpose of interpretation, the English translation shall govern.

b) The governing law to which the Contract is to be subjected and according to which the Contract is to be construed shall be the Law for the time being in force in Nepal or India and within the jurisdiction of Indian/Nepal Courts.

c) The Contractor shall pay all taxes, duties, fee and obtain all permits, licenses and approvals as required by laws of India and Nepal in relation to the execution and completion of the work and remedying of any defects and the Contractor shall indemnify and hold the Employer harmless against and from the consequences of any failure to do so.

**ii) Documents Mutually Explanatory**

Several documents forming the Contract are to be taken as mutually explanatory of one another, but in case of ambiguities or discrepancies, the documents shall take precedence in the order in which they are set out in the proforma of Agreement (Annex-III).

**CLAUSE-6: DRAWINGS**

i) After the award of Contract the supplier & purchaser will hold design co-ordination meetings to finalize steps to be taken to implement the Contract including procedure for submission of drawings, design details & approval thereof in such a manner & procedures which would bring out workable solution to step by step process. At least five print copies of all the drawings for any part of the Work and five copies of complete design calculations shall be submitted by the Contractor for approval, at least 90 (ninety) days prior to the date on which such drawings are required to ensure that the work is carried out in accordance with the approved Work programme. The Engineer-in-Charge shall accord and convey the approval to the design calculations and drawings, if found in order, within thirty days from the receipt of the drawings from the Contractor. Otherwise he shall apprise the Contractor of his comments on such design calculations and drawings within the above-mentioned period.

ii) Where such comments are communicated to the Contractor, the Contractor shall be bound to ensure that 5 (five) print copies of all the revised drawings and five copies of revised design calculations, in view of these comments, are submitted to the Engineer-in-Charge, within thirty days of receipt of these comments. Similar course of action as aforesaid shall be taken by the Engineer-in-Charge on the revised design calculations and drawings. On receipt of approval of drawings/design processes/design calculation etc. the Contractor shall furnish four (4) copies and one (1) nos. paper type reproducible copies of approved drawings and seven copies of approved design calculation within 30 (thirty) days of such approval. In addition for Computer/AutoCAD drawings 2 sets of CDs of such approved drawings shall also be supplied.

iii) Notwithstanding the approval of the Engineer-in-Charge to the Contractor's design and drawings, the Contractor shall be responsible for the stability of Works in accordance with the provisions of the Contract and the approval accorded shall not

absolve him of his responsibility for meeting all requirements of specifications.

iv) One copy of the approved drawings shall be kept by the Contractor on the site and the same shall, at all reasonable times be available for inspection and use by the Engineer-in-Charge and the Engineer-in-Charge's Representative and by any other person authorized by the Engineer-in-Charge.

v) The Engineer-in-Charge shall, however, have full power and authority to modify, from time to time, during the progress of Works, the drawings approved previously in consultation with Contractor as shall be necessary for the purpose of proper execution and completion of Works. The Contractor, shall carry out and be bound by such modification.

vi) Final Drawings to be submitted by the Contractor on Completion of Erection Work.

After completion of the erection work the Contractor shall furnish 5 (five) copies duly bound in folder) and one copy on tracing cloth of final as built drawings of the work. For computer/AutoCAD drawn drawings, two sets of floppies, CDs containing such drawings shall be supplied. Each set shall include an index showing the drawing numbers, Revision No. & Titles.

vii) Instructions/Procedures for Storage & Preservation, Installation/ Erection, Painting, Testing & Commissioning at Site and Operation & Maintenance of Goods.

The Contractor shall submit five (5) sets of detailed written Instructions/ Procedures in English language, for Storage & Preservation, Installation/Erection, Painting, testing & commissioning at site and Operation and Maintenance manual for each components of equipment. The instructions/procedures shall

be submitted as early as possible so that final reviewed copies can be made available to the field for use in planning the work well in advance of actual installation/execution and operation. After review, five (5) durable bound copies of the final instructions shall be furnished. Each of these copies shall have a presentation similar to a hardbound book, resistance to wear and tear and firmly holding each of the pages. A book shall contain a maximum of approximately 240 pages to facilitate easy handling; if the material/matter requires more space; the manual shall be divided into two (2) or more volumes. Each volume shall have its title, printed on the front of the binding and on the back of the book. The paper used, the reproduction technique, the binding, and the presentation shall be of an approved quality and type. Two (2) sets of CDs containing final Instructions/Procedures shall also be furnished.

viii) The MEA's specification drawings, specifications and other information to the Contractor shall remain the property of the MEA. They shall not, without the consent of the MEA, be used, copied or communicated to a third party by the Contractor unless necessary for the purposes of this Contract.

ix) The Contractor shall be responsible for any errors or omissions in the Contractor's drawings. Errors, if any, noticed by the Contractor in the MEA's drawings, specification and other information shall, however, be promptly pointed out by the Contractor to the MEA. Approval by the Engineer-in-Charge of the Contractor's drawings shall not relieve the Contractor from any responsibility under this Sub-Clause.

x) The contractor shall bear all costs, which he may incur as a result of delay in providing drawings and other information or as a result of errors or omissions therein, for which he is responsible.

xi) The Contractor shall, at his own cost, carry out any alterations or remedial work necessitated by such errors or omissions for which he

is responsible and modifies the Contractor's drawings and such other information accordingly.

xii) The following technical drawings and documentation is to be submitted.

a) Outline drawings with dimensions and clearance diagrams for all tower types.
b) Loading diagrams for all tower types
c) Technical data for all the structural steel proposed for tower members and bolts.
d) Detailed design calculations including stress table, member & bolt sizes, factors of safety, foundation loads etc. for type A tower.
e) Drawings and / or catalogues of bidder's equipment.
f) Outline drawings of foundations of each type, which are proposed with typical calculations.
g) Final conductor and shield wire sag/tension charts.
h) Full description of the proposed method of tension stringing.

## CLAUSE-7: CONTRACTOR'S GENERAL RESPONSIBILITIES

### i) Contractor to carry out Work with care and diligence

The Contractor shall, in accordance with the Contract and with due care and diligence, design, manufacture, assemble, test at manufacturer's Works before dispatch, transport to site, insure till defect liability period, store and preserve, assemble and erect, test and commission the Goods and carry out the Works within the Time for Completion. The Contractor shall also provide all necessary plant, equipment and machinery, superintendence, labour and all other necessary facilities required for completion of works thereof.

### ii) Contractor Responsible for Stability and Safety of Site Operations

The Contractor shall take full responsibility for the adequacy, stability and safety of all site operations and methods of execution, notwithstanding any approval by the Engineer-in-Charge. The Contractor shall provide, at his cost sufficient illumination, fire-fighting equipment in and around the place of work to the satisfaction of Engineer-in-Charge. Further, contractor shall follow the safety precaution as covered in Section-5 of this Document

**iii) Instructions and Orders in Site Order Book**

All instructions and orders given by the Engineer-in-Charge or his representative at site are to be maintained in the Site Order Book and shall be taken to have been conveyed to the Contractor for his compliance.

**iv) Contractor's Site Office**

The Contractor must have a site office to receive normal correspondence between **9.00 AM** and **5.30 PM** on working days and urgent correspondence at any time on all days.

**v) Shift Works**

a) To achieve the required progress, the Work, may be required to be carried out round the clock. The time for completion and number of working days shall not be affected by the number of shifts each day. No extra amount on account of any shift work is payable to the Contractor.

b) Whenever the work is carried out in shifts, notice to this effect shall be given by the Contractor to the Engineer-in-Charge regarding the details of Works he intends to carry out in shifts so that necessary supervision arrangements can be made.

**vi) Setting out**

The Contractor shall set out the Works in relation to original points, lines, and levels of reference given by the Engineer-in-Charge in writing, and shall provide all necessary instruments, appliances and labour for such purposes. Further shifting of point, lines and levels to the place of work shall be the responsibility of the Contractor. Before starting the erection work, Contractor may check the accuracy of points, lines and levels given by the Engineer-in-Charge.

If, at any time during the execution of the Works, any error appears in the position, levels, dimensions or alignment of the Works, the Contractor shall rectify the error.

The Contractor shall bear the cost of rectifying the error, unless the error results from incorrect information supplied in writing by the Engineer-in-Charge or from default by another Contractor, in which case the cost shall be borne by the MEA or the other Contractor as the case may be.

The checking of any setting out by the Engineer-in-Charge shall not relieve the Contractor of his responsibility for accuracy thereof.

**vii) Contractor to keep Site Clean**

a) During the progress of the Works, the Contractor shall keep the site reasonably free from all unnecessary obstructions and shall remove from site any of his plant, equipment and machinery, surplus material or temporary works, no longer required. The Contractor shall also keep the site clean, tidy and orderly at all times and remove from site any wreckage, rubbish, scrap, packing material etc. promptly.

b) In case the Contractor does not keep the area clean and if found necessary to get the area cleaned, the Engineer-in-

Charge shall issue a notice of forty-eight hours to the Contractor. In the event of non-compliance by the Contractor, the Engineer-in-charge shall get the area cleaned by some other agency. The cost of such cleaning shall be borne by the Contractor. In case of rubbish, accumulating due to deposition by more than one Contractor, the share of charges to be borne by the Contractors as indicated by the Engineer-in-Charge shall be final.

**viii) Clearance of Site on Completion**

On the completion of the Works, the Contractor shall clear away and remove from the Site all his plant, equipment and machinery, surplus materials, rubbish and Temporary Works of every kind, and leave the whole of the Site and Works clean and in a workman like condition to the satisfaction of the Engineer-in-Charge.

**ix) Giving of Notices, Payment of Fees and Compliance with Statutes and Regulations etc.**

a) Giving of Notices and Payment of Fees

The Contractor shall give all notices and pay all fees required to be given or paid under any National or State Statute, Ordinance, or other Law, or any regulation, or bye-law of any local or other duly constituted authority in relation to the execution of Works and by the rules and regulations of all public bodies and companies whose property or rights are affected or may be affected in any way by the Works.

b) Compliance with Statutes, Regulations etc.

The Contractor shall conform, in all respects, with the provisions of any such Statute, Ordinance or Law as aforesaid and the regulation or bye-law of any local or other duly

constituted authority which may be applicable to the Works and with such rules and regulations of public bodies and companies as aforesaid and shall keep the MEA indemnified against all penalties and liability of every kind for breach of any such Statute, Ordinance or Law, regulation or bye-law.

c) Statutory Obligations

If the cost to Contractor in the performance of the Contract shall increase or reduce by reasons of the making, passing or promulgation of any law, 30 days prior to the latest date of submission of bids, in India or Nepal or any order, regulation or by-law having the force of the law, the amount of such an increase or reduction shall be added to or deducted from the Contract Price as the case may be.

**x) Opportunities for Other Contractors**

a) The Contractor shall, in accordance with the requirements of the Engineer-in-Charge, afford all reasonable opportunities for carrying out their Works to:

- Any other Contractors employed by the MEA, and workmen, and

- The workmen of the MEA, and

- The workmen of any duly constituted authorities who may be employed in the execution on or near the Site of any work not included in the Contract or of any Contract which the MEA may enter into in connection with or ancillary to the Works.

b) The Contractor shall jointly use with other Contractors and the MEA, approach roads, access roads and adits, drainage and

other facilities. The use of other Contractor's facilities shall be coordinated by the Engineer-in-Charge between the Contractors, if required, for execution of the Works connected with the project. Cost, if any, on this account shall be settled between the Contractors concerned.

The use of common facilities shall be coordinated by the Engineer-in-Charge through meetings of various parties. In case of any conflict, the decision of the Engineer-in-Charge in the matter shall be binding on all the parties.

c) If any part of the Contractor's work depends, for proper execution or results, upon the work of any other Contractor, the Contractor shall inspect and promptly report in writing to the Engineer-in-Charge, any defects in such work that render it unsuitable for such proper execution and results. His failure to inspect and report shall constitute an acceptance of other Contractor's work as fit and proper for the reception of his own work, except as to defects, which may develop in the other Contractor's work after the proper execution of his own work.

**xi) Patent Rights and Royalties**

a) The Contractor shall indemnify MEA from and against all claims and proceedings for or on account of infringement of any patent rights, designs, trademark or name or other protected rights in respect of any of his plant, equipment and machinery or materials used for or in connection with the Works or any of them and from and against all claims, proceedings, damages, costs, charges and expenses, whatsoever, in respect thereof or in relation thereto.

Except where otherwise specified, the Contractor shall pay all royalties, rent and other payments or compensation, if any, for getting any materials required for the Works.

b) In the event of any claims made under or action brought against MEA in respect of any such matters, as aforesaid, the Contractor shall be immediately, notified thereof and the Contractor shall be at liberty, at his own expense, to settle any disputes or to conduct any litigation that may arise there from. Provided that the Contractor shall not be liable to indemnify the MEA, if the infringement of the patent or design or any alleged patent or design right is the direct result of an order passed by the Engineer-in-Charge in this behalf.

**xii) Packing**

a) The Contractor shall provide such packing of the Goods as is required to prevent their damage or deterioration during transit to the final destination as indicated in the Contract. The packing shall be sufficient to withstand, without limitation, rough handling during transit and exposure to extreme temperatures, humid and salt laden climate (where applicable) and precipitation during transit and open storage. Packing case size and weights shall take into consideration, the remoteness of the Goods' final destination, the existing road condition and the absence of heavy handling facilities at all points in transit and project storage site.

b) The Contractor shall submit instructions for packing, handling, marking, storage code and documentation within and outside the package for approval by the Engineer-in-Charge. The packing, handling, marking, storage code and documentation within and outside the package shall comply strictly with such instructions. These instructions can be modified/ changed at any time during the execution of works by the Engineer-in-Charge and Contractor shall comply with such instructions.

**xiii) Delivery and Documents**

a) Delivery of the Goods shall be made by the Contractor in accordance with the terms specified in the Contract. The Contractor shall warrant that the goods supplied under the Contract are new, unused, of most recent or current models and incorporate all recent improvements in design and materials unless provided otherwise in the Contract. The Contractor further warrants that the goods supplied under this Contract shall have no defect arising from design, materials workmanship, installation or erection or from any act of omission of the supplier that may develop under normal use of supplied goods in conditions available at site.

b) The Contractor shall carryout all the required tests at his works as per approved Quality Assurance Plan. No material/ goods shall be dispatched unless required shop tests have been performed and Material Dispatch Clearance Certificate (MDCC) has been issued by the Engineer-in-Charge.

c) The Contractor shall request the Engineer-in-Charge for issue of MDCC as under:

i) In case tests at works are not to be witnessed by MEA, Contractor shall carryout these tests and submit the test certificates to Engineer-in-Charge along with request for issue of MDCC for that component.

ii) In case test at works are to be witnessed by MEA, Contractor shall submit test certificates to the Engineer-in-Charge after such inspection along with a request for issue of MDCC for that component.

iii) In case tests at works are to be witnessed by MEA and the inspection is waived off by MEA, the procedure as at c) (i) above shall apply for issue of MDCC.

iv) MDCC shall be issued within 21 (twenty one) days after the approval of test certificates.

d) The Contractor shall be responsible for arranging Import License and Customs clearance (wherever required). The MEA will assist the Contractor where required, in arranging Import License and Import Duty exemption certificate and obtaining clearance through the Customs. Any assistance that the MEA can give to the Contractor shall be provided on a "no responsibility basis".

**xiv) Transportation and Storage/Preservation**

a) The Contractor is required under the Contract to undertake transportation of goods from Ex-works to Project Site including clearing, forwarding and handling at port of entry (if any), storage and preservation at site, intermediate location (if any) and further transportation to work site, including handling wherever required. All necessary transportation equipment including lifting and handling equipment shall be provided and/or hired by the Contractor at his own cost.

b) Where the Contractor is required to effect delivery under any other terms, for example, by post or to another address, the Contractor shall be required to meet all the expenses until delivery on the site.

c) Where the Contractor is required under the Contract to deliver the goods on CIF basis, the Contractor shall arrange for ocean transportation on conference vessels or on Indian National Flag carriers. The Contractor may arrange for such transportation on alternative carriers if the conference vessels or Indian national Flag carriers are not available to transport the goods within the time periods specified in the Contract. In

this case, Contractor shall submit certificate of non-availability of Conference Vessel or Indian National Flag Carrier.

**xv) Quality Assurance**

In order to ensure that the Goods to be supplied under this Contract meet the specification requirements, the Contractor shall prepare a comprehensive quality assurance plan and submit the same within 30 days after commencement date of the Contract to the Engineer-in-Charge for approval. Any National or International quality assurance certificates such as IS: 14000 series/ISO 9000 series obtained by the Contractor along with its validity period shall be stated.

## CLAUSE-8: CONTRACT AGREEMENT

The Contractor shall, when called upon to do so, enter into and execute a Contract Agreement in the Proformae (Annex-III), with such modification as may be necessary.

## CLAUSE-9: PERFORMANCE SECURITY:

**A) PERFORMANCE SECURITY**

i) For the due performance of the Contract, the Contractor shall, within 30 (thirty) days of receipt of notification of award but not later than the date of signing of the Contract Agreement, furnish to the MEA, a performance security for an amount equivalent to 10 (ten) percent of the Contract Price. The cost of complying with the requirements of this Clause shall be borne by the Contractor, unless the Contract otherwise provides.

ii) The performance security shall be in the form of an irrevocable Bank Guarantee on the Proforma (Annex-IV). The Bank Guarantee shall be

in favour of the MEA, issued by Nationalized/Scheduled Bank located in India or Nepal.

iii) The proceeds of the performance security shall be payable to MEA as compensation for any loss, resulting from Contractor's failure to complete his obligations under the Contract.

iv) The performance security shall be valid until 30 (thirty) days after the date of issue of last Defects Liability Certificate. No claim shall be made against the performance security after the issue of the last Defects Liability Certificate and the performance security will be discharged and returned to the Contractor within thirty days after the expiry of last Defects Liability Period.

v) If the completion of last Defects Liability Period is extended due to the delays attributable to the Contractor, he shall, at his own cost, get the validity period of Bank Guarantee extended. Bank charges for extension of validity period of Bank Guarantee due to reasons attributable to MEA shall be born by MEA. The Contractor shall furnish the extended revised Bank Guarantee one month before the expiry date of the Original Bank Guarantee or any extension thereof. In case the extended/revised Bank Guarantee is not received by MEA within the specified period, the MEA, entirely at its discretion, shall be at liberty to encash the aforesaid Bank Guarantee.

**CLAUSE-10: INSPECTION OF SITE**

i) The Contractor shall be deemed to have inspected and examined the Site and its surroundings and information available in connection therewith and to have satisfied himself, as to

a) The form and nature thereof

b) The hydrological and climatic conditions

c) The extent and nature of work, materials necessary for the execution and completion of the Works and remedying of any defects therein, and

d) The means of access to the Site and the accommodation he may require and, in general, shall be deemed to have obtained all necessary information as to risks, contingencies and all other circumstances.

ii) The Contractor shall be responsible for the interpretation of any data supplied by the MEA.

**CLAUSE-11: SUFFICIENCY OF BID**

i) The Contractor shall be deemed to have satisfied himself as to the correctness of the rates and prices stated in the Schedule of Prices, all of which shall, except in so far as it is otherwise provided in the Contract, cover all his obligations under the Contract and all matters and things necessary for the proper execution and completion of the Works and remedying of any defects therein.

**CLAUSE-12: WORK TO BE EXECUTED IN ACCORDANCE WITH THE CONTRACT**

The Contractor shall execute and complete the Works and remedy any defects therein in strict accordance with the Contract to the satisfaction of the Engineer-in-Charge and shall comply with and adhere strictly to the Engineer-in-Charge's instructions and directions on any matter whether mentioned in the Contract or not, touching or concerning the Works. The Contractor shall take instructions and directions only from the Engineer-in-Charge or subject to the limitations referred to in **Clause-2** hereof, from the Engineer-in-charge's Representative.

**CLAUSE-13: PROGRAMME TO BE FURNISHED**

i) The Contractor shall within 30 (thirty) days after the Commencement Date, submit to the Engineer-in-Charge, for his approval a detailed work programme in Primavera along with 2 (two) sets of CDs of same indicating the following:

a) The order in which the Contractor proposes to carry out the Works (including design, manufacture, supply, erection, testing and commissioning) so as to complete the works within specified time schedule.

b) The times when submission and approval of the Contractor's drawings are required (time frame for this shall conform to that set out under **Clause-6** hereof).

c) The times by which the Contractor requires the MEA

- To furnish data/specification drawings, if any

- To have completed any other associated Works

The approval by the Engineer-in-Charge of the programme shall not relieve the Contractor from any of his obligations under the Contract.

ii) The programme shall cover activities on the site, procurement and delivery and no material alteration to such programme shall be made without prior approval of Engineer-in-Charge.

iii) The programme shall be in the form of a network diagram which shall show in detail and in orderly sequence all activities, their descriptions, duration, and dependencies or precedencies, necessary to the completion of the Works.

iv) The Contractor shall base his programme on the completion times and periods and other relevant Contract requirements and shall co-ordinate his programme with the information given to him by the Engineer-in-Charge concerning the project programme and programme of other Contractors to be engaged on the site to the extent that this can be done within the framework of the periods and information available at the time.

v) The Contractor shall, supply to the Engineer-in-Charge, at such times as he may direct during the progress of the Works, such written particulars, photographs and information as are required by the Engineer-in-Charge to enable a progress record to be maintained in respect of the Works.

vi) The Contractor shall also submit a narrative report periodically with updated analysis which shall include but not be limited to the description of the problem areas, current and anticipated, delaying factors and their impact and an explanation of the corrective actions taken or proposed.

**CLAUSE-14: CONTRACTOR'S SUPERINTENDENCE**

The Contractor shall provide all necessary superintendence during the execution of the Works and as long thereafter as the Engineer-in-Charge may consider necessary for the proper fulfilling of the Contractor's obligations under the Contract. The Contractor, or a competent and authorized representative approved of in writing by the Engineer-in-Charge, whose approval may at any time be withdrawn, shall give his whole time to the superintendence of the Works. Such authorized representative shall receive on behalf of the Contractor, instructions from the Engineer-in-Charge or subject to the provisions of **Clause-2** hereof the Engineer-in-Charge's Representative. If approval of the representative is withdrawn by the Engineer-in-Charge, the Contractor shall, as soon as is practicable,

having regard to the requirement of replacing him as herein after mentioned, after receiving notice of such withdrawal, remove the representative from the Works and shall not thereafter employ him again on the Works in any capacity and shall replace him by another representative approved by the Engineer-in-Charge.

## CLAUSE-15: CONTRACTOR'S EMPLOYEES

i) The Contractor shall provide on the Site in connection with the execution and the completion of the Works and the remedying of any defects therein;

a) Only such technical assistants as are skilled and experienced in their respective trades and such foremen and leading hands as are competent to give proper superintendence of the Works; and

b) Such skilled, semi-skilled and unskilled labour as is necessary for the proper and timely fulfilling of the Contractor's obligations under the Contract.

ii) The Engineer-in-Charge shall be at liberty to object to and require the Contractor to remove forthwith from the Works any person provided by the Contractor who in the opinion of the Engineer-in-Charge, misconducts himself, or is incompetent or negligent in the proper performance of his duties, or whose presence on the site is otherwise considered by the Engineer-in-Charge to be undesirable and such persons shall not be again allowed upon the Works without the written consent of the Engineer-in-Charge. Any person so removed from the Works shall be replaced as soon as possible by a competent substitute approved by the Engineer-in-Charge.

## CLAUSE-16: EXTRAORDINARY TRAFFIC

**Protection of Highways and Bridges**

The Contractor shall use every reasonable means to prevent any of the highways or bridges communicating with or on the routes to the

site from being damaged by any traffic of the Contractor or any of his subcontractors and, in particular, shall select routes, choose and use vehicles and restrict and distribute loads so that any such extraordinary traffic, as will inevitably arise from the moving of Goods or his plant, equipment and machinery and materials from and to the site, shall be limited, as far as reasonably possible, and so that no unnecessary damage may be occasioned to such highways and bridges. In case, however, highways and bridges are damaged on account of movement of any traffic of the Contractor, he shall be liable to restore the highways and bridges to their original condition at his expense.

## CLAUSE-17: SAFETY, SECURITY AND PROTECTION OF THE ENVIRONMENT

The Contractor shall, throughout the execution and completion of the Works and the remedying of any defects therein;

i) Have all the regard for the safety of all persons entitled to be on the site and keep the site and the Works in an orderly state appropriate to the avoidance of danger to such persons, and

ii) Provide and maintain, at his own cost all lights, guards, fencing, warning signs and watching, when and where necessary or required by the Engineer-in-Charge or by any duly constituted authority, for the protection of the machines, equipment, works or for the safety and convenience of the public or others, and

iii) Take all reasonable steps to protect the environment on and off the site and to avoid damage or nuisance to persons or to property of the public or others resulting from pollution, noise or other causes arising as a consequence of his methods of operation, and shall preserve and protect all existing vegetation such as trees on or adjacent to the site which do not unreasonably interfere with the

execution of the Works. The Contractor shall be held responsible for all unauthorized cutting of and damage to trees, by careless operation of his plant, equipment and machinery and stockpiling of materials etc. and the MEA shall have no responsibility on this account.

**CLAUSE-18: QUALITY ASSURANCE PROGRAMME (QAP)**

Detailed QAP will be prepared to ensure that the equipment and services under the scope of this Contract whether manufactured or performed within the Contractor's works or at his Sub-Contractor's premises or at any other place of work are in accordance with the specifications at all points as necessary. Such programme shall be outlined by the Contractor and shall be finally accepted by the WAPCOS after discussions. The quality Assurance Programme of the Contractor shall generally cover the following:

a) His organization structure for the management and implementation of the proposed Quality Assurance Programme.
b) Documentation control system.
c) Qualification data for Contractor's key personnel.
d) The procedure for purchase of materials, parts, components and selection of Sub-Contractor's service including vendor analysis, source inspection, incoming new material inspection, verification of material purchased etc.
e) System for shop manufacturing and site erection controls including process controls and fabrication and assembly controls.
f) Control of non-conforming items and system for corrective actions.

g) Inspection and test procedure both for manufacture and field activities.

h) Control of calibration and testing of measuring and testing equipment.

i) A quality plan detailing out the specific quality control procedure adopted for controlling the quality and characteristics relevant to each item of material furnished.

**CLAUSE-19: LABOUR**

**i) Engagement of Labour**

The Contractor shall make arrangements for the engagement of all labour, local or otherwise, for their transport, housing, food, medical care etc. at his own expenses. The contractor shall not employ in connection with the Works any person who has not completed 18 years of age. No female labour shall be employed in night shifts. The contractor shall have to arrange permits for the labour/staff for their entry into Nepal at his own cost .The contractor shall not recruit or attempt to recruit his staff and labour from amongst persons in the services of Govt. of Nepal.

The labour force, technical, administrative and other personnel engaged by the Contractor in Nepal shall be confined to the nationals of India or Nepal or Country of origin of Goods/Works.

**ii) Supply of Water**

The Contractor shall, so far as is reasonably practicable, provide at the site, to the satisfaction of the Engineer-in-Charge or Engineer-in-Charge's Representative, an adequate supply of drinking and other water for the use on the Works, as well as for his staff and workmen.

**iii) Alcoholic Liquor or Drugs**

The Contractor shall not, otherwise than in accordance with the Statutes, Ordinances and Govt. Regulations or Orders for the time being in force, import, sell, give, barter or otherwise dispose of any alcoholic liquor or drugs, or permit or suffer any such importation, sale, gift, barter or disposal by his subcontractors, agents or staff or labour.

**iv) Epidemics**

In the event of any outbreak of illness of an epidemic nature, the Contractor shall comply with and carry out such regulation, orders and requirements as may be made by the Government of India/Nepal, or the local medical or sanitary authorities for the purpose of dealing with and overcoming the same.

**v) Disorderly Conduct etc.**

The Contractor shall, at all times, take all reasonable precautions to prevent any unlawful, riotous or disorderly conduct by or amongst his staff and labour and for the preservation of peace and protection, of persons and property in the neighbourhood of the Works.

**vi) Contractor to follow Labour Laws and Chathrim**

The Contractor shall, in respect of labour employed by him, comply with the provision of the Labour Act & Minimum Wages Rules and Regulations, as per Chathrim issued by Ministry of Labour and Human Resource, India/Nepal and shall indemnify the Purchaser in respect of all claims that may be made against the Purchaser for non-compliance thereof by the Contractor.

In case of non-compliance by the Contractor, the Engineer-in-Charge may take such actions as may be necessary for compliance of the Labour Act and recover the costs thereof from the Contractor.

**vii) Housing for Labour**

Save insofar as the Contract otherwise provides, the Contractor shall provide and maintain such accommodation and amenities as he may

consider necessary for all his staff and labour, employed for the purpose of or in connection with the Contract, including all fencing, water supply (both for drinking and other purposes), electricity supply, sanitation, cook houses, fire prevention and fire fighting equipment, and other requirements in connection with such accommodation or amenities. On completion of the Contract, unless otherwise agreed with the MEA, the temporary camps/housing provided by the Contractor shall be removed and the Site reinstated to its original condition, to the satisfaction of the Engineer-in-Charge.

**viii) Accident Prevention Officer**

The Contractor shall have on his staff on Site an officer dealing only with questions regarding the safety and protection against accidents of all staff and labour. This officer shall be qualified for this work and shall have the authority to issue instructions and shall take protective measures to prevent accidents.

**ix) Health and Safety**

Due precautions shall be taken by the Contractor, and at his own cost, to ensure the safety of his staff and labour and, in collaboration with and to the requirements of the local health authorities, to ensure that medical staff, First Aid equipment and stores, sick bay and suitable ambulance service are available at the camps, housing and on the Site at all times throughout the period of the Contract and that suitable arrangements are made for the prevention of epidemics and for all necessary welfare and hygiene requirements.

**x) Observance by Sub-Contractors**

The Contractor shall be responsible for observance by his sub-contractors of the aforesaid provisions.

**CLAUSE-20: RETURNS OF LABOUR**

The Contractor shall deliver to the Engineer-in-Charge or Engineer-in-Charge's Representative or at his office, a return in detail in such

form and at such intervals as the Engineer-in-Charge may prescribe showing the supervisory staff and the number of the several classes of labour from time-to-time employed by the Contractor at the site and such information in respect of the Contractor's plant, equipment and machinery as the Engineer-in-Charge may require.

## CLAUSE-21: WORKMANSHIP AND MATERIALS

### i) Manner of execution

The goods to be supplied shall be manufactured and all Works to be done shall be executed in the manner set out in the Contract. Where the manner of manufacture and execution is not set out in the Contract, the Work shall be executed in a proper and workman like manner in accordance with recognized good practice.

### ii) Covering up work

The Contractor shall give the Engineer-in-Charge full opportunity to examine, measure and test any work at site, which is about to be covered up or put out of view.

The Contractor shall give due notice to the Engineer-in-Charge whenever such work is ready for examination, measurement or testing.

The Engineer-in-Charge shall then, unless otherwise notifies the Contractor that he considers it unnecessary, without unreasonable delay carry out the examination, measurement or testing.

### iii) Uncovering work

If so instructed by the Engineer-in-Charge, the Contractor shall expose any parts of the works. The Contractor shall reinstate and make good such works to the satisfaction of the Engineer-in-Charge.

## CLAUSE-22: INSPECTION AND TESTING

**Type Test:**

All the equipment/materials Conductor, Groundwire, Conductor/ Earthwire accessories, Insulators, Suspension/Tension Hardware fittings, Bolts and Nuts offered shall be fully tested as per relevant standards and the Bidder shall furnish four sets of type test reports along with the offer. These tests must not have been conducted earlier than five years.

The purchaser for any change in the design/type already type tested and the design/type offered against this specification, the purchaser reserved the right to demand, repetition of tests without any extra cost.

Engineer-in-Charge shall have the right to re- inspect any material though previously inspected and approved by him, at the Contractor's works before and after the same are erected at site. If by the above inspection, the Engineer-in-charge rejects any material, the Contractor shall make good for such rejections either by replacement or modifications /repairs as many be necessary, to the satisfaction of the Engineer-in-charge. Such replacements will also include the replacements or re-execution of such of those works of the other Contractors and/ or agencies, which might have got damaged or affected by the replacements of re-works done to the Contractor's work.

The Engineer-in-Charge, his duly authorized representative and/or an outside inspection agency acting on behalf of the Engineer-in – charge shall have at all reasonable times, access to the Contractor's or Sub-Contractor's premises, stores or works and shall have the

power at all reasonable times to inspect and examine the materials and workmanship of the works during its fabrication or erection. They will be given all help by the Contractor in carrying out such inspection.

The inspection by the Engineer-in-charge or his authorized representative and issue of inspection certificate thereon shall in no way limit the liabilities and responsibilities of the Contractor in respect of agreed quality assurance programme forming a part of the contract.

**i) Independent Inspection**

The Engineer-in-Charge shall have the right to inspect and/or to test the goods to confirm their conformity to the Contract specifications at no extra cost to the Purchaser. The Technical Specifications shall specify the inspection and tests required by Engineer-in-Charge. The Engineer-in-Charge may delegate inspection and testing of contracted equipment or a part thereof to an independent Inspector and such independent Inspector shall be considered as the Engineer-in-Charge's Representative. Notice of such appointment shall be given by the Engineer-in-Charge to the Contractor.

**ii) Inspection and Testing During Fabrication/Manufacture**

The Engineer-in-Charge shall be entitled during fabrication/ manufacture to inspect, examine and test the materials and workmanship and check the progress of fabrication/manufacture of the Goods to be supplied under the Contract. This shall take place on the Contractor's premises. If the Goods are being fabricated/ manufactured on other premises, the Contractor shall obtain permission from the Engineer-in-Charge to carry out such inspection, examination and testing on those premises.

The Contractor shall certify that his persons conducting the tests are qualified specialist on the subject matter of relevant tests. No such inspection, examination or testing shall release the Contractor from any obligation under the Contract.

**iii) Dates for Inspection and Testing**

The Contractor shall give at least 30 (thirty) days notice to the Engineer-in-Charge regarding his intention to carry out the tests. The Contractor shall agree with the Engineer-in-Charge about the time and place for the testing of the Goods as provided in the Contract. The Engineer-in-Charge shall give the Contractor at least 24 hours notice of his intention to attend the tests.

If the tests are not witnessed by the Engineer-in-Charge, the Contractor shall carryout the tests himself and the test reports shall be submitted by the Contractor to the Engineer-in-Charge for his approval/comments. If the Engineer-in-Charge fails to communicate his approval/comments with in 45 (forty five) days of the receipt of test report, the report shall be deemed to have been approved by Engineer-in-Charge.

**iv) Certificate of Testing**

When the Goods have passed the tests referred to in the Contract, the Engineer-in-Charge shall furnish to the Contractor a certificate or endorse the Contractor's test certificate to that effect.

**v) Rejection**

If, as a result of the inspection, examination or testing, the Engineer–in-Charge decides that any work is defective or otherwise not in accordance with the Contract, he may reject such work and shall notify the Contractor thereof immediately. The notice shall state the Engineer-in-Charge's objections with reasons.

The Contractor shall then, with all speed, make good the defect or ensure that any rejected work complies with the Contract.

If the Engineer-in-Charge requires such Works to be re-tested, the tests shall be repeated under the same terms and conditions. All costs incurred for the repetition of the tests shall be borne by the Contractor.

**vi) Facilities for Testing**

Where the contract provides for tests on the premises of the Contractor or of any sub-Contractor, the Contractor shall provide Air/train tickets as applicable from Delhi to place of inspection, Lodging & Boarding, Local Transportation (Delhi & place of Inspection) for the experts of Employer, documents, labour, material, electricity, fuel, apparatus and instruments as may be necessary to carry out the tests efficiently without any extra cost to WAPCOS. Each inspection shall be carried out by at least two Engineers from WAPCOS depending on the requirement.

## CLAUSE-23: SUSPENSION OF WORKS, TRANSPORTATION OR ERECTION

**i) Order to Suspend**

The Engineer-in-Charge may at any time instruct the Contractor to:

a) Suspend progress of the Works, or

b) Suspend transportation of the Goods, if fabricated and manufactured at a place other than on the site, which are ready for transportation to the site at the time specified in the programme, or if no time is specified, at the time appropriate for it to be transported, or

c) Suspend the erection of the Goods which have been delivered to the site

The Contractor shall, during suspension, protect and secure the Works or Goods affected at the Contractor's Works or elsewhere or on the site, as the case may be, against any deterioration, loss or damage.

**ii) Cost of Suspension**

The additional cost, if any, incurred by the Contractor in protecting, securing and insuring the Works or the Goods in following the Engineer-in-Charge's instructions under **Sub-Clause i)** of this Clause and in resumption of the Work, shall be added to the Contract Price.

The Contractor shall not be entitled to be paid any additional costs if such suspension is necessary by reason of some default on the part of Contractor.

The Contractor shall not be entitled to additional costs unless he notifies the Engineer-in-Charge of his intention to make such claim within 30 (thirty) days after receipt of the order to suspend progress or transportation or erection.

**iii) Suspension Lasting more than 90 days**

If suspension under **Sub-Clause i)** of this clause has continued for more than 90 (ninety) days, and the suspension is not due to Contractor's default, the Contractor may, by written notice to the Engineer- in-Charge, request for permission within 30 (thirty) days after the expiry of the above period to proceed with the Works.

If permission is not granted within that time, the Contractor may treat the suspension as an omission under Clause-32 hereof, of the

section it affects or if the suspension affects the whole of the Works, as an abandonment of the Contract by the Purchaser.

## CLAUSE-24: TIME FOR COMPLETION, EFFECTIVE DATE AND COMMENCEMENT DATE

The Contract shall become effective after the acceptance of the performance security by the MEA and signing of Contract by the parties. The effective date shall be considered as commencement date.

The time for completion of the Works or part thereof shall be as specified hereunder. The time for completion shall be reckoned from Commencement date i.e. the date of signing of Contract Agreement by the Contractor and the MEA.

Time is the essence of Contract. The delivery, erection, testing & commissioning of all 132 kV line shall be completed within a period of **8 (Eight) months.**

The Contractor shall submit the detailed PERT network indicating all activities including Survey, Delivery, Erection, Testing and Commissioning dates under the contract to match the above commissioning schedule for the approval of WAPCOS. The works shall be completed and shall have passed the tests on completion within the time indicated above.

## CLAUSE-25: EXTENSION OF TIME FOR COMPLETION

The Contractor may claim an extension of the Time for Completion, if the completion of the Works is delayed by any of the following causes:

i) Extra or additional work ordered in writing under **Clause-32** hereof.

ii) Delay by any other Contractor engaged by the MEA, which affects this contract materially.

iii) Any suspension of the Works under **Clause-23** hereof, except when due to the Contractor's default.

iv) Any Force Majeure conditions

The Contractor shall give to the Engineer-in-Charge, notice of his intention to seek for an extension of time within 14 (fourteen) days of the circumstances becoming known to the Contractor for such an extension. The notice shall be followed as soon as possible with full supporting details.

The Engineer-in-Charge will evaluate such details and grant the Contractor from time to time, either prospectively or retrospectively; such extension of Time for Completion as may be justified provided always that, the circumstances leading to the extension of Time for completion are other than through a default of the Contractor. The Engineer-in-Charge shall notify the Contractor accordingly.

**CLAUSE-26: RATE OF PROGRESS**

If for any reason, which does not entitle the Contractor to an extension of Time for Completion, the rate of progress of the Works or any section at any time is not commensurate with the time for completion set out under **Clause-24** hereof and in the opinion of the Engineer-in-Charge does not ensure completion by the prescribed Time or extended Time for Completion, the Engineer-in-Charge shall so notify the Contractor in writing and the Contractor shall thereupon take such steps as are necessary and the Engineer-in-Charge may approve to expedite progress so as to complete the Works or such section by the prescribed time or extended time. The Contractor shall not be entitled to any additional payment for taking such steps.

**CLAUSE-27: LIQUIDATED DAMAGES FOR DELAY**

If the Contractor fails to complete the Work as per time period as specified in **Clause-24** hereof, the purchaser shall, without prejudice to its other remedies under the Contract, deduct the amount from any monies in its hands, due or which may become due to the Contractor, as liquidated damages (which is a genuine pre-estimate agreed by the parties hereto of the loss or damage which the purchaser would have suffered on account of delay without giving any proof of the loss or damages) a sum equivalent to **0.25 (point Two Five)** percent per day subject to a maximum of 10% of the Contract price.

The payment or deduction of such damages shall not relieve the Contractor from his obligations to complete the works or from any of his obligations and liabilities under the Contract.

**CLAUSE-28: PROLONGED DELAY**

If at any time it appears to the Engineer-in-Charge that the Contractor is unable to adhere to the prescribed time schedule and the delay is not due to a cause for which the MEA or some other Contractor employed by it is responsible or if the liquidated damages levied in terms of the provisions under **Clause-27** hereof has reached a maximum of ten percent of the Contract Price, then the MEA may at its discretion, by further notice to the Contractor either:

i) Require the Contractor to complete, or

ii) May itself complete at the Contractor's risk and cost, provided that it does so in a reasonable manner, or

iii) Terminate the Contract.

If the MEA terminates the Contract, it shall be entitled to recover from the Contractor the loss it has suffered.

## CLAUSE-29: TESTS ON COMPLETION

### i) Notice of Tests

The Contractor shall give to the Engineer-in-Charge, **15 (fifteen) days** notice of the date after which he will be ready to make the Tests on Completion hereinafter called the Tests. Unless otherwise agreed, the Tests shall take place within **15 (fifteen) days** after the said date, on such day or days as the Engineer-in-Charge notifies the Contractor.

### ii) Time for Tests

If the Engineer-in-Charge fails to notify a time after having been asked to do so, or does not attend at the time and place notified, the Contractor shall be entitled to proceed with the Test in his absence and such tests shall be deemed to have been carried out in the presence of Engineer-in-Charge.

### iii) Delayed Tests

If the Tests are being unduly delayed by Contractor, the Engineer-in-Charge may, by a notice, require the Contractor to make the Tests within **21 (twenty-one) days** after the receipt of such notice. The Contractor shall make the Tests on such days within that period as the Contractor may fix and of which he shall give notice to the Engineer-in-charge.

If the Contractor fails to make the Tests within **21 (twenty-one) days**, the Engineer-in-Charge may himself proceed with the Tests. All Tests so made by the Engineer-in-Charge shall be at the risk and cost of the Contractor and the cost thereof shall be deducted from

the Contract Price. The Tests shall then be deemed to have been made in the presence of the Contractor and the results of the Tests shall be accepted as accurate.

**iv) Facilities for Tests on Completion**

Except where otherwise specified, the Contractor shall provide, at his cost, such labour, material, instruments, electricity, fuel, apparatus and other necessary equipment as may be required to carry out the Tests.

**v) Re-Testing**

If the Works or any section fails to pass the Tests, the Engineer-in-Charge may require such Tests to be repeated on the same terms and conditions. The costs on account of repetition of the Tests under this Sub-Clause or under Sub-**Clause-31** vii) hereof shall be borne by the Contractor.

**vi) Disagreement as to Results of Tests**

If the Engineer-in-Charge and the Contractor disagree on the interpretation of the Test results, each shall give a statement of his views to the other within **14 (fourteen) days** after such disagreement arises. The statement shall be accompanied by all relevant evidence. In case of such disagreement the decision of the MEA shall be final.

**vii) Consequences of Failure to Pass Tests on Completion**

If the Works or any section fails to pass the Tests on the repetition thereof under **Sub-Clause v)** of this Clause, the Engineer-in-Charge shall be entitled to:

a) order one further repetition of the Tests under the conditions of **Sub-Clause v)** of this Clause, or

b) Reject the Works or section in which event the Contractor shall replace that part of work or section without any cost to the purchaser within a reasonable time without affecting the completion schedule. Testing on this part of work or section shall be performed in the presence of Engineer-in-Charge or his representatives as per procedure specified above.

**viii) Test Certificate**

As soon as the Works or any section thereof has passed the Tests, a joint protocol shall be signed based upon which the Engineer-in-Charge shall issue a Certificate to the Contractor to that effect within 7 (seven) days of signing of protocol and submission of all relevant documents.

## CLAUSE-30: TAKING OVER

**i) Taking over**

The Works shall be taken over by the MEA when they have been completed in accordance with the Contract, except in minor respects that do not affect the use of the Works for their intended purpose, have passed the Tests on Completion and a Taking Over Certificate has been issued in accordance with **Sub-Clause (ii)** of this Clause. The mandatory spares, testing instruments & devices, tools & tackles and consumables etc required for operation & maintenance of goods under the contract shall be taken over by Purchaser at the time of issue of last Taking over Certificate of works under the Contract.

**ii) Taking Over Certificate**

The Contractor may apply to the Engineer-in-Charge for issue of a Taking over Certificate not earlier than **14 (fourteen) days** before he

proposes to carry out commissioning and acceptance tests on the goods under the contract.

The Engineer-in-Charge shall, **within thirty days** after the receipt of the Contractor's application either:

a) Issue the Taking Over Certificate to the Contractor stating the date on which the Works were complete and ready for taking over, or

b) Reject the application giving his reasons and specifying the work required to be done by the Contractor to enable the Taking over Certificate to be issued.

If the Works are divided by the Contract into sections, the Contractor shall be entitled to apply for separate Taking over Certificates for each such section.

**iii) Use before Taking Over**

The Purchaser shall not use any part of the Works unless a Taking over Certificate has been issued in respect thereof. If nevertheless, the MEA uses any part of the Works, that part which is used shall be deemed to have been taken over at the date of such use. The Engineer-in-Charge shall, on request of the Contractor, issue a Taking over Certificate accordingly. If the MEA uses any part of the Works before taking over, the Contractor shall be given the earliest opportunity of taking such steps as may be necessary to carry out the Test on Completion.

The Works shall not be deemed to have been taken over if they are not substantially in accordance with the Contract. The provisions set out under **Clauses-29** and **31** hereof shall apply as if the part had been taken over on the date it was taken into use.

**iv) Interference with Tests on Completion**

If the Contractor is prevented from carrying out the tests on completion by a cause for which the Engineer-in-charge or other Contractors employed by the MEA are responsible, the MEA shall be deemed to have taken over the Works on the date when the Tests on Completion would have been completed but for such prevention. The Engineer-in-Charge shall issue a Taking over Certificate accordingly.

The Works shall not be deemed to have been taken over if they are not substantially in accordance with the Contract.

If the Works are taken over under this **Clause**, the Contractor shall, nevertheless, carry out the Tests on Completion during the Defects Liability Period. The Engineer-in-Charge shall require the Tests on Completion to be carried out by **14 (fourteen) days** notice and in accordance with the relevant provisions of **Clause-29** hereof.

## CLAUSE-31: DEFECTS AFTER TAKING OVER

**i) Defects Liability Period**

The expression "Defects Liability Period" shall mean a period of Twelve months from the date the Complete Works are taken over under Clause 30 (i) hereof and the Taking Over Certificate is issued in accordance with Clause 30 (ii) hereof.

The Defects Liability Period for each item of mandatory spare parts shall be 12 months after particular spare item has been put into operation.

**ii) Notice of Defects**

If any defect appears or damage occurs during the defect liability period, the Engineer-in-Charge shall forthwith notify the Contractor

thereof. However, delay or failure of the Engineer-in-Charge in notifying shall not relieve the Contractor from his liability for remedying the defects at his own cost.

**iii) Making Good Defects**

Upon receipt of such notice, the Contractor shall be responsible for making good any defect in or damage to any part of the Works which may appear or occur during the Defects Liability Period and which arises from either;

a) Any defective materials, workmanship or design, or

b) Any act or omission of the Contractor during the Defects Liability Period.

The Contractor shall make good the defect or damage as soon as practicable and at his own cost.

**iv) Extension of Defects Liability Period**

The provisions of this Clause shall apply to all replacements or renewals carried out by the Contractor as if the replacement and renewals had been taken over on the date they were completed.

The Defects Liability Period for the Works shall be extended by a period equal to the period during which the Works cannot be used by reasons of a defect or damage. If only a part of the Works is affected, the Defects Liability Period shall be extended only for that part.

In neither case shall the Defects Liability Period be extended by more than **twelve months**.

**v) Failure to Remedy Defects**

If the Contractor fails to remedy a defect or damage within a reasonable time, the Engineer-in-Charge may fix a final time for remedying the defect or damage.

If the Contractor fails to do so, the Engineer-in-Charge may carry out the work himself or by others at the Contractor's risk and cost. The costs actually incurred by the Engineer-in-Charge in remedying the defect or damage shall be recovered from any payments due or which may become due to the Contractor.

**vi) Removal of Defective Work**

If the defect or damage is such that repairs cannot be expeditiously carried out on the site, the Contractor may, with the consent of the Engineer-in-Charge and after furnishing a proper security acceptable to the Purchaser in case the item is paid for, remove from the site, for the purposes of repair, any part of the Works which is defective or damaged.

**vii) Further Tests on Completion**

If the replacements or renewals are such that they may affect the performance of the Works, the Engineer-in-Charge may request that the Tests on Completion be repeated to the extent necessary. The request shall be made by notice **within 30 (thirty) days** after the replacement or renewal. The Tests shall be carried out in accordance with **Clause-29** hereof.

**viii) Right of Access**

Until the Final Certificate of Payment has been issued, the Contractor shall have the right of access to all parts of the Works and to records of the working and performance of the Works.

Such right of access shall be during the Purchaser's normal working hours at the Contractor's risk and cost. Access shall also be granted to any duly authorised representative of the Contractor, whose name has been communicated in writing to the Engineer-in-Charge. Subject to the Engineer-in-Charge's approval, the Contractor may also, at his own risk and cost, make any tests which he considers desirable.

**ix) Defects Liability Certificate**

When the Defects Liability Period for the Works or any part thereof has expired and the Contractor has fulfilled all his obligations under the Contract for defects in the Works or that part, the Engineer-in-Charge shall issue, **within 30 (thirty) days,** to the Contractor, a Defects Liability Certificate to that effect.

No certificate other than the Defects Liability Certificate referred to herein above shall be deemed to constitute approval of the Works.

**x) Exclusive Remedies**

The Purchaser remedies under this Clause shall be in place of and to the exclusion of any other remedy in relation to defects whatsoever.

## CLAUSE-32: VARIATIONS

**i)** The Engineer-in-Charge may make any variation in the form, quality or quantity of the Works or any part thereof or substitution for original specifications, design, drawings and instructions that may, in his opinion be necessary and for that purpose, or if for any other reason it shall, in his opinion be desirable, he shall have power to order the Contractor to do the following and the Contractor shall do the same;

a) Increase or decrease the quantity of any work included in the Contract,

b) Omit or substitute any such work,

c) Change the drawings, designs specifications, character or quality or kind of any such work,

d) Change the levels, lines, positions and dimensions of any part of the Works,

e) Execute additional work of any kind necessary for the completion of the Works,

f) Change any specified sequence, method or timing of construction of any part of the Works,

g) Change method of dispatch or packing, and

h) Change the place of delivery.

No such variations shall in any way vitiate or invalidate the Contract. Any altered, additional or substituted work which the Contractor may be directed to do in the manner above specified as part of the Work, shall be carried out by the Contractor on the same conditions in all respects on which he agreed to do the main Work.

The Contractor may also at any time propose variations of the Works to the Engineer-in-Charge.

**ii) Procedure to order variation**

The Engineer-in-Charge shall notify the Contractor of the nature and form of the variation considered necessary. After having received such notice, the Contractor shall submit to the Engineer-in-Charge.

a) A description of work, if any, to be performed and a programme for its execution, and

b) The Contractor's proposal for any modifications to the programme, if considered necessary, according to **Clause-25** hereof or to any of the Contractor's obligations under the Contract, and

c) The Contractor's proposals for adjustment to the Contract Price.

Following the receipt of the Contractor's submission, the Engineer-in-Charge shall, decide as soon as possible whether or not the variation shall be carried out.

If the Engineer-in-Charge decides that the variation shall be carried out, he shall notify the Contractor to proceed with the variations. If the Engineer-in-Charge and the Contractor are unable to agree the adjustment of the Contract Price, the provisions of **Sub-Clause (iii)** of this Clause shall apply.

**iii) Disagreement on Adjustment of the Contract Price**

If the Contractor and the Engineer-in-Charge are unable to agree on the adjustment of the Contract Price, the adjustment shall be determined in accordance with the rates specified in the Schedule of Prices.

No payment shall be made for the items of Work ordered to be omitted.

Additional items of Work, which are not provided in the Schedule of Prices, shall be paid on the basis of actual expenditure relating to that item including cost of materials, fabrication/machinery,

handling and installation at site plus **25% (twenty five percent)** towards overheads including profits.

The price of varied items determined by the Engineer-in-Charge shall be final and binding on the Contractor. No claim of the Contractor shall be entertained by MEA in this regard.

**iv) Contractor to Proceed**

On receipt of the notification to proceed with the variations, the Contractor shall forthwith proceed to carry out the variation and be bound to these conditions in doing so as if such variation was stated in the Contract.

The work shall not be delayed pending the granting of an extension of the time for completion or an adjustment to the Contract Price under **Sub-Clause iii)** of this Clause and the Contractor shall execute the varied work at the same terms and conditions provided in the Contract.

**v) Records of costs**

In any case where the Contractor is instructed to proceed with a variation prior to the determination of the adjustment to the Contract Price in respect thereof, the Contractor shall keep records of the cost of undertaking the variation and of time expended thereon. Such records shall be open to inspection by the Engineer-in-Charge at all reasonable times.

## CLAUSE-33: PAYMENT TERMS AND MODE OF PAYMENT

**i) Advance Payment**

a) Adjustable Advance payment – 10% of the Contracted Price less provisional sum/contingencies, if any shall be released within 30

days of signings of Agreement , on submission of Bank Guarantee for an equal amount valid until 60 days beyond the time of completion or any extended time granted in the prescribed proforma (Annex-v).Such Bank Guarantee shall be executed in favour of " **Pay & Accounts Officer, Ministry of External Affairs, Govt. of India** " by any branch of any Nationalised Bank of India, preferably by the New Delhi branch of State Bank of India.

**(ii) Payment for Supply of Goods and Services**:-

a) 80% of Contract Price (Ex-works) of goods shall be paid as progressive payment/RA bills on the receipt of goods at site and on submission of supplier's commercial invoice in triplicate, copy of GR/RR, copy of packing list, Material Dispatch Clearance Certificate (MDCC), Indemnity Bond as per format annexed at **Annexure-VI**, Material receipt certificate based on packing list issued by Engineer-in-Charge after receipt of goods at site and copy of insurance policy(ies) taken by the Contractor as per provisions of Contract.

b) 90% of the Contract Price in respect of transportation, handling & insurance charges up to project storage site on prorata basis shall be paid as progressive payment on receipt of goods on site and on submission of supplier's commercial invoice in triplicate, material receipt certificate based on packing list issued by Engineer-in-charge after receipt of goods at site and copy of Insurance Policy (ies) taken by the Contractor as per provisions of Contract.

c) 90% of the Contract Price in respect of storage & preservation charges, handling, transportation charges from project storage to site of installation, along with prorata insurance charges for the same shall be paid in monthly installments against pro-rata contract value of the Services completed (proper storage, preservation & handling) and certified by the Engineer-in-Charge and on submission of supplier's commercial invoice in triplicate and copy of insurance policy(ies) taken by the contractor as per provisions of contract.

d) 90% of Erection, Testing and Commissioning charges, along with prorata insurance charges shall be paid in monthly installments against pro-rata contract value of the work completed and certified by the Engineer-in-Charge on submission of Supplier's commercial invoice in triplicate, completion certificate issued by EIC and copy of Insurance Policy(ies) taken by the Contractor as per provision of Contract.

e) 100% of admissible taxes/duties and levies, if any on receipt of goods at site.

f) Progressive payment (minus Insurance Charges for Defects Liability Period) will be released within 30 (thirty) days of submission of clear bills.

g) The balance payment (minus insurance charges for Defect Liability Period) of the contract price shall be made after successful erection, testing & commissioning **& within 30 (thirty) days** after issue of last Taking over Certificate by the Engineer-in-Charge.

I) Prorata payment of insurance charges for Defect Liability Period shall be paid in monthly installments during defect liability period.

II) Deduction towards income tax shall be made from every interim payment certified by the Engineer-in-Charge in Terms of Nepal Income Tax Rules as in force from time to time.

III) If the payments are released through Demand Draft, the charges towards DD prepared shall be to the Contractor's account.

h) The payments shall be released only after obtaining approval of competent authority in MEA. The contractor shall supply billing breakup for approval by the client.

**ii) Civil Works**

**a) Bill of Quantities**

The Contractor shall indicate the quantities in BOQ. The Contractor shall be paid for the quantity of the work done at the approved rate in the Bill of Quantities for each item.

**b) Variations**

Any altered, additional or substituted work which the Contractor may be directed to do in the manner above specified as part of the work, shall be carried out by the Contractor on the same conditions in all respects on which he agreed to do the main Work.

The unit rate entered in Bill of Quantities for the individual items shall apply for the quantities of work increased provided in the Bill of Quantities.

The rate for the increased/altered/ changed in quantities, additional or substituted item shall be determined in accordance with procedure indicated under clause-33 ii d) hereof.

**c) Payments for Variations**

The rates for such items of Work as are required to be executed due to variations as stated in Clause-33 ii c) above shall be payable in the manner as stated hereunder:

(a) If the rate for altered, additional or substituted work for which no rate is specified in the Contract and such item of work exists in India/Nepal Schedule of Rates (CPWD/NSR), then such work shall

be carried out at the rates provided in the CPWD/NSR (latest edition), modified to the extent of average % above/below of the contract as determined based on the original estimated value viz-à-viz, the awarded value of work.

(b) For derivation of rates for extra and substituted items which do not exist either in the BOQ or in the CPWD/NSR, "similar class of work" will be interpreted as items having similar procedure of working. The rates shall be derived by adding/deducting the additional /fewer materials, labour involved in the "similar class of work" in CPWD/NSR (latest edition) at scheduled rate and by adding/deducting the average tendered percentage of "similar class of work" to the schedule rate or market rate of materials/labour.

(c) If the rates of the altered, additional or substituted item of work cannot be determined in the manner specified under clause-33) ii) d ) 1), then the rates for such items of work and the items of works shall be determined by the Engineer-in-charge on the basis of actual analyzed cost comprising the cost of materials to be supplied by the Contractor (including transportation and taxes, levies, if paid), wages of labour actually engaged for the particular work, cost of operation and maintenance of plant and machinery used for work plus 20% to cover the Contractor's overhead, profit, supervision and other charges. The decision of the Engineer-in-Charge in deriving rates as aforesaid shall be conclusive and binding on the Contractor.

1) Under no circumstances the contractor shall at any stage, suspend the work on account of non-settlement on rates of such altered, additional or substituted items.

2) Any operational incidental to, or necessary for proper execution of the item included in the Bill of Quantities or in the Schedule of Rates mentioned above, whether or not, specifically indicated in the description of the item and the relevant specifications, shall be deemed to be included in the rate quoted by the tender or the rate

given in the said Schedule of Rates, as the case may be. Nothing extra shall be admissible for such operations.

**d) Payments:**

Items of the Works for which no rate or price has been entered in the priced Bill of Quantities shall not be paid for by the MEA and shall be deemed covered by other rates and prices in the Contract.

**e) Retention**

The MEA shall retain from each payment due to the Contractor 5% of the amount included in each Interim payment certificate until completion of the whole of the works & **within 30 (thirty) days** after issue of last Taking over Certificate by the Engineer-in-Charge the retention amount shall be released.

**f) Deductions towards Income Tax**

Deductions towards Income Tax shall be made from every interim bill certified by the Engineer-in-Charge in terms of Nepal Income Tax rules as in force from time to time. Nothing in the Contract shall relieve the Contractor from his responsibility to pay any tax that may be levied in Nepal on profits made by him in respect of the Contract save as provided under ITB Clause 2.15.

**CLAUSE-34: CLAIMS**

i) Pursuant to the provisions under the Contract, the procedure for submitting claims by the Contractor shall be as under;

a) The Contractor shall give to the Engineer-in-Charge, a notice of his intention to make such claim **within 30 (thirty days)** after such claim arises stating the reasons for his claim and

b) As soon as reasonably practical after the date of such notice, submit to the Engineer-in-Charge full and detailed particulars of his claim, but not **later than 90 (ninety) days** after such notice, unless otherwise agreed by the Engineer-in-Charge. The Contractor shall thereafter promptly submit such further particulars as the Engineer-in-Charge may require to assess the validity of the claim.

**ii) Assessment**

When the Engineer-in-Charge has received full and detailed particulars of the Contractor's claim in accordance with **Sub-Clause (i)** of this Clause and such further particulars as he may have required, he shall determine whether the Contractor is entitled to additional payment and notify him accordingly.

The Engineer-in-Charge may reject any claim for additional payment, which does not comply with the requirements of **Sub-Clause i)** of this clause and the decision of the Engineer-in-charge shall be final and binding on the Contractor.

## CLAUSE-35: CURRENCIES FOR PAYMENTS

The Payments shall be made in Indian Rupees.

## CLAUSE-36: RISK AND RESPONSIBILITY

**i) Allocation of Risks and Responsibility**

The Risks of loss or damage to physical property and of death and personal injury, which arise as a consequence of the performance of the Contract, shall be allocated between the MEA and the Contractor as follows:

a) The MEA's Risks as specified in **Sub-Clause ii)** below.

b) The Contractor: the Contractor's Risks as specified in **Sub-Clause iii)** below.

**ii) MEA's Risks**

The MEA's Risks are:

a) Loss or damage due to the use or occupation of the Works or any part thereof by the MEA; except as may be provided for in the Contract;

b) Loss or damage to the extent that it is due to the design of any part of the Works by the MEA or those for whom the MEA is responsible.

**iii) Contractor's Risks**

The Contractor's Risks are all risks other than those identified as the MEA's Risks.

## CLAUSE-37: CARE OF THE WORKS AND PASSING OF RISK

**i) Contractor's Responsibility for the Care of the Works**

The Contractor shall be responsible for the care of the Works or any section thereof from the Commencement Date until the Risk Transfer Date applicable thereto under **Sub-Clause ii)** of this Clause.

The Contractor shall also be responsible for the care of any part of the Works upon which any outstanding work is being performed by the Contractor during the Defects Liability Period until completion of such outstanding work.

**ii) Risk Transfer Date**

The Risk Transfer Date in relation to the Works or a section thereof is the earliest of either:

a) The date of issue of the Taking Over Certificate, or

b) The date when the Works are deemed to have been taken over in accordance with **Clause-30** hereof, or

c) The date of expiry of the notice of termination when the Contract is terminated by the Purchaser in accordance with the Conditions of the Contract.

**iii) Passing of Risk of Loss or of Damage to the Works**

The risk of loss or of damage to the Works or any section thereof shall pass from the Contractor to the MEA on the Risk Transfer Date applicable thereto.

**iv) Loss or Damage Before Risk Transfer Date**

Loss of or damage to the Works or any section thereof occurring before the Risk Transfer Date shall:

a) To the extent caused by any of the Contractor's risks, be made good forthwith by the Contractor at his own cost, and

b) To the extent caused by any of the Purchaser's Risks, be made good by the Contractor at the Purchaser expense if so required by the Engineer-in-Charge **within 30 (thirty) days** after the occurrence of the loss or damage. The price for making good such loss and damage shall be in all circumstances reasonable and shall be agreed by the Purchaser and the Contractor, or in the absence of agreement, the MEA shall fix a reasonable price which shall be final and binding.

**v) Loss or Damage after Risk Transfer Date**

After the Risk Transfer Date, the Contractor's liability in respect of loss of or damage to any part of the Works shall, except in the case of gross misconduct, be limited:

a) To the fulfillment of the Contractor's obligations under **Clause-31** hereof in respect of defects therein, and

b) To making good forthwith loss or damage caused by the Contractor during the Defects Liability Period.

## CLAUSE-38: DAMAGE TO PROPERTY AND INJURY TO PERSONS

### i) Contractor's Liability

Except as provided under **Sub-Clause iii)** of this Clause, the Contractor shall be liable for and shall indemnify the Purchaser against all losses, expenses and claims in respect of any loss of or damage to physical property, death or personal injury occurring before the issue of the last Defects Liability Certificate to the extent caused by;

a) Defective design, material or workmanship of the Contractor,

or

b) Negligence or breach of statutory duty of the Contractor, his sub-contractors or their respective employees and agents.

### ii) Purchaser's Liability

The Purchaser shall be liable for and shall indemnify the Contractor against all losses, expenses or claims in respect of loss of or damage to any physical property or of death or personal injury whenever occurring, to the extent caused by any of the Purchaser's Risks.

### iii) Accidents

The Contractor shall be liable for and shall indemnify the MEA against all losses, expenses or claims arising in connection with the death of or injury to any person employed by the Contractor or his sub-contractors for the purposes of the Works, unless caused by any defaults of the Engineer-in-Charge or other Contractors engaged by the MEA or by their respective employees or agents and in such cases the MEA shall be liable for and shall indemnify the Contractor against all losses, expenses and claims arising in connection therewith.

## CLAUSE-39: LIMITATIONS OF LIABILITY

### i) Liability after expiration of Defects Liability Period

The Contractor shall have no liability to the MEA for any loss of or damage to the MEA's physical property, which occurs after the expiration of the Defects Liability Period unless caused by gross misconduct of the Contractor.

### ii) Exclusive Remedies

The MEA and the Contractor intend that their respective rights, obligations and liabilities as provided for in these conditions shall alone govern their rights under the Contract and in relation to the Works.

Accordingly, the remedies provided under the Contract in respect of or in consequence of:

a) Any breach of Contract, or
b) Any negligent act or omission, or
c) Death or personal injury, or
d) Loss or damage to any property

Are to be to the exclusion of any other remedy that either may have against the other under the law governing the Contract or otherwise.

**iii) Mitigation of Loss or Damage**

In all cases the party claiming a breach of Contract or a right to be indemnified in accordance with the Contract shall be obliged to take all reasonable measures to mitigate the loss or damage.

**CLAUSE-40: INSURANCE**

**i)** The Contractor shall take all risk insurance cover for the full value of the contract plus 15% thereon from Ex-works till the expiry of the Defects Liability Period naming Purchaser as the beneficiary. In case erection and/or commissioning is delayed due to any reason, the period of insurance shall be extended to cover the actual Defect Liability Period. However, the purchaser shall reimburse the cost of insurance for extended period of delays not attributable to the Contractor. The insurance cover shall be taken against any loss or damage during;

a) Transportation of the Goods up to Project storage site, including loading/unloading, intermediate storage etc.

b) Storage & Preservation, handling i.e. transportation from storage to the place of installation, loading/unloading etc.;

c) Erection, testing and commissioning and;

d) The Defects Liability Period.

The goods supplied under the Contract shall be comprehensively insured through Insurance companies in India to cover all risks

including but not limited to floods, riots, earthquakes, any other natural calamities etc. against loss or damages incidental to manufacture till the Defects Liability Period. For the items lost/ damaged during the entire period of insurance, the claim for the same will be lodged by the Contractor with the insurance company and replacement will be made by the Contractor expeditiously without any cost to the purchaser.

The claim ascertained by the insurance company on account of loss or damage will be passed on to the Contractor after the Contractor has made good the loss or damage.

**ii) Contractor's Personal, Plant, Equipment and Machinery**

a) The Contractor shall insure his personal, labour for suitable compensation in the event of death due to accident or injury caused in employment or in the course of employment. The plant, equipment and machinery brought on to the site may be insured for its full replacement value, while on the site against any loss or damage caused by any of the Contractor's Risks.

**iii) Third Party Insurance**

a) The Contractor shall insure against his liability due to any act or omission on the part of Contractor, his agents, his employees, his representatives and sub-Contractors or from riots, strikes and civil commotion for any material or physical damage, loss or injury which may occur to any property, including that of the MEA, or to any person, including any employee of the MEA, by or arising out of the execution of the Works or in the performance of the Contract and occurring before the issue of the last Defects Liability Certificate.

b) Such insurance shall be affected for an amount of ₹ **0.1 (point one) million** for any one loss on reinstatement basis but in

total not exceeding ₹ **0.5 (point five) million**, and if this ceiling is touched, the Contractor shall take a policy for the Third Party Insurance for an amount to be decided by the Engineer-in-Charge and the premium for such an additional insurance policy will be reimbursed by the MEA to the Contractor as per actual.

c) In the event of any claim in respect of which the Contractor would be entitled to receive indemnity under the policy being brought or made against the MEA, the insurer will indemnify the MEA against such claims and any costs, charges and expenses in respect thereof.

**iv) Employees**

The Contractor shall insure and maintain insurance against his liability under **Sub-Clause-38 (iii)** hereof.

**v) General Requirements of Insurance Policies**

The Contractor shall:

a) Submit the policies of the insurance, which he is required to effect under the Contract together with receipts for the premiums to the Engineer-in-Charge.

b) Effect all insurances for which he is responsible with an insurer.

c) Make no material alternations to the terms of any insurance without the MEA's approval. If an insurer makes any material alteration to the terms, the Contractor shall forthwith notify the MEA.

d) In all respects comply with any conditions stipulated in the insurance policies which he is required to place under the Contract.

e) Effect all insurance for which he is responsible under the Contract.

**vi) Remedies on the Contractor's failure to pay premiums**

If the Contractor fails to pay the premiums, then the MEA may pay such premiums to keep in force such insurance. Premiums paid by the MEA for this purpose shall be deducted from any payments due or which may become due to the Contractor.

**CLAUSE-41: FORCE MAJEURE**

**i) Definition of Force Majeure**

Force Majeure means any circumstances beyond the control of the parties, including but not limited to:

a) War and other hostilities, (whether war be declared or not), invasion, act of foreign enemies, requisition or embargo;

b) Rebellion, revolution, insurrection, military or usurped power and civil war;

c) Ionizing radiation or contamination by radio activity from any nuclear fuel or from any nuclear waste from the combustion of nuclear fuel, radio-active toxic explosives, or other hazardous properties of any explosive nuclear assembly or nuclear components thereof;

d) Riot, commotion or disorder, except where solely restricted to employees of the Contractor or of his sub-contractors.

e) Earthquake affecting Contractor's work.

**ii) Effect of Force Majeure**

Neither party shall be considered to be in default or in breach of his obligations under the Contract to the extent that performance of such obligations is prevented by any circumstances of Force Majeure which arise after the date of the Letter of Award or the date when the Contract becomes effective, whichever is the earlier.

**iii) Notice of Occurrence**

If either party considers that any circumstances of Force Majeure have occurred which may affect performance of his obligations, he shall promptly notify the other party.

**iv) Performance to Continue**

Upon the occurrence of any situation of Force Majeure, the Contractor shall endeavour to continue to perform his obligations under the Contract so far as reasonably practicable. The Contractor shall notify the Engineer-in-Charge of the steps he proposes to take including any reasonable alternative means for performance, which is not prevented by Force Majeure. The Contractor shall not take any such steps unless directed so to do by the Engineer-in-Charge.

**v) Additional Costs caused by Force Majeure**

If the Force Majeure events **exceed a period of six months** and if the Contractor incurs additional costs in complying with the Engineer-in-Charge's directions under **Sub-Clause (iv)** of this Clause then, the Contractor shall be compensated for the additional costs and expenses during the period of Force Majeure exceeding six months and for the costs and expenses to be incurred for the continuation of execution of the Contract.

**vi) Termination in Consequence of Force Majeure**

If circumstances of Force Majeure have occurred and shall continue for a **period of 12 (Twelve) months** then, notwithstanding that the Contractor may by reason thereof has been granted an extension of Time for Completion of the Works, either party shall be entitled to serve upon the other 30 (thirty)days' notice to terminate the Contract. If at the expiry of the period of **30 (thirty) days**, Force Majeure shall still continue, the Contract shall be terminated.

**vii) Payment on Termination for Force Majeure**

If the Contract is terminated under **Sub-Clause (vi)** of this Clause, the Contractor shall be paid the value of the work done.

The Contractor shall also be entitled to receive;

a) The amounts payable in respect of any preliminary items so far as the work or service comprised therein has been carried out and a proper proportion, as certified by the Engineer-in-Charge, of any such item in which the work or service comprised has only been partially carried out,

b) The cost of materials or goods reasonably ordered for the Works or for use in connection with the Works which have been delivered to the Contractor or of which the Contractor is legally liable to accept delivery. Such materials or goods shall become the property of MEA when paid for by it and the Contractor shall place the same at the MEA's disposal,

c) The amount certified by the Engineer-in-Charge, being the amount of any expenditures which in the circumstances was reasonably incurred by the Contractor in the expectation of completing the whole of the Works insofar as such expenditure shall not have been covered by any other payments referred to in this Sub-Clause.

## CLAUSE-42: DEFAULT

### i) Notice of Default

If the Contractor is not executing the Works in accordance with the Contract or is neglecting to perform his obligations there under so as to seriously affect the carrying out of the Works, the Engineer-in-Charge may give notice to the Contractor requiring him to make good such failure or neglect.

### ii) Contractor's Default

If the Contractor;

a) Has failed to comply, within a reasonable time, with a notice under **Sub-Clause i)** of this Clause, or

b) Assigns the Contract or subcontracts the whole or part of the Works without the MEA's written consent, or

c) Becomes bankrupt or insolvent, has a receiving order made against him or compounds with his creditors, or carries on business under a receiver, trustee or manager for the benefit of his creditors or goes into liquidation. the MEA may, after having given **7 (seven) days' notice** to the Contractor, terminate the Contract and expel the Contractor from the site. Any such expulsion and termination shall be without prejudice to any other rights or powers of the MEA under the Contract. The MEA may upon such termination, complete the Works itself or by any other Contractor.

### iii) Valuation at Date of Termination

The Engineer-in-Charge shall, as soon as possible after such termination, certify the value of the Works and all sums then due to the Contractor as at the date of termination in accordance with **Clause-33** hereof.

**iv) Payment after Termination**

The MEA shall not be liable to make any further payments to the Contractor until the Works have been completed and the Defects Liability Period is over. The MEA shall be entitled to recover from the Contractor the extra costs, if any, of completing the Works after allowing for any sum due to the Contractor under **Sub-Clause (iii)** of this Clause. If there is no such extra cost, the MEA shall pay any balance due to the Contractor.

**v) Effect on Liability for Delay**

The Contractor's liability under **Clauses-27** and **28** hereof shall immediately cease when the MEA expels him from the site without prejudice to any liability there under that may have already occurred.

## CLAUSE-43: INCREASE OR DECREASE OF COSTS

i) Contract price of goods, services, erection, testing and commissioning etc. under the contract shall be **firm during the execution of contract.**

ii) For the purpose of release of receipt payments, Contractor shall submit to the Engineer-in-Charge within 45 (forty five) days of commencement date, a detailed billing schedule indicating sub-components and prices thereof along with delivery schedule of these components at site for his approval.

## CLAUSE-44: TAXES AND DUTIES

**i) For Supply of Goods**

The prices shall include all duties, levies and taxes in India that may be levied according to the Laws and regulation, save, as provided

under **para 1.13** of 'Information & Instructions' and **Clause 33 (ii)** of the General Conditions of the Contract. Nothing in the contract shall relieve the contractor from his responsibility to pay any tax that may be levied in Nepal on profits made by him in respect of the Contract.

**ii) Income Taxes on Staff**

The Contractor's staff, personnel and labour will be liable to pay Personal Income Tax in Nepal in respect of such of their salaries and wages as are chargeable under the laws and regulations for the time being in force and the Contractor shall perform such duties in regard to such deductions thereof as may be imposed on him by such laws and regulations.

**CLAUSE-45: OWNERSHIP**

Ownership of goods shall pass from the Contractor to the MEA on arrival of the goods at site. However, such passing of ownership shall not in any way dilute the responsibility of the Contractor to insure the goods as per **Clause-40** hereof and shall not absolve the Contractor of his obligations and liabilities under the Contract. The goods shall be handed over back to the Contractor for performance of services under the Contract for which Contractor shall submit an Indemnity Bond to the purchaser as per proforma attached at **Annex-VII** of the bidding document.

**CLAUSE-46: NOTICES**

**i) Service of Notices on Contractor**

All notices or written orders to be given by the MEA or by the Engineer-in-Charge to the Contractor under the terms of the Contract shall be served either by sending by post or delivering the same to the Contractor's office on site or his principal place of business, or such other address as the Contractor shall nominate for this purpose.

**ii) Service of Notices**

All notices to be given to the Engineer-in-Charge under the terms of Contract shall be served by sending by post or delivering the same at his office.

**iii) Change of Address**

Either party may change a nominated address to another address by prior written notice to the other party.

## CLAUSE-47: ARBITRATION

Except where otherwise provided in the Contract all questions and disputes relating to the meaning of the specifications, design, drawings and instructions herein before mentioned and as to the quality to workmanship or materials used on the Work or as to any other question, claim, right, matter or thing whatsoever in any way arising out of or relating to the Contract, designs, drawings, specifications, estimates, instructions, orders to these conditions or otherwise concerning the Works or the execution or failure to execute the same whether arising during the progress of the Work or after the cancellation, termination, completion or abandonment thereof shall be dealt with as mentioned hereinafter.

i) If the Contractor considers any work demanded of him to be outside the requirements of the Contract, or considers any decision of the Engineer-in-Charge on any matter in connection with or arising out of the Contract or carrying out of work to be unacceptable, he shall promptly ask the Engineer-in-Charge in writing, for written instructions or decision. Thereupon the Engineer-in-Charge shall give his written instructions or decision within a period of thirty days of such request.

Upon receipt of the written instructions or decision, the Contractor shall promptly proceed without delay to comply with such instructions or decision.

If the Engineer-in-Charge fails to give his instructions or decision in writing **within a period of 30 (thirty) days** after being requested for or if the Contractor is dissatisfied with the instructions or decision of the Engineer-in-Charge, the Contractor may within thirty days after receiving the instructions or decision, file a written appeal to the Purchaser who will constitute a committee, to resolve the dispute. The Committee shall afford an opportunity to the Contractor to be heard and to offer evidence in support of his appeal **within 45 (forty-five) days** of the receipt of the appeal by the MEA. The Director MEA shall give a decision on behalf of the Committee **within a period of 30 (thirty) days.** After the Contractor has been heard and the Contractor has given evidence in support of his appeal. If the Director MEA does not give a decision **within 30 (thirty) days,** the Contractor will have the right to refer the dispute to arbitration.

If the Contractor is dissatisfied with this decision, the Contractor, **within a period of thirty days** from receipt of the decision, shall indicate his intention to refer the dispute to arbitration failing which the said decision shall be final and conclusive.

ii) Except where the decision has become final and conclusive in terms of Sub-para i) above, disputes or difference shall be referred for adjudication through ICADR Arbitration ruled, 1996.

The Arbitral Tribunal shall follow/be guided by the basic principles and procedures as contained in the Indian Arbitration and Conciliation Act 1996. All arbitration under the Contract shall be treated as domestic arbitration. The

parties shall be free to agree on a procedure for appointing the Arbitrators.

iii) The arbitrator shall have full power to open up, revise and review any decision, opinion, direction, certificate of valuation of the MEA.

iv) The reference to arbitration may proceed notwithstanding that the Works shall not then be or be alleged to be complete, provided always that the obligations of the MEA, and the Contractor shall not be altered by reason of the arbitration being conducted during the progress of the Works. Neither party shall be entitled to suspend such work to which the dispute relates and payment to the Contractor shall be continued to be made in terms of the Contract.

v) a) All arbitration shall be held at New Delhi, India.

b) The language of the arbitration proceedings and that of all documents and communications between the parties shall be English.

vi) The decision of the arbitrator shall be final and binding upon both the parties.

vii) The cost of the arbitration as fixed by the arbitrator shall be borne equally by the parties unless the settlement agreement provides for a different apportionment. However, the expenses incurred by a party in connection with the preparation, and presentation of its cases prior to, during and after the arbitration proceeding shall be borne by that party.

viii) The award of arbitration shall be in writing and shall state reasons for the amount awarded.

**CLAUSE-48: TERMINATION OF CONTRACT FOR MEA's CONVENIENCE**

i) The MEA shall be entitled to terminate this Contract at any time for the MEA's convenience after giving **60 (Sixty) days** prior notice to the Contractor, with a copy to the Engineer-in-Charge.

ii) In the event of such termination, the Contractor shall be paid by the MEA as provided in **Sub-Clause-41 vii)** hereof.

# SECTION-3

# PROJECT FEATURES

## CONTENTS

# SECTION-3

# PROJECT FEATURES

## 3.1 INTRODUCTION

India has been assisting Nepal to partly meet its requirement of electricity. On the request of the Government of Nepal to increase the supply of power to meet its enhanced requirement, the Government of India has decided to take measures to enhance the quantum of power being supplied to Nepal. The Project of Strengthening of India- Nepal power Transmission Interconnection is expected to enable India to supply an additional power of electricity to Nepal.

## 3.2 PROJECT FEATURES

**3.2.1** At present, India is supplying power to Nepal at 132kV voltage level through 132 kV Kataiya and Raxual Substations of erstwhile Bihar State Power Transmission Company Ltd (BSPTCL) and through 220/132 kV Tanakpur substation of 4x40 MW Tanakpur Hydro Electric Project ,NHPC, Banbsa, Uttarakhand. Enhanced power shall be fed from Indian Grid substation at Raxaul and Kataiya substation (BSPTCL) to Parwanipur & Kusaha sub-station in Nepal through existing as well as new transmission lines.

The new works shall be covered under Strengthening of India-Nepal Power Transmission Interconnection project as below.

### A. 132 kV Kataiya- Kusaha Substation

1. 132 kV line bay at Kataiya substation (BSEB, India) - 1 No.
2. 132 kV S/C transmission line on D/C towers from Kataiya sub-station to Kusaha substation to feed power from India -16 km
3. 132 kV line, bay at Kusaha substation, Nepal -1 No.

**B. 132 kV Raxaul- Parwanipur Substation**

1. 132 kV line bay at Raxaul substation (BSEB, India) - 1 No.
2. 132 kV bay at Parwanipur substation, Nepal -1 No.
3. 132kV S/C transmission line on D/C tower -22 km
   from Raxaul to Parwanipur

132 kV bays shall comprise SF-6 circuit breakers, Isolators cum earth switch, CTs, CVTs, LAs, PLCC, C&R panels & G.I. Structures, grounding etc. and all **associated civil works.**

## 3.3 SCOPE OF WORK

The brief description of works is as follows:

**a) 132 KV Kataiya (BSEB, India) – Kusaha (NEA, Nepal) Single Circuit (S/C) on Double Circuit (D/C) Tower line (New)**

i. 132 KV Kataiya (BSEB, India) – Kusaha (NEA, Nepal) Single Circuit (S/C) on Double Circuit (D/C) Tower transmission line with Panther conductor.

The above cross border 132 kV line is to be developed from the existing 132 KV sub-station of BSEB at Kataiya to the 132 kV existing sub-station at Kusaha in NEA, Nepal (16 km approximately).

**b) Raxaul (BSEB, India) – Parwanipur (NEA, Nepal) 132 KV Single Circuit (S/C) on Double Circuit (D/C) Tower line (New)**

i. 132 KV Raxaul(BSEB) – Parwanipur (NEA) S/C on D/C Tower transmission line with Panther conductor

The above cross border 132 KV Raxaul (BSEB) – Parwanipur (NEA) line is to be developed from the existing 132 KV sub-station of BSEB at Raxaul to the existing 132 KV sub-station at Parwanipur in Nepal(22 km approximately).

## 3.4 BACK GROUND OF UTILITIES INVOLVED FROM INDIAN SIDE

### 3.4.1 BIHAR STATE ELECTRICITY BOARD

Bihar State Electricity Board ("Board" or "BSEB") originally constituted on 1st April 1958 under Section 5 of the Electricity (Supply) Act, 1948 and was engaged in the management of electricity generation, transmission, distribution and related activities in the State of Bihar Under the new 'Bihar State Electricity Reforms Transfer Scheme 2012', the BSEB has been unbundled into five companies:

i. Bihar State Power Company Limited (Holding Company),

ii. Bihar State Power Transmission Company,

iii. Bihar State Power Generation Company,

iv. South Bihar Power Distribution Company and

v. North Bihar Power Distribution Company.

### 3.4.2 BACK GROUND OF UTILITIES INVOLVED FROM NEPAL SIDE

**NEPAL ELECTRICITY AUTHORITY (NEA)**

Nepal Electricity Authority (NEA) was created on August 16, 1985 (Bhadra 1, 2042) under the Nepal Electricity Authority Act. 1984, through the merger of the Department of Electricity of Ministry of Water Resources, Nepal Electricity Corporation and related Development Boards. The primary objective of NEA is to generate, transmit and distribute adequate, reliable and affordable power by planning, constructing, operating and maintaining all generation, transmission and distribution facilities in Nepal's power system both interconnected and isolated.

# SECTION-4

# CONTRACTOR'S LABOUR REGULATIONS

## CONTENTS

# SECTION-3

# CONTRACTOR'S LABOUR REGULATIONS

## 4.1 SHORT TITLE

These regulations may be called the "MEA's, Contractor's Labour Regulations".

## 4.2 DEFINITIONS

In these regulations, unless otherwise expressed or indicated, the following words and expressions shall have the meaning hereby assigned to them respectively, that is to say:

i) "Labour" means workers employed by MEA's Contractor directly or indirectly through a sub-contractor or other persons or by an agent on his behalf but will not include supervisory staff like Section Officers, etc.

ii) "Fair Wage" means wage whether for time or piece work notified at the time of inviting bids for the work, and where such wages have not been so notified, the wages prescribed by the State/Local Authority for the area in which the work is done. Such wages will not be less than the minimum wages fixed by the Government of India and Nepal for that class of employee engaged on the same type of work in the same area.

iii) "Contractor" shall include every person whether a sub-contractor or headman or agent, employing labour on the work taken on contract.

Normally working hours of a worker should not exceed 9 hours a day. The working day shall be so arranged that inclusive of interval for rest, if any, it shall not spread over more than 12 hours on any day.

## 4.3 DISPLAY OF NOTICE REGARDING WAGES, ETC.

The Contractor shall

i) before he commences his work on Contract, display and correctly maintain and continue to display and correctly maintain in a clean and legible condition in conspicuous place on the work, notices in English and in Hindi and local language spoken by the majority of the workers, giving the rate of wages which have been certified by the Engineer-in-Charge as fair wage and the hours of work for which such wage are earned, and

ii) Send a copy of such notices to the certifying office.

## 4.4 PAYMENT OF WAGES

i) Wages due to every worker shall be paid to him direct.

ii) Arrears claimed after 3 months after the completion of the Work shall not be entertained.

iii) All wages shall be paid in current coin or currency or in both.

## 4.5 FIXATION OF WAGE PERIODS

i) The Contractor shall fix the wage periods in respect of which the wages shall be payable.

ii) No wage period shall exceed one month.

iii) Wages of every worker employed on the contract shall be paid;

(a) in the case of establishment in which wage period is one week within 3 days from the end of the wage period and

(b) in the case of other establishments before the expiry of the 7th day or 10th day from the end of the wage period for the number of workers employed in such establishment not exceeding 1000 and exceeding 1000 respectively.

iv) When the employment to any worker is terminated by or on behalf of the Contractor, the wages earned by him shall be paid before the expiry of the day succeeding the one on which his employment is terminated.

v) All payments of wages shall be made on a working day except when the work is completed before the expiry of the wage period in which case final payment shall be made within 48 hours of the last working day at work site and during the working time.

## 4.6 WAGE BOOK AND WAGE SLIPS ETC.

i) The Contractor shall maintain a Wage Book of each worker in such forms, as may be convenient at the place of works, but the same shall include the following particulars:

a) Name of the worker.

b) Rate of daily or monthly wages.

c) Nature of work on which employed.

d) Total number of days worked during each wage period.

e) Dates and periods for which worked overtime.

f) Gross wages payable for the work during each wage period.

g) All deductions made from the wage with an indication in each case of the ground on account of which the deduction is made.

h) Wages actually paid for each wage period

i) Signature or thumb impression of the workers.

ii) The Contractor shall also issue a wage slip containing the aforesaid particulars to each worker employed by him on the work at least a day prior to the day of disbursement of wages.

iii) The Contractor shall also issue an "Employment Card" in the prescribed 'Form-I' (attached) to each worker on the day of work or entry into his employment.

iv) The Contractor shall issue an 'Attendance cum Wage Card' as per 'Form II' to each worker on the day of entry into his employment.

## 4.7 REGISTER OF UNPAID WAGES

The Contractor shall maintain a register of unpaid wages in such form as may be convenient at the place of work but the same shall include the following particulars.

i) Full particulars of the labourers whose wages have not been paid.

ii) Reference number of the muster roll and wage register.

iii) Rate of Wages.

iv) Wage period.

v) Total amount not paid.

vi) Reasons for not making payment.

vii) How the amount of unpaid wages was utilised.

viii) Acquittance with dates.

## 4.8 REGISTER OF ACCIDENTS

The Contractor shall maintain a register of accidents in such form as may be convenient at the work place, but the same shall include the following particulars.

i) Full particulars of the Worker(s) who met with accident.

ii) Rate of wages.

iii) Sex.

iv) Age.

v) Nature of accident and cause of accident.

vi) Time and date of accident.

vii) Date and time when admitted in hospital.

viii) Date of discharge from the hospital.

ix) Period of treatment and result of treatment.

x) Percentage of loss of earning capacity and disability assessed by medical officer.

xi) Compensation required to be paid.

xii) Date of payment of compensation.

xiii) Amount paid with details of the person to whom the same was paid.

xiv) Authority by whom the compensation was assessed.

xv) Remarks.

## 4.9 FINES AND DEDUCTIONS WHICH MAY BE MADE FROM WAGES

i) The wages of a worker shall be paid to him without any deductions of any kind except the following:

   a) Fines

   b) Deductions for absence from duty i.e. from the place or the places where, by the terms of his employment, he is required to work. The amount of deduction shall be in proportion to the period for which he was absent.

c) Deduction for damage to or loss of goods expressly entrusted to the employed person for custody, or for loss of money or any other deduction which he is required to account, where such damage or loss is directly attributable to his neglect or default.

d) Deduction for recovery of advance or for adjustment of over payment of wages, advances granted shall be entered in a register.

e) Any other deduction which the MEA may, from time to time, allow.

ii) No fine shall be imposed on any worker except in respect of such acts and omissions on his part as have been approved of by the Engineer-in-Charge.

iii) No fine shall be imposed on a worker and no deduction for damage or loss shall be made from his wages until the worker has been given an opportunity of showing cause against such fines or deductions.

## 4.10 REGISTER OF FINES

i) The Contractor shall maintain a 'Register of Fines' and a 'Register of Deductions for Damages or Loss' in 'Form Nos. III and IV' respectively which shall be kept at the places of work.

ii) The Contractor shall maintain, both in English and in the local language, a list approved by the Engineer-in-Charge clearly stating the acts and omissions for which penalty or fine may be imposed on a workman and display it in a good condition in a conspicuous place on the work.

## 4.11 PRESERVATION OF REGISTER

The wage book, the wage slips, register of unpaid wages, the register of accidents, the register of fines, deduction required to be maintained under these regulations shall be preserved for 12 (Twelve) months after the date of last entry made in them and shall be made available for inspection by the Engineer-in-Charge, labour officer or any other officer authorised by the MEA on their behalf.

## 4.12 POWERS OF LABOUR WELFARE OFFICERS TO MAKE INVESTIGATION OR ENQUIRY

The Labour Welfare Officer or any other person authorised by the MEA on their behalf shall have power to make enquiries with a view to ascertain and enforce, due and proper observance of the fair wage clause and the provisions of these regulations. He shall investigate into any complaint regarding the default made by the contractor or sub-contractor in regard to such provision.

## 4.13 REPORT OF LABOUR WELFARE OFFICER

The Labour Welfare Officer or other persons authorised as aforesaid shall submit a report of result of his investigation or enquiry to the Engineer-in-Charge concerned indicating the extent, if any, to which the default has been committed, with a note that necessary deductions from the contractor's bill be made and the wages and other dues be paid to the labourers concerned. In case an appeal is made by the contractor under **para 6.14** of these regulations, actual payment to labourers will be made by the Engineer-in-charge or authorised agent after the MEA has given its decision on such appeal.

The Engineer-in-Charge shall arrange payments to the labourers concerned **within 45 days** from the receipt of the report from the Labour Welfare Officer.

## 4.14 APPEAL AGAINST THE DECISION OF LABOUR WELFARE OFFICER

Any person aggrieved by the decision and recommendations of the Labour Welfare Officer or other person so authorised may appeal such decision to the Engineer-in-Charge, **within 30 days** from the date of decision. The decision of the Engineer-in-charge shall be final and binding upon the Contractor.

## 4.15 INSPECTION OF BOOKS AND SLIPS

The Contractor shall allow inspection of the wage books and the wage slips, register of unpaid wages, register of accidents, the register of fines and deductions in respect of any of his workers or his agent, at convenient time and place after due notice is received, to the Labour Welfare Officer or any other persons, authorised by Engineer-in-Charge on his behalf.

## 4.16 SUBMISSION OF RETURNS

The Contractor shall submit periodical returns as may be specified from time to time by the Engineer-in-Charge.

## 4.17 AMENDMENTS

The MEA may from time to time add to or amend the regulations and on any question as to the application, interpretation or affect of those regulations. The decision of the Engineer-in-Charge or of his authorised representative shall be final.

**FORM-I**

**EMPLOYMENT CARD REGULATION**
**(refer para 6.6 (iii) Section VI)**

Name & Sex of the worker
Father's Name

Age or date of birth.
Identification marks.
(Particulars of next of kin (wife and children, if any, or of dependent next to kin in case the worker has no wife or child)

Name .....
Full address of dependants
(Specify village, district and state).

| **Sl. #** | **Name and address of employer (Specify whether a Contractor or Sub-Contractor).** | **Particulars of location of work site and description of work done** | **Total period for which the worker is employed (From.....to.....)** | **Actual number of days worked** | **Leave taken (Number of days should be specified)** |
|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 |

**FORM-I (Contd.)**
**(BACK SIDE OF THE CARD)**

| **Nature of work done by the worker** | **Wage period** | **Wage rate (with particulars of unit in case of piece- work)** | **Total wage earned by the worker during the period shown under column (5)** | **Remarks** | **Signature of the employer** |
|---|---|---|---|---|---|
| 7 | 8 | 9 | 10 | 11 | 12 |

**FORM-II**

**ATTENDANCE CUM-WAGE CARD**

**(Referred to in Para 6.6 (iv) Chapter-VI)**

Card No. .....
Name of Contractor.....
Name of Work.....
Name of Worker.....
Address.....
Designation.....
Rates of Wages .....

| Dates | Attendance | Signature of person marking attendance | REMARKS |
|---|---|---|---|
| 1.<br>2.<br>3.<br>4.<br>5.<br>etc. | | | |

**FORM –II (Contd.)**
**(ON THE BACK SIDE OF CARD)**

| Wage period | Date on which overtime Worked | Gross wages payable | Deductions if any | Actual Wages paid | Date of payment | Signature of the Worker |
|---|---|---|---|---|---|---|

**FORM-III**

**REGISTER OF FINES**

**(refer para 6.10 (i) Section-VI)**

| Sl. No. | Name | Father's/ Husband's Name | Sex | Dept. | Nature and Date of the offence for which fine imposed | Whether worker showed cause against Fine or not, if so, enter date | Rate of Wages | Date and amount of fine Imposed | Date on which Fine Realised | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |

**FORM-IV**

**REGISTER OF DEDUCTIONS FOR DAMAGES OR LOSS**

**(Refer para 6.10 (i) Section-VI)**

| **Sl. No.** | **Name** | **Father's/ Husband's Name** | **Sex** | **Dept.** | **Damage or loss caused with date** | **Whether worker showed cause against deduction, if so, enter date** | **Date and amount of deduction imposed** | **Number of installment, if any** | **Date on which total amount Realised** | **Remarks** |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |

# SECTION-5

# SAFETY PRECAUTIONS

## CONTENTS

# SECTION-5

# SAFETY PRECAUTIONS

**5.1** Suitable scaffolds shall be provided for workmen for all Works that cannot safely be done from the ground, or from solid construction except such short period work as can be done safely from ladders. When a ladder is used, an extra workman shall be engaged for holding the ladder. If the ladder is used for carrying materials as well, suitable footholds and handholds shall be provided on the ladder and the ladder shall be given an inclination not steeper than 0.25 to 1 (0.25 horizontal and 1 vertical).

**5.2** Scaffolding or staging more than 3.6m above the ground or erected floor, swung or suspended from an overhead support or erected with stationary support shall have a guard rail properly attached, bolted, braced and otherwise secured at least 0.9m high above the floor or platform of such scaffolding or staging and extending along the entire length of the outside and ends thereof with only such opening as may be necessary for the delivery of the materials. Such scaffolding or staging shall be so fastened as to prevent it from swaying from the structure.

**5.3** Working platform, gangways and stairways shall be so constructed that they do not sag unduly or unequally, and if the height of the platform or the gangway or the stairway is more than 3.6m above ground level or floor level, they shall be closely boarded, and shall have adequate width and shall be suitably fastened.

**5.4** Every opening in the floor of a structure or in a working platform shall be provided with suitable means to prevent the fall of persons or materials by providing suitable fencing or railing whose minimum height shall be 0.9m. Employees working on steep slopes or otherwise subject to possible falls from levels not protected by guardrails or safety nets, shall be secured by safety belts.

**5.5** Safe means of access shall be provided to all working platforms and other working places. Every ladder shall be securely fixed. No portable single ladder shall be over 9.0m in length while the width between side rails in hung ladder shall, in no case, be less than 28cm, for ladder upto and including 3.0m in length. For longer ladders, this width shall be increased at least by 6mm for each additional 30cm of length. Uniform step spacing shall not exceed 30cm. Adequate precautions shall be taken to prevent danger from electrical equipment. No materials on any of the Sites of Work shall be so stacked or placed as to cause danger or inconvenience to any person or the public.

## 5.6 EXCAVATION AND TRENCHING

All trenches, 1.2m or more in depth, shall, at all times, be supplied with at least one ladder for each 30m length or fraction thereof. Ladder shall be extended form bottom of the trench to at least 0.9m above the surface of the ground. The side of the trenches, which are 1.5m or more in depth shall be stepped back to give suitable slope or securely held by timber bracing, so as to avoid the danger of sides to collapse. The excavated materials shall not be placed within 1.5m of the edges of the trench or half of the depth by the trench, whichever is more. Cutting shall be done from top to bottom. Under no circumstances undermining or undercutting shall be done.

## 5.7 DEMOLITION

Before any demolition work is commenced and also during the process of the work:

i) All roads and open areas adjacent to the site shall either be closed or suitably protected.

ii) No electric cable or apparatus, which is liable to be a source of danger over a cable or apparatus used by the operator, shall remain electrically charged.

iii) All practical steps shall be taken to prevent danger to persons employed from risk of fire or explosion or flooding. No floor, roof or other part of the structure shall be overloaded with debris or materials as to render it unsafe.

**5.8** All necessary personal safety equipment as considered adequate by the Engineer-in-Charge shall be kept available for the use of the persons employed on the Site and maintained in condition suitable for immediate use, and the Contractor shall take adequate steps to ensure proper use of equipment by those concerned.

i) The Contractor shall provide rubber gauntlets, gloves, mats, boots and galoshes, insulated platform and stools, safety belts, hand lamps, tower wagons and other special insulated devices as required for working on electrical equipment and apparatus.

ii) Workers employed on mixing asphaltic materials, cement mortar and cement concrete shall be provided with protective footwear and protective goggles.

iii) Those engaged in mixing or stacking of cement bags or any materials, which is injurious to eyes, shall be provided with protective goggles.

iv) Those engaged in welding Works shall be provided with welder's protective eye shields.

v) Stonebreakers shall be provided with protective goggles and protective clothing and seated at sufficiently safe intervals.

vi) The Contractor shall not employ any person **below the age of 18 years**. Whenever a person above the age of 18 years is employed on the work of lead painting, the following precautions shall be taken:

a) No paint containing lead, sulphate of lead or product containing their pigments shall be used except in the form of paste or readymade paint.

b) Suitable face masks shall be supplied for use by the workers when paint is applied in the form of spray or a surface having lead paint dry rubbed and scrapped.

c) Overalls shall be supplied by the Contractor to the workmen and adequate facilities shall be provided to enable the working painters to wash during the cessation of Work.

d) Measures shall be taken, whenever required, in order to prevent danger arising from the application of a paint in the form of spray.

e) Measures shall be taken, whenever practicable, to prevent danger arising out from dust caused by dry rubbing down and scrapping.

f) Suitable arrangements shall be made to prevent clothing put off during working hours, being spoiled by painting materials.

g) Cases of lead poisoning and suspected lead poisoning shall be notified.

vii) The Contractor shall observe all safety precautions to control the noise on all Sites and also provide all workmen deployed in the affected areas with the necessary equipment for safety against noise.

**5.9** When the Work is done near any place where there is risk of drowning, all necessary equipment shall be provided and kept ready for use and all necessary steps taken for prompt rescue of any person in danger and adequate provision shall be made for prompt first aid treatment of all injuries likely to be sustained during the course of the Work.

**5.10** Use of hoisting machines and shackle including their attachments, anchorage and supports shall conform to the following standards or conditions:

i) These shall be of good mechanical construction, sound materials and adequate strength and free from patent defect and shall be kept in good working order.

ii) Every rope used in hoisting or lowering materials or as a means of suspension shall be of durable quality and adequate strength and free from patent defects.

iii) Every crane driver or hoisting appliance operator shall be properly qualified for his job.

iv) In case of every hoisting machine and of every chain ring hook, shackle swivel and pulley block used in hoisting or as means of suspension, the safe working load shall be ascertained by adequate means. Every hoisting machine and all gears referred to above shall be plainly marked with the safe working load.

In case of hoisting machine having a variable safe working load, each safe working load and the conditions under which it is applicable shall be clearly indicated. No part of any machine or any gear referred to above in this paragraph shall be loaded beyond the safe working load except for the purpose of testing. The capacity of the hoisting machines shall be periodically checked.

v) The Contractor shall notify the safe working load of the machines to the Engineer-in-Charge, whenever he brings any machinery to Site of work and gets it verified by the Engineer-in-Charge or his representative.

**5.11** Motors, gearing, transmission, electric wiring and other dangerous parts of hoisting appliances shall be provided with efficient safeguards.

Hoisting appliances shall be provided with such means as shall reduce to the minimum, the risk of any part of a suspended load becoming accidentally displaced. When workmen are employed on or near electrical installations, which are already energized, insulating mats, wearing apparel, such as gloves, sleeves and boot, as may be necessary, shall be provided. The workers shall not wear any rings, watches and carry keys or other materials, which are good conductors of electricity.

**5.12** All scaffolds, ladders and other safety devices mentioned or described herein shall be maintained in safe conditions and no scaffold, ladder or equipment shall be altered or removed, while it is in use. Adequate washing facilities shall be provided at or near places of Work.

**5.13** These safety provisions shall be brought to the notice of all concerned by display on a notice board at a prominent place on the Site. The person responsible for compliance of the safety code shall be named therein by the Contractor.

**5.14** To ensure effective enforcement of the rules and regulations relating to safety precautions, the arrangements made by Contractor shall be open to inspection by the Labour officer or the Engineer-in-Charge.

**5.15** The Contractor shall at all time exercise reasonable and proper precautions for the safety of the people on the Works and shall comply with the provisions of current safety law and building and construction codes as may be applicable. All machinery and equipment and other sources of physical hazards shall be properly guarded. The Contractor shall have a full time staff exclusively in charge of securing the safety of the Work ensuring that all safety

regulations are followed and in charge of indoctrination and teaching course on safety to the work force.

**5.16** The Contractor shall provide all necessary fencing and lights to protect the public from accidents and shall be bound to bear all the expenses of defence of every suit, action and other proceedings at Law that may be brought by any person for injury sustained owing to neglect of the above precautions and to pay any damages and costs which may be awarded in any such suit, action and proceedings to any such persons or which may, with the consent of the Contractor be paid to compromise any claim by any person.

**5.17** About his employees, the Contractor shall ensure as follows:

i) Each employee shall be provided initial indoctrination regarding safety by the Contractor so as to enable him to conduct his Work in a safe manner.

ii) No employee shall be given a new assignment of work unfamiliar to him without proper introduction as to the hazardous incident thereto, both to himself and his fellow employees.

iii) Under no circumstances shall an employee hurry or take unnecessary chances when working under hazardous conditions.

iv) Employees shall not leave naked fires unattended. Adequate fire fighting equipment shall be provided at crucial locations.

v) Employees under the influence of any intoxicating beverage, even to the slightest degree, shall not be permitted to remain on Work.

vi) There shall be suitable arrangement on every site for rendering prompt and sufficient first aid to the injured under the guidance of the Medical Officer.

vii) The staircases and passageways shall be adequately lighted.

viii) The employees, when working around moving machinery, shall not be permitted to wear loose garments. Safety shoes are recommended when working in shops or places where materials or tools are likely to fall. Only experienced workers shall be permitted to go behind guardrails or to clean around energized or moving equipment.

ix) The employees shall use the standard protection equipment intended before and after it is used.

**5.18** The following precautions shall be taken for fire prevention:

i) All construction areas and storage yards shall be kept clean and well arranged.

ii) A clear space of 15m around the outer boundary of sawmill and lumber storage area may be provided. All lumber shall be stored in sections with firebreaks with a distance of 15m between consecutive section.

iii) All combustible waste material, wood scaling and soiled rags etc shall be removed daily and burnt in suitable burning area. The sawmill and lumberyard shall be kept free from accumulation of combustible debris.

iv) Fires, welding, flame cutting shall in general not be permitted in combustible area. Fires and open flame devices shall not be left unattended.

v) Smoking shall be prohibited in all fire prone areas, flammable material storages viz. Carpentry, paint shops, garages, service stations etc. "No Smoking" signs shall be pasted on all such areas.

vi) Accumulations of flammable liquids on floors, walkways etc. should be prohibited. All spills of flammable liquids shall be cleaned up immediately.

vii) Smoke pipes from Diesel Engines passing through roof of combustible material e.g. in compressor stations on various Sites shall be insulated by asbestos. All joints of smoke pipe shall be riveted, welded or otherwise securely fastened together and supported to prevent accidental displacement or separation. The joints shall not be leaky.

viii) Flammable liquids, lubricants etc. shall be handled and transported in safe containers and drums, which can be kept tightly capped.

ix) Storage of fuels and other flammable materials and liquids shall be set not less than 100m away from the Works and permanent installations. All storage installations and tanks shall conform to the regulations set out in relevant Indian Standards.

x) Petrol or other flammable liquids with a flash point below 100°C shall not be used for cleaning purpose.

xi) Oxygen cylinders shall not be stored with combustible materials.

xii) All electric installation shall be properly earthen. Repairs shall not be made on electrical circuits until the circuit has been de-energized.

**5.19 THE FOLLOWING FIRE FIGHTING ARRANGEMENTS SHALL BE MADE BY THE CONTRACTOR:**

i) Fire extinguishers and fire buckets filled with clean dry sand, painted red, shall be provided at all fire hazardous locations viz. Bathing and Mixing Plant, Winch houses, Workshops, store yards, Sawmill, Switchgear Room, Compressor Stations, Office establishments etc. The extinguishers shall be inspected, serviced and maintained in accordance with manufacturer's instructions. The inspection shall be evidenced by notations on tag, attached to the extinguisher.

ii) Full reliance shall never be placed on portable hand extinguishers as all of these have a very limited capacity. Water, in ample quantity and under adequate pressure, shall always be available for fire fighting.

iii) Where a group of work points are located beyond the range of protection from a public water supply, the installation of a water system for private fire protection shall be warranted.

iv) Evacuation facilities and fire exit shall be provided at all locations featuring fire hazards.

v) Siren or other suitable fire alarm arrangement shall be made on all Sites. Warning signs shall be pasted at all locations having fire hazards.

vi) All staff shall be conversant with the use of all type of fire extinguishing apparatus.

vii) In the event of fire on electrical mains or apparatus, the effected part shall immediately be completely isolated from its source of supply of electrical energy.

viii) Demonstrations and training in fire fighting shall be conducted at sufficient intervals to ensure that sufficient personnel are familiar with and are capable of operating fire fighting equipment.

**5.20** When any work is carried on, which is likely to affect the security or stability of an installation or structure or any part thereof and endanger any person employed, all practicable precautions shall be taken by shoring or otherwise to prevent collapse of structure or fall of any part thereof and thus remove the cause of danger to such structures and the persons employed.

**5.21** For persons engaged in handling of corrosive materials, adequate equipment shall be provided.

**5.22** Where, in connection with any grinding, cleaning, spraying or manipulation of any material, there is emission of dust or fume of such character and to such extent as is likely to be injurious to the health of persons employed, all practical measures shall be taken by securing adequate ventilation or by the provision and use of suitable respirators or otherwise to prevent inhalation of such dust and fume.

**5.23** In addition to instructions contained here-in-above the safety regulations contained in the following IS Codes shall also apply wherever the provisions in the codes are exhaustive in nature:

| | | |
|---|---|---|
| 1 | IS: 3696-1987 (Part-I)<br>(Reaffirmed 1991) | Safety Code of Scaffolds & Ladders<br>(Pt. I Scaffolds) |
| 2 | IS: 3696-1991 (Part-II) | Safety Code of Scaffolds & Ladders<br>(Pt. II Ladders) |
| 3 | IS: 3016-1982<br>(Reaffirmed 1990) | Fire precaution in welding and cutting operations |
| 4 | IS: 5216-1982<br>Part 1 & 2 (Reaffirmed 1990) | Guide for Safety procedures and Practices in Electrical work<br>Part 1 – General<br>Part-2 – Life saving techniques |

**5.24** Notwithstanding the above provisions, the Engineer-in-Charge may require the Contractor to follow any other Act or Rules in force in Nepal/India in respect of Safety Precautions so as to ensure the safety of the Workmen and the Plant and the Contractor shall promptly comply with such requirements.

**ANNEXURE -I**

**PROFORMA OF BID (FOR TECHNICAL BID)**
**(Refer Clause 1.12, Section-1)**

Tender : Strengthening of India- Nepal Power Transmission Interconnection Project

Tender Notice No. :

From :

To : **Director(DPA),Ministry of External Affairs,**
**Room No. 3121,B Block,**
**Jawaharlal Nehru Bhawan,**
**23-D,Janpath,New Delhi-110011**

**Sub:** Bid for 132 kV Transmission Lines for Strengthening of India-Nepal Power Transmission Interconnection
(Description of works)

Dear Sir,

With reference to Bidding Documents forwarded to us under your letter no. _____ dated _____, we, the undersigned, having examined the Bidding Documents including corrigenda/addenda for the execution of the above named Work, offer to execute and complete the whole of the Works in conformity with the said Bidding Documents.

We are enclosing herewith the Bid Security amounting to _____ (in words and in figures) in the form of _____ as prescribed in Clause 1.16 of the "Information & Instructions".

We confirm that our Bid shall remain valid for one hundred eighty (180) calendar days and the Bid Security shall remain valid for a period of two hundred and ten (210) calendar days from the date of opening of Techno-Commercial Bid.

We undertake, if our bid is accepted, to commence and to complete the whole of the works comprised in the contract within the time specified by MEA in the Bidding Documents.

We further confirm that in the event the Bid is accepted, we shall furnish performance security in accordance with Cl. 1.35 of the "Information & Instructions" towards successful performance of the contract and shall execute the Contract Agreement in accordance with clause 1.36 of the "Information & Instructions".

Unless and until a formal Contract Agreement is executed, this Bid, subsequent correspondences together with the Letter of Award of MEA shall constitute a binding Contract between MEA and us.

We understand that MEA is at liberty not to accept the lowest Bid Price. We also understand that MEA is at liberty not to accept any or all Bids and MEA is at liberty to negotiate with Bidder(s) at any stage.

Dated this _____ day of _____ 20 __.

_____

_____
(Signature and Full Name)

Title _____(affix seal here)

**Firm's address:**

_____

_____

_____

Telephone: Telex:
Cable Address: Fax:

**Witness**

_____

_____
(Signature and Full Name)

**ANNEXURE-IA**

**PROFORMA OF BID (FOR PRICE BID)**
**(Refer Clause 1.12, Section-1)**

Tender : Strengthening of India- Nepal Power Transmission Interconnection Project

Tender Notice No. :

From :

To : **Director(DPA),Ministry of External Affairs,**
**Room No. 3121,B Block,**
**Jawaharlal Nehru Bhawan,**
**23-D,Janpath,New Delhi-110011**

**Sub:** Bid for 132 kV Transmission Lines for Strengthening of India-Nepal Power Transmission Interconnection
(Description of works)

Dear Sir,

With reference to Bidding Documents forwarded to us under your letter no. _____ dated _____, we, the undersigned, having examined the Bidding Documents including corrigenda/addenda for the execution of the above named Work, offer to execute and complete the whole of the Works in conformity with the said Bidding Documents for the sum of _____(in words & figure).

We are enclosing herewith the Bid Security amounting to _____ (in words and in figures) in the form of _____ as prescribed in Clause 1.16 of the "Information & Instructions".

We confirm that our Bid shall remain valid for one hundred eighty (180) calendar days and the Bid Security shall remain valid for a period of two hundred and ten (210) calendar days from the date of opening of Techno-Commercial Bid.

We undertake, if our bid is accepted, to commence and to complete the whole of the works comprised in the contract within the time specified by MEA in the Bidding Documents.

We further confirm that in the event the Bid is accepted, we shall furnish performance security in accordance with Cl. 1.35 of the "Information & Instructions" towards successful performance of the contract and shall

execute the Contract Agreement in accordance with clause 1.36 of the "Information & Instructions".

Unless and until a formal Contract Agreement is executed, this Bid, subsequent correspondences together with the Letter of Award of MEA shall constitute a binding Contract between MEA and us.

We understand that MEA is at liberty not to accept the lowest Bid Price. We also understand that MEA is at liberty not to accept any or all Bids and MEA is at liberty to negotiate with Bidder(s) at any stage.

Dated this _____ day of _____ 20___.

_____

_____
(Signature and Full Name)

Title ----------(affix seal here)

**Firm's address:**

_____

_____

_____

Telephone: Telex:
Cable Address: Fax:

**Witness**

_____

_____
(Signature and Full Name)

**Annexure-II**

**PROFORMA FOR BANK GUARANTEE FOR BID SECURITY**
**(Refer Clause 1.12 Section-1)**

To

**Director(DPA),**
**Ministry of External Affairs,**
**Room No. 3121,B Block,**
**Jawaharlal Nehru Bhawan,**
**23-D,Janpath, New Delhi-110011**

WHEREAS, (Name of the Bidder)_____ (hereinafter called "the BIDDER") has submitted his bid dated _____for (Name of Contract) _____(hereinafter called "the Bid").

KNOW ALL men by these presents we (Name of Bank)_____ of (Name of Country) _____ having our registered office at _____(hereinafter called "the Bank") are bound upto the Director (DPA),Ministry of External Affairs, Room No.-3121, B Block ,Jawaharlal Nehru Bhawan,23-D,Janpath ,New Delhi-110011(MEA) in the sum of _____ for which payment well and truly to be made to the MEA, the Bank binds himself, his successors and assigns by these presents.

SEALED with the Common Seal of the said Bank this _____ day of _____20_____

THE CONDITIONS of this obligation are;

i) If the Bidder withdraws his Bid during the period of bid validity specified in the Proforma of Bid; or

ii) If the Bidder having been notified of the acceptance of his Bid by the MEA during the period of bid validity;

a) fails or refuses to execute the Proforma of Agreement in accordance with the Instructions to Bidders, if required; or

b) fails or refuses to furnish the Performance Security, in accordance with the Instructions to Bidders.

We undertake to pay to the MEA upto the above amount upon receipt of its first written demand, provided that in its demand the MEA will note that amount claimed by it is due to it owing to the occurrence of one or both conditions, specifying the occurred condition or conditions.

This Guarantee will remain in force upto and including the date 210

days after the closing date of submission of bids as stated in the Information and Instructions and any demand in respect thereof should reach the Bank not later than the above date.

**DATE.....** **SIGNATURE OF THE BANK.....**

**WITNESS.....** **SEAL.....**
(Signature, Name and Address)

**ANNEXURE-III**

## PROFORMA OF AGREEMENT
## (Refer Clause 1.36.1, Section-1)

THIS AGREEMENT MADE the .....day of .....20……BETWEEN Ministry of External Affairs, New Delhi (Mailing address of MEA) ……hereinafter called "the MEA") of the one part and (Name of Contractor)……of (mailing address of Contractor)…….. (hereinafter called "the Contractor" ) of the other part.

WHEREAS the MEA is desirous that certain goods and services should be provided viz. (Brief description of goods & service)……..and has by a letter of Award dated……..accepted the offer by the Contractor for the supply of Goods and carrying out the services.

NOW THIS AGREEMENT WITNESSETH as follows;

1. In this Agreement words and expressions shall have the same meanings as are respectively assigned to them in the conditions of Contract hereinafter referred to.

2. The following documents shall be deemed to form and be read and construed as part of this Agreement, viz;

   (a) This Proforma of Agreement
   (b) The Letter of Award
   (c) The additional conditions of Contract
   (d) The General conditions of Contract
   (e) The Technical Specifications
   (f) The Drawings
   (g) The Schedule of Prices
   (h) The offer by the Contractor
   (i) Model rules for Health and Sanitary arrangements for contractor's workmen
   (j) Contractor's labour regulation
   (k) Safety precautions
   (l) The Information and Instructions
   (m) The schedule of supplementary information, if any

3. The aforesaid documents shall be taken as complementary and mutually explanatory of one another, but in case of ambiguities or discrepancies, shall take precedence in the order set out above.

4. In consideration of the payments to be made by the MEA to the Contractor as hereinafter mentioned, the Contractor hereby covenants with the MEA to provide goods and services and remedy defects therein in conformity, in all respects, with the provisions of the Contract.

5. The MEA hereby covenants to pay the Contractor, in consideration of the provisions of goods and services and remedying defects therein and completion of the Works, the Contract Price at the times and in the manner prescribed by the Contract.

In WITNESS whereof the parties hereto have caused their respective common seals to be hereunto affixed (or have hereunto set their respective hands and seals) the day and year first above written.

SIGNED, SEALED AND DELIVERED

By the said
.....
NAME .....
On behalf of the Contractor
In the presence of :

.....
NAME .....
Address.....
.....

By the said
.....
NAME .....
On behalf of the MEA
in the presence of :

.....
NAME .....
Address.....
.....

**ANNEXURE-IV**

**PROFORMA FOR BANK GUARANTEE FOR PERFORMANCE SECURITY**
**(Refer Clause 1.35, Section-1)**

To
**Director(DPA),**
**Ministry of External Affairs,**
**Room No. 3121,B Block,**
**Jawaharlal Nehru Bhawan,**
**23-D,Janpath,New Delhi-110011**

WHEREAS (Name and Address of Contractor) …… (hereinafter called "the Contractor") has undertaken, in pursuance of Contract No. … Dated ……..to execute (Name of Contract and Brief Description of Works)…… (hereinafter called "the Contract").

AND WHEREAS it has been stipulated by you in the said Contract that the Contractor shall furnish you with a Bank Guarantee by a recognized bank for the sum specified therein as security for compliance with his obligations in accordance with the Contract;

AND WHEREAS we have agreed to give the Contractor such a Bank Guarantee;

NOW THEREFORE we hereby affirm that we are the Guarantor and responsible to you, on behalf of the Contractor, upto a total of ……(Amount of Guarantee) in words and figure……..to be inserted by the Guarantor, representing the percentage of the Contract Price, specified in the Contract, and we undertake to pay you, upon your first written demand and without cavil or argument, any sum or sums within the limits of ……[Amount of Guarantee] as aforesaid without your needing to prove or to show grounds or reason for your demand for the sum specified therein.

We hereby waive the necessity of your demanding the said debt from the Contractor before presenting us with the demand.

We further agree that no change or addition to or other modification of the terms of the Contract or of the Works to be performed thereunder or of any of the Contract documents which may be made between you and the Contractor shall in any way release us from any liability under this guarantee, and we hereby waive notice of any such change, addition or modification.

This guarantee is valid until the date 30 days after issue of the last Defects Liability Certificate (Specify date).

SIGNATURE AND SEAL OF THE GUARANTOR
Name of Bank
Address Date

**ANNEXURE-V**

**PROFORMA FOR BANK GUARANTEE FOR ADVANCE PAYMENT**
(ON A NON-JUDICIAL STAMP PAPER OF THE REQUISITE VALUE)
**(Refer Clause 33(i), Section-2)**

1. In consideration of President of India, The Ministry of External Affairs, (MEA) (which expression shall unless repugnant to the subject or context include its administrators, successors and assigns), (hereinafter called the Principal) having agreed to make advance payment to (Name and full address of the Contractor)….(hereinafter called "the Contractor(s)"), (Which expression shall unless repugnant to the subject or context or meaning thereof include its successors, administrators, executors and permitted assigns), whose bid for (Name of the Contract)……has been accepted and to whom the acceptance of the bid has been communicated by a Letter of Award and who is required to execute a formal agreement on conditions of productions of a Bank Guarantee for (amount both in figures and words)…….

   We, the …… (Bank of Nepal or State Bank of India or any scheduled Bank of India or foreign bank licensed to do business in India by Reserve Bank of India (hereinafter referred to as "the Bank") do hereby undertake promise and guarantee payment to the Principal on demand all the amount advanced by the Principal to the said Contractor.

2. The Bank Further agrees that:

   (i) The Principal shall have the fullest liberty without affecting in any way the liability of the Bank under the Guarantee or Indemnity, from time to time, to vary any of the terms and conditions of the said Contract or to extend time for performance by the said Contractor or to postpone for any time and from time to time any of the powers exercisable by it against the said Contractor and either to enforce or forbear from enforcing any of the terms and conditions governing the said Contract or the securities available to the Principal and the Bank shall not be released from its liability under these presents by any exercise by the Principal of the Liberty with reference to the matters aforesaid or by reason of time being given to the said Contractor or any other forbearance, act or omission on the part of the Principal or any indulgence by the Principal to the said Contractor or of any other matter or thing whatsoever which under the law relating to sureties would but for this provision have the effect of a releasing the Bank from its such liability.

   (ii) These presents shall be governed by and construed in accordance with Nepalese/Indian laws.

(iii) The Bank hereby declares that it has the power to issue this Guarantee and the undersigned has full power to do so.

(iv) The amount of Bank Guarantee shall be reduced at every six months interval to the extent of the amount of advance adjusted.

(v) It shall not be necessary for the Principal to proceed against the Contractor before proceeding against the Bank and the Bank Guarantee herein contained shall be enforceable against the Bank, notwithstanding any other security which the Principal may have obtained or obtain from the Contractor, shall at the time when proceedings are taken against the Bank hereunder, be outstanding or unrealized.

(vi) The Guarantee herein contained shall remain in full force and effect, during the period that would be taken for the performance of the terms and conditions of the said Contract, Letter of Award and the Agreement which is to be executed as aforesaid and that it shall continue to be enforceable until the completion of delivery of goods at site.

3. The Bank lastly undertakes not to revoke this Guarantee until …….

Dated the ……. Day of …….20…..

Here affix the Common Seal of the Bank

**Annexure-VI**

## PROFORMA FOR REQUIREMENT OF POWER LOAD

(Refer Clause 3.4 (i), Section-3)

| Sl. No. | Location/ Purpose | Load Requirement in KW | Expected Time Schedule | Remarks |
|---|---|---|---|---|
| | | | | |
| **Total** | | | | |

**ANNEXURE-VII**

**INDEMNITY BOND**
**(Refer Clause 33(i) (b), Section-2)**

THIS INDEMNITY BOND is made this day _____ by _____ _____, a company incorporated under the _____ having its Registered Office at_____ (hereinafter called as "Contractor" or "Obligee" which expression shall include its successors and permitted assigns) in favour of Ministry of External Affairs, India and having its Project site from Raxaul, Kataiya, Kusaha and Parwanipur (hereinafter called "MEA" which expression shall include its successors and assigns):

WHEREAS MEA has awarded to the Contractor a Contract for _____of Equipment and materials of _____ vide its Letter of Award/Contract No. _____ (hereinafter called the "Contract") in terms of which MEA is required to hand over various equipment to the Contractor for execution of the Contract.

And WHEREAS by virtue of the said Contract, the Contractor is required to execute an Indemnity Bond in favour of MEA for the Equipment handed over to it by MEA for the purpose of performance of the Contract/Storage, Preservation, Erection portion of the contract (hereinafter called the "Equipment").

AND THEREFORE, This Indemnity Bond witnesseth as follows:

1. That in consideration of various Equipment as mentioned in the Contract, valued as per attached schedule to be handed over to the Contractor in installments from time to time for the purpose of performance of the Contract, the Contractor hereby undertakes to indemnify and shall keep MEA indemnified, for the full value of the Equipment. The Contractor hereby acknowledges actual receipt of the initial installment of the Equipment etc. as per details in the Schedule appended hereto. Further, the Contractor agrees to acknowledge actual receipt of the subsequent installments of the Equipment etc. as required by MEA in the form of Schedules consecutively numbered which shall be attached to this Indemnity Bond as to form integral parts of this Bond. The Contractor shall hold such Equipment etc. in trust as a "Trustee" for and on behalf of MEA.

2. That the Contractor is obliged and shall remain absolutely responsible for the safe transit/protection and custody of the Equipment at MEA Project site against all Contractor's risks whatsoever till the Equipment are duly used/erected in accordance with the terms of the Contract and the plant/package duly erected and commissioned in accordance with the terms of the Contract is taken over by MEA. The Contractor undertakes to keep MEA harmless against any loss or damage that may

be caused to the Equipment.

3. The Contractor undertakes that the Equipment shall be used exclusively for the performance/execution of the Contract strictly in accordance with its terms and conditions and no part of the equipment shall be utilized for any other work or purpose whatsoever. It is clearly understood by the Contractor that non-observance of the obligations under this Indemnity Bond by the Contractor shall inter-alia constitute a criminal breach of trust on the part of the Contractor for all intents and purpose including legal/penal consequences.

4. That MEA is and shall remain the exclusive Owner of the Equipment free from all encumbrances, charges or liens of any kind, whatsoever. The Equipment shall at all times be open to inspection and checking by Engineer-in-Charge/his representative or any other employees of MEA authorized by him in this regard. Further, MEA shall always be free at all times to take possession of the Equipment in whatever form the Equipment may be, if in its opinion, the Equipment are likely to be endangered, misutilised or converted to use other than those specified in the Contract, by any acts of omission or commission on the part of the Contractor or any other person or on account of any reason whatsoever and the Contractor binds himself and undertakes to comply with the directions or demand of MEA to return the Equipment without any demur or reservations.

5. That this Indemnity Bond is irrevocable. If at any times any loss or damage occurs to the Equipment or the same or any part thereof if misutilised in any manner whatsoever, then the Contractor hereby agrees that the decision of the Engineer-in-Charge/his representative as to assessment of loss or damage to the Equipment shall be final and binding on the Contractor. The Contractor binds itself and undertakes to replace the lost and/or damaged Equipment at its own cost and/or shall pay the amount of loss to MEA without any demur, reservation or protest. This is without prejudice to any other right or remedy that may be available to MEA against the Contractor under the Contract and under this Indemnity Bond.

6. That any loss or damage as stipulated in Clause-40, Section-II, Volume-I of Bid document of the equipment and the material during transit, storage, handling, erection, testing, commissioning & operation and maintenance till the end of defects liability period at any stage shall be Contractor's responsibility and the replacement of the damaged equipment shall be entirely at Contractor's costs irrespective of the amount and time of receipt of any claim by the Contractor.

And in consideration of the provisions of the Letters of Award/Contract No. _____, the Contractor has the obligation to insure the equipment until the Defects Liability Period.

Therefore, the Indemnity Bond shall apply absolutely irrespective of the amount and time of receipt of any claim.

7. NOW THE CONDITION of the Bond is that if the Contractor shall duly and punctually comply with the terms and conditions of this Bond to the satisfaction of MEA, THEN, the above Bond shall be void, but otherwise, it shall remain in full force and virtue.

IN WITNESS WHEREOF, the Contractor has hereunto set its hand through its authorized representative under the common seal of the Company, the day, month and year first above mentioned.

**SCHEDULE NO.**

| Sl. No. | Particulars of the Equipment handed over | Qty. | Particulars of Dispatch title Document ..... RR/GR/B/L/AWB No. & Date | Value of the Equipment Nu./Rs. |
|---|---|---|---|---|
| | As per list attached | | | |

Total FOB/Ex-works value

Add pro-rata Marine/ inland transportation and Marine/inland insurance.

WITNESS For and on behalf of

# GOVERNMENT OF INDIA
# MINISTRY OF EXTERNAL AFFAIRS

# TECHNICAL SPECIFICATIONS

# OF

# 132 KV TRANSMISSION LINES

# FOR

# STRENGTHENING OF INDIA-NEPAL POWER TRANSMISSION INTERCONNECTION

## VOLUME-2

**Consultants:**


**WAPCOS LIMITED**
**(A Govt. of India Undertaking)**
**PLOT NO. 76-C**
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**CENTRAL ELECTRICITY AUTHORITY,**
**SEWA BHAWAN ,**
**R.K.PURAM,**
**NEW DELHI-01**


**June , 2014**

# BIDDING DOCUMENT FOR ENGINEERING, PROCUREMENT AND CONSTRUCTION ON TURNKEY BASIS OF 132 kV S/C TRANSMISSION LINES ON D/C TOWERS IN INDIA & NEPAL

## TECHNICAL SPECIFICATIONS OF

## TRANSMISSION LINES

## VOLUME – 2

## TABLE OF CONTENTS

# SECTION - I
# GENERAL TECHNICAL REQUIREMENTS

**1.1 SCOPE**

**1.1.1** The specification covers design, manufacture, assembly, material testing, supply and delivery for project site in India and Nepal, storage, transportation of materials to work sites of galvanized steel towers, ACSR 'PANTHER' conductor, ground wire, insulator strings complete with insulators and hardware, conductor and ground wire accessories & all other line materials, detailed/check survey, erection, testing and commissioning of following Transmission lines as per the route alignment shown in exhibit -1 on turnkey basis in 24 months from the date of placement of LOI/order, whichever is earlier.

i) 132 kV S/c line on D/c Towers from Kataiya (Bihar, India) – Kusaha (NEA, Nepal) with Panther Conductor, approximately 15.718 km.

ii) 132 kV S/c line on D/c Towers from Raxaul (BSEB, India) – Parwanipur (NEA, Nepal) with Panther Conductor, approximately 21.713 km.

**1.1.2** The tenderer shall quote in two parts- Part-I "Technical and General Terms and Condition" and Part-II "Price Bid" for complete work of design, fabrication, galvanizing, testing and supply of towers and complete line materials and erection, testing and commissioning of 132 kV S/c Transmission lines. The incomplete bids are liable to be rejected.

**1.1.3** For detailed scope, the stipulation given in each Chapter shall be applicable.

**1.1.4** Tower Types A, B, C, D & Special Towers shall be designed for the above line with the minimum temperature as $0^0$ C.

**1.1.5** Maximum Tension:

**1.1.5.1** Maximum tension shall be as under:

- At $32^oC$ with full wind pressure, or
- At $32^oC$ with 75% full wind pressure, or
- At $0^oC$ with 36% full wind pressure

**1.1.5.2** The initial conductor/ground wire tension at $32^oC$ and without wind shall be considered as 25% of ultimate tensile strength of conductor / ground wire.

## 1.1.6 DESCRIPTION

**1.1.6.1** The scope includes the detail survey, check survey, soil investigation for which the most economical and stable route will have to be selected by the contractor. The route alignment is to be fixed by the contractor together with representative of the Owner after award of the Contract. After detail survey the Contractor shall be required to prepare final profile and submit for approval of WAPCOS/CEA. Based on the final survey report accepted by WAPCOS/CEA, actual quantities of different type of towers and line materials will be calculated for purpose of supply, execution and payment.

The bidder shall quote for the complete work of design, fabrication, galvanizing, testing, supply of towers as well as line materials which includes conductors, ground wire, insulators, hardware, earthing materials and conductor/ground wire accessories etc., erection of the line complete in all respects, failing which the tenders shall not be considered. The unit rates quoted against provisional quantities in the schedule shall be applied for the final quantities arrived at after completion of survey by the Contractor.

## 1.1.7 COMPLETION SCHEDULE

The complete work i.e. Design, Manufacture, Testing and supply of tower parts and accessories, power conductor, ground wire, conductor & ground wire accessories, insulator strings and hardware fittings, erection, testing and commissioning of Transmission Lines are to be completed on turnkey basis within 24 months from date of signing of the contract agreement between the contractor and MINISTRY OF External Affairs, New Delhi (MEA). The tenderer shall submit along with the tender a bar chart giving schedule for completion of entire works covering supply as well as foundation and erection indicating commencement and completion of each activity considering zero date as the day order is placed. The tenderer / bidder shall also indicate the number of independent gangs/groups intended by him to be deployed for execution of the work.

## CHAPTER – 1

## TOWERS AND ACCESSORIES
## DESIGN, FABRICATION, ASSEMBLY, TESTING AND SUPPLY OF GALVANISED STEEL TOWERS INCLUDING TOWER ACCESSORIES

### 1.1 SCOPE

**1.1.1** This part of the specification covers design, fabrication including supply of steel, proto type testing, Galvanizing, Testing before dispatch, packing, supply and delivery FADS (free at destination site/stores) of 132kV Single Circuit lines on Double Circuit Towers, tower accessories complete in all respects including bolts, nuts and washers. The scope also covers design of foundations for all type of towers, in different types of soils.

### 1.2 STANDARDS

**1.2.1** The Indian Standard Specification (IS) mentioned below as amended up to date shall be applicable to the materials and process used in the manufacture of towers and tower accessories.

| **Sl. No.** | **Indian Standards (IS)** | **TITLE** |
|---|---|---|
| 1. | IS 2-1960 | Rules for rounding off numerical values |
| 2. | IS 209-1992 | Specification for Zinc |
| 3. | IS 278-1991 | Specification for Galvanised steel barbed wire for fencing |
| 4. | IS 432-1982 | Mild steel & Medium tensile steel bars & hard drawn steel wire for concrete Reinforcement |
| 5. | IS 456-2000 | Code of practice for plain & Reinforced concrete |
| 6. | IS 802 (Part-1) | Code of practice for use of structural steel in overhead transmission line Towers : Material, Loads and permissible stresses |
| | Section-1-1995 | Materials & Loads |
| | Section-2-1992 | Permissible stress |
| 7. | IS 802 -(Part II)-1990 | Code of practice for use of structural steel in overhead transmission line : Fabrication, galvanising, inspection and packing |
| 8. | IS 802-(Part-III) Latest Edition | Code of practice for use of structural steel in overhead transmission line : Testing |
| 9. | IS 808-1991 | Specification for hot rolled steel beams, channels & Angle sections |
| | Part-V | Equal Leg angles |
| | Part-VI | Unequal Leg angles |
| 10. | IS 1200-1974 | Method of measurement of Building and civil |

| | | |
|---|---|---|
| | | works |
| 11. | IS 1367-1992 | Technical supply conditions for threaded fasteners |
| 12. | IS 1573-1991 | Specification for Electroplated coatings for zinc on iron and steel |
| 13. | IS 1893-1991 | Criteria for earthquake resistant design of structures |
| 14. | IS 2016-1992 | Specification for Plain washers |
| 15. | IS 2062-2011 | Specification for steel for general purpose |
| 16. | IS 2551-1990 | Danger Notice plates |
| 17. | IS 2629-1990 | Recommended practice for hot dip galvanising of iron and steel |
| 18. | IS 2633-1992 | Method of testing uniformity of coating on zinc coated articles |
| 19. | IS 3063-1994 | Specification for Single coil rectangular section spring washers for bolts, nuts and screws |
| 20. | IS 3757-1992 | High strength structural bolts |
| 21. | IS 4091-1979 | Code of practice for design and construction of foundations for transmission line towers and poles |
| 22. | IS 4759-1990 | Specification for Hot dip zinc coating on structural steel and other allied products |
| 23. | IS 5358-1969 | Specification for Hot dip galvanised coating on fasteners |
| 24. | IS 5613-1985 (Part-2/Sec-1) | Code of practice for design, installation and maintenance of overhead power Lines : Designs |
| 25. | IS 5613-1985 (Part-2/Sec-2) | Code of practice for design, installation and maintenance of overhead power Lines : Installation and maintenance |
| 26. | IS 6610-1991 | Specification for Heavy washers for steel structures |
| 27. | IS 6639-1990 | Specification for Hexagonal bolts for steel structures |
| 28. | IS 6745-1990 | Specification for Methods for determination of weight of zinc coating of zinc coated iron and steel articles |
| 29. | IS 7215-1974 | Specification for Tolerance for Fabrication of steel structures |
| 30. | IS 10238-1989 | Step bolts for steel structures |
| 31. | IS 12427-1988 | Transmission tower bolts |
| 32. | | Indian Electricity Rules, 1956 |
| 33. | Publication No.19/N/700/1963 | Regulation for electrical crossings for Railway tracks. |
| 34. | CBI&P Publication No. | Manual on Design of long span River Crossing Towers |

## 1.3 MATERIALS AND WORKMANSHIP

**1.3.1** All materials used in the manufacture of the tower and tower accessories shall be conforming to relevant standards given in Clause 1.2.

## 1.4 TYPE OF TOWERS

The towers shall be of types A, B, C, D & Special towers, fully described under Table-A is given below:

**TABLE A**

| Type of Tower | Designation of towers | Type of string | Typical use |
|---|---|---|---|
| 1 | 2 | 3 | 4 |
| Tangent tower (0-2 deg.) | A | Suspension | To be used on straight runs and upto 2 deg. line deviation |
| Small Angle Tower (2-15 deg.) | B | Tension | To be used for line deviation from 2 to 15 deg. |
| Medium Angle Tower (15-30 deg.) | C | Tension | To be used for line deviation from 15 to 30 deg. |
| Large Angle & dead end tower (30-60 deg. & Dead End) | D | Tension | To be used for line deviation from 30 to 60 deg. or for dead end. |
| Special Towers | | | These may be required for major river crossings or for very long valley spans. For special requirements of these structures refer Chapter-IV. |

Note : -

The angles of line deviation specified above are for the design span. The span may, however, be increased up to an optimum limit with reduced angle of line deviation, if adequate ground and phase clearances are available. The tenderer shall indicate

optimum limit of spans for each type of above mentioned towers with reducing angle of deviation with supporting calculations.

## 1.5 EXTENSIONS

**1.5.1** The towers shall be designed so as to be suitable for adding 3 m, 6 m & 9 m body extensions as well as single leg extensions of 1.5 m, 3 m & 4.5 height for maintaining adequate ground clearance. The strength of tower members for all loading cases shall be adequate with and without extensions. Wherever 18m & 25 m extensions are required, the spans shall be reduced suitably. The contractor shall have to indicate/recommend suitable spans when tower with such extensions are used.

**1.5.2** To spot the tower in the hilly terrain the Bidder shall have to design leg extensions/hill side Extensions for all types of towers ranging from plus 1.5m, 3m, 4.5m & 6.0 meters suitable to be fitted to normal towers as well as towers with extensions. The standard tower shall have K-bracing in the lower most panel to facilitate such arrangement.

The quantities of hill side extensions shall be finalised only after completion of detailed survey. The quoted unit rates per metric tonne shall be applicable on hill-side extensions also. The unit rate per metric tonne for supply shall be derived from the corresponding composite rates of tower super structure.

## 1.6 CONFIGURATION AND TYPE OF CONNECTIONS

**1.6.1** The towers shall be of vertical configuration. The typical tower out line drawing is annexed for reference vide drawing No. SETD/01. The contractor shall submit detailed drawings.

**1.6.2** All member connections used in the tower and extensions shall be of bolted type.

**1.6.3** The standard tower and tower with extensions shall have K-bracings along with plan bracings in the lowest panel. Further, the lower most three panels of standard tower including K-bracings shall be provided with hip bracings instead of plan cleats. The plan cleats in the lower panels should not be permitted.

## 1.7 ROAD, POWER LINE, TELECOMMUNICATION LINE, DEEP VALLEY & RIVER CROSSING AND RAILWAY CROSSING

### 1.7.1 ROAD CROSSING

At Road crossings, the towers shall be fitted with normal Double suspension/double tension insulator strings as required so that ground clearances at the highest point of the road at maximum temperature in still air is not less than the specified values. The effects of conductor creep and broken conductor in the adjacent span is also to be taken into account in addition to above ground clearance.

### 1.7.2 POWER LINE CROSSINGS

Where the line has to cross over another line of the same voltage or lower voltage, suspension/tension towers with suitable extensions shall be used. Where long shut-downs are envisaged it would be preferable to undertake power line crossings on suspension towers followed by angle towers suitably guyed.

### 1.7.3 TELE-COMMUNICATION LINE CROSSINGS

The crossings shall be designed in such a manner that the clearance between conductors of the power line and the telecommunication wires is not less than specified value given in Section-II. For further details, the contractor shall refer to "Code of Practice for Crossings between Power and Tele-communication Lines – 1974.

### 1.7.4 DEEP VALLEY & RIVER CROSSINGS

In case of major river crossing, towers shall be of suspension type using double suspension strings and the anchor towers on either side of the main river crossings shall be D or DD type tower. Clearance required by navigation authority shall be provided. For non navigable river, clearance shall be reckoned with respect to highest flood level (HFL).

### 1.7.5 RAILWAY CROSSINGS

Railway crossings shall be supported on dead end type towers on either side, depending on the merits of each case and shall be constructed in conformity with the specification laid down by the Railway Authorities.

## 1.8 TOWER DESIGN

**1.8.1** The tenderer shall indicate the method intended to be deployed for the design of towers in the tender. Any computer programme to be employed shall be prepared or approved by a recognised institution and the particulars and name of the computer programme shall also be indicated in the tender. The tenderers shall supply the names of the customers to whom the towers have been supplied based on the above computer programme and also the tower test results proving the efficiency of the programme.

A hard copy of the tower designs along with soft copy of input files of the computer software used for analysis of various type of towers shall be submitted by the successful contractor. The Purchaser will check the tower designs submitted by the contractor and if any modifications/ changes are necessitated consequent to the checking, the same shall be carried out by the contractor without additional cost to the Purchaser.

The design of towers shall generally be based on the procedure and guide lines as out lined in IS-802 (Part-1/Section-1)-1995 and as here under as also parameters given in the specific technical requirement (Section-II) of this specification.

If there is any deviations between the stipulation of this specification and IS:802 (Part-1/Section-1)-1995 the stipulations laid down in this specification shall prevail.

The procedure given here under for the design of towers are based on probabilistic approach.

For 132 kV lines covered in this specification, the relevant parameters for design of towers are as follows.

Reliability level for 132 kV Single Circuit Lines on Double Circuit Towers-1 (Return period 50 years).
Terrain Category-2 for Normal Double Circuit Tower.
Basic wind speed (Vb) – 47 m/s
At 10 M height above mean ground level in open terrain (Category-2) for 50 years return period.
Reference wind speed "VR" = Vb/K0, K0=1.375
= 47/1.375
= 34.18 m/s

e) Design wind speed "Vd" = VRxK1xK2
f) Design wind pressure "Pd" = 0.6xVdxVd

| Description/item | Unit | 132 kV D/C Towers |
|---|---|---|

| | | | |
|---|---|---|---|
| Reliability Level | | 1 | |
| Factor K1 | | 1.0 | |
| Factor K2 | | 1.00 | |
| Design wind speed "Vd" | m/s | | 34.18 |
| Design wind pressure "Pd" | | N/sq.m | 701 |

### 1.8.2 STATUTORY REQUIREMENTS

Statutory requirements as laid down in the "Indian Electricity Rules 1956" or by any other statutory body applicable to such structures shall be satisfied/observed.

### 1.8.3 WIND LOAD ON TOWER

In order to determine the wind load on tower, the tower is divided into different panels having a height "h". These panels should normally be taken between the intersections of the legs and bracings. For a lattice tower of square cross section, the resultant wind load Fwt in Newtons, for wind normal to a longitudinal face of tower, on a panel height "h" applied at the center of gravity of this panel is :

Fwt = Pd x Cdt x Ae x Gt
Where Pd = Design wind pressure in N/sqm
Cdt = Drag coefficient for panel under consideration against which the wind is blowing. Value of Cdt for the different solidity ratio are given in Table 1.

Solidity ratio is equal to the effective area (projected area of all the individual elements) of a frame normal to the wind direction divided by the area enclosed by the boundary of the frame normal to the wind direction.

Ae = Total net surface area of the legs, bracings, cross-arm and secondary members of the panel projected normally to the face in sq m. (The projections of the bracings of the adjacent faces and of the plan and hip bracings may be neglected while determining the projected surface of a face).

Gt = Gust response factor, peculiar to the ground roughness and depends on the height above ground. Values of Gt for 132 kV towers are given in Table 2.

**TABLE –1**

| DRAG COEFFICIENT, Cdt FOR TOWERS | |
|---|---|
| Solidity Ratio | Drag coefficient, Cdt |
| Upto 0.05 | 3.6 |
| 0.1 | 3.4 |
| 0.2 | 2.9 |
| 0.3 | 2.5 |
| 0.4 | 2.2 |
| 0.5 and above | 2.0 |

NOTE :-

Intermediate values may be linearly interpolated.

Drag coefficient takes into account the shielding effect of wind on the Leeward face of the tower. However, in case the bracing on the Leeward face is not shielded from the windward face, then the projected area of the Leeward face of the bracing should also be taken into consideration.

**TABLE – 2**
**GUST RESPONSE FACTOR FOR TOWERS (Gt)**
**AND FOR INSULATORS (Gi)**

| Height above Ground, m | | Values of Gt and Gi for 132 kV towers | |
|---|---|---|---|
| (1) | (2) | (3) | (4) |
| Up to 10 | 1.70 | 1.92 | 2.55 |
| 20 | 1.85 | 2.20 | 2.82 |
| 30 | 1.96 | 2.30 | 2.98 |
| 40 | 2.07 | 2.40 | 3.12 |
| 50 | 2.13 | 2.48 | 3.24 |
| 60 | 2.20 | 2.55 | 3.34 |
| 70 | 2.26 | 2.63 | 3.46 |
| 80 | 2.31 | 2.69 | 3.58 |

**Note : - Intermediate values may be linearly interpolated.**

## 1.8.4 WIND LOAD ON CONDUCTOR AND GROUND WIRE

The load due to wind on each Conductor and Ground Wire, Fwc in Newtons applied at supporting point normal to the line shall be determined by the following expression:

Fwc = Pd x Cdc x L x d x Gc

Where :

Pd = Design wind pressure, in N/sqm:
Cdc = Drag coefficient, taken as :
1.0 for Conductor and 1.2 for Ground Wire
L = Wind span, being sum of half the spans on either side of supporting structures, in meters
d = Diameter of Conductor/Ground Wire , in meters
Gc = Gust response factor, takes into account the turbulence of the wind and the dynamic response of the conductor. Values of Gc are given in Table 3 for 132 kV towers for the average height of the Conductor/Ground Wire above the ground.

Note :

The average height of conductor shall be taken up to clamping point of top conductor on tower less two-third sag at minimum temperature and no wind. The average height of the Ground Wire is clamping point of Ground Wire less two-third sag at minimum temperature and nil wind.

**TABLE – 3**

**VALUES OF GUST RESPONSE FACTOR Gc FOR CONDUCTOR AND GROUND WIRE**

| | **Terrain Cate-gory** | **Height above ground mts** | **Values of Gc for ruling span in meter upto 300** | **400** | **500** | **600** | **700** | **800 & above** |
|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 1 | upto | 10 | 1.70 | 1.65 | 1.60 | 1.56 | 1.53 | 1.50 | 1.47 |
| | | 20 | 1.90 | 1.87 | 1.83 | 1.79 | 1.75 | 1.70 | 1.66 |
| | | 40 | 2.10 | 2.04 | 2.00 | 1.95 | 1.90 | 1.85 | 1.80 |
| | | 60 | 2.24 | 2.18 | 2.12 | 2.07 | 2.02 | 1.96 | 1.90 |
| | | 80 | 2.35 | 2.25 | 2.18 | 2.13 | 2.10 | 2.06 | 2.03 |
| 2 | upto | 10 | 1.83 | 1.78 | 1.73 | 1.69 | 1.65 | 1.60 | 1.55 |
| | | 20 | 2.12 | 2.04 | 1.95 | 1.88 | 1.84 | 1.80 | 1.80 |
| | | 40 | 2.34 | 2.27 | 2.20 | 2.13 | 2.08 | 2.05 | 2.02 |
| | | 60 | 2.55 | 2.46 | 2.37 | 2.28 | 2.23 | 2.20 | 2.17 |
| | | 80 | 2.69 | 2.56 | 2.48 | 2.41 | 2.36 | 2.32 | 2.28 |
| 3. | upto | 10 | 2.05 | 1.98 | 1.93 | 1.88 | 1.83 | 1.77 | 1.73 |
| | | 20 | 2.44 | 2.35 | 2.25 | 2.15 | 2.10 | 2.06 | 2.03 |
| | | 40 | 2.76 | 2.67 | 2.58 | 2.49 | 2.42 | 2.38 | 2.34 |
| | | 60 | 2.97 | 2.87 | 2.77 | 2.67 | 2.60 | 2.56 | 2.52 |
| | | 80 | 3.19 | 3.04 | 2.93 | 2.85 | 2.78 | 2.73 | 2.69 |

NOTE : - INTERMEDIATE VALUES MAY BE LINEARLY INTERPOLATED.

### 1.8.5 WIND LOAD ON INSULATOR STRINGS

Wind load on insulator strings "Fwi" shall be determined on Insulator length from the attachment point to the center line of the conductor in case of suspension tower and upto the end of clamp in case of tension tower, in the direction of the wind as follows:

Fwi = Cdi x Pd x Ai x Gi
Where,
Cdi = Drag coefficient of insulators taken as 1.2
Pd = Design wind pressure in N/sq. m ;
Ai = 50% of the area of insulator string projected on a plane which is parallel to the longitudinal axis of string .
Gi = Gust response factor, peculiar to the ground roughness and depends on the height of insulator attachment point above ground. Values of Gi are given in Table (2).

### 1.8.6 SAG TENSION CALCULATION:

Sag tension calculations for Conductor and Ground Wire shall be made for the following combinations.

(i) 100% design wind pressure after accounting for drag coefficient and Gust response factor at every day temperature, and
(ii) 75% design wind pressure after accounting for drag coefficient and Gust response factor at every day temperature, and
(iii) 36% design wind pressure after accounting for drag coefficient and Gust response factor at minimum temperature.

### 1.8.7 CLIMATIC LOADS

Climatic loads are related to Reliability Requirements :
These are random loads imposed on tower, conductor, insulator strings and Ground Wire due to action of wind on transmission line and do not act continuously. Climatic loads shall be determined under either of the following climatic conditions, whichever is more stringent:

(i) 100% design wind pressure at every day temperature, or
(ii) 75% design wind pressure at every day temperature, or
(iii) 36% design wind pressure at minimum temperature.

Note:-

1. Condition (ii) above is to be adopted for suspension tower under security condition.

2. Condition (iii) above is normally not crucial for tangent tower but shall be checked for angle or dead end towers, particularly for short spans.

### 1.8.8 FAILURE CONTAINMENT LOADS

Failure containment loads are related to Security Requirements. These loads comprise of:

Anticascading loads, and
Torsional and longitudinal loads

#### 1.8.8.1 ANTICASCADING LOADS

Cascade failure may be caused by failure of small items such as insulators, hardware, joints, failures of major elements such as towers, foundations, conductor due to defective material or workmanship or from climatic overloads or sometimes from casual events such as misdirected aircraft, avalanches, sabotage etc. The security measures adopted for containing cascade failures in the line is to provide angle towers at specific intervals which shall be checked for anti-cascading loads (see Cl.No. 1.8.12).

#### 1.8.8.2 TORSIONAL AND LONGITUDINAL LOADS

a) These loads are caused by breakage of Conductors or Ground Wire . All the towers shall be designed for these loads for the number of conductors considered broken according to (Cl. No. 1.9).

b) The mechanical tension of conductor and Ground Wire is the tension corresponding to design wind pressure at every day temperature and 0.36 times the design wind pressure at minimum temperature after accounting for drag coefficient and guest response factor.

### 1.8.9 SAFETY REQUIREMENTS (CONSTRUCTION AND MAINTENANCE)

These loads are related to the safety requirement of the working personnel on the line. These are loads imposed on tower during construction and maintenance of transmission lines.

### 1.8.10 SPAN:

a) Normal Span
The normal ruling span of the transmission lines shall be 305 meters.

b) Wind Span

The wind span is the sum of the two half spans adjacent to the support under consideration. For normal Horizontal span this equals to Normal ruling span. For 132 kV lines covered in this specification, the wind span shall be considered as 305 meters.

c) Weight Span
The weight span is the horizontal distance between the lowest point of the conductors on the two spans adjacent to the tower. For design of structures, the span limits given in section-II shall prevail :

## 1.8.11 COMPUTATIONS OF LOADS

### 1.8.11.1 TRANSVERSE LOADS

Transverse loads shall be computed for reliability, security and safety requirements.

a) Reliability Requirements
These loads shall be calculated as follows, for the climatic conditions specified in Clause 1.8.7.

i) Wind action on tower structures, Conductors, Ground Wire and insulator strings computed according to 1.8.3, 1.8.4 and 1.8.5 respectively.

ii) Component of Deviation loads (Fwd) due to mechanical tension of Conductor and Ground Wire due to wind shall be determined a) everyday temperature and full design wind pressure or b) minimum temperature and 0.36 times the design wind pressure for climatic conditions specified in Clause No. 1.8.7.

Total transverse Load = (i) + (ii) = Fwt+Fwc+Fwi+Fwd
Where "Fwc", "Fwi" and "Fwd" are to be applied on all Conductors/Ground Wire points and "Fwt" to be applied on tower, at peak, cross arm level and at any one convenient level between bottom cross arms and ground level for normal towers. In case of towers with extensions, one more application level shall be taken at top end of extension.

b) Security Requirements
Transverse loads for security requirements (broken wire conditions) shall be taken as under :

i) Wind action on tower structures, Conductors and Ground Wire and insulator shall be computed as per 1.8.11.1 (a) i except that 60% wind span shall be considered for broken wire condition and 100% wind span for intact span

conditions. In case of suspension towers wind action on towers, conductors, insulator etc. shall be corresponding to 75% of full wind pressure at every day temperature.

ii) Component of mechanical tension computed as :

a) For suspension towers, it is component of 50% mechanical tension of Conductor and component of 100% mechanical tension of Ground Wire corresponding to 75% of full wind pressure at every day temperature.

b) For tension towers, it is component of 100% mechanical tension of Conductor and Ground Wire corresponding to the relevant loading conditions as per cl. No. 1.8.7 of the specification.

c) Safety Requirements (Construction and Maintenance)
Transverse loads for safety requirements are horizontal loads due to mechanical tensions of Conductors and Ground Wire at everyday temperature and no wind, on account of line deviation.

### 1.8.11.2 VERTICAL LOADS

Vertical loads shall be computed for reliability, security and safety requirements.

a) Reliability Requirements

i) These loads comprise of:
Loads due to weight of Conductor/Ground Wire based on design weight span, weight of insulator strings and accessories, and

ii) Self-weight of tower structure upto point/level under consideration.

b) Security Requirements
These shall be taken as :

i) Same as in 1.8.11.2 (a) (i) except for broken wire condition (broken span) where the load due to weight of Conductor/Ground Wire shall be considered 60% of weight span, and

ii) Same as in 1.8.11.2(a)(ii).

c) Safety Requirements (Construction and Maintenance)
These loads comprise of :

i) Normal conditions :-

a) Weight of Conductor/Ground Wire based on weight span, weight of insulator strings and accessories multiplied by an over load factor of 2.0.

b) Self weight of tower upto point/level under consideration.
c) Load of 1500 N shall be considered acting at each cross arm tip, as a provision of weight of lineman with tools.
d) Load of 3500 N to be considered acting at the tip of cross arms for 132 kV lines for design of cross arms.

ii) Broken wire condition :-
Same as under Normal condition considering 60% weight span for broken span(s) and 100% for intact spans.

### 1.8.11.3 LONGITUDINAL LOADS

Longitudinal Loads shall be computed for reliability, security and safety requirements.

a) Reliability Requirements

These loads shall be taken as:

i) No longitudinal loads for suspension and tension towers.
ii) Longitudinal loads which might be caused on tension towers by adjacent spans of unequal lengths can be neglected in most cases, as the strength of the supports for longitudinal loads is checked for security requirement and for construction and maintenance requirements.
iii) Longitudinal load for dead-end towers to be considered corresponding to mechanical tension of Conductors and Ground Wire corresponding to the relevant loading conditions as per cl. No. 1.8.7 of the specification.

b) Security Requirements (Broken Wire Condition)

These loads shall be taken as under :-

1. Suspension Tower :
Longitudinal loads equal to component of 50% of mechanical tension of Conductor and 100% mechanical tension of Ground Wire shall be considered under every day temperature and 75 % of full wind pressure.
2. Tension Towers :
Horizontal loads in longitudinal direction due to mechanical tension of Conductors and Ground Wire corresponding to the relevant loading conditions as per cl. No. 1.8.7 of the specification.
3. Dead End Towers :
Horizontal loads in longitudinal direction equal to mechanical tension of Conductor and Ground Wire

corresponding to the relevant loading conditions as per cl. No. 1.8.7 of the specification.

c) Safety Requirements : These loads shall be taken as under

i) Normal condition :-

Suspension Tower:- Nil

Tension Tower :- Nil

Dead end Towers :- Longitudinal load equal to mechanical tension of Conductor/Ground Wire at every day temperature and no wind. Longitudinal loads due to unequal spans may be neglected.

ii) Broken Wire Condition

a) Suspension Towers :-

Longitudinal loads per Conductor and Ground Wire shall be considered as 10,000 N and 5,000 N respectively.

b) Tension Towers :-

Load equal to twice the sagging tension (sagging tension is equal to 50% of tension at every day temperature and no wind) for wire under stringing and 1.5 times the sagging tension for all intact wires (stringing completed).

c) Dead End Towers : Intact conductors same as under normal condition and nil for broken conductors.

### 1.8.12 ANTI CASCADING CHECKS

All angle towers shall be checked for the following anticascading conditions without any over load factors with all Conductors and Ground Wire intact only on one side of the tower.

a) Transverse loads

This shall be taken as under no wind condition, at every day temperature.

b) Vertical loads

The vertical loads shall be the sum of weight of Conductor/Ground Wire intact only on one side of tower, weight of insulator strings and accessories and self weight of tower.

c) Longitudinal loads

The longitudinal loads shall be the pull of Conductor/Ground Wire at every day temperature and no wind applied simultaneously at all points on one side with zero degree line deviation.

### 1.8.13 TENSION LIMITS

Conductor/Ground Wire tension at everyday temperature and without external load, should not exceed the following percentage of the ultimate tensile strength of the conductor :

| | |
|---|---|
| Initial unloaded tension | 35 percent |
| Final unloaded tension for Conductor | 25 percent |
| Final unloaded tension for Ground Wire | 25 percent |

Provided that the ultimate tension under everyday temperature and 100% design wind pressure or minimum temperature and 36% design wind pressure does not exceed 70 percent of the ultimate tensile strength of the Conductor/Ground Wire .

## 1.9 BROKEN WIRE CONDITIONS :

The following broken wire conditions shall be assumed in the design of towers :

| Type of Tower to be adopted | Broken wire conditions |
|---|---|
| (a). Single Circuit towers | Any one phase or groundwire broken, whichever is more stringent for a particular member. |
| (b). Double, triple Circuit and quadruple Circuit towers: | |
| (i). Suspension towers | Any one phase or ground wire broken, whichever is more stringent for a particular member. |
| (ii). Small & Medium Angle Tower | Any two phases broken on the same side and same span or anyone phase and one ground wire broken on the same side and same span whichever Combination is more stringent for a particular member. |

| | |
|---|---|
| (iii). Large Angle tension towers/Deadend towers | Any three phases broken on the same side and the same span or any two phases and one ground wire broken on the same side and same span, whichever combination constitutes the most stringent condition for a particular member. |

## 1.10 STRENGTH FACTORS RELATED TO QUALITY

The design of tower shall be carried out in accordance with the provisions covered in IS:802 (Part-1/Section 2):1992. However, to account for the reduction in strength due to dimensional tolerance of the structural sections, yield strength of steel used, the following strength factors shall be considered :

i) If steel with minimum guaranteed yield strength is used for fabrication of tower, the estimated loads shall be increased by a factor of 1.02, to account for dimensional tolerances.

ii) If steel of minimum guaranteed yield strength is not used for fabrication of tower, the estimated loads shall be increased by a factor of 1.05, in addition to that mentioned in (i) above.

## 1.11 TOWER STEEL SECTIONS

Steel sections in conformity to IS:808-1991 are to be used in towers, extensions and stub-setting-templates and shall be of tested quality conforming to IS:2062-2011. No individual members shall be longer than 6000 mm. Use of high tensile steel as per IS:2062 is permitted for fabrication of towers.

The steel sections as per any other International standards, if used shall be of equal or superior quality with corresponding Indian Standards.

For designing of towers, only rationalized steel sections shall be used. During execution of the project, if any particular section is not available, the same shall be substituted by higher section at no extra cost to the purchaser.

However, design approval for such substitution shall be obtained from the Purchaser. Angle sections upto size 120 x 120 x12 mm may be procured from re-rollers provided these are made from the tested billets of SAIL satisfying conditions stated in volume -1 of the Bidding Documents.

## 1.12 THICKNESS OF MEMBERS

**1.12.1** The minimum thickness of angle section used in the design of towers, unless otherwise specified elsewhere in this specification, shall be kept not less than the following values :

a) Main corner leg members including the peak and lower members of cross arm in compression — Ground Wire 5 mm

b) For all other members — 4 mm

## 1.13 ALLOWABLE STRESS

Structural steel angle section manufactured according to the latest IS:808-1991 (Part V and VI) and tested according to the latest edition of IS:2062-2011 or any other equivalent or superior International Standards will be used in the fabrication of the towers having its yield strength not less than 250 N/sq.mm. and stress value of high tensile steel (Fe 490 High Tensile and Fe 540-High Tensile) grade according to IS:2062-2006.

### 1.13.1 AXIAL STRESS IN TENSION

The estimated tensile stress on the net effective sectional area in various members, shall not exceed 250 N/sq.mm for mild steel or the specified yield stress of the High tensile steel sections if proposed to be used in the fabrication of towers as per stresses value of high tensile steel according to IS:2062-2011 or any other equivalent to International Standards.

### 1.13.2 AXIAL STRESS IN COMPRESSION

**1.13.2.1** The estimated compressive stress in various members shall not exceed the value given by the formulae specified in Clause 5.2 of IS:802 (Part-I/Section 2)-1992. The provisions are reproduced for reference.

**1.13.2.2** The allowable unit stress Fa, in Mpa on the gross cross sectional area of the axially loaded compression members shall be :

$$Fa = \left[1 - 1/2 \left(\frac{KL/r}{Cc}\right)^2\right] \times Fy$$

When $KL/r \leq Cc$

And,

b) $$Fa = \frac{\Pi^2 \times E}{(KL/r)^2}$$

When KL/r > Cc

Where,

Cc = Π x sq. root, (2E/Fy)

Fy = minimum guaranteed yield stress of the material, Mpa

E = modulus of elasticity of steel that is $2x10^5$ Mpa,

KL/r = largest effective slenderness ratio of any unbraced segment of the member,

L = unbraced length of the compression member in cm, and

r = appropriate radius of gyration in cm.

**1.13.2.2.1** The formulae given in 1.13.2.2 are applicable provided the largest width thickness ratio b/t is not more than the limiting value given by :

(b/t) lim = 210/sq. root (Fy)

Where

b = distance from edge of fillet to the extreme fibre in mm, and

t = thickness of flange in mm.

**1.13.2.2.2** Where the width thickness ratio exceeds the limits given in 1.13.2.2.1, the formulae given in 1.13.2.2 shall be used substituting for Fy the value Fcr given by :

a) $Fcr = \left[1.677 - \frac{0.677 \times (b/t)}{(b/t)\ lim}\right] \times Fy$

when (b/t) lim ≤ b/t ≤ 378/sq.root (Fy)

and,

b) $Fcr = \frac{65550}{(b/t)^2}$

when b/t > 378/sq.root (Fy)

Note : The maximum permissible value of b/t for any type of steel shall not exceed 25.

**1.13.2.3** The redundant members shall be checked individually for 2.5 percent of axial load carried by the member to which it supports.

**1.13.3 STRESSES IN BOLTS**

The estimated stresses in bolts shall not exceed the values given in Table (1) of IS:802-Part-1/ Section (2) 3rd revision. Table-1, is reproduced.

**TABLE 1 ULTIMATE STRESSES IN BOLTS, MPa**

| Nature of stress | Permissible Stress For Bolts of Property Class | | Remarks |
|---|---|---|---|
| | 4.6 | 5.6 | |
| Shear | | | |
| Shear stress on gross Area of bolts | 218 | 310 | For bolts in double shear the area to be assumed shall be twice the area defined. For gross area of bolts refer item(a) below. |
| Bearing | | | |
| Bearing stress on bearing gross diameter of bolts | 436 | 620 | for the bolt are in see item (b) below. |
| Tension | | | |
| Axial tensile stress | 194 | 250 | |

Item : (a) Gross area of Bolt : - For the purpose of calculating the shear stress, the gross area of bolts shall be taken as the nominal area of the bolt.

(b) Bearing Area of Bolt :- Shall be taken as dxt, where "d" is the nominal diameter of the bolt, and "t" the thick ness of the thinner of the parts jointed.

## 1.14 SLENDERNESS RATIO

**1.14.1** Slenderness ratios of compression and redundant members shall be computed in accordance with clause 6 of IS:802 (Part1/ section 2) 3rd revision. Provisions reproduced for reference.

| | Type of Members | Value of KL/r |
|---|---|---|
| a) | Compression Members | |
| i) | Leg sections or joint members bolted in both faces at connections for ) 0 < L/r < 120 | L/r |
| ii) | Members with concentric loading at both ends of the unsupported panel for 0 < L/r < 120 | L/r |
| iii) | Member with concentric loading at one | 30+0.75 L/r |

| | | |
|---|---|---|
| | end and normal framing eccentricity at the other end of the unsupported panel for 0 < L/r < 120 | |
| iv) | Member with normal framing eccentricities at both ends of the un-supported panel for 0 < L/r < 120 | 60+0.50 L/r |
| v) | Member unrestrained against rotation at both ends of the unsupported panel for 120 < L/r < 200 | L/r |
| vi) | Member partially restrained against rotation at one end of the unsupported panel for 120 < L/r <225 | 28.6+0.762 L/r |
| vii) | Member partially restrained against rotation at both ends of the unsupported panel for 120 < L/r < 250 | 46.2+0.615 L/r |

b) Redundant Members

i) For ) 0< L/r < 250 L/r

Note : The values of KL/r corresponding to (a) (vi) and (a) (vii), the following evaluation is suggested :

The restrained member must be connected to the restraining member with at least two bolts.

The restraining member must have a stiffness factor I/L in the stress plane (I=Moment of inertia and L=Length) that equals or exceeds the sum of the stiffness factors in the stress plane of the restrained members that are connected to it.

Angle members connected by one leg should have the holes located as close to the outstanding leg as feasible. Normal framing eccentricities at load transfer connection imply that connection holes are located between the heel of the angle and the centre line of the framing leg.

**1.14.1.1** In calculating the slenderness ratio of the members, the Length L should be the distance between the intersections of the centre of gravity lines at each end of the member.

**1.14.2** The following maximum limit of the effective slenderness ratio i.e. the ratio of unsupported length of the section in any plane to the appropriate radius of gyration shall not exceed value specified here under.

a) For main corner leg members including the corner 120
members of Ground Wire peak and the lower members

of the cross-arms in compression

b) For the members having calculated stresses 200

c) For redundant members 250

d) For members having tensile stress only 400

## 1.15 QUANTITIES AND WEIGHTS

The quantities stated in the Schedule are provisional. The Purchaser reserves the right to vary the quantities upto plus or minus 20%. The rates, terms and conditions quoted in the bid shall be valid throughout the period of the contract.

**1.15.1** After the award of contract, the contractor shall submit to the Purchaser, for his approval, the detailed design calculations, drawings for each type of tower, extension and stub template etc. The weights of towers shall be calculated by using the standard sectional weights of steel structures of the sizes indicated in the approved fabrication drawings and bill of materials, without taking into consideration the reduction in weight due to drilling of bolt holes, skew cuts, chamfering, etc. or increase in weight due to galvanisation but taking into consideration the weight of bolts, nuts, washers, hangers, D-Shackles, `U' bolts, strain plates etc.

In case, the weight of the tower, finally approved and accepted by the Purchaser on the basis of designs and drawings so submitted and the tests successfully carried out is more than the guaranteed weight, no extra payment shall be made to the Contractor on this account. If, however, the weight of the finally approved and adopted tower is less than guaranteed weight, the weight as per the finally approved design shall form the basis of payment.

**1.15.2** The Contractor, while designing towers, shall use only such sizes of steel structures which are easily procurable. If for any reason, the sections approved are not easily procurable, it is the Contractor's responsibility to procure the alternative sizes which are satisfactory from the point of view of design, fabrication, galvanisation and supply the same at no additional cost to the Purchaser.

## 1.16 ERECTION STRESS

Where erection stresses combined with other possible co-existent stresses could produce a working stress in any member appreciably above the permissible stress, such additional strengthening of the member shall be effected or such other provision made as is necessary to bring the working stress within the permissible limit.

## 1.17 CLEARANCES

### 1.17.1 GROUND CLEARANCE

The minimum ground clearance from the lowest conductor shall be considered as given in Section-II.

**1.17.2** The following provision are made for considering the ground undulations, errors in stringing, and creep in conductor

(i). 150mm towards ground undulation and errors in stringing.

(ii). Temperature compensation by increasing the stringing tension by reducing the stringing temperature by $26^0$ C.

The tenderer shall make necessary provision to cater for the above requirement. No creep compensation shall be provided in case of ground-wire

## 1.18 CLEARANCES OF LIVE PARTS TO TOWER MEMBERS

**1.18.1** The minimum clearances between the live parts, tower and cross-arm members have been given in Section-II. Whenever necessary the jumper loops at tension towers may be weighed with the approval of the Purchaser with suitable weights to reduce the angles of swing and provide necessary air clearances under wind conditions. Pilot suspension strings to restrict the jumper swings can be used on heavy angle towers. For the purpose of computing the clearances, the dimensions of insulator strings as given in Section-II and drawing No. SETD/02 to SETD/05 of this specification may be assumed together with standard arcing horns. The design of the towers shall be such that it would satisfy all the above conditions when clearances are measured from any live point of the strings.

**1.18.2** The clearances at all the cross-arms for specified swing angles of the insulator strings shall also be checked for suspension/tension insulator strings.

## 1.19 MIDSPAN CLEARANCE

**1.19.1** The minimum vertical midspan clearance between Ground Wire and the nearest Power Conductor shall not be less than the value specified in Section-II. The minimum vertical midspan clearance shall mean the vertical clearance between Ground Wire and the nearest conductor under all temperatures conditions and still air in the normal ruling span. The Ground Wire sag shall be not more than 90 per cent of the corresponding sag of Power Conductor under still air conditions for the entire specified temperature range.

**1.19.2** The successful tenderer in consultation with the Purchaser/insulator and insulator hardware suppliers shall verify

the string length and ensure that the specified clearances and other relevant requirements are fully met and submit the final clearance diagrams based on the exact lengths of insulator strings for approval of the Purchaser.

## 1.20 NUMBER OF PARTS

**1.20.1** Tower members shall be so fabricated as to be bolted together easily at site. Preference will be given to the design with least number of parts and the one which offers best facilities for transport, erection and maintenance. In designing towers, for a minimum number of parts, the Contractor shall not, however, employ parts of such dimensions as will prove difficult to handle. The length of the longest piece shall not exceed 6 meters.

## 1.21 INSULATOR STRINGS AND GROUND WIRE CLAMP ATTACHMENTS

a) For the attachment of "I" type suspension insulator strings a suitable swinging hanger on the tower shall be provided so as to obtain requisite clearance under extreme swinging conditions and free swinging of the string. The hanger shall be designed to withstand highest possible load which may be imposed on it. A typical outline drawing of the hanger is enclosed with this specification vide drawing NO. SETD/06.

b) Ground Wire suspension clamps / tension clamps will be supplied by the Contractor, the reference drawing No. SETD/07 & SETD/08 for the same are enclosed with the specification. Ground Wire peaks/cross arms are to be suitably designed to accommodate the Tension clamps.

c) At tension towers strain plates of suitable dimensions on the underside of the each cross-arm tip and at the top of Ground Wire peak, should be provided for taking the D-shackles of the tension insulator strings or Ground Wire tension clamps as the case may be. Full details of the attachments shall be submitted by the Contractor for Contractor's approval before starting the mass fabrication.

## 1.22 GROUNDING OF TOWERS

**1.22.1** Grounding of towers shall be done in accordance with IS:5613 (Part 2/Section 2 ) -1985 or the latest edition of IS.

**1.22.2** The angle of shielding is defined as the angle formed by the line joining the centre lines of the Ground Wire and power conductor/outer power conductor, in still air, at tower, to the

vertical line through the centre line of the Ground Wire . The angle of shielding to be maintained for the design of transmission lines under the project has been specified in Section-II. The drop of 150 mm on account of Ground Wire suspension assembly shall be considered while calculating the minimum angle of shielding.

**1.22.3** Two 17.5 mm dia holes shall be drilled about 50 mm apart on all stubs such that the lower hole is about 350 mm above the ground level, clear of the concrete muffing, for connecting the earth strip.

**1.22.4** The tenderer shall quote for the supply of grounding materials complete with galvanised mild steel strip, necessary bolts, nuts, counter poise wires and washers required for connecting the strip to the tower.

**1.22.5** Counterpoise earths, where necessary, shall be provided by the Contractor in accordance with IS:5613 (Part-2/Section-2)-1985.

**1.22.6** The tenderer shall quote unit rates for the pipe type and per meter rate for counterpoise earthing.

## 1.23 STEP BOLTS & LADDERS:

**1.23.1** Each tower shall be provided with step bolts which shall conform to IS:5613 Part-2/Section-1-1985 of not less than 16mm diameter and 175 mm long, spaced not more than 450 mm apart and extending from about 3.5 meters above the ground level to the top of the tower. The step bolts shall be fixed on diagonally opposite legs upto the top of the tower. Bolt holes shall be provided below 3.5 m level and step bolts will not be filled but the same will be handed over to the Purchaser.

**1.23.2** Each step bolts shall be provided with two nuts on one end to fasten the bolt securely to the tower and button head at the other end to prevent the feet from slipping away. The step bolts shall be capable of withstanding a vertical load not less than 1.5 KN.

## 1.24 NUMBER, DANGER & PHASE PLATES

Bidder shall supply number plates, danger plates & phase plates for all towers as shown in drawing No. SETD/9 to SETD/11.

Danger plates shall conform to IS:2551-1982.

The number, circuit and phase plates shall conform to IS:5613 (Part-2/Section-1)-1985.

## 1.25 ANTI-CLIMBING DEVICE

**1.25.1** Towers shall be fitted with anti-climbing devices which shall be as per drawing No. SETD/12 and conform to IS:5613 (Part-2/Section-1)-1985. Anti-climbing devices shall be installed on the tower at the height duly approved by the Purchaser.

**1.25.2** Necessary holes shall be provided on the tower members for installation of the anticlimbing device.

**1.25.3** The tenderer shall quote unit rate for anticlimbing device inclusive of structures and barbed wire.

## 1.26 BIRD GUARDS

**1.26.1** The bird guards for suspension towers shall be made of galvanised iron sheet and shall be as per drawing No. SETD/13 and shall conform to IS:5613 (Part-2/Section-1)-1985.

**1.26.2** Necessary holes shall be provided on the cross-arm of the suspension towers for fixing the bird guards.

## 1.27 DESIGN OF FOUNDATION

### 1.27.1 SCOPE

**1.27.1.1** This section covers the design requirements of plain and reinforced cement concrete foundations of self-supporting galvanized lattice towers for 132 kV D/C Transmission Lines under the scope of this specification.

**1.27.1.2** The bidders shall furnish with his technical bid the sample design calculations, drawings and bar bending schedules for a typical plain cement concrete (PCC) Pyramid type foundation and reinforced cement concrete (RCC) Pad type foundation which are proposed to be used for the proposed transmission lines.

**1.27.1.3** The contractor shall furnish the complete detailed design and drawings including bar bending schedule for foundations for all types of normal towers and towers with 3.0 m, 6.0 m & 9.0 m body extensions.

**1.27.1.4** The design of foundation shall be developed as per soil properties given in the **Section-II** of the specification. However, during execution, if different type of soil (other than specified in **Section-II**) is encountered at any location, the design of foundations for such soils shall also be in the scope of this specification.

**1.27.1.5** The payment for different items of foundation work viz. excavation, concrete and reinforcement shall be as per unit rates quoted in the Price schedules. The payment shall be limited to guaranteed quantities or the quantities as per approved foundation drawing, whichever is lower.

**1.27.1.6** The payment for special foundation like pile or normal foundations for soil type different than specified in these specifications and for different items of protection work viz. earth work in excavation, lean concrete, RR masonry/ Brick masonry etc shall be made as per unit rates quoted by bidder in the Price Schedules for actual quantities as per approved drawings**.**

## 1.27.2 CLASSIFICATION OF SOILS

**1.27.2.1** Terrain: As per report of Walk Over Survey, most part of the terrain along the alignment of line is flat (plain) and being cultivated land except some patch of barren land and social forestry. Whole section of the plain terrain is well connected with irrigation canals due to which ground water table is relatively high.

**1.27.2.2** Type of soil likely to be encountered enroute proposed Transmission Lines is expected to be generally of normal type and could be wet, partially submerged or fully submerged depending on location water of table or standing water like in Paddy Fields. The physical properties of different type of soils, which are required for the design of foundations, are given in **Section-II**. In case other types of soils, other than given in **Section-II**, are encountered at any location, the contractor shall be required to develop the designs of foundations for such soils as per site conditions and considering soil properties as per geotechnical investigation report. The quoted rates for various items of foundation work viz., excavation, concrete, reinforcement etc. shall also be applicable for such foundations.

## 1.27.3 GROUPING AND CLASSIFICATION OF FOUNDATIONS

**1.27.3.1** The foundations for normal towers and normal towers with body extensions shall be grouped as under:

(i). Normal Towers

(ii). Normal Towers with 3.0 m, 6.0 m & 9.0 m body extensions.

**1.27.3.2** The single design of foundation for towers with 3.0m, 6.0m and 9.0m body extension shall be developed for each type of tower based on critical loading in that group for a particular soil

condition and the same design shall be adopted irrespective of body extension i.e. 3.0m, 6.0m and 9.0m.

**1.27.3.3** The tower with unequal leg extensions and truncations are not envisaged in these specification. However, if required during execution, the design of foundation for such towers shall be developed by contractor based on the critical loading conditions for a particular soil type.

**1.27.4 CLASSIFICATION OF FOUNDATIONS:**

**1.27.4.1** Depending on the location of water table and the presence of surface water, the following types of foundation designs shall be used for each type of tower:

(i). Normal dry type – To be used for locations in normal cohesive or non-cohesive soils where water table is expected to be below foundation level.

(ii). Wet type – To be used for locations in normal cohesive or non-cohesive soil and

1. where sub-soil water is met at 1.5 m or more below the ground level at or above foundation level.
2. Which are in surface water for long period with water penetration not exceeding one meter below the ground level e.g. the paddy fields.

(iii). Partially sub-merged type: To be used at locations in normal cohesive or non-cohesive soil and where sub-soil water table is met between 0.75 m to 1.5 m below the ground level.

(iv). Fully submerged type: To be used at locations in normal cohesive or non-cohesive soil and where sub-soil water is met at or less than 0.75 m below the ground level.

**1.27.4.2** In addition to the above, depending on the site conditions more varieties of foundations may be introduced for suitable intermediate conditions under the above classifications to effect more economy.

**1.27.4.3** For the purpose of evaluation of bids, the classification of foundation shall be considered in the ratio of 10:40:30:20 for Dry, Wet, PS, FS type of normal soil.

**1.27.4.4** The relevant characteristics of the various types of soils are given in **Section-II** of this specification. It shall be the responsibility of the contractor to draw the attention and obtain approval of the Purchaser for the departures necessitated in these design data,

based on geotechnical investigation at tower location, results of trial pits, etc.

### 1.27.5 FORCES FOR DESIGN OF FOUNDATIONS

**1.27.5.1** The following forces/loads transmitted to foundation by superstructure due to the action of wind, conductor tension, temperature, earthquake etc. acting thereon shall be considered in the design of foundation:

a) Maximum Tension/Uplift Force.

b) Maximum Compression Force/Down Thrust.

c) Maximum horizontal shears/side thrusts in longitudinal and transverse directions.

d) Additional forces due to eccentricities in the foundation system (if any).

### 1.27.6 PARTIAL SAFETY FACTORS ON LOADS

**1.27.6.1** For the design of foundation under most critical loading, the partial factor of safeties on loads shall be considered as under:

a) Towers up to angle of deviation of 0-15 deg.: 1.10.

b) Towers with angle of deviations above 15 deg. : 1.20

### 1.27.7 STABILITY OF FOUNDATION

**1.27.7.1** The foundation shall be designed to withstand the most critical combinations of forces specified in clause 1.27.5 multiplied by relevant partial factor of safety as specified in Clause 1.27.6. The stability of foundation, in general, shall be checked for the following aspects:

(i) Stability against Uplift

(ii) Stability against Limiting Bearing Pressure of soil

(iii) Stability against Side Thrust

**1.27.7.2** The types of soil resistances to be considered for balancing the various imposed forces by the superstructure on the foundation shall be considered as under:

#### (i) RESISTANCE AGAINST UPLIFT FORCES

The uplift force shall be assumed to be resisted by the weight of earth in an inverted frustum of a conical pyramid of earth

on the foundation pad with the sides of the pyramidal cone of earth at an angle equal to the angle of repose of the soil with vertical. The weight of concrete including reinforcement shall also be considered for resisting the uplift. In case the frustum of earth pyramid of two legs superimpose each other, the earth frustum shall be assumed truncated by a vertical plane passing through the centre line of the tower base. The angle of internal friction and density of various types of soils and the properties of concrete are given in **Section-II** of the Specification.

**(ii) RESISTANCE AGAINST COMPRESSION FORCE/DOWN THRUST:**

The total compression force/down thrust load including additional effective weight of concrete and weight of embedded steel parts shall be resisted by limiting bearing pressure of the soil acting on contact area of footing with soil. The limiting bearing pressures for various types of soil likely to be encountered enroute the 132 kV D/C line are given in **Section-II**.

**(iii) RESISTANCE AGAINST THE SIDE THRUST:**

The horizontal shears / side thrusts shall be assumed to be resisted by the passive pressure of soil around the footing. The passive resistance of the soil shall be calculated as per Rankine's formula. In case, complete side thrust is not balanced by available passive resistance of soil, unbalanced part of the side thrusts shall be balanced by bearing pressure of soil under the footing.

## 1.27.8 STRUCTURAL DESIGN OF FOUNDATION

**1.27.8.1** Isolated identical footings shall be provided for each leg of the tower.

Depending on soil conditions and loading, the foundation of tower shall be one
of the following types:

a) PYRAMID TYPE P.C.C FOOTING
b) SLAB TYPE R.C.C. FOOTING
c) PILE FOUNDATION

**1.27.8.2** The choice of type of footing between pyramid type and slab type R.C.C. shall be decided based on techno-economical

considerations. Slab type R.C.C. footings shall be provided at locations where, from techno-economical considerations, pyramid types of foundations are not acceptable.

**1.27.8.3** Seismic Forces: Design of foundations for towers against seismic forces shall conform to IS: 1893-2002 and other International Practices. The importance factor to be considered in the calculation of seismic forces shall be 1.5 and other factors shall be as per above code. In the event of award of contract, detailed supporting design calculations regarding adequacy and safety of foundations against seismic forces shall be furnished by the contractor.

**1.27.8.4** All foundations shall be designed so as to satisfy and meet the following requirements:

(a) The chimney of the foundation shall at least be 300 mm square providing a minimum clear concrete cover of not less than 100 mm to any part of the stub angle in case of dry foundations and at least 400 mm square with minimum clear concrete cover of not less than 150 mm to any part of the stub angle in case of wet, partially submerged and fully submerged foundations.

(b) The chimney top shall extend 300 mm (Minimum) above ground level inclusive of coping and coping shall be up to 50 mm below the joint between the bottom bracing and the leg members.

(c) In all foundations, a lean concrete sub-base having a thickness of 100mm and of size equal the concrete pyramid base/R.C.C. shall be provided under structural concrete. The lean concrete shall be of grade M-10 (1:3:6) conforming to IS: 456-2000. The lean concrete sub-base provided under the footings shall not be considered in the structural calculations.

(d) The embedded end of the stub angle shall have a 150 mm thick clear concrete cover up to the top of the lean concrete sub-base in the case of dry foundations and a 200 mm thick clear concrete cover in the case of wet, partially submerged and fully submerged foundations.

(e) The minimum length of stub encased in concrete below the ground level shall not be less than 1.5 metres. However, the stub shall extend up to the bottom of foundation having a clear concrete cover as specified in para (d) above.

(f) The depth of foundation below ground level shall not be more than 3.0 m.

(g) The joints between the tower stubs and the superstructure bracing members shall be 350 mm above ground level.

(h) The centroidal axis of the stub shall coincide with axis of the chimney and pass through the centre of the footing base. The design of the foundation shall take into account the additional forces resulting from eccentricity introduced due to non-compliance of above requirements.

(i) The chimney shall be designed as a composite member for combined action of axial forces and bending moments. The maximum compression/tension force along with moments in both the directions due to horizontal shears viz. transverse and longitudinal shall be considered in the design of chimney. The adequacy of chimney section shall be checked as per above and necessary reinforcement in chimney shall be provided as per design requirement. The chimney shall be designed as a composite section consisting of concrete, steel stub and reinforcement bars. The design shall be carried out as per limit state method of design in accordance with IS: 456-2000. Irrespective of design requirements, minimum reinforcement consisting of 0.15% of the cross sectional area of the chimney or 4 Nos. of 12 mm dia. bars, whichever is more, shall be provided in the chimney. The arrangement and other requirements except minimum requirement of reinforcement as specified in clause 26.5.3 of IS: 456-2000 shall be met.

(j) Wherever reinforcement is provided in foundation, the clear concrete cover to reinforcement shall not be less than 50 mm.

**1.27.8.5** The pyramid type of isolated foundations shall also satisfy and meet the following requirements in addition to requirements specified in Clause 1.27.8.4 above:

(a) The slope of concrete pyramid shall be limited to 45 degrees with respect to vertical.

(b) The minimum thickness of the concrete pyramid base slab shall be 100 mm in case of dry foundations and 200 mm in case of wet, partially submerged and fully submerged foundations.

(c) The portion of stub and the angel cleats in the pyramid portion only shall be capable of developing the required bond strength corresponding to the uplift load.

(d) The grade of concrete used in Pyramid type foundation in chimney and Pyramid portion shall be M20.

**1.27.8.6** The slab type R.C.C. foundations shall also satisfy and meet the following requirements is addition to requirement specified in Clause 1.27.8.5 above:

(a) The structural design of foundations shall be strictly in accordance with IS: 456-2000 and other relevant I.S. codes.

(b) The design of R.C.C. foundations shall be carried out by limit state method in accordance with IS: 456-2000, using partially safety factors as given in the clause 1.27.5.1.

(c) The minimum thickness of footing slab for foundations shall not be less than 250 mm in case of dry locations and 300 mm in case of wet locations.

(d) As specified in IS : 456-2000, the minimum thickness of footing slab at the edges shall not be less than 150 mm.

(e) In case of stepped foundations, the reinforcement at top face of each step shall be separately provided. The reinforcement from one step to another step at top face of the footings shall not be permitted.

(f) In the design of footing slabs, actual soil pressure under the footing shall be considered for calculating the maximum moments and shears at various sections. The critical sections for moments and shears shall be as specified in IS: 456-2000. The reinforcement in the footings shall be calculated so that the moment of resistance shall be at least equal to the bending moment at the section. **The concrete area of compression flange only shall be considered while calculating the moment of resistance of the section.**

(g) The grade of concrete to be used in RCC slab type foundation in chimney and pad shall be M25.

**1.27.8.7** Full particulars of foundations along with guaranteed volumes of excavation, concrete and reinforcement, for all types of specified towers shall be given in the tender as per Schedule - 6(1).

### 1.27.8.8 PILE FOUNDATION:

Pile foundation may be required at some tower locations especially located in flood plain of rivers where there are chances of scouring during floods or at locations where bearing capacity of soil is very poor and shallow foundation cannot be provided.

Bored pile shall be provided in case pile foundations are found necessary. The design of Bored pile foundation shall be in accordance with IS: 2911(Part - I). The pile foundation shall also satisfy and meet the following requirements:

(i) The minimum diameter of pile shall be not less than 400mm.

(ii) The grade of concrete shall be minimum M-25.

(iii) The minimum clear cover to reinforcement shall be not less than 50mm.

(iv) The minimum spacing of piles shall not be less than 3.0 times the diameter of pile.

(v) The minimum longitudinal reinforcement in the pile shaft shall not be less than 0.4% of the cross-section area of pile shaft.

(vi) The minimum diameter of main reinforcement bars shall not be less than 16mm and minimum diameter of links shall not be less than 8mm. Minimum nos. of main reinforcement bars shall be not less than 6 nos.

(vii) The pile shall project minimum 100mm into the pile cap concrete.

(viii) The clear cover to main reinforcement in pile cap shall not be less than 60 mm.

(ix) Pile load test shall be carried out as per IS: 2911 (Part-IV) to ascertain the ultimate load carrying capacity of pile for vertical as well as lateral load conditions, if required by the Purchaser.

**1.27.8.9** The bidder shall quote the unit rates for pile foundation in Schedule 6(3).

### 1.27.9 QUALITY ASSURANCE PLAN :

A Quality Assurance Plan for civil works of foundations and protection works shall be submitted by the Contractor. The Contractor shall follow the approved Quality Assurance Plan in true spirit.

## 1.28 FABRICATION

**1.28.1** The fabrication of towers shall be in accordance with the provisions made in the following sub-clauses.

**1.28.1.1** Except where here-in-after modified, details of fabrication shall conform to the relevant clauses of IS : 802(Part -II) -1990 or latest edition.

**1.28.1.2** The Contractor during fabrication of tower members shall ensure that mild steel and high tensile steel do not get mixed up during fabrication and as such identification mark shall be embossed on each and every H.T.Steel section at the time of shearing of members . The tenderer in his tender shall clearly bring out the means adopted to identify the mild steel and high tensile steel sections during fabrication.

**1.28.1.3** All parts of the towers shall be cut to correct lengths and fabricated in accordance with the shop drawings approved by the Purchaser. Welding of two or more pieces to obtain the length of member specified will not be allowed. Members shall be straight to the permissible tolerances or better when required to ensure proper fit before being laid off or worked and after galvanising.

**1.28.1.4** Normally butt splices shall be used. The components constituting the joint shall have a total strength greater than the heavier of the members connected. Lap splices may be used for connecting members of unequal sizes. The inside angle of lap splice shall be ground at the heel to fit the fillet of the outside angle. All splices shall develop full strength of the members connected through bolts, But as well as lap splices shall be made above and as close to the main panel points as possible.

**1.28.1.5** Joints shall be so designed and detailed as to avoid eccentricity as far as possible. However, where the connections are such that the elimination of gusset plates would result into eccentric joints gusset plates and spacer plates may be used in conformity with modern practices. The thickness of gusset plates shall not be less than 6 mm. Where a gusset plate is required to transmit stress, its thickness shall not be less than the thickness of the thickest connected bracing members but not less than 6 mm.

**1.28.1.6** The use of fillers in the connections shall be avoided as far as possible. The diagonal web members in tension may be connected entirely to the gusset plate where necessary to avoid the use of fillers. Each diagonal shall be in one piece without splices or centre

gusset, and it shall be connected at the point of intersection by one or more bolts.

**1.28.1.7** The tower members shall be accurately fabricated to bolt together easily at site without any undue strain on them or the bolts.

**1.28.1.8** No angle member shall have the two leg flanges brought together by closing the angle.

**1.28.1.9** All parts of the towers shall be accessible for inspection and cleaning. Drain holes shall be provided at all points where pockets or depressions are likely to hold water.

**1.28.1.10** All similar parts shall be made strictly interchangeable. No rough edges shall be permitted any where throughout the work.

**1.28.2.1 STRAIGHTENING:**

Straightening shall be so done that it does not injure the material. Hammering shall not be permitted for straightening / or flattening of members. Sharp bends shall be a cause for rejection.

**1.28.2.2. CUTTING :**

The cut surfaces shall be clean , smooth, reasonably square and free from any distortion.

**1.28.2.3 BENDING :**

Mild steel angle sections upto 75x75mm (thickness upto and including 6mm ) shall be bent cold upto and including bend angles of 10 deg. Mild steel angle sections above 75x75mm (thickness upto and including 6mm ) and upto and including 100x100mm (thickness upto 8mm ) may also be bent cold upto bend angles of 5 deg. All other angle sections and bend angles not covered above shall be bent hot. All plates upto 12mm thickness shall be cold worked upto a maximum bend angle of 15deg. Hot bending shall be employed for greater bend angles and thicker plates. All hot bent material shall be air-cooled. The bends shall be of even profile and free from any surface damages. Bends on all high tensile steel sections shall be done hot

**1.28.2.4 HOLING:**

Holes in the members shall either be drilled or punched to jig and shall not be formed by flame cutting process. All burrs left by punching or drilling shall be completely removed. Punching may be adopted for M.S. sections with thickness upto 16mm . For thicker sections, drilling shall be done. The holes near the bend line of a bent member on both sides of bend line should be punched/drilled after bending and relative positions of those

holes shall be maintained with the use of proper templates/jigs and fixtures. The limit of punching for H.T. Steel section may be indicated in the bid.

## 1.29 FASTENERS : BOLTS, NUTS AND WASHERS

**1.29.1** All bolts and nuts shall conform to IS: 6639-1990 and IS 12427-1988 or latest edition. All bolts and nuts shall be galvanised and shall have hexagonal head and hexagonal nut. The heads being forged out of the solid truly concentric, and square with the shank, which must be perfectly straight ultimate stresses in the bolts shall be as given in table - I of cl. 5.4.1 of IS 802(part I /Section 2 ) 3rd revision.

**1.29.2** Fully threaded bolts shall not be used. The length of bolts shall be such that the threaded portion will not extend into the plane of contact of the member.

**1.29.3** All bolts shall be threaded to take the full depth of the nut and threaded for enough to permit firm gripping of the members, but not further. It shall be ensured that the threaded portion of each bolt protrudes not less that 3mm and not more than 8mm when fully tightened. All nuts shall fit and tight to the point where the shank of the bolt connect to the thread.

**1.29.4** Flat and tapered washers shall be provided wherever necessary. Spring washers designated as B-16 as per IS-3063 Electro galvanised shall be provided for insertion under all nuts. These washers shall be of steel and electro-galvanised, conforming to IS-1573 -1991 and positive lock type and 3.5 mm in thickness for 16 mm dia bolt and 4mm for 20mm dia bolt and 4.5mm for 24mm bolt as per IS:3063-1994.

**1.29.5** The Bidder shall furnish bolt schedules giving thickness of members connected, the nut and the washer and the length of shank and the threaded portion of bolts and sizes of holes and other special detail of this nature.

**1.29.6** To obviate bending stress in bolts or to reduce to minimum, no bolt shall connect aggregate thickness of more than (3) times the bolt diameter and also the number of members carrying stresses to be connected by a single bolt shall not generally exceed three ( excluding gusset and packing).

**1.29.7** The bolt positions in assembled towers shall be as per IS: 5613(Part-3/Section-2)-1989.

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

**1.29.9 SPACING OF BOLTS AND EDGE DISTANCE :**

The minimum spacing of bolts and edge distances shall be as given below:

| Bolt dia-meter (mm) | Hole dia-meter (mm) | Minimum bolt spacing (mm) | Minimum edge Distance(mm) Hole centre to rolled or sawn edge | Hole centre to sheared or flame cut edge |
|---|---|---|---|---|
| 16 | 17.5 | 40 | 20 | 23 |
| 20 | 21.5 | 48 | 25 | 28 |
| 24 | 26.0 | 60 | 33 | 38 |

**1.29.10 LOCKING DEVICES**

Electrogalvanised/hot dip galvanised spring washers of type B of thickness indicated below corresponding to bolt diameter shall be provided for insertion under all nuts.

| Bolt Diameter (mm) | Thickness of spring washer (mm) |
|---|---|
| 16 | 3.5 |
| 20 | 4.0 |
| 24 | 5.0 |

**1.29.11** The gap between the ends of two connected members in a butt shall not be more than 6 mm and less than 4 mm.

**1.29.12 TOLERANCES**

**1.29.12.1** The fabrication tolerances in general shall conform to IS:7215-1974 unless otherwise specified here-in-under:

**1.29.12.2** The maximum allowable differences in diameter of the holes on the two sides of the plate or angle shall be 0.8mm i.e. the allowable taper in a punched hole shall not exceed 0.8 mm on diameter.

**1.29.12.3** Tolerance cumulative and between consecutive holes shall be within ±0.5mm.

**1.29.12.4** Tolerence on the overall length of a member shall be within ±1.6 mm.

**1.29.12.5** Tolerance on guage distance shall be within ±0.5mm.

## 1.30 ERECTION MARK

**1.30.1** Each individual member shall have erection mark conforming to the component number given to it in the fabrication drawings. This mark shall be punched with marking dies of 16 mm size before galvanising and shall be legible after galvanising.

**1.30.2** Erection Mark shall be A-BB-CC-DDD

| | | |
|---|---|---|
| A | = | Purchaser's code assigned to the contractors-Alphabet. |
| BB | = | Contractor's Mark-Numerical |
| CC | = | Tower Type-Alphabet |
| DDD | = | Number mark to be assigned by Contractor-Numerical. |

## 1.31 CHECK ASSEMBLY OF TOWERS.

**1.31.1** Before proceeding with the bulk fabrication of any type of tower, the Contractor shall fabricate and assemble in his works for inspection by the purchaser or his authorised representative, one tower of each type as finally approved by the Purchaser for checking the fabrication accuracy and workmanship. The check assembly shall be in a horizontal position. Proto assembly made on ground in horizontal position shall be adequately supported to prevent distortion and overstressing of members to ensure proper fit and shall be accomplished without extraordinary effort to align bolt holes or to force pieces into position. For the check assembly, bolts and nuts shall be not more than finger tight.

## 1.32 GALVANISING

**1.32.1** All tower members and stubs shall be fully galvanised. Galvanising of the member of the towers and stubs shall conform to IS:2629-1990 and IS: 4759-1990. All galvanised members shall withstand tests as per IS:2633-1992. For fasteners, the galvanising shall conform to IS : 5358-1969. The Galvanising shall be done after all fabrication work is completed, except that the nuts may be tapped or re-run after galvanising. Threads of bolts and nuts shall have a neat fit and shall be such that they can be turned with finger throughout the length of the threads of bolts and they shall be capable of developing full strength of the bolts. Spring washers shall be eletro-galvanised as per Grade 4 of IS :1573-1991.

**1.32.2** The finished materials shall be dipped into the solution of dichromate after galvanising or treated with approved inhibitor (the

details of which shall be given in the tender) for protection against white rust formation during sea transportation.

## 1.33 STUB SETTING TEMPLATES

Stub templates shall be designed, fabricated and supplied by the contractor for all types of tower with or without extensions and also for leg extension. Stub templates suitable for standard towers and tower with extension of 3 metre, 6 metre, and 9 metre shall be of adjustable type. The stub templates shall be painted with anticorrosive paints. The number of templates of each type of tower is to be arranged by the contractor to the satisfaction of the purchaser for timely completion of line. The quantities of templates indicated in the Schedule are required by the purchaser for keeping in stores.

**1.33(a)** Thickness of Stubs:
"The thickness of stub-section should be kept 2mm more than the thickness of the last leg members connected to the stub."

## 1.34 DRAWINGS AND BILL OF MATERIALS.

**1.34.1.a** The following technical drawings and documentation are to be submitted along with the tender without which the tender is liable to be rejected:-

Outline drawings with dimensions and clearance diagrams for all tower types.
Loading diagrams for all tower types.
Technical data for all the stuctural steel proposed for tower members and bolts, nuts and washers.
Detailed design calculations including stress tables, member & bolt sizes, foundation loads etc. for tangent tower(s).
Drawings and /or catalogues of bidder's equipment.
Out line drawings of foundations of each type which are proposed with typical calculation.
Final Conductor and Ground Wire sag/tension charts.
Full description of the proposed method of tension stringing.

**1.34.1.b** The tenderers shall furnish the following designs and drawings after award of contract.
Fully dimensioned drawing for each standard type of tower complete with cross arms showing sizes of all steel sections. fittings, bolts, attachments etc. and clearance diagrams.
Dimensioned drawings for extensions with sizes of steel sections employed.
Dimensioned drawings for stubs.
Dimensioned drawings for stub setting templates.

Dimensioned drawings for anti-climbing device.
Loading diagram for all towers under different working conditions.
Dimensioned drawings for foundations for each type of standard tower, and tower with 3 metre, 6 metre, & 9 metre extensions with detailed design computation resisting uplift, down thrust and side thrust shall be furnished. Drawings shall show all details of keying rods, cleat angles, etc. to be provided for concrete foundations.
For foundations of each type of towers, the drawings shall furnish the
following information:-

a) Dimensions of excavation per leg.
b) Volume of concrete.

The capacity charts for all types of towers to be used for smaller angles and longer spans shall be furnished after award of Contract.

**1.34.2** Award of contract:- The contractor shall submit after placement of letter of award detailed designs of tower, extension, alongwith computer output together with sample calculations for few critical members etc.A soft copy of input files of computer program used for analysis of various type of towers shall also be supplied for cheking the tower designs.

**1.34.3** The design and drawings as covered in clause 1.34.1.b. above shall be approved/commented by the owner as the case may be with in thirty (30) days of receipt of designs/ drawings in Chief Engineer's office. If the designs/drawings are commented by the owner, the contractor shall submit revised designs/drawings duly incorporating all comments within fifteen (15) days of date of issue of comments.

**1.34.4** The Contractor shall furnish to the Purchaser for approval the various contract drawings, bills of materials, bolt and washer schedules loading/rigging arrangements for tower testing etc. as called for in the various clauses of this specification. These shall include, but shall not be limited to the followings :-

a) Design Calculations and drawings: All design drawings and calculations listed in clause 1.34.1.b given above.
b) Shop Drawing: Shop drawings shall list in a space above the title, the part number and required quantity of each member detailed on the drawing. Members may be detailed separately or in places in any assembly.
c) Erection Drawings: Erection drawings shall be furnished for each type of tower and extension , shall show assembly diagram of structures clearly indicating the position of each member and the position of each member and the quantity and size of bolts for each joint.

d) Bill of Materials: A complete bill of material for each type of tower shall be submitted with the erection drawings indicating each part number, required quantities for one tower section of member length, calculated weight and relevant design drawing reference.

e) Bolts, Nuts and washer Schedule: Bolts, nuts and washers schedules shall list the number of bolts and washers required per tower alongwith the sizes and lengths of bolts and number, type and size of washers. The shank length and length of threaded portion of various types of bolts shall be indicated in drawing / table.

## 1.35 TESTING OF TOWERS

**1.35.1** All standard tests, including quality control tests in accordance with relevant Indian Standards shall be carried out.

**1.35.2** 1.35.2 An ungalvanised (black)tower of each type complete with 9m extension shall be subjected to design and destruction tests by first applying test loads equivalent to the specified ultimate tower loadings and applied in a manner approved by the purchaser. The tower shall withstand these tests without showing any sign of failure or permanent distortion in any part. Thereafter the tower shall be subjected to destruction by increasing the loads further in an approved manner till it fails. The tower shall be tested for all the conditions considered for the design of tower. The successful Bidder shall submit to the Purchaser, for approval, the detailed programme and proposal for testing the towers showing the methods of carrying out the tests and manner of applying the loads. After the Purchaser has approved the test procedures and programmes the contractor will intimate the purchaser about carrying out of the tests at least 30 days in advance of the scheduled date of tests during which the Purchaser will arrange to depute his Consultant's / representatives to be present at the time of carrying out of the tests. Six copies of the test reports shall be submitted.

The Contractor shall submit one set of shop drawings alongwith the bill of materials at the time of prototype tower testing for checking the tower material. Further at the time of submitting test report, the contractor has to submit the final tracings of shop drawings and Bill of materials for Purchaser's reference and record.

**1.35.3** In case of premature failure the tower shall be retested and steel already used in the earlier test shall not be used again. However, in case of minor failures, the contractor can replace the members with higher section and carry out the testing, The Contractor shall provide facilities to the Purchaser or their representatives for

inspection of materials during manufacturing stage and also during testing of the same.

**1.35.4** In case of any premature failure even during waiting period, the tower is to be retested with rectified members. However, if the failures are major in nature and considerable portion of tower is to be re-erected, in such cases all the tests which has been carried out earlier to be reconducted again to the entire satisfaction of Purchaser.

**1.35.5** No part of any tower subject to test shall be allowed to be used on the line. The price will be quoted after allowing rebate for the scrap value of the tower material which will be retained by the successful Bidder.

**1.35.6** The Contractor shall ensure that the specification of materials and workmanship of all towers actually supplied conform strictly to the towers which have successfully under gone the tests. In case any deviation is detected the Contractor shall replace such defective towers free of cost to the Purchaser. All expenditure incurred in erection, to and fro transportation, any other expenditure or losses incurred by the Purchaser on this account shall be fully borne by the successful Bidder. No extension in completion time shall be allowed on this account.

The Purchaser, however, reserves the right to waive off the testing of the towers, provided the successful Bidder had earlier successfully tested, erected and commissioned same towers and certificate for such tests carried out earlier are furnished duly certified by that purchaser and are found acceptable.

**1.35.7** Each type of tower to be tested shall be a full scale prototype black tower and shall be erected vertically on rigid foundation and the stub protruding above ground level as provided in the design drawing between ground level and concrete level. This portion of the stub shall be kept unbraced while testing. The tower erected on test bed shall not be out of plumb by more than 1 in 360.

**1.35.8** All the measuring instruments shall be calibrated in systematic approved manner with the help of standard weight/device. Calibration shall be done before commencing the test of each tower upto 20% above maximum anticipated loads to be applied during testing.

**1.35.9** The sequence of testing shall be at the discretion of the purchaser.

**1.35.10** The Purchaser may decide to carry out the tensile test, bend test etc. as per relevant IS on few members of the test tower after completion

of the test. The decision of the Purchaser's representative regarding which member and number of members to be tested is final and binding. The successful bidder shall make suitable arrangement for the same.

**1.35.11** Prefix 'T' shall be marked on all members of test tower in addition to the mark no. already provided.

**1.35.12** Calibration of Measuring Instruments

All measuring instruments shall be calibrated atleast 20% above the maximum anticipated load to be applied during testing with the help of standard weights. The test loads shall be corrected with the help of calibration curves.

**1.35.13 TESTS**

The procedure for conducting the tower test shall be as specified in IS: 802 (Part - III) (latest edition).

**1.35.13.1 BOLT SLIP TEST :**

The test loads shall be gradually applied upto the design loads according to rigging diagram, kept constant for two(2) minutes at the design loads and then released gradually. The initial and final readings on the scales before application and after the release of loads respectively shall be taken with the help of theodolite and the bolt slip shall be determined from the readings so obtained.

**1.35.13.2 NORMAL LOAD/BROKEN WIRE LOAD TESTS :**

All the loads shall be applied gradually upto the ultimate design loads in the following steps and shall be released in a similar manner :

25 percent
50 percent
75 percent
90 percent
95 percent; and
100 percent.

Under normal and broken wire load tests, the tower shall be kept under observation for any sign of failure for two minutes (excluding the time for adjustment of loads) for all intermediate steps of loading upto and including 95% of ultimate design loads.

For normal as well as broken-wire tests, the tower shall be kept under observation for five minutes with 100% ultimate design load applied to it.
While the loading operations are in progress, the tower shall be constantly watched and if it shows any tendency of failure anywhere, the loading shall be immediately stopped, released and then the entire tower shall be inspected. The re-loading shall be started only after corrective measures are taken.

The deflection of the tower shall be recorded at each intermediate and final stage of normal load/ broken - wire load test by means of a theodolite and graduated scales fitted on the tower. The structures shall be considered to be satisfactory if it is able to support the specific ultimate load for five(5)minutes with no visible deformation after unloading (such as bowing, buckling )and no breakage of elements or constituent parts. Ovalization of holes and permanent deformation of bolts shall be considered as failure.

**1.35.13.3** Destruction Tests : If desired by the purchaser, all types of towers shall be tested to destruction. The test shall be carried out under normal condition. All the provisions as stated in clause 1.35.13.2 shall be applicable to destruction test. However, the loads shall be increased in steps of 5% after the ultimate design loads have been reached.

**1.35.13.4** Material Test : In case of failure of towers after retest, coupons shall be cut from test tower members and tested in a laboratory to ascertain conformity of the material to the governing standard.

**1.35.14 RETEST**

**1.35.14.1** In the event of premature failure of tower, the part that has failed may be replaced by another with a greater mechanical strength. The modified structure shall be required to pass the test for the specified ultimate load values (100% step)

**1.35.14.2** In case of failure of tower during testing, and retest is to be conducted at a later date, all the expenses for witnessing of test, by the representative of the purchaser, shall be borne by the Contractor.

**1.36 PACKINGS**

**1.36.1** The material shall be boxed or bundled for transport in the following manner :-

**1.36.2** Angles shall be packed in bundles securely wrapped four times around at each end and at every metre with No.9 guage galvanised

steel wire with ends twisted tightly. Gross weight of any bundle shall not exceed approximately 450 kg.

**1.36.3** Cleat angles, brackets , fillet plates and similar small loose pieces shall be nested and bolted together in multiples , and securely wired together through holes, wrapped round at least four times with No.9 guage galvanised steel wire and ends twisted tightly. Gross weight of each bundle shall not exceed approximately 70kg.

**1.36.4** The correct number of bolts, nuts and washers to be packed in heavy gunny bags accurately tagged in accordance with the contents and a number of bags packed in a solid box of 22mm thick lumber with panelled ends to be securely nailed and further reinforced with 22mm x No. 18 guage iron band stretched entirely around the battons with ends over lapping at least 150mm. Gross weight of each box shall not exceed approximately 70kg.

All packing shall be subject to the approval of the Purchaser, or his appointed representatives.

The packing shall be carried out with caution to protect the material from moisture, salt or any impurities which may cause rust or harmful effects.

The packages shall be new and sufficiently sturdy in construction to withstand normal service incident to shipping and field handling.

## 1.37 MARKING OF PACKINGS

Each bundle or package shall have the following marks :

**1.37.1** The contract/purchase order no. and date, the name or designation of the consignee (to be furnished by the Purchaser).

**1.37.2** Ultimate destination (as required by the Purchaser).

Detailed despatch instruction shall be asked for by the contractor from the Purchaser at least 4 weeks ahead of the scheduled date of despatch.
All packages shall be marked with the standard packing mark as desired by the Purchaser.

## 1.38 PLACE OF MANUFACTURE AND MANPOWER

1.38.1 The tenderer must have established steel fabrication facilities in his works or at the works of his Associates. The galvanising bath plant & equipment available for fabrication ,testing facilities available in their works and other Institution which they intend to make use of

shall be stated in the Schedules in Section III,and shall not be changed without the approval of the Purchaser. The tenderer shall also submit the details of manpower available with his Organisation indicating clearly the number of personnels engaged in the design, fabrication of supporting structures and for erection/construction of the transmission lines. The tenderer shall give a brief profile of the Organisation(s)

**1.39 GUARANTEED TECHNICAL PARTICULARS**

**1.39.1** The tenderer shall fill in the guaranteed technical particulars in the Schedule-A in section-III of this Specification and submit the same with tender.

**1.40 SCHEDULE OF REQUIREMENTS AND DESIRED DELIVERY**

**1.40.1** The schedule of requirements (tentative ) and desired deliveries is given in Section -II of this Specification.

**1.41 PERFORMANCE SCHEDULE**

**1.41.1** The tenderer shall furnish the details of his performance in respect of the major works carried out by him involving supplies of materials for and/or erection of such EHV lines preferably 132 kV lines which are in service, at least for the last five years, in the performance schedule contained in Section - III of this Specification.

**1.42 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 plain 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.

**1.43 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, (technical or commercial ) otherwise it shall be presumed that the tenderer agrees to the provision/s of this specification and same shall be included in the purchase order and the contract in case of successful tenderers.

## 1.44 PAYMENTS

The payments towards supply of tower part shall be in accordance with the section General Condition of Contract(GCC) and of section Special Condition of Contract (SCC) of volume I of this specification.

## CHAPTER-2
## SURVEY

### 2.1 SCOPE

**2.1.1** This chapter covers finalisation of alignment of the transmission lines, detailed survey, route profile, tower spotting and soil testing for determining the characteristics of soils at selected locations for design of foundation along the transmission lines route.

### 2.2 TRANSMISSION LINE ROUTE

**2.2.1** The proposed route of the transmission lines is shown in exhibit-I. The contractor shall examine the proposed route from the under mentioned considerations and prepare the route alignment map indicating clearly the changes, if any, considered necessary by the contractor in the interest of economy/better alignment for the approval of the purchaser.

a) The lines are near to and along the available roads in the area.

b) The route should be as short and as straight as possible.

c) The number of angle towers should be minimum and within these the number of heavier angle towers shall be as small as possible.

d) Good farming areas, uneven terrain, religious places, civil and defence installations, industries, aerodromes and their approach and take-off funnels, public and private premises, ponds, tanks, lakes, gardens and plantations should be avoided as far as practicable.

e) Costs of securing and clearing right-of-way(ROW), making access roads and the time required for these works should be minimum.

f) The line should be as away as possible from the telecommunication lines and should not run parallel to these.

g) Crossing with permanent objects such as railway lines & Roads should be minimum and preferably at right angles.

h) Difficult and unsafe approaches should be avoided.

i) A detour in the route is preferable so that it should be capable of taking care of future load developments without major modifications.

j) The line should be away from the buildings containing explosives, bulk storage oil tanks, oil or gas pipelines.

## 2.3 DETAILED SURVEY

**2.3.1** The Contractor shall submit the proposal for detailed route survey based on approved preliminary route alignment. The contractor shall finalize and submit proposal for all obligatory points within three (3) months from the date of commencement of work at site. These obligatory points shall include all the River crossings, Railway Crossings, Power Line Crossings or any other important crossings encountered in the transmission line route. The following schedule shall be adhered to in respect of obligatory points:

| | |
|---|---|
| Submission of proposal and profile to WAPCOS/ CEA | 3 months from the date of award of contract i.e. date of receipt of advance |
| Submission of soil investigation Report | 1 month from the date of approval of profile. |

The Bidder should note that Owner will not furnish the topographical maps prepared by Survey of India but will make available any assistance that may be required in obtaining the topographical maps.
The detailed survey shall be made along the approved alignment.

## 2.4 ROUTE MARKING

At the starting point of the commencement of route survey, an angle iron spike of 65x65x6 mm section and 1000 mm long shall be driven firmly into the ground to project only 150 mm above the ground level. A punch mark on the top section of the angle iron shall be made to indicate location of the survey instrument. Teak wood peg 50x50x6 mm size shall be driven at prominent positions at intervals of not more than 750 meter along the transmission line to be surveyed upto the next angle point. Nails of 100 mm wire should be fixed on the top of these pegs to show the location of instrument. The pegs shall be driven firmly into the ground to project 100 mm only above ground level. At angle position, stone/concrete pillar with WAPCOS/ CEA, New Delhi marked on them shall be put firmly on the ground for easy identification. Paint mark in white lead paint shall be put in about 300 mm squares with a direction indication on near by bolders rocks, trees along the complete alignment.

## 2.5 PROFILE PLOTTING AND TOWER SPOTTING

From the field book entries, the route plan with reroute details and level profile shall be plotted and prepared to scales of 1 : 2000 horizontal & 1 : 200 vertical on 1.0, 10 mm squared paper as per approved procedure. Reference levels at every 20 meters along the profile are also to be indicated on the profile besides, R/Ls at undulations. Areas along the profile which, in the view of the contractors, are not suitable for tower spotting, shall also be clearly marked on the profile plots. If the difference in levels be too high the chart may be broken up according to requirement. A 10 mm overlap shall be shown on each following sheet. The chart shall progress from left to right. Sheet shall be 594 mm wide in accordance with the IS Standard. For as built profiles these shall be in A1 size.

## 2.6 TOWER LOCATION

### 2.6.1 SAG TAMPLATE

Sag template drawing will be prepared and submitted by the contractor at the time of detailed survey for approval of the WAPCOS/ CEA. Based on the above drawing, the Contractor has to prepare sag template on rigid transparent plastic sheet and provide two sets of the same to Owner for checking purpose.

### 2.6.2 TOWER SPOTTING

With the help of sag template and tower spotting data enclosed with specification, tower locations shall be marked on the profiles. While locating the towers on the profile sheet, the following shall be borne in mind:

a) Span
The number of consecutive spans between the section points shall not exceed 10. A section point shall comprise of tension point with B, DB type or C, DC type or D, DD type towers.

b) Extension
An individual span shall be as near to the normal design span as possible. In case an individual span becomes too short with normal supports on account of undulations in ground profile, one or both the supports of the span may be extended by inserting standard body extension designed for the purpose according to technical specification.

c) Loading
There shall not be any upward force on suspension towers under normal working conditions and the suspension towers

shall support at least the minimum weight span as provided in the designs. In case uplift is unavoidable, it shall be examined if the same can be overcome by adding standard body extension to the towers failing which tension towers designed for the purpose shall be employed at such positions.

d) Road Crossing

At all important road crossings, the towers shall be fitted with normal suspension or tension insulator strings depending on the type of towers but the ground clearance at the roads under maximum temperature and in still air shall be such that even with conductor broken in adjacent span, ground clearance of the conductor from the road surfaces will not be less than 6.10 meters. At all national highways, tension towers shall be used. The crossing span, however will not exceed 250 meters in any case.

e) Railway Crossings

Railway crossings shall be supported on B, DB type or C, DC type or D, DD type towers on either side, depending on the merits of each case and shall be constructed in conformity with the specification laid down by the Railway Authorities. Necessary copies of tracings and prints of plan, profile etc., required for the approval of railway crossings shall be supplied by the Contractor to the Owner free of cost.

In case of rail crossing the minimum height above rail level of the lowest portion of any conductor under condition of maximum sag, in accordance with the regulation for Electrical Crossing of Railway track as prevailing at the time of construction of line shall be applicable. As per present regulation (revised in 1987) the minimum clearance that is required to be maintained between the lowest point of the 132 kV line conductor and the rail level, is stipulated as 14.60 meters.

f) Power Line Crossings

Where this line is to cross over another line of the same voltage or lower voltage, A/DA type tower with suitable extensions shall be used. Provision to prevent the possibility of its coming into contact with other overhead lines shall be made in accordance with the Indian Electricity Rules, 1956. In order to reduce the height of the crossing towers, it may be advantageous to remove the ground-wire of the line to be crossed (if this is possible, and permitted by the owner of the line to be crossed). All the works related to the above proposal shall be deemed to be included in the scope of the contractor without any extra cost to the owner.

g) Telecommunication Line Crossing
The angle of crossing shall be as near to $90^0$ as possible. However, deviation to the extent of $30^0$ may be permitted under exceptionally difficult situations.
When the angle of crossing has to be below $60^o$ , the matter will be referred to the authority in charge of the telecommunication system. On a request from the Contractor, the permission of the telecommunication authority will be obtained by the Owner. Also in the crossing span, power line support will be as near the telecommunication line as possible, to obtain increased vertical clearance between the wires.

h) Details Enroute
All topographical details, permanent features, such as trees, building etc.,
13.5 m on either side of the alignment shall be detailed on the profile plan.

**2.7 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 upto date.

**2.7.1** The tree-cutting shall be the responsibility of the owner including for that required during survey. If any tree cutting by the contractor is require, 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 Contractors work.

**2.7.2** To evaluate and tabulate the trees and bushes coming within 13.5 meters on either side of the central line alignment, the trees will be numbered and marked with quality paint serially from angle point 1(i) onwards and the corresponding number will be painted on the stem of the trees at a height of 1 meter from ground level. The trees list should contain the following:

a) Girth circumference measured at a height of 1 meter from ground level.
b) Approximate height of the tree with an accuracy of $\pm$ 2 meters.
c) Name of the type of species/tree
d) The bushy and undergrowth encountered in the 27 meters belt should also be evaluated with its type, height and area

in square meters, clearly indicating the growth in tree/bush statement.

**2.7.3** The contractor shall be responsible for tree enumeration for the purpose of initiating proposal for obtaining forest clearance from Ministry of Environment & Forest. The contractor shall submit 10 copies of the complete proposal to be moved for forest clearance to the satisfaction of the engineer-in-charge of the work.

## 2.8 PRELIMINARY SCHEDULE

The profile sheets, duly spotted, alongwith preliminary schedules indicating type of towers, type of foundations, wind span, weight span, angle of deviation, river or road crossing and other details shall be submitted for the approval of the owner. After approval, the Contractor shall submit six more sets of the approved reports alongwith one set of reproducible of final profile drawings to the owner for record purpose.

## 2.9 GEO-TECHNICAL INVESTIGATION:

**2.9.1** The contractor shall be required to carry out the following field/ laboratory tests or any other test which may be necessary for ascertaining the soil properties required for design of the foundations:

| **Sl. No.** | **Type of test** | **Depth below NGL** | |
|---|---|---|---|
| | | **For Shallow foundation** | **For Pile foundation** |
| 1 | SPT test & collection of disturbed soil samples | 1.5m, 3m, 6m, 9m, 12m, 15m | 2m, 5m, 8m, 11m, 14m, 17m, 20m, 23m, 26m, 29m, 30m. |
| 2 | Collection of Undisturbed soil samples and prescribed laboratory tests | 1.0m, 2.5m, 4.5m, 7.5m, 10.5m, 13.5 m | 1.5m, 3.5m, 6.5m, 9.5m, 12.5m, 15.5 m, 18.5m, 21.5m, 24.5m, 27.5m. |
| 3 | Laboratory tests on Disturbed soil samples | 1.5m, 3m, 6m, 9m, 12m, 15m | 2m, 5m, 8m, 11m, 14m, 17m, 20m, 23m, 26m, 29m, 30m. |

The soil shall be classified in accordance with IS:1200 (Part - I) and IS:5613 (Part II/Sec-2) (latest edition). For detailed soil investigation, the field and laboratory tests as per procedures specified in latest

edition of following IS codes and soil conditions available at site shall be carried out:

| | |
|---|---|
| IS: 1080 | Code of practice for design and construction of simple spread foundations. |
| IS: 1498 | Classification and Identification of Soil for general Engineering Purpose. |
| IS: 1892 | Code of practice for Subsurface Investigation for Foundation. |
| IS: 1904 | Code of practice for design and construction of foundation in Soils:<br>General Requirements. |
| IS: 2131 | Method of Standard Penetration Test for Soils. |
| IS 2720(Part 1) | Methods of test for soils: Part 1 Preparation of dry soil samples for various tests |
| IS 2720(Part 2) | Methods of test for soils: Part 2 Determination of water content |
| IS 2720(Part 3/Sec-1) | Methods of test for soils: Part 3 Determination of specific gravity, Fine grained soils |
| IS 2720(Part 3/Sec-2) | Methods of test for soils: Part 3 Determination of specific gravity, Fine, medium and coarse grained soils |
| IS 2720(Part 4) | Methods of test for soils: Part 4 Grain size analysis |
| IS 2720(Part 5) | Methods of test for soils: Part 5 Determination of liquid and plastic limit |
| IS 2720(Part 6) | Methods of test for soils: Part 6 Determination of shrinkage factors |
| IS 2720(Part 7) | Methods of test for soils: Part 7 Determination of water content- dry density relation using light compaction |
| IS 2720(Part 8) | Methods of test for soils: Part 8 Determination of water content- dry density relation using heavy compaction |
| IS 2720(Part 9) | Methods of test for soils: Part 9 Determination of dry density- moisture |

| | |
|---|---|
| | content relation by constant mass of soil method |
| IS 2720(Part 10) | Methods of test for soils: Part 10 Determination of unconfined compressive strength |
| IS 2720(Part 11) | Methods of test for soils: Part 11 Determination of the shear strength parameters of a specimen tested in unconsolidated undrained triaxial compression without the measurement of pore water pressure |
| IS 2720(Part 12) | Methods of test for soils: Part 12 Determination of shear strength parameters of soil from consolidated undrained triaxial compression test with measurement of pore water pressure |
| IS 2720(Part 13) | Methods of test for soils: Part 13 Direct shear test |
| IS 2720(Part 14) | Methods of test for soils: Part 14 Determination of density index (relative density) of cohesion less soils |
| IS 2720(Part 15) | Methods of test for soils: Part 15 Determination of consolidation properties |
| IS 2720(Part 16) | Methods of test for soils: Part 16 Laboratory determination of CBR |
| IS 2720(Part 17) | Methods of test for soils: Part 17 Laboratory determination of permeability IS 2720(Part 18) Methods of test for soils: Part 18 Determination of field moisture equivalent |
| IS 2720(Part 19) | Methods of test for soils: Part 19 Determination of centrifuge moisture equivalent |
| IS 2720(Part 20) | Methods of test for soils: Part 20 Determination of linear shrinkage |
| IS 2720(Part 21) | Methods of test for soils: Part 21 Determination of total soluble solids |
| IS 2720(Part 22) | Methods of test for soils: Part 22 Determination of organic matter |
| IS 2720(Part 23) | Methods of test for soils: Part 23 Determination of calcium carbonate |

| | |
|---|---|
| IS 2720(Part 24) | Methods of test for soils: Part 24 Determination of cation exchange capacity |
| IS 2720(Part 25) | Methods of test for soils: Part 25 Determination of silica sesquioxide ratio |
| IS 2720(Part 26) | Methods of test for soils: Part 26 Determination of pH value |
| IS 2720(Part 27) | Methods of test for soils: Part 27 Determination of total soluble sulphates |
| IS 2720(Part 28) | Methods of test for soils: Part 28 Determination of dry density of soils, in-place, by the sand replacement method |
| IS 2720(Part 29) | Methods of test for soils: Part 29 Determination of dry density of soils in-place, by the core-cutter method |
| IS 2720(Part 30) | Methods of test for soils: Part 30 Laboratory vane shear test |
| IS 2720(Part 31) | Methods of test for soils: Part 31 Field determination of California bearing ratio |
| IS 2720(Part 33) | Methods of test for soils: Part 33 Determination of the density in place by the ring and water replacement method |
| IS 2720(Part 34) | Methods of test for soils: Part 34 Determination of density of soil in place by rubber balloon method |
| IS 2720(Part 35) | Methods of test for soils: Part 35 Measurement of negative pore water pressure |
| IS 2720(Part 36) | Methods of test for soils: Part 36 Laboratory determination of permeability of granular soils (constant head) |
| IS 2720(Part 37) | Methods of test for soils: Part 37 Determination of sand equivalent value of soils and fine aggregates |
| IS 2720(Part 38) | Methods of test for soils: Part 38 Compaction control test (Hilf method) |
| IS 2720(Part 39/Sec1) | Methods of test for soils: Part 39 Direct shear test for soils containing gravel Section 1 Laboratory test |

| | |
|---|---|
| IS 2720(Part 39/Sec2) | Methods of test for soils: Part 39 Direct shear test for soils containing gravel Section 2 In-situ shear test |
| IS 2720(Part 40) | Methods of test for soils: Part 40 Determination of free swell index of soils |
| IS 2720(Part 41) | Methods of test for soils: Part 41 Measurement of swelling pressure of soils |
| IS 2809 | Glossary of terms and symbols relating to soil engineering May 2010 |
| IS: 2911(Part 1/Sec2): | Code of practice for design and construction of Pile foundations: Bored Cast in- situ concrete Piles. |
| IS: 2911 (Part 4): | Code of practice for design and construction of Pile foundations: Load test on Piles. |
| IS: 6403 | Code of practice for determination of Allowable Bearing Pressure on Shallow foundation. |
| IS: 6935 | Method of determination of Water level in a Bore-Hole. |
| IS: 8009 | Code of practice for calculation of settlement of foundation subjected to symmetrical vertical loads. |
| (Part-I) | -Shallow foundations. |
| (Part-II) | -Deep foundations. |
| IS: 8763 | Guide for Undisturbed Sampling of Sands. |

**2.9.2** The geotechnical investigation shall be carried out at all the angle tower locations of transmission lines, and wherever there is change in strata, or at the locations where pile foundation or special foundation is envisaged as directed by Purchaser. The depth of exploration shall be as specified in clauses and it shall be carried out at the centre of tower locations.

**2.9.3** The limiting bearing capacity shall be calculated by multiplying a factor of 2.5 (as per CBIP manual) to the safe bearing capacity of soil arrived at from shear failure and permissible settlement criteria. However, the limiting bearing capacity shall not be more than the/ ultimate bearing capacity.

**2.9.4** The Geotechnical investigation report shall recommend the limiting bearing capacities at all the test locations for footing sizes 2.0m, 2.5m, 3.0m, 3.5m and 4.0m at 3.0m depth below ground level.

**2.9.5** Strength parameters and consolidation parameters shall be evaluated by various field and laboratory tests e.g. tri-axial shear test, direct shear test, Unconfined compression test, consolidation test etc. depending on the available soil type.

**2.9.6** The geo-technical investigation report shall include classification of soil, gradation, specific gravity, Atterberg limits e.g. Liquid limit, Plastic limit, plasticity index, in-situ density, bulk density, dry density, natural moisture content, void ratio and compression index ultimate & limiting bearing capacity of soil, strength parameters i.e. cohesion 'C' and angle of internal frication 'Ø', angle of response of soil etc.

**2.9.7** The contractor shall submit the report of soil investigation of each tower location in three copies to Purchaser for approval.

## CHAPTER 3
## CHECK SURVEY, ERECTION, TESTING & COMMISSIONING

### 3.1 SCOPE

**3.1.1** This chapter covers check survey, erection, testing and commissioning of the transmission lines enumerated in Section I - "GENERAL TECHNICAL REQUIREMENT". The successful bidder will transport the tower members, tower accessories and other line materials to the work sites.

**3.1.2** The erection work shall also include the cost of labour, all tools and plants including tension stringing equipment and all other incidental expenses in connection with the check-survey, erection, testing & commissioning of the lines.

**3.1.3 VARIATION IN QUANTITIES**

The rates indicated in the Price schedule shall hold good upto + 20% variation in quantity. When quantity against any item exceeds 20% of the scheduled quantity the contractor shall bring the fact to the notice of the Chief Engineer (Hydro), WAPCOS Ltd. well in advance and obtain his approval before commencing execution of such excess quantity.

### 3.2 SPECIFIC TECHNICAL REQUIREMENTS

### 3.2.1 TRANSMISSION LINE ROUTE

**3.2.1.1** The detailed survey of the transmission lines have to be carried out by the successful bidder based on the preliminary survey carried out by WAPCOS Ltd. Preliminary route alignment is available in the office of the Chief Engineer (Hydro), WAPCOS Ltd and can be examined there by the successful tenderer. A tentative route of the transmission lines are shown in Drawing - Exhibit-1. The Contractor shall examine the route and indicate clearly the changes, if any, considered necessary by the Contractor in the interest of economy/better alignment for the approval of the purchaser.

**3.2.1.2** The specific technical requirements for erection, testing and commissioning of the lines and the particulars of the line, completion programme, etc. are specified in Section-II of this Specification

## 3.3 STANDARDS

**3.3.1** Except where otherwise specified or implied the erection, testing and commissioning shall conform to the provisions of IS :5613 (part 2 / Section-2) -1985 (as amended upto date).

**3.3.2** The Indian Standard Specifications mentioned below shall be applicable to the materials and processes used in executing the work.

| | | | |
|---|---|---|---|
| i) | IS: 383-1970 | : | Course and Fine Aggregates from Natural Sources for Concrete. |
| ii) | IS:1200-( Part I)-1974 | : | Method of Measurement of Building and Civil Engineering Works: Earthwork |
| iii) | IS:456-1978 | : | Code of Practice for plain and Reinforcement Concrete. |
| iv) | IS:2502-1963 | : | Code of Practice for Bending and Fixing of Bars for Concrete Reinforcement. |
| v) | IS:3043-1966 | : | Code of Practice for Earthing. |
| vi) | IS:3764-1966 | : | Safety Code for Excavation Work |
| vii) | IS:4081-1967 | : | Safety Code for Blasting and Related Drilling Operation |
| viii) | IS:4091-1967 | | Code of Practice for Design and Construction of Foundations for Transmission Line Towers and Poles. |
| ix) | IS:5613(Part 2-1985) | | Code of Practice for Design Installation, and Maintenance of over head power lines |
| | Section - 1 | : | Design |
| | Section - 2 | : | Installation and Maintenance. |

## 3.4 COMMUNICATION AND TRANSPORT

**3.4.1** The information about the existing communication and transport facilities may be verified from the concerned authorities before submitting his offer.

## 3.5 MATERIAL HANDLING AND ACCOUNTING

**3.5.1** The towers and tower accessories shall be handed over to the Erection Contractor at site by the Supplier of The Towers. The Erection Contractor shall be responsible for taking delivery, clearance and unloading of material from wagons, transportation of the material to their storage yards and storage of the material etc. Complaint of Short delivery and damages during transportation shall be made by the Erection Contractor on behalf of the Purchaser to the supplier of the tower and tower accessories as well as to the Insurance under writers within the stipulated period. In case of loss/damage of the material, the Erection Contractor shall be responsible for making good the shortages/damages within the period specified by the Purchaser. Any demurrage and wharfage incurred on the material due to Erection Contractor's carelessness shall be to his account.

**3.5.2** The Erection Contractor shall be responsible for safe transportation of Conductor, Ground Wire , insulators, etc. from the Purchaser's stores to the work sites. He shall be responsible for proper distribution of the Conductor and Ground Wire drums so that the numbers and lengths of cut pieces are minimum.

**3.5.3** No separate charges shall be paid for head loading of materials, tools and tackles. The tenderers shall inspect the line route before submitting their tenders.

## 3.6 ERECTION LOSSES

**3.6.1** The Erection Contractor shall make every effort to minimise the breakages, losses and wastages of line materials supplied by the Purchaser during erection. Cut lengths from conductor drums on account of non-compliance of the drum schedule as approved by the site Engineer shall be to Erection contractor's account. This wastage will not be considered within the permissible erection wastages and losses.

## 3.7 GENERAL STORAGE OF MATERIAL

**3.7.1** Cement of approved quality will be arranged by Contractor in bulk. The Contractor shall store the cement in suitable weather proof, properly ventilated buildings with dry floors so as to prevent deterioration, also refer clause 3.14.0.

**3.7.2** The Erection Contractor shall stack the fabricated steel members in separate piles member - wise and tower - wise . These shall be stacked clear off the ground with their heels upwards in order to avoid entrapping of water between the angle-sections. The

reinforcement bars shall also be stored in separate piles in a suitable manner to minimise corrosion. Other line material shall be stocked properly with a view of ease of handling, issue, accounting minimum exposure to inclement weather etc.

**3.7.3** The Erection Contractor shall store the aggregates on hard smooth and clean surfaces so that there is no possibility of intrusion of any foreign materials. Aggregates of different grades shall be stored in piles which shall be spaced well apart to prevent their intermixing.

**3.7.4** Engineer-In-Charge shall have the right of excersising inspection of Contractor's stores at any time to ensure no damages to the material.

## 3.8 RIGHT-OF -WAY, CUTTING OF TREES, ETC.

**3.8.1** The purchaser will arrange the right of way along the transmission line route. Any avoidable or deliberate damage done to standing crop or private property by the Erection Contractor's labourers shall be the Erection Contractor's responsibility.

**3.8.2** The Purchaser will acquire only such piece of land as is actually required for each tower foundation. Any extra land required by the Erection Contractor temporarily for dumping of the construction material and consequent damage to crops etc. shall be the responsibility of the Erection Contractor. The Purchaser shall also not be responsible for arranging access roads/right - of - way for transport of material from road side to work sites. If the Erection Contractor has to adopt any such arrangements, he may do so with the consent of the property owners and any compensation in that respect will be his responsibility. The Erection Contractor shall take all reasonable steps for preventing damage to crops during execution of the contract work.

**3.8.3** Clearing of obstructions falling in the right -of way as per IS:5613 (part-2/ section 2)-1985 and lopping or trimming of the portion of the trees falling within the minimum electrical clearance zone shall be the responsibility of the Purchaser. However, any lopping or trimming of tree branches obstructing the line of sight during check survey shall be the responsibility of the Erection Contractor.

## 3.9 ROADS, RIVER, KHUD / NALLAH, POWER AND TELE COMMUNICATION LINE AND RAILWAY CROSSINGS.

**3.9.1** The crossings of roads, river, khuds/nallahs, power and telecommunication lines, and railway tracks falling in the line

route shall be carried out with the types of structures and at angles as indicated in the approved profile sheets and tower schedules , ensuring that the minimum clearances at maximum temperature in still wind condition, after taking the effect of conductor creep and slack caused by the broken conductor in the adjoining span are not less than the relevant clearances specified in Section -II of this specification.

**3.9.2** The crossings of railway tracks, telecommunication lines and erection of lines in the vicinity of aerodromes shall in addition meet the requirements of the regulations/ code listed below:

i) Regulation for Electrical crossing of Railway Tracks issued by the Ministry of Railways.

ii) Code of Practice for Crossings between power and telecommunication lines -1974 ( as amended upto date).

iii) Requirements for routing of over head lines in the vicinity of Aerodromes laid down by the Director, General of Civil Aviation, Govt. of India.

## 3.10 CROSSING OF PUBLIC UTILITIES

**3.10.1** The Erection Contractor shall be responsible for giving requisite notice to the appropriate authorities and intimate them the date and time when he proposes to carry out erection of the conductors and groundwires along or across power lines or telecommunication lines, public roads, water ways, railways etc. Lowering of the conductors, groundwires etc. of the existing power lines and its restringing and taking all necessary precautions to avoid damage to the existing lines will be the responsibility of the Erection Contractor. Any guying, temporary reinforcement required for the existing structures will also be the responsibility of the Erection Contractor.

**3.10.2** Where other authorities or public undertakings affected , deem it necessary for the protection of their employees, property, public or for the assistance of traffic to provide flagmen or watchmen, the cost of such provision shall be borne by the Erection Contractor.

**3.10.3** Where it is necessary to provide scaffolding over roads, power lines or telecommunication lines this shall be carried out by the Erection Contractor at such times as may be convenient to the requisite Authority and such work shall be deemed to be covered in the rates. Flagmen and approved types of danger or warning notices shall be provided by the Erection Contractor to ensure

safety of the public. The time taken to effect the crossing shall be kept to the minimum.

## 3.11 ERECTION TOOLS AND PLANTS

**3.11.1** The Erection Contractor shall provide at his own expenses all necessary erection tools and plants such as surveying instruments, tackles, spanners, wrenches, pumps, timbering, scaffoldings, jacks, winches, ropes and all construction machinery such as tractors, bull dozers, hydraulic compressors and dies, dynamometers, come along clamps, tension stringing equipments, camping requisites etc.

## 3.12 EXECUTION OF WORKS

**3.12.1** Setting out and Check Survey

**3.12.1.1** The duly approved profile sheets and tower schedules prepared on the basis of detailed survey shall be handed over to the Contractor for carrying out the check survey. A preliminary tower schedule based on the check survey will be submitted by the Contractor. The locations of towers so marked shall be got inspected from the authorised representative of the Purchaser. The changes desired by the Purchaser in the preliminary tower schedule shall be carried out by the Contractor who shall thereafter submit a final tower schedule for the approval of the Purchaser. The tower schedule submitted for approval shall show position and types of towers, wind spans, weight spans, angle of deviations, foundations, river or road crossings etc.

**3.12.1.2** Tower erection schedules shall be made in convenient construction lengths and work shall not be started in any length until the schedule has been approved by Purchaser in writing.

**3.12.1.3** The Contractor shall then be responsible for correct setting of towers as per approved profiles. If tower, after erection, are found to be out of approved alignment, Contractor shall dismantle and re-erect them correctly at his own cost and without extension of time.

## 3.13 ELECTRIC POWER FOR CONSTRUCTION PURPOSES

**3.13.1** The Erection Contractor shall make all necessary arrangements and provide all necessary electric power for construction purposes at his own cost. In case the power is available with the Purchaser, the same shall be supplied at the prevailing tariff rates.

## 3.14. CONSTRUCTION OF TOWER FOUNDATIONS :

### 3.14.1 GENERAL

**3.14.1.1** The type of foundation to be constructed at each tower location shall be based on the soil characteristics indicated on the route profile sheets and as determined by the Purchaser during the progress of the work. The Purchaser reserves the right to change the type of foundation at any location where conditions during the progress of work indicated the use of a different type of foundation.

**3.14.1.2** Each tower shall have four identical footings each of which shall have steel stub angle embedded in concrete. The footings for each tower in a straight section of the line shall be placed so that the longitudinal axis of the tower cross arm will be in a plane perpendicular to the transverse of the line. Unless otherwise directed by the Purchaser, the footings for each angle tower shall be placed in a manner so that the tower cross arms lie in a plane bisecting the interior angle formed by the intersection of the transverses of adjacent sections of the line.

**3.14.1.3** Foundations shall be constructed in accordance with the approved foundation drawings

### 3.15 SETTING OF STUBS :

**3.15.1** The stubs shall be set correctly at the exact locations with prescribed alignment and precisely at correct levels with the stub setting template and leveling instruments. Stubs shall be set in the presence of authorized representative of the Purchaser available at site, for which adequate advance intimation shall be given to the Purchaser by the Contractor. This shall not, however, absolve the Contractor of his responsibility for correctness of stub setting and for the correct erection of towers.

**3.15.2** The stubs shall be set with their tops above the ground level as per approved drawing and given a coping without making a plinth.

### 3.16 EXCAVATION:

### 3.16.1 SCOPE:

This section covers technical specification for excavation for foundation work of transmission line towers. This shall include all works involved in excavation, dressing of soil, shoring & strutting and carting of good quality earth, if required for back

filling. The sub-surface data regarding nature of soil, sub-soil water etc. shown on drawings or otherwise furnished to the contractor shall be taken as a guidance only, and any variation there from shall not affect the terms of the contract. The Contractor must satisfy himself of the character and volume of all works under this item and expected surface, sub-surface, and /or subsoil to be encountered. He must also satisfy himself about general conditions of transmission line route and ascertain the existing and future obstructions likely to come up during the execution of the contract to carry out the work under this scope.

**3.16.2** For purposes of excavation of earthwork, the term 'soil ' shall apply to all kinds of soil containing any percentage of kankar, moorum or/and shingle etc.

**3.16.3** Excavations shall include the removal of all materials required to execute the work properly and shall be made with sufficient clearance to permit the placing, inspection, setting of forms and completion of all works for which the excavation was made.

**3.16.4** Sides and bottom of excavation shall be cut sharp and true to the slopes indicated in the drawing. Undercutting shall not be permitted. Earth sides of excavation shall not be used in lieu of formwork for placement of concrete unless authorized, in special cases, by the Purchaser or his representative where limitations of space for large excavation necessitate such a decision.

**3.16.5** When machines are used for excavation, the last 300mm before reaching the required level shall be excavated by hand or by such equipment that will leave the soil at the required final level in its natural condition.

**3.16.6** The bottom of excavations shall be trimmed to the required levels and when carried below such levels due to contractor's fault, the excess depth shall be filled to the required level, at the contractor's cost, with cement concrete not leaner than M-10 (1: 3: 6) or richer as directed by the Purchaser in each individual case.

**3.16.7** If the contractor is directed by the Purchaser to excavate to a lower level than that indicated in the drawings, such additional excavation shall be paid for at the applicable unit rate.

**3.16.8** Excavated material shall be placed beyond 1.5 m from the edge of the pit or half the depth of the pit whichever is more or further away if directed by the Purchaser.

**3.16.9** Excavation shall not be carried below the foundation level of structures close by, until required precautions have been taken.

**3.16.10** The contractor shall be responsible for assumptions and conclusions regarding the nature of materials to be excavated and the difficulty of making and maintaining the required excavations and performing the work required as shown on the drawings and in accordance with these specifications. Cofferdams, sheeting, shoring, bracing, and draining, dewatering etc. shall be furnished and installed as required. The contractor shall be held responsible for any damage to any part of the work and property caused by collapse of sides of excavation. Material may be salvaged if it can be done with safety for the work and structures, as approved by the Purchaser and no extra claim shall be entertained for materials not salvaged or any other damage to contractor's property as a result of the collapse. He shall not be entitled to any claim for redoing the excavation as a result of the same.

**3.16.11** Excavations for foundations where specified shall be carried at least 100 mm below the bottom of structural concrete and then be brought to the required level of placing lean concrete of M-10 (1: 3: 6) mix with coarse aggregate of 40 mm maximum nominal size.

**3.16.12** The contractor shall control the grading in the vicinity of all excavations so that the surface of the ground shall be properly sloped or dyked to prevent surface water from running into the excavated areas during construction.

**3.16.13 SHORING AND STRUTTING:**

a) Shoring and strutting shall be done keeping in view the requirements given in IS: 3764 (latest). For excavations to be made in sandy soils or water bearing strata or in any other type of soil where there is every likelihood of pits collapsing, shoring and strutting made out of timber planks of approved quality Sal wood or steel frames of adequate strength as per requirements shall necessarily be provided.

b) Where excavation required bracing, sheeting or shoring etc., the contractor shall submit to the Purchaser the design and drawings showing arrangement and details of proposed installation for examination and approval, and shall not proceed until he has received approval from the Purchaser. However, such approval shall not construed as relieving the contractor of his responsibility for the suitability and adequacy of the measures provided.

### 3.16.15 EXCAVATION BELOW WATER TABLE:

a) Wherever water table is met with during the excavation, the contractor shall immediately report the fact to the Purchaser who shall arrange to record the exact level of the water table.

b) The contractor shall have due regard to the possibility of heavy seepage and provide pumps and other equipments to dewater and maintain the water table below bottom of the excavated level during excavation, concreting and back fillings.

c) The guidelines for de-watering during construction specified in IS: 9759(Latest) shall be followed. Dewatering shall be carried out either manually or by mechanical pumps or power driven pumps to facilitate excavation and casting of foundation. The pits shall be kept dewatered till 24 hours of concreting the foundation.

## 3.17 EXCAVATION FOR TOWER SITES, DRAINAGE AND LINE CLEARANCE:

### 3.17.1 SCOPE:

This item covers excavation for leveling around the individual tower footings, drainage, line clearance, etc. but excludes the excavation for tower foundations. The excavation shall be carried out as per clause 3.16.0 above and as described herein.

**3.17.2** The excavations for tower sites, drainage and line clearance shall be made to the approved dimensions and shall be finished according to the specified lines and grades. Wherever, the Purchaser considers it necessary, adequate drainage shall be provided around tower foundations. Except as otherwise provided in this specification, excavated materials shall be used for grading as directed, around the site from where the materials are excavated. The requirement of excavation for tower sites, drainage and line clearance and the amount of excavation required at a location shall be optional with the Purchaser.

### 3.17.3 MEASUREMENT AND PAYMENT:

Measurement for payment for excavation for tower sites, line clearance and drainage shall be made to the most practicable

lines and grades as approved by the Purchaser. Payment for such excavation, including the associated grading shall be made at the unit rate per cubic meter quoted in the Schedule of prices.

## 3.18. EXCAVATION FOR TOWER'S FOUNDATIONS:

### 3.18.1 SCOPE

This item covers excavation for the individual tower footings etc. The excavation shall be carried out as per clause 3.16.0 above and as described herein.

**3.18.2** Except as hereinafter provided, all excavations for footings shall be made to the lines and grades of the foundation designs approved by the Purchaser. Any excavation done beyond the lines of the foundation shall be at the expense of the Contractor. Any sand, mud, salt or other undesirable materials which may have accumulated in the excavated pits shall be removed by the Contractor at no extra cost to the Purchaser, before placing the concrete. The rate of excavation shall include all associated activities like shoring, strutting, dewatering, stocking piling, dressing, back filling the foundation after concreting with excavated / borrowed earth (irrespective of lead) and consolidation of earth, carriage of surplus earth to the suitable point of disposal as required by the Purchaser or any other activities related to the completion of foundation works.

### 3.18.3 CLASSIFICATION OF SOIL FOR EXCAVATION:

The materials to be excavated shall be classified in accordance with latest edition of IS: 1200 (Part-1), IS: 5613 (Part-2/Section-2) and IS: 1498 and as follows unless otherwise specified.

**ALL TYPE OF SOILS:**

Generally any soil which yields to the ordinary application of pick and Shovel, or PHAWRA, rake or other ordinary digging implement, such as organic soil, turf, gravel, sand, silt, loam, clay, peat etc. This shall also include soft/ disintegrated rock and boulders that may be quarried or split with crowbars. This shall also include laterite and hard conglomerate.

**3.18.4** Where soils at tower locations are of composite nature, i.e. partly soil and partly hard rock, the payment for excavation shall be made for each according to unit rates, and total volume of hard rock and soil excavations shall be within guaranteed

volume of excavation. The decision of the Purchaser shall be final and binding with reference to the classification of soils.

**3.18.5** The cost of drilling, blasting & chiseling shall be included in the quoted rates for hard rock excavation. Blasting materials shall be arranged by the contractor at his own cost. For soils other than hard rock excavation rate to be quoted shall include the cost of back filling with excavated soil/borrowed soil.

**3.18.6** Where rock is encountered, the holes for tower footings shall preferably be drilled, but where blasting is to be resorted to as an economy measure, it shall be done in accordance with the relevant Indian Standard and with utmost care to minimize the use of concrete for filling up the blasted areas. All necessary precautions for handling and use of the blasting material shall be taken as per the requirements of the relevant Safety Codes. Only the persons having certificate for blasting issued by the competent authority shall be deployed for carrying out the blasting.

In case, unnecessary large quantities are excavated / blasted resulting in the use of large volumes of concrete, payment for concrete shall be limited to the guaranteed volume and the cost of any concrete in excess of that shall be borne by the Contractor. In case drilling is done, the stubs may be shortened suitably as approved by the Purchaser.

**3.18.7 MEASUREMENT AND PAYMENT**

Measurement for payment shall be based on volume calculations determined by the existing grade and upto the bottom elevation of lean concrete. If pay line of adjacent foundations as per approved foundation drawings overlap, the overlapped portion shall be paid only once. Payment for excavations for tower footings shall be made at the unit rate per cubic meter quoted for the appropriate type of soil. The unit prices quoted shall include the cost of necessary labour and material for all timbering, shoring , strutting, backfilling, spreading and compacting the excess material evenly around the site. Unit rate quoted shall also include the cost of dewatering during excavation and as well as laying of foundations and nothing extra shall be paid on this account. However, payments shall be restricted to guaranteed volumes or actual whichever is less as per unit rates.

If during the progress of excavation or after the completion of excavation, any alteration in the dimensions of excavation actually made become necessary, compensation there of shall be determined as follows:

a) Where additional excavation is called for on account of alteration in the dimensions of excavation for a footing as a result of the use of improper methods of excavation or means for supporting excavation or providing inadequate protection to the excavation against weathering or delay between excavating the pit and placing of the concrete by the Contractor, the cost of all additional excavation and also that of all additional reinforcement, cement, concrete, backfilling and compacting shall be borne by the Contractor.

b) Where additional excavation is called for due to change of the type of footing on account of different soil conditions, payment shall be made in accordance with the provision existing in this Specification.

## 3.19 EXCAVATION OF BORROWED EARTH FOR BACKFILL:

### 3.19.1 SCOPE:

This item covers excavation of borrowed earth required for backfill at the borrow areas designated by the Purchaser.

**3.19.2** The Contractor shall strip the borrow area of all unsuitable material as may be necessary to obtain the required quantities of borrowed materials of approved quality. The surfaces of borrow areas shall be left in reasonably even condition.

### 3.19.3 MEASUREMENT

No separate payment shall be made to contractor for borrowed earth required for backfilling and same is deemed to be inclusive in the rates quoted by him for excavation in Clause 3.18.7.

## 3.20 BACKFILLING

### 3.20.1 SCOPE:

This section covers the technical requirements for backfilling. The contractor shall furnish all labour, equipment and materials required for complete performance of the work in accordance with the approved foundation drawings and as described herein.

**3.20.2** After completion of foundation work and other construction below the elevation of the final grades and prior to backfilling, all forms, temporary shoring, timber etc. shall be removed and repairs, if any to the foundations shall be done and the

excavation cleaned of all trash, debris and perishable materials. Backfilling shall begin only with the approval of the Purchaser.

**3.20.3** Back filling shall normally be done with the excavated soil unless it consists of large boulders/stones in which case the boulders shall be broken to a maximum size of 75 mm. The backfill material shall be clean and free from vegetation, pieces of timber and other undesirable materials. Back filling shall be done with inorganic materials, obtained from the excavation or borrow pits and subject to the approval of the Purchaser.

**3.20.4** Backfill shall not be dropped directly upon or against any foundation or facility where there is danger of displacement or damage.

**3.20.5** Backfill shall be placed in horizontal layers not to exceed 200 mm in thickness. Each layer shall be compacted with proper moisture content with such equipment as may be required to obtain a density not less than 95% of maximum proctor dry density as determined by the relevant Indian Standards (latest edition). Trucks or heavy equipment for depositing or compacting backfill shall not be used within 1.5 m of foundation that may damage the foundation by their weight or operation. The methods of compaction shall be subject to the approval of the Purchaser. Pushing of earth for backfilling shall not be adopted under any circumstances.

**3.20.6** After backfilling, 150 mm high earthen embankment (Bund) along the sides of excavation pits shall be made and sufficient water poured in the back-filled pits so that standing water remains above the back-filled earth for at least 24 hours. All surplus soil including residual sand, stone and concrete waste lying around, if any, shall be stacked within the tower base.

**3.20.7** While backfilling of footings, the pad shall be covered with about 300 mm layer of fine material before any coarse material is deposited. Care shall be taken to avoid damage to the concrete during back filling and compaction of soil.

**3.20.8** All topsoil shall be placed at the surface in the case of towers located on cultivated land.

**3.20.9** Where excavated material is not considered to be suitable by the Purchaser for use as back-fill, borrowed earth shall be used for backfilling, for which the provision of clause 3.19 of this Specification shall be applicable.

**3.20.10** On completion of foundation work, the earth surrounding them shall be accurately finished to line and grade as shown on

drawings or as directed by the Purchaser. Finished surface shall be free of irregularities and depressions and shall be within 50 mm of the specified level.

**3.20.11 MEASUREMENT:**

The cost of backfilling and compaction is deemed to be included in the unit prices quoted for excavation in clause 3.18.7.

**3.21 FORM WORK:**

**3.21.1 SCOPE:**

This section covers technical requirements for furnishing and installation of formwork for construction of tower foundations. The contractor shall furnish all labour, equipment and materials required for complete performance of the work in accordance with the drawings and as described herein.

Formwork shall be as per IS: 456-2000 and shall be composed of steel and /or best quality shuttering wood of non-absorbent type timber. The timber shall be free from knots and shall be of medium grain as far as possible.

**3.21.2** The formwork shall conform to the shape, lines and dimensions of the footings as per the approved foundation drawings.. All details of the formwork, placing, tieing, etc. shall be subject to the approval of the Purchaser. The Contractor shall submit the design and drawings showing details of the form construction to the Purchaser for approval before commencement of actual work. The formwork shall be adequate to withstand the pressure of freshly placed concrete or other loads imposed, without failure, movement or deflection of the component parts. Formwork shall be sufficiently tight to prevent the loss of liquid from the concrete.

**3.21.3** The inner surfaces of formwork coming in contact with concrete shall be smooth and free from projections. All rubbish particularly chipping, shavings dust and traces of concrete, if any, shall be removed from the interior of the formwork before the concrete is placed. The surface in contact with the concrete shall be wetted and sprayed with fine sand or treated with an approved composition to prevent absorption of water from the concrete. Such composition shall be kept out of contact with reinforcement and shall be non-staining and non-injurious to concrete.

### 3.21.4 MEASUREMENT

The cost of formwork is deemed to be included in the unit prices quoted for concreting.

## 3.22 CONCRETE

### 3.22.1 SCOPE

This section covers the technical requirements in respect of materials used in forming, mixing, placing, finishing, curing and testing of plain and reinforced cement concrete for foundation for transmission line towers. The contractor shall furnish all materials, labour, equipments etc. required for complete performance of the work in accordance with the drawings and as described herein.

### 3.22.2 STANDARDS

a) Except where otherwise specified or implied, the concrete shall conform to the provisions of IS:456 - 2000.

b) The Indian Standard Specifications mentioned below shall be applicable to the materials and processes used in the preparation of concrete.

i) IS: 269 (latest edition): Specification for ordinary, rapid hardening and low heat Portland cement.

ii) IS: 383(latest edition): Specification for coarse and fine aggregate from natural sources for concrete.

iii) IS: 5613-(Part -2/Sec -2) (latest edition): Code of Practice for Design installation and maintenance of overhead power lines.

iv) IS: 4091(latest edition): Code of Practice for Design and Construction of Foundations for Transmission line Towers and Poles.

**3.22.3** The provision of the latest revision of IS: 456 shall be complied with unless permitted otherwise and any other Indian Standard Code (latest revision) shall form a part of this specification to the extent it has been referred to or applicable within this specification.

### 3.22.4 GENERAL REQUIREMENTS

All materials, tests, mixing, placing, formwork, reinforcing and workmanship shall conform to IS: 456-2000 'PLAIN AND REINFORCED CONCRETE- CODE OF PRACTICE' and other relevant Indian Standard codes.

### 3.22.5 MATERIALS:

#### a) CEMENT

Cement used shall be Ordinary Portland Cement conforming to IS: 269 (latest revision), IS: 8112 (latest revision) and IS: 12269 (latest revision). Cement, which has set or partially set, shall not be used.

Cement shall be stored by contractor in silos or suitable weather proof enclosure. The stacking shall not be more than 10 bags high to avoid lumping under pressure. Cement held in storage for more than 90 days shall be got tested in approved laboratory before put to use.

#### b) COARSE AGGREGATES

Coarse aggregates shall be of specified nominal size and well graded within the limits by weight specified in IS:383(latest edition) and shall be of specific nominal size and well graded with in he limits by weight specified in IS:303(Latest Edition) and shall be more or less cubical in shapes, hard, strong, durable and of uniform and fine texture, free from faults or planes of weakness, free from weathered faces and also free from laminations. It shall be clean and free from clay films and other adherent coating. Porous or absorbent coarse aggregate shall not be used. Coarse aggregates shall not contain any deleterious material liable to attack the steel reinforcement.

Coarse aggregates shall be so stored so as not to get mixed with soils or other deleterious materials. The coarse aggregate shall be stored on hard firm ground having sufficient slope to provide adequate drainage for rainwater. The stack of the coarse aggregates shall be such that the same may be measured easily whenever found necessary by the owner or his authorized representative. Aggregate of different class shall be stored separately.

**c) FINE AGGREGATES**

Coarse and fine sand shall be well graded within the limits by weight as specified in IS: 383(Latest). Fineness modules shall not vary by more than plus or minus 0.20 from that of the approved sample. Fineness modules for sand shall not be less than 2.5. Washing of fine aggregates by approved means shall be carried out, if found necessary by Purchaser. Coarse and fine aggregates shall be batched separately.

Fine aggregates shall be so stored so as not to get mixed with soils or other deleterious materials. The fine aggregate shall be stored on hard firm ground having sufficient slope to provide adequate drainage for rainwater. The stack of the fine aggregates shall be such that the same may be measured easily whenever found necessary by the owner or his authorized representative.

**d) WATER**

Water used for mixing and curing the concrete shall be clean, fresh and free from injurious amounts of oil, acids, alkalies, organic material or other deleterious matters in solution or in suspension in such amounts that may impair the strength or durability of the concrete. Saltish and muddy water shall not be used. Potable water shall be generally satisfactory. IS: 3025(latest) and IS: 3550(latest) may be followed for testing of water, if required, by the Purchaser. The permissible limits of solids shall be within limits corresponding to Table-I of IS:456-2000. The pH value of water shall not be less than 6.

**e) ADMIXTURES**

The use of admixtures in concrete for promoting workability, improving strength, entraining air or for any other purpose may be used only with the approval of the Purchaser. Addition of admixture shall not reduce the specified strength of concrete or durability of concrete in any case nor increase the risk of corrosion of reinforcement. The admixtures shall conform to IS: 9103 (Latest edition). Admixtures shall be used, if necessary only with the written permission of the Purchaser.

### 3.22.6 GRADE OF CONCRETE

Structural concrete shall be either design mix or nominal mix as specified and in grades designated as M15, M20 and M25 in accordance with IS: 456 and these specifications. Lean concrete shall be of grade M10 with 40 mm nominal size of aggregate.

### 3.22.7 NOMINAL MIX CONCRETE

a) Nominal mix concrete shall be used only with written permission of Purchaser and only at difficult tower locations where accurate control is impracticable and not necessary.

b) Concrete mix proportions for nominal mix concrete shall be, in general, as per Table 9 of IS: 456-2000.

c) If nominal mix concrete made in accordance with the proportions given in Table-9 of IS: 456-2000 for a particular grade does not yield the specified strength and fails to satisfy the requirements of 'Acceptance Criteria' as specified in IS: 456-2000, the cement content shall be increased as directed by the Purchaser to obtain a specified strength at no extra cost to the Purchaser.

d) Nominal mix concrete proportion for a given grade specified under relevant Para above shall not however, be classified as a higher grade on the ground that the test strengths were found higher than the minimum specified.

### 3.22.8 DESIGN MIX CONCRETE

a) Design mix concrete shall be used for structural concrete works except where specified otherwise. Design mix concrete for use in plain cement concrete structures shall be of grade M-15 and M-20 and for reinforced cement concrete structures shall be of grade M-20 & M-25.

b) The mix proportions for all grades of concrete shall be designed to obtain strengths corresponding to the values specified hereinafter for respective grades of concrete. Preliminary tests as specified in the IS: 456 and required by the Purchaser, shall be carried out sufficiently ahead of the actual commencement of the work with different grades of concrete made from representative samples of

aggregates and cement expected to be used on the job to ascertain the ratios by weight of cement to total quantities of fine and coarse aggregate and the water cement ratio required to produce a concrete of specified strength and desired workability.

c) Mix design for all grades of design mix concrete shall be undertaken to investigate the grading of aggregates, water cement ratio, workability and the quantity of cement required to give concrete the minimum strength specified in IS: 456 and these specifications whichever is more. The proportions at the mix shall be determined by weight. Adjustment of aggregate proportions due to moisture present in the aggregate shall be made.

| | **Grade of Concrete** | **M-15** | **M-20** | **M-25** |
|---|---|---|---|---|
| (i) | Preliminary Tests at 28 days | 20N/mm$^2$ | 26N/mm$^2$ | 31N/ mm$^2$ |
| (ii) | Work tests at 7 days | 10N/mm$^2$ | 13.5N/mm$^2$ | 17N/ mm$^2$ |
| (iii) | Work tests at 28 days | 15N/mm$^2$ | 20N/mm$^2$ | 25N/ mm$^2$ |

Note:

(i) Preliminary Tests: A test conducted in laboratory on the trial mix of concrete produced in a laboratory with the object of:

a) Designing of a concrete mix before the actual concreting operation start
b) Determining the adjustments required in the design mix when there is a change in the materials used during the execution of work.
c) Verifying the strength of the concrete mix.

(ii) Work Tests: A test conducted in the field or in a laboratory on the specimen made on the works out of the concrete being used on the works.

a) Design mix concrete shall be used on all concrete works, except where specified otherwise. Work shall not commence until the Purchaser has approved the control/design concrete mix. The contractor shall allow sufficient time for all the obligations and tests etc. to be carried out prior to approval.

### 3.22.9 CONCRETE MIX REQUIREMENTS

a) Design mix concrete as defined in IS: 456 shall be used for all foundations unless permitted otherwise.

b) Concrete mix shall conform to IS: 456 and these specification.

**c) MINIMUM CEMENT CONTENT IN CONCRETE**

The minimum quantity of cement content for each grade of concrete notwithstanding the strength requirements specified in the specification, shall not be less than specified in Table-5 of IS:456-2000 depending on exposure or as given below whichever is more.

| Grade Of Concrete | Minimum Cement Content Per Cubic Meter |
|---|---|
| M-10 | 240 Kg |
| M-15 | 280 Kg |
| M-20 | 320 Kg |
| M-25 | 350 Kg |

d) Based on the contractor's mix design, if the actual requirement of cement for a grade of concrete is found to be more than those specified above, such excess quantity of cement shall be used for which nothing extra shall be paid.

e) Concrete slump shall be kept as low as possible consistent with proper handling and thorough compaction.

f) The admixture content, batching method and time of introduction into the mix shall be in accordance with the manufacturer's recommendations for compliance with these specifications.

g) The concrete shall be of such consistency as to give a slump of 75 to 100 mm with a maximum water cement ratio of 0.50.use of admixtures for increasing the work ability and / or retarding the initial setting time of concrete may be used subject to approval by the Purchaser.

### 3.22.10 CONCRETE MIX REVIEW

a) The source and quality of concrete materials and concrete proportions proposed for the work shall be submitted to the Purchaser for review before the concrete work is started.

Complete certified reports prepared by an independent testing laboratory and covering the materials and proportions shall be submitted to the Purchaser. Review of these reports shall be for generally acceptability only and continued compliance with all contract provisions only shall be required. The Purchaser shall have the option to witness the preparation of the trial mixes, testing etc.

b) Reports on admixture shall include the classification, brand, manufacturer and active chemical ingredient. All admixtures, conforming to relevant IS Codes, shall be the products of one manufacturer approved by the Purchaser.

c) Reports on the coarse aggregates shall include the source, type, gradation, deleterious substances, soundness, abrasion loss and the results of all tests required to comply with IS: 383 (Latest edition).

d) Reports on the fine aggregates shall include the sources, type, gradation, deleterious substance, soundness and the results of all tests required to verify compliance with IS: 383 (Latest edition).

e) Using concrete materials acceptable to the Purchaser, a tentative concrete mix shall be designed and tested for each size and gradation of aggregates and for each consistency intended for use on the work. Design quantities and test results of each mix shall be submitted for review. Acceptable mixes shall be subjected to field adjustments as necessary to meet the requirements of these Specifications.

f) The report for each tentative concrete mix submitted for review shall include the following:

1. Slump on which the design is based.
2. Total liters of water per cubic meter of concrete.
3. Water-cement ratio.
4. Ratio of fine to total aggregates.
5. Weight (surface dry) of each aggregate per cubic meter of concrete.
6. Quantity of each admixtures.
7. Air content, if any.
8. Compressive strength based on 7 days and 28 days compression

test.

9. Time of initial set.
10. Weight of cement used in the mix.

g) Concrete tests specimens shall be made, cured and tests in conformity with IS: 516 (Latest edition). These tests shall be conducted at approved laboratory. The mould and materials for cubes shall be supplied by the contractor who shall also arrange to transport the cubes to laboratory at his cost. Actual cost of the testing shall also be borne by the Contractor.

### 3.22.11 CONCRETE MIXING

a) Concrete mixing shall conform to IS: 456-2000. Concrete shall normally be mixed in a mechanical mixer. Mixing on metallic watertight platform shall be allowed only in very difficult approach area with 10 % additional cement at no extra cost to Purchaser.

b) The proportion of fine and coarse aggregates, cement and water shall be as determined by the mix design in case of controlled concrete. The quantities of fine and coarse aggregates shall be determined by weight. The Purchaser may allow the quantity of aggregates to be determined by equivalent volume basis after the relationship between the weight and volume is well established by trial and the same shall be verified frequently. The quantity of cement shall always be determined by weight. The water shall be measured accurately after giving proper allowance for surface water present in the aggregates for which regular check shall be made for bulking in the case of volume batching in accordance with IS: 2386 (PART -III).

c) All concrete shall be mixed until there is a uniform distribution of materials and shall be discharged completely before the mixer is recharged. Mixing shall be done in a mechanical mixer complying with IS:1791 and IS:12119 and the type and size shall be subjected to the approval by the Purchaser. Mixer shall be rotated at a speed recommended by the manufacturer and the water shall not be added to the mix until all the cement and aggregates constituting the batch are already, in the drum and dry mixed for at least one minute and thereafter mixing shall be continued for at least 2 minutes and at least forty (40) revolutions after all materials are in the drum. For batches large than 0.75 cu.m mixing time shall be increased by 15 seconds for each

additional 0.75 cu.m or fraction thereof. All concrete shall be discharged within 3 minutes after the introduction of mixing water to the cement and aggregates, unless a different time is specified by the Purchaser.

d) Before beginning a run of concrete, all partially set or hardened concrete and foreign material shall be removed from the inner surfaces of mixing conveying equipment. The first batch of concrete for use in the works, through a cleaned mixer and shall contain 10% additional cement at no extra cost to allow for loss in the drum. All conveyances, buggies and barrows shall be thoroughly cleaned at frequent intervals during the placing of concrete. Concrete shall be rapidly handled from the mixer to the place of final deposit and shall not be delivered by spout or troughs nor dumped into carriers with a free fall from the mixer of more than 1.0 M. Every possible precaution shall be taken to prevent segregation or loss of the ingredients while transporting the concrete.

### 3.22.12 CONCRETE PLACEMENT

(a) The handling, depositing and compacting of concrete shall conform to these specifications, subject to adjustments by the Purchaser for weather or placement conditions. During hot or cold weather, the concreting shall be done as per the procedure set out in IS: 7861(Part -I & Part-II).

(b) Concrete shall not be placed until the formwork, reinforcements and preparation of surfaces involved in casting are approved by the Purchaser and shall be placed only in the presence of Purchaser or his authorized representative. The concrete shall not be placed under water and all excavations prepared for concrete shall be maintained free of water until the concreting is completed and 24 hours thereafter. All surfaces of foundations upon or against which concrete is placed shall be free from mud and loose earth.

(c) Contractor shall keep an accurate record of the date on which the concrete is cast for each part of work and date on which the forms are removed.

(d) Concrete shall be conveyed to the point of final deposit by methods that shall prevent the segregation or loss of the ingredients. Concrete shall be deposited in its final

position without moving it laterally in the forms for a distance in excess of 1.5 meter.

(e) Concrete shall be deposited in approximately horizontal layers to proper depth for affecting compaction. However, the depth of a layer shall not exceed 300 mm. Each layer of concrete shall be plastic when covered with the following layer and the forms shall be filled at a rate of vertical rise of not less than 150 mm per hour. Construction joints shall be provided as necessary and as accepted by the Purchaser to comply with these requirements.

(f) Plastic concrete is defined as concrete which can be re-vibrated at least to the extent that an immersion type vibrator stud shall penetrate into the concrete at least 25 mm by vibration action and its weight. Concrete which is not longer plastic but which must be covered by an additional lift shall be immediately chipped back to well consolidated concrete and flushed with mortar puddle as follows:

The surface of hardened concrete upon which fresh concrete is to be placed shall be rough and clean and damp. Surface mortar shall be removed to expose the aggregate. The hardened surface shall be cleaned of all foreign substances (including curing compound), washed with clean water, and kept saturated for the 24 hours period preceding placement of fresh concrete. Coarse aggregates shall be omitted from the batches of concrete deposited on hardened concrete. This mortar puddle shall cover the hardened concrete to a depth of not less than 15 mm at every point.

(g) To secure maximum density and eliminate formation of air pockets, the concrete shall be thoroughly vibrated and worked around all reinforcements, embedded facilities and into corners of forms during and immediately after placing. Unless other methods are authorized by the Purchaser, the mechanical vibrators conforming to IS : 2505, IS: 2506, IS: 2514 and IS: 4656, (all Latest editions) shall be used for this purpose, the type and operation of which is subject to the approval of the Purchaser.

(h) The placing of concrete shall be in a continuous operation with no interruption in each location. Concrete shall be handled from the place of mixing to the place of final

deposit as rapidly as practicable by methods, which shall prevent segregation.

(i) Concrete shall normally be placed in continuous horizontal layers. Construction joints in foundations shall not be permitted. Concrete shall be compacted to the maximum practicable density during the placement and thoroughly worked around the reinforcement, if any, and around the embedded stubs and into the corners of the formwork, with vibrators or any other means approved by the Purchaser.

(j) Repairs of imperfection in concrete shall be completed within 24 hours after the removal of forms. Repair of concrete shall be performed only in the presence of the Purchaser or his authorized representative. All exposed corners shall be slightly rounded or chamfered. Concrete in the top of footings shall be sloped to provide drainage away from stub angles.

### 3.22.13 TEMPERATURE OF CONCRETE

i) In hot weather, the temperature of concrete when it is placed in the forms shall not be more than 38 deg C. In extreme hot weather, some suitable means out of those mentioned below shall be employed to lower the temperature of concrete:

   a) Using cold mixing water.

   b) Cooling coarse aggregate with cold water by sprinkling or inundation.

   c) Insulating mixer drums or cooling with sprays or with wet burlap coverings.

   d) Shading materials and facilities from heat.

   e) Working only at night. Use of ice for mixing water zshould be carefully controlled to ensure complete melting before mixing is completed.

ii) In cold weather, the temperature of concrete when it is placed at or below freezing temperatures shall be maintained at least 4.5 deg C. No frozen material or material containing ice shall be used. Depending upon the severity of weather, it is necessary to heat the mixing water or aggregate. Heating of mixing water shall be preferred. Very hot water shall not be allowed to touch the cement to avoid quick or flash setting, hot water and coldest portion of aggregate shall be brought together in the mixer first.

iii) If subject to the approval of Purchaser, heating of aggregate is used, the aggregate shall be heated uniformly and carefully avoiding overheating and excessive drying. The average temperature of aggregate shall not exceed 65 deg C and the maximum temperature shall not exceed 100 deg C.

### 3.22.14 STRIPPING TIME

Under fair weather conditions with average daily temperature not less than 20 deg C and when ordinary cement is used, forms may be struck after 24 hours of placing the concrete. In very cold temperatures, the forms shall be struck after 48 hours of the placing of concrete.

### 3.22.15 PROTECTION OF CONCRETE

a) In very cold weather, the concrete shall be protected from freezing for at least 48 hours of placement when the mean daily temperature is 4.5 deg C. When the mean daily temperature in the vicinity of work site falls below 4.5 deg C for more than one day, the concrete shall be maintained at a temperature not less than 10 deg. C for at least 72 hours after it is placed. Concrete cured by water curing shall be protected at 10 deg. C.

b) In hot weather, the curing shall be commenced even before stripping the form work by loosening the forms and allowing curing water to run down between the concrete forms.

### 3.22.16 CURING

a) Uncovered concrete footing above the ground level shall be cured by wrapping around hessian sacking or similar absorbent material and keeping it constantly wet. For curing the foundations below ground level, after backfilling, 150 mm high earthen embankment along the sides of excavation pits shall be made and sufficient water shall be poured in the backfilled pits so that standing water may remain above the backfilled earth.

b) In high temperature and low humidity areas, more frequent sprinkling shall be done.

c) In cold weather at or below freezing temperature, the concrete shall be insulated with layer of stray or similar material covered with a water proof sheet material to help

retention of the original heat of concrete plus heat of hydration. Curing shall be carried out for longer periods to the satisfaction of Purchaser, to ensure that the concrete attains the strength and quality.

### 3.22.17 SAMPLING AND TESTING

a) Samples shall be cured under laboratory conditions except when in the opinion of the Purchaser, the extreme weather conditions may prevail at which time the Purchaser may require additional cubes cured under job conditions.

b) The Contractor shall promptly furnish to the Purchaser certified reports of all tests made by the testing laboratory.

c) If the strength of the cubes for any portion of the concrete work falls below the specified compressive strength, the criteria for acceptance of the portion of the work shall be as stipulated in IS: 456-2000. The Purchaser shall also reserve the right to reject whole or any part of the work. In case of acceptance of such works, the standard deviations shall be worked out, and examined by the Purchaser and if he is satisfied only then such works can be accepted at the reduced rates provided with reduced strength of concrete, the design of foundation is found to be safe. Furthermore, the Purchaser shall have the right to order a change in the mix design or the water cement ratio for the remaining portion of the foundations at no extra cost.

### 3.22.18 CONCRETING OF FOUNDATION

The Contractor shall inform the Purchaser or his authorized representative sufficiently in advance about the programme of concreting the location.

### 3.22.19 MEASUREMENT

Measurement of concrete shall be in cubic meter correct up to second place of decimal and it shall be based on approved drawings of foundations. No deduction shall be made for embedments and reinforcements. The payment shall be limited to actual volumes as per approved drawing or guaranteed volumes whichever is less.

## 3.23 REINFORCEMENT

### 3.23.1 SCOPE:

This section covers the technical requirements for supply and installation of reinforcement steel in foundation work of transmission line towers. The contractor shall furnish all materials, labour and equipment required for complete performance of the work in accordance with the approved foundation drawings and as described herein.

**3.23.2** Reinforcing steel shall be clean and free from loose mill scales, dust, loose rust and coats of paints, oil, grease or other coatings, which may impair or reduce bond. It shall conform to the following IS Specifications:

High Yield Strength Deformed reinforcement steel of grade Fe-415 or Fe-500 conforming to of IS: 1139 and IS: 1786 shall be used. All steel reinforcements including and above 6mm diameter shall necessarily be of tested quality.

**3.23.3** Reinforcement accessories shall be furnished by the contractor. Binding wire shall be annealed iron wire quality not less than No. 16 swg (1.65mm dia.). Bar support, chairs and bolsters shall be sufficiently strong to support the steel reinforcement properly.

**3.23.4** The bending and fixing of reinforcement bars for reinforced concrete work shall be in accordance with IS: 2502, SP-34 and IS:456-2000.

**3.23.5** The measurement shall be based on the calculated weights of reinforcement steel as per approved foundation drawing in tonnes (MT) correct to 3rd place of decimal, no allowance being made for wastage. No payment shall be made for wire required for binding the reinforcement, chairs and spacers etc. as the cost of these is deemed to be included in the unit rate quoted for the item of reinforcement. The payment shall be limited to guaranteed quantity or actual as per approved drawing whichever is less.

## 3.24 PROTECTION OF TOWER FOOTINGS

**3.24.1** The work shall include all necessary stone revetment, breast/retaining walls, earth filling above ground level etc. Special measures for protection of foundations shall be taken in respect of locations close to/in nallah, riverbeds, etc. by providing suitable crate of galvanized wire netting and meshing

packed with boulders. The top seal cover of the revetment work shall be done with M-15 grade concrete. The Contractor shall furnish recommendations for providing protection at such locations. Where the ground surface is irregular, the foundation shall be finished off in a substantial and permanent way by forming a plinth by side cutting and building a suitable stone / brick/ concrete revetment or in case of rock foundation by building up with cement concrete as desired by the Purchaser. The number of retaining walls and breast walls enroute transmission line shall be intimated by the Contractor for obtaining the decision of the Purchaser before taking up erection.

### 3.24.2 MEASUREMENT

The unit rates of protection of the tower footing shall be quoted in the Schedule of Prices and shall be based on volumes calculated up to two places of decimal as per approved drawings and shall include the pointing in RR Masonry and plastering in brick masonry retaining walls.

## 3.25 GROUNDING

**3.25.1** The installation of earthing sets shall be in accordance with relevant standard specifications. The galvanised steel pipe sets shall be installed in the ground near the towers and connected to the tower legs by means of galvanised steel flat as shown in Drg. No. SETD/14 The grounding shall be effected by making about 350 mm dia and 3600 mm deep pit at a distance of not less than 3650 mm diagonally away from the stubs and filling in the pits with finely broken coke having grannite sizes not more than 25 mm thick. The coke shall be maintained upto a distance of 150 mm from the pipe on all sides. The top edge of the pipe shall be at least 600 mm below the ground level. The steel strip shall be buried not less 450 mm deep from the ground level. Where tower footing resistance exceed that specified in Section II of this Specification, the desired earthing resistance shall be obtained by installing additional pipe earthing sets. The distance between two electrodes in such a case shall preferably be not less than twice the length of electrode.

**3.25.2** At locations, where it is not possible to obtain the desired footing resistance by the means mentioned in clause 3.25.1 installation of counterpoise earthing shall be resorted to. Four galvanised steel stranded conductors shall be radiated from tower as shown in Drg. No. SETD/15. The measured earthing resistance of tower shall not exceed 10 ohms in dry weather.

**3.25.3** In case the measured resistance of the earthing arrangement described in 3.25.2 still exceeds the values, use of continuous counterpoise shall be made as per the arrangement shown in Drg. No.SETD/15.

**3.25.4** Where a tower stands on rock, efforts shall be made to obtain a good ground by carrying a length of galvanised steel flat from the tower legs to earthing pipe driven in damp soil at the shortest possible distance from the tower. The connecting flat shall be buried in a groove cut in the rock surface and adequately protected from damage.

**3.25.5** The Erection Contractor shall measure and record the resistance of each tower to earth after erection and before installing the earth wire and submit the same to the Purchaser.

## 3.26 HANDLING AND TRANSPORTATION OF STEEL

**3.26.1** All galvanised tower steel, including stub angles, shall be handled and transported to work site by the Erection Contractor with care to avoid bending of members and damage to galvanised surfaces.

## 3.27 TOWER ERECTION

**3.27.1** The Towers shall be erected by member by member assembly or any other standard method without overstressing any member on foundations at least after 14 days of casting but a gap of 28 days shall be preferred. The tower shall be erected in the best workmanlike manner.

**3.27.2** The Erection Contractor shall be entirely responsible for correct erection for all towers as per the approved drawings and their correct setting on the alignment finally approved by the Purchaser. The towers must be truly vertical after erection, the permitted tolerance in verticality being 1 in 360 of the tower height. No straining will be permitted to make the towers vertical.

**3.27.3** A reasonable amount of drifting as permissible in IS:5613 (Part 2/ Section -2) 1985 shall be allowed in assembling, but reaming for correction of mis-matched holed due to shop errors will not be permitted. If any shop errors are discovered, the Erection Contractor shall notify the Purchaser, who will decide whether the errors may be corrected in the field or members returned to tower fabricator for correction or replacement. All galvanised surfaces damaged as a result of correction shall be made good as directed by the Purchaser.

**3.27.4** All errors and omissions in erection of towers shall be corrected by the Erection Contractor at no additional cost to the Purchaser. Any tower damaged during erection due to incomplete bolting, improper guying or any other reasons, shall be repaired/ replaced by the Erection Contractor as directed by the Purchaser.

**3.27.5 ASSEMBLY**

**3.27.5.1** The method followed for the erection of towers, shall ensure the points mentioned below:

a) Straining of the members shall not be permitted for bringing them into position. It may, however, be necessary to match hole positions at joints and to facilitate this, tommy bars not more than 450 mm long may be used.
b) Before starting erection of an upper section, the lower section shall be completely braced and all bolts provided in accordance with approved drawings.
c) All plan diagonals relevant to a section of tower shall be placed in position before assemble upper section is taken up.
d) The bolt positions in assembled towers shall be as per IS:5613 (part-2 / Section-2)-1985.
e) Tower shall be fitted with number plate, danger plate, phase plates, circuit plate and anticlimbing device as described.
f) All the blank holes, if any left, after complete erection of the tower, are to be filled up by bolts and nuts of correct size.

**3.28 TIGHTENING AND PUNCHING OF BOLTS AND NUTS**

**3.28.1** All nuts shall be tightened properly using correct size spanners. Before tightening, it will be ensured that filler washers and plates are placed in relevant gaps between members, bolts of proper size and length are inserted and one spring washer shall be placed under each nut, and in case of step bolts, spring washers have been placed under the outer nuts. The tightening shall progressively be carried out from the top downwards, care being taken that all bolts at every level are tightened simultaneously. The threads of bolts projecting outside the nuts shall be punched at three position on the diameter to ensure that the nuts are not loosened in coarse of time. If during tightening a nut is found to be slipping or running over the bolt threads, the bolt together with the nut shall be replaced.

**3.28.2** All the bolts projected outside the nuts shall be welded with the nuts at two diametrically opposite places. The length of each welding shall be atleast 10 mm . The welding shall be provided

from ground level upto bottom cross arm level. After welding cold galvanised paint (zinc rich paint) having atleast 90% zinc content shall be applied to the welded portion. Atleast two coats of the paint shall be applied. The cost welding including application paint shall be deemed to be included in the erection price.

## 3.29 TOWER ACCESSORIES

**3.29.1** Each tower shall be fitted with number plate, danger plate and phase plates.

**3.29.2** Anti- climbing device shall be provided on all towers.

**3.29.3** Bird- guards shall be provided on suspension towers.

**3.29.4** The compression dead end and jumper connection in tension assemblies shall be fixed to conductor in accordance with manufacturer's recommendation which shall be furnished by the contractor.

## 3.30 INSULATOR HOISTING

**3.30.1** The insulators, string fittings and insulator string assembly drawings shall be supplied to Erection Contractor. The number of insulator units required per string are given in Section-II of this specification for suspension as well as tension strings. Single suspension insulator strings shall be used on tangent towers and double tension insulator strings on all tension towers.

**3.30.2** Damaged insulators and fittings, if any, shall not be used in the assemblies. All insulators shall be cleaned in a manner that will not spoil , injure or scratch the surface of the insulator, but in no case any oils shall be used for the purpose. Before hoisting, the components of the insulator string shall be checked for any damage, crack and missing of security clips etc.. Corona control rings in case of 132kV lines only shall be fitted in an approved manner. The yoke arrangements shall be horizontal for tension and longitudinal for suspension strings. Torque wrench shall be used for fixing different components, like suspension clamp for conductor and ground-wire, etc. whenever, recommended by the manufacturer of the same.

**3.30.3** The installation of string assemblies shall also include the installation of armour rod sets at suspension locations.

**3.30.4** The compression dead ends and jumper connection in tension assemblies shall be fixed to conductor in accordance with manufacturer's recommendations which shall be furnished to the Erection Contractor.

**3.30.5** Sacking shall be wrapped over the cross arm members of towers to prevent damage to the galvanised surface during hoisting of string assemblies.

**3.30.6** Payment for installing insulator assemblies of various types shall be included in the rates quoted in the Schedule of Prices for stringing of conductors.

## 3.31 HANDLING OF CONDUCTOR AND GROUND WIRE

**3.31.1** Before commencement of stringing, the Erection Contractor shall submit stringing charts for the conductor and Ground Wire for various temperatures corresponding to spans and equivalent spans prepared on the basis of the data given in Section - II of this Specification and also on the data obtained from the detailed survey for the approval of the Purchaser.

**3.31.2** The Erection contractor shall be entirely responsible for any damage to the towers or conductor's during stringing. While running out the conductors care shall be taken that the conductors do not touch and rub against the ground or objects which could cause scratches or damage to the strands. The conductor shall be run out of the drums from the top in order to avoid damage due to chafing. Immediately after running out, the conductor shall be raised at the supports to the levels of the clamp and placed into the running blocks. The groove of the running blocks shall be of such a design that the seat is semi-circular and larger than the diameter of the conductor, groundwire and it does not slip over or rub against the sides. The grooves shall be lined with hard rubber or neoprene to avoid damage to conductor and shall be mounted on properly lubricated bearing.

**3.31.3** The running blocks shall be suspended in a manner to suit the design of the cross-arm. All running blocks, especially those at the tensioning end shall be fitted on the cross arms with jute cloth wrapped over the steel work and under the slings to avoid damage to the slings as well as to the protective surface finish of the steel work. Normally, suspension towers shall not be used even for temporary termination. In case small or medium angle

towers are used even for temporary terminations, these shall be well guyed and steps be taken by the Erection Contractor to avoid damage. Guying proposal alongwith necessary calculations shall be submitted by the Erection Contractor to Engineer -in - Charge, for the approval. Proper T & P shall also be made available to the Purchaser by the Erection Contractor for checking tensions in the guy wires. The drums shall be provided with a suitable braking device to avoid damages, loose running out and kinking of the conductor. The conductor shall be continuously observed for loose or broken strands or any other damage. When approaching end of a drum length, atleast three coils shall be left when the stringing operations are to be stopped. These coils are to be removed carefully, and if another length is required to be run out, a joint shall be made as per the recommendations of the conductor manufacturers.

**3.31.3** Alternative procedure for stringing other than that specified may be offered.

**3.31.4** Repairs to conductors, if necessary, shall be carried out during the running out operations, with repair sleeves. Repairing of conductor surface shall be done only in case of minor damage, scuff marks etc. keeping in view both electrical and mechanical safety requirements. The final conductor surface shall be clean smooth and shall be without any projections, sharp points, cuts abrasions etc.

**3.31.5** Conductor splices shall be so made that they do not crack or get damaged in the stringing operation. The Erection Contractor shall use only such equipment/methods during conductor stringing which ensures complete compliance in this regard.

**3.31.6** Derricks and scaffolding shall be used where roads, rivers, channels, telecommunication or overhead power lines, railways lines, fences or walls have to be crossed during stringing operations. It shall be seen that normal services are not interrupted or damage caused to property. Shut-down shall be obtained when working at crossing of overhead power lines. The Erection Contractor shall be entirely responsible for the proper handling of the conductor, Ground Wire and accessories in the field.

**3.31.7** Suitable guards/sheaves shall be used to protect the conductor from damage in places where it would otherwise be impossible to save the conductors from coming in contact with objects which may injure the conductors. Guards shall consist of material over which the conductor may slide without injury and shall be subject to the approval of Purchaser.

**3.31.8** The sequence of running out shall be from top to downwards, i.e. The Ground Wire shall be run out first, followed by the conductors in succession. Unbalances of loads on towers shall be avoided as far as possible.

**3.31.9** The proposed 132 kV Transmission lines may run parallel for certain distance with the existing 132 kV, 220 kV, 66 kV lines which may remain energized during the stringing period. As a result there is a possibility of dangerous voltage build up due to electromagnetic and electrostatic coupling in the pulling wire conductors and groundwires, which although comparatively small during normal operations can be severe during switching operation. It shall be the Erection Contractor's responsibility to take adequate safety precautions to protect his employees and other from this potential danger.

**3.31.10** The small and medium angle tension towers of 132kV lines are not designed for one side stringing. Proper guying arrangement shall therefore be made by the Erection Contractor during stringing to avoid unbalanced loads on towers. All the expenditure on account of the above work is deemed to be included in the tender and no extra payment shall be made for the same.

## 3.32 STRINGING OF CONDUCTOR AND GROUND WIRE

**3.32.1** The stringing of the conductor for 132 kV lines shall be done by the control tension method.

## 3.33 JOINTING

**3.33.1** All the joints on the conductor and Ground Wire shall be of compression type, in accordance with the recommendations of the manufacturer for which all necessary tools and equipment like compressors, dies, etc. shall have to be arranged by the Erection Contractor. Each part of the joint shall be cleaned by wire brush to make it free of rust or dirt etc. and shall properly be greased with anti-corrosive compound, if required and as recommended by the supplier before the final compression is done with the compressors.

**3.33.2** All joints or splices shall be made atleast 15 metres away from the structures. No joints or splices shall be made in the spans crossing over main roads, railways and rivers. The joints in the tension spans shall be permitted after the approval of the Purchaser Engineer. Not more than one joint per sub-

conductors shall be allowed in one span. The compression type fitting used shall be self - centring type or care shall be taken to mark the conductors to indicate when the fitting is centered properly. During compression or splicing operation, the conductor shall be handled in such a manner as to prevent lateral or vertical bearing against the dies. After pressing the joint, the aluminium sleeve shall have all corners rounded, burrs and sharp edges removed and smoothened.

**3.33.3** During stringing of conductor, to avoid any damage to the joint, the Erection Contractor shall use a suitable protector with mid span compression joints in case joints are to be passed over pulley blocks /aerial rollers. The size of the groove of the pulley shall be such that the joint along with protector can be passed over it smoothly. The arrangement to be adopted shall be explained in the tenders.

## 3.34 SAGGING-IN-OPERATION

**3.34.1** The conductors and Ground Wire shall be pulled upto the desired sag and left in running block for atleast one hour after which the sag shall be re-checked and adjusted, if necessary, before transferring the conductors from the running blocks to the suspension clamps. The conductors shall be clamped within 36 hours of sagging in.

**3.34.2** The sag will be checked in the first and the last span of the section in case of sections upto eight spans and in one intermediate span also for sections with more than eight spans. The sag shall also be checked when the conductors have been drawn up and transferred from running blocks to the insulator clamps.

**3.34.3** The running blocks, when suspended from the transmission structure for sagging shall be so adjusted that the conductors on running blocks will be at the same height as the suspension clamp to which it is to be secured.

**3.34.4** At sharp vertical downward angles, the sags and tensions shall be checked on both sides of the angles, the conductor and earthwire shall be checked on the running block for equality of tension on both sides. The suspension insulator assemblies shall normally assume vertical positions when the conductor is clamped.

**3.34.5** Tensioning and sagging operations shall be carried out in calm weather when rapid changes in temperatures are not likely to occur. In areas where calm weather is not prevalent during

working season, the Erection Contractor shall recommend the precautions to be taken during final tensioning and sagging of conductor.

## 3.35 TENSIONING AND SAGGING OF CONDUCTORS AND GROUND WIRE

**3.35.1** The tensioning and sagging shall be done in accordance with the approved stringing charts before the Conductors and Ground Wire are finally attached to the towers through the Ground Wire clamps for the Ground Wire and insulator strings for the conductor. Dynamometers shall be employed for measuring tension in the conductor and Ground Wire . The dynamometers employed shall be periodically checked and calibrated with a standard dynamometer.

**3.35.2** Provision for ground undulations, errors in stringing has been made in clause No.1.17.2 This shall be considered at the time of stringing of conductors.

**3.35.3** No prestressing / over-tensioning of the Ground Wire shall be done.

**3.35.4** The Erection Contractor shall terminate the line conductors and groundwire at the dead end towers on each end of the line. Payment for stringing work shall be made for the actual route length of the line at the unit rates quoted for the stringing of conductors and Ground Wire in the Schedule of Prices.

## 3.36 CLIPPING IN

**3.36.1** Clipping of the conductors in position shall be done in accordance with the recommendations of the Purchaser. Conductor shall be fitted with the armour rods at suspension point and with vibrations dampers at suspension and tension points.

**3.36.2** The jumpers at the section and angle towers shall be formed to parabolic shape to ensure maximum clearance requirements. Pilot suspension insulator string shall be used, if so desired by the Purchaser to restrict the jumper swings to the designed values.

**3.36.3** Fasteners in all fittings and accessories shall be secured in position. The security clip shall be properly opened and strung into position.

## 3.37 FIXING OF CONDUCTOR AND GROUND WIRE ACCESSORIES

**3.37.1** Vibration dampers and other conductor and Ground Wire accessories supplied by the Purchaser shall be installed by the Erection Contractor as per the design requirements and respective manufacturer's instruction. Vibration dampers shall be fitted within 24 hours. of the conductor clamping.While installing the conductor and Ground Wire accessories proper care shall be taken to ensure that the surfaces are clean and smooth and no damage shall occur to any part of the accessories.

**3.37.2** The Erection Contractor shall ensure that drain holes, if provided, in the weights of the vibration dampers are open. The vibration dampers shall be installed at the intervals indicated by the Purchaser. The required number of spacer cars/ cycles with metre counters suitable for installing vibration damper shall be arranged by the Erection Contractor.

**3.37.3** Rates for installing vibration dampers shall be included in the rates of stringing of Conductor and Ground Wire.

## 3.38 REPLACEMENT

If any replacements are to be effected after stringing and tensioning or before handing over, leg members and bracings shall not be removed without reducing the tension on the tower with proper guying or releasing the conductor. If the replacement of cross arms becomes necessary after stringing, the conductor shall be suitably tied to the tower at tension points or transferred to suitable roller pulleys at suspension points.

## 3.39 FINAL CHECKING, TESTING AND COMMISSIONING

**3.39.1** After completion of the works, final checking of the line shall be done by the Erection Contractor to ensure that all the foundation works, tower erection, and stringing have been done strictly according to the specifications and as approved by the Purchaser. All the works shall be thoroughly inspected keeping in view of the following main points:

a) Sufficient backfilled earth is lying over each foundation pit and it is adequately compacted.
b) Concreted chimneys and their copings are in good finally shaped conditions.

c) All the tower members are correctly used, strictly according to final approved drawings and are free from any defect or damage whatsoever.

d) All bolts are properly tightened and punched /and tack welded ( as specified ).

e) The stringing of the conductors and Ground Wire has been done as per the approved sag and tension charts and desired clearances are clearly available.

f) All conductor and Ground Wire accessories are properly installed.

g) All other requirements to complete the work like fixing of danger plate, phase plates, number plate, circuit plates anti-climbing device, Bird guards etc. are properly installed.

h) Wherever required, it should be ensured that revetment is provided.

i) The original tracings of profile, route alignment and tower design, structural drawings bill of material, shop drawings of all towers are submitted to the Purchaser for reference and record.

j) The line insulation is tested by the Erection Contractor by providing his own equipment, labour etc. to the satisfaction of the Purchaser.

k) The line is tested satisfactorily for commissioning purpose.

l) The right-of-way all along the route of line is clear of all obstructions and meets requirements of clause 5.3 of IS:5613 (Part -2/ Section-2)-1985.

m) Any defects found as a result of testing shall be rectified by the Erection Contractor forthwith to the satisfaction of the Purchaser without any extra charges.

n) Before taking over of the line by the Purchaser , the line shall be energised at full working voltage.

## 3.40 PAYMENTS

**3.40.1** The payment to the Erection Contractor for various items of works shall be based on the rates quoted in the Schedule of prices for Erection.

**3.40.2** The payment for excavation and concreting shall be based on the finally approved design volumes of excavation and concreting, subject to the guaranteed volumes where applicable.

**3.40.3** The payment for super-structure erection shall be based on the calculated weights of towers and their extensions as per the finally approved bill of material for each type of tower subjected to the guaranteed weights where applicable.

**3.40.4** The payment of stringing charges for spans exceeding design span given in items 3.1 of Section-II and falling within the capacity of the normal tower shall be governed as per rates given in Price Schedule.

**3.40.5** No claim for idle period resulting from any "force majeure" condition shall be entertained by the Purchaser.

## 3.41 ERECTION EXPERIENCE AND FINANCIAL RESOURCES OF TENDERER

**3.41.1** The tenderer should have experience of erection and commissioning of 132kV lines as per volume - I. The bids received from the tenderers who do not fulfil these requirements shall not be considered. The tenderers shall submit details of the 132 kV lines of similar construction erected by them which are in operation, in 'Performance Schedule', alongwith certificates from their customers in support of the satisfactory construction and operation of the lines. Information about financial resources of the tender shall also accompany the tender.

## 3.42 ERECTION SCHEDULE

**3.42.1** The transmission line(s) covered under this specification are required to be completed as per the programme given in the Annexure I.

**3.42.2** The tenderer shall submit erection schedule(s) covering all phases of work starting from the date of award of contract upto the commissioning of the transmission line, in the form of flow-diagrams showing critical path construction schedule of all

phases of work simultaneously or in the form of Bar Chart for all the lines separately.

## 3.43 PROGRESS REPORT

**3.43.1** Weekly Progress Reports of erection work in triplicate shall be submitted by the Erection Contractor.

## CHAPTER - 4
## SPECIAL TOWERS

### 4.1 GENERAL

**4.1.1** Special towers shall be used for major river crossing, Deep valley crossing and other long spans of the order of 800m and above or as otherwise required for these lines. The scope covers supply of these towers, check survey, foundation, tower erection and stringing. The Contractor shall submit the most economical design for the special towers and foundations as per the procedure laid down in CBIP publication No 290. (Manual on design of towers for long span river crossing)

**4.1.2** The unit rates per tonne for design, fabrication, galvanising and supply of special towers, their stubs/anchor bolts and rates for stub-setting, erection and stringing shall be quoted as given in appropriate schedule.

**4.1.3** For river crossing spans the towers shall be of suspension type followed by Anchor type tower on either side of the river span. Anchor towers to be used for anchoring shall also be special type angle towers. The towers for deep valley and other long span crossings shall also be of special type angle towers.

**4.1.4** All the requirements for standard towers shall apply for special towers except as given in the following clauses:

### 4.2 SHIELDING ANGLE AND CLEARANCES

The shielding angle shall not be greater that 20 deg.

**4.2.1** The minimum clearance from lowest point of power conductor from highest flood level in navigable rivers for crossing towers shall be obtained from the navigation authority for Owner's approval.

**4.2.2** The minimum electrical clearance between live parts and tower body and crossarm members will be same as for normal tower.

**4.2.3** The approximate height of foundation, on which stubs for river crossing towers are to be set, over the highest flood level of the river shall be fixed only after Owner's approval.

## 4.3 ANGLE OF DEVIATION

**4.3.1** The angle of deviation to be considered for river crossing suspension towers is 5 deg. and all the live metal clearances to be computed considering double suspension string as per drawing No. SETD/03.

**4.3.2** The tower foundations shall be designed for loads as obtained from tower reactions at base level considering following partial safety factors as follows.

i) Tower with angle of deviation upto 15 deg. : 1.1
ii) Tower with angle of deviation above 15 deg. : 1.2

## 4.4 MAXIMUM TENSION LIMITS FOR CONDUCTOR AND GROUNDWIRE

The maximum tension limits for conductor and groundwire of special towers shall be same as that of normal tower's of the line.

## 4.5 RIVER CROSSING SPAN / DESIGN SPAN

Crossing span is the distance between two river crossing towers or two tall towers placed on banks for crossing the river. Height of the river crossing tower or tall tower is fixed depending on crossing span. Crossing span is an important parameter for designing river crossing or tall tower.

## 4.6 ANCHOR SPAN

The distance between river crossing tower and anchor tower on either bank of the river is anchor span. In some cases anchor span is kept little more than normal span to avoid uplift on anchor tower consequent to tall river crossing tower.

## 4.7 WIND SPAN

The wind span is the sum of the two half spans adjacent to the river crossing tower under consideration.

## 4.8 WEIGHT SPAN

The weight span is the horizontal distance between the lowest point of the conductors on the two adjacent spans.

## 4.9 RULING SPAN/ EQUIVALENT SPAN

The ruling /equivalent span is calculated from the following formula between anchor tower to anchor tower on either side of the river.

$$\text{Ruling span} = \sqrt{\frac{(L_1^3 + L_2^3 + L_3^3)}{(L_1 + L_2 + L_3)}}$$

Where

$L_1$ = Span between anchor tower and river crossing tower on one side of river.

$L_2$ = River crossing span

$L_3$ = Span between river crossing tower and anchor tower on other side of the river.

## 4.10 SAG TENSION CALCULATION

The sag and tension calculation for river crossing stretches are very important. Sag and tension calculations are carried out for ruling/ equivalent span following catenary equation which decides the tension that will prevail in the conductors between anchor tower to anchor tower. Heights of river crossing and anchor towers are finalised based on the sag at crossing span and anchor span calculated with the tension of equivalent/ ruling span at maximum temperature no wind condition. The factor of safety for conductor at starting condition should not be less than 5.0 at no wind condition and everyday temperature.

## 4.11 USE OF SPECIAL CONDUCTOR

For suitable reduction in tower height, special conductors / earthwire of higher strength shall be used in the river crossing stretches. Aluminium alloy conductor steel reinforced (AACSR) / special earthwire are recommended in this regard. Using of such conductor / earthwire not only reduces tower height but also saves in tower weight.

## 4.12 STEEL QUALITY

Normally, members of tall river crossing tower are loaded heavily. This is due to extraordinary height of towers, conductor and

groundwire above ground level encountering heavy wind. To have desired capacity in tower members to withstand heavy loads, combination of mild and high tensile steel are normally used. HT steel to be used shall have yield stress not more than that of steel equivalent to IS: 8500- 490B/BSEN-10025-S355 JR.

## 4.13 MINIMUM THICKNESS OF ANGLE SECTION USED

River crossing towers are subjected to heavy loads. Therefore, angle section less than 5 mm thickness should not be used in the tower to achieve adequate rigidity in the structure. The minimum thickness of angle section shall not be less than following:

(i) Leg members, main members of cross-arm and peak = 6 mm

(ii) Other members including bracings and redundants = 5 mm

## 4.14 BOLTS AND NUTS

Normally two sizes of bolts (diameters) are used in the tower. One size is used for lightly loaded members and the higher size bolt is used for heavily loaded member especially legs. This is required to minimize the number of bolts in heavily loaded members. To avoid any error during tower erection in respect of use of lower size bolt, it is preferable to have distinguisable gap between the two sizes of bolts used. For example, if one size of bolt is 16 mm dia, the second size should be 24 mm dia bolt.

## 4.15 SLENDERNESS RATIO

Slenderness ratio for members shall be computed in accordance with IS - 802 (Part 1/Sec-2) - 1992. Slenderness ratio (kl/r) for compression and tension members shall not exceed the following values:

| | | | |
|---|---|---|---|
| a) | Leg members including corner members of earthwire peak and tower corner members of the cross-arms in compression. | = | 120 |
| b) | For other members carrying computed stresses | | 200 |
| c) | For redundant members | | 200 |
| d) | For members under tensile stress only | | 375 |

## 4.16 REDUNDANT MEMBER

All the redundant members should be designed for slenderness ratio of not more than 200. Redundant members connected to leg member should be designed for actual axial load or for 2.5% load carried by the leg member whichever is more stringent. Adequate number of bolts shall be provided in the redundant members accordingly.

## 4.17 WIND LOADS

The wind loads on the special towers shall be calculated as given below.

a) The procedure for wind load calculation on tower, conductor, groundwire & insulators shall be same as adopted for normal towers of the line except the reliability level 3 (Return period 500 years) and terrain roughness factor K2=1.08 shall be considered for working out loads on special/river crossing towers.

b) The tower members will be designed considering the following angle of incidence of wind for whichever case is more stringent for a particular member.

   i) Angle of incidence of wind 90º to the tower and 90º to the conductor, groundwire & insulator.

   ii) Angle of incidence of wind 45º to the tower and 45º to the conductor, groundwire & insulator.

   iii) Angle of incidence of wind 0º to the tower (longitudinal direction)

The recommendation of the tenderer if any on the value of wind pressure on conductors and towers to be considered shall be clearly thought out in the tender.

## 4.18 BROKEN WIRE CONDITION

The broken wire conditions shall be considered as per IS:802(part 1 / sec1)-1995.

## 4.19 LONGITUDINAL LOADS

a) The longitudinal loads due to power conductor and ground wire for suspension towers shall be nil under normal

conditions and 100 percent of maximum working tension of conductor or ground wire under broken wire conditions.

b) Under normal condition, unbalanced longitudinal load due to difference in tensions in ruling span for special crossing tower on one side and normal span of the line on the other side shall also be considered for the design of special towers.

## 4.20 AVIATION REQUIREMENTS

The river crossing / Long span crossing tall towers shall be painted and provided with markers respectively to caution the flying aircraft as given below:

Visual aids in the form of markers and luminaries shall be installed on the transmission lines and transmission line supports of height more than 35m to give warning to the flying aircraft. These aids shall be weatherproof and should not cause tracking on their surface due to leakage current. The Directorate of Flight Safety, Air Headquarters, Ministry of Civil Aviation and Chairman National Airport Authority should be approached for obtaining their approval at the time of execution of lines.

### a) VISUAL AIDS

i) **MARKERS** - The mechanical markers in the form of colour gloubles of dia 40-50cm at an interval of 20m (as per requirement of Directorate of Flight Safety) or not more than 40m (as per ICAO) shall be installed on the ground wire(s) in such a way that the top of each marker is not below the level of highest wire. In case of two ground wires used on a transmission line, the colour gloubles may installed on each ground wire but staggered. The colour of the marker should contrast with the background against which they are to be seen. Orange and white or alternatively red and white markers should be used except where such colour merge with the background. Typical sketch of a marker is given in IS : 5613.

ii) **LUMINARIES**-

a) Electrical luminaries used in HV and EHV lines works on the principle of power obtained by capacitive coupling. The system, as shown in IS: 5613 comprises a lamp producing red light constituting the light source and an auxiliary conductor for flowing of electric energy produced by capacitive coupling for lighting the lamp. The size of lamp and length of auxiliary conductor depends upon the voltage of the transmission line.

b) **LUMINARIES USED ON TRANSMISSION LINE SUPPORTS**.
High intensity obstacle lights shall be installed at these levels. The highest light level should beat the top of the support structure. On lowest light level at the level of the lowest point in the catenary between the two support structures and the middle level at the mid-point between the top and bottom levels. The high intensity obstacle lights should have a daytime effective intensity of not less than 100,000cd. The intensity of light should reduce automatically to 20,000cd + 25 percent at twilight and again automatically to a nighttime intensity of 1320cd + 25 percent. The light on a supporting structure should flash sequentially @ 60 sequences per minute. The middle level light shall flash first, followed by top level and then the bottom level. The interval between the flashing of top level and bottom level should be approximately twice the interval between the middle level and the top level. The interval between the end of one sequence and the beginning of next should be about 10 times the interval between the middle level and the top level.

c) The full height of the towers shall be painted over the galvanised surface in contrasting bands of orange or red white. The bands should be horizontal and not less than 1.5m and not more than 3m in height. The bands on the extremities should be orange or red colour.

## CHAPTER – 5

## CONDUCTOR, GROUND WIRE, CONDUCTOR & GROUND WIRE ACCESSORIES

### 5.1 POWER CONDUCTOR

### 5.1.1 SCOPE

This section covers design, manufacture, testing before despatch, packing, supply and delivery F.O.R destination of 116 Kms of 'PANTHER' ACSR Conductor of size 30/7/3.0 mm.

### 5.1.2 STANDARDS

**5.1.2.1** 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.

**5.1.2.2** The ACSR Conductor shall also conform to the following standards.

| Sl. No. | Indian Standard | Title | International Standards |
|---|---|---|---|
| 1. | IS:209-1979-1992<br>BS:3436-1986 | Specification for Zinc | |
| 2. | IS:398-1996 | Specification for aluminium conductors for overhead transmissIon purposes. | |
| | Part-II -1996 | Aluminium conductors galvanised steel reinforced | IEC:1089-1981<br>BS:215(Part-II) 1970 |
| 3. | IS:1521-1991 | Method of Tensile Testing of Steel wire | ISO6892-1984 |
| 4. | IS:1778-1980 | Reels and Drums for Bare conductors | BS:1559-1984 |
| 5. | IS:1521-1991 | Method of tensile testing Of steel wire | |

| | | | |
|---|---|---|---|
| 6. | IS:1841-1978 | E.C.Grade Aluminium rod produced by rolling | |
| 7. | IS:2629-1990 | Recommended practice for Hot Dip Galvanising of iron and steel | |
| 8. | IS:2633-1992 | Method of testing uniformity of coating of zinc coated articles. | |
| 9. | IS:4826-1992 | Galvanised coatings on round steel wires. | IEC: 888-1987<br>BS:443-1969 |
| 10. | IS:5484-1978 | E.C.Grade Aluminium rod produced by continuous casting and rolling. | |
| 11. | IS:6745-1990 | Methods of determination of weight of zinc-coating of zinc coated iron and steel articles | BS:443-1969 |
| 12. | IS:8263-1990 | Method of radio-interference tests on high voltage installations. | IEC:437-1973<br>NEMA:107-1964<br>CISPR |
| 13. | IS:8263-1990 | Hard drawn Aluminium wire for overhead line Conductor | IEC:889-1987 |

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**5.1.2.3** Offers conforming to Standards other than IS-398 shall be accompanied by the English version of relevant standards in support of the guaranteed particulars to be furnished as per Section-III enclosed.

**5.1.3 GENERAL TECHNICAL REQUIREMENTS**

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

The Bidder shall furnish guaranteed technical particulars in Section-III.

### 5.1.3.1 MATERIALS/WORKMANSHIP

**5.1.3.1.1** 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.

**5.1.3.1.2** 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 Section-II and shall be tested and determined according to the latest IS-2633 or any other authoritative standard.

**5.1.3.1.3** The steel strands shall be hot dip galvanised 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.

### 5.1.3.2 CONDUCTOR PARAMETERS

**5.1.3.2.1** The Parameters of individual strands and composite steel cored aluminium conductor, shall be in accordance with the values given in Section-II.

**5.1.3.2.2** 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 degree C and everyday tension of 25% of UTS of conductor of 132 kV Lines.

### 5.1.3.3 TOLERANCES

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

**5.1.3.3.2** The cross-section of any wire shall not depart from circularity by more than an amount corresponding to the tolerance on the standard diameter.

**5.1.3.3.3** The details of diameters, lay ratios of Aluminium and steel wires shall be in accordance with the Section-II "Technical Requirements".

### 5.1.3.4 SURFACE CONDITIONS

**5.1.3.4.1** All aluminium 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.

### 5.1.3.5 JOINTS IN WIRES

#### 5.1.3.5.1 Aluminium wires

**5.1.3.5.1.1** During stranding, no aluminium wire welds shall be made for the purpose of achieving the required conductor length.

**5.1.3.5.1.2** 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 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.

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

**5.1.3.6 STRANDING**

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

**5.1.3.6.2** 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 given under Section-II.

**5.1.3.7 PACKING**

**5.1.3.7.1** 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 1500 meters of 'PANTHER' ACSR conductor.

**5.1.3.7.2** The drums shall be suitable for wheel mounting and for letting off the conductor under a minimum controlled tension of the order of 5KN.

**5.1.3.7.3** 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 concerned Indian/Nepalese Authorities.

**5.1.3.7.4** 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.

**5.1.3.7.5** All flanges shall be 2-ply construction with 64 mm thickness, with each ply at right angles to the adjacent ply and nailed together. The nails shall be driven from the inside face flange, punched and then clenched on the outer face. The thickness of each ply shall not vary by more than 3mm from nominal thickness. There shall be at least 3 nails per plank of ply with maximum nail spacing of 75 mm. Where a slot is cut with flange to receive the inner end of the conductor the entrance shall be in line with the periphery of the barrel.

**5.1.3.7.6** 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.

**5.1.3.7.7** 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.

**5.1.3.7.8** 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.

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

**5.1.3.7.10** 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.

**5.1.3.7.11** 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.

**5.1.3.7.12** 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.

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

**5.1.3.7.14** 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.

**5.1.3.7.15** 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.

**5.1.3.8 LABELLING AND MARKING**

**5.1.3.8.1** The drum number shall be branded or guaged 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.

**5.1.3.9 STANDARD LENGTHS**

**5.1.3.9.1** The standard length of the conductor shall be 1500 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.

**5.1.3.9.2** Unless otherwise agreed to between the purchaser and the manufacturer, it shall be permissible to supply not more than 10 percent of the lengths on any one order in random lengths; none of them shall be shorter than one third of the nominal length.

**5.1.3.10 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.

**5.1.4 TESTING**

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

**5.1.4.1.1** The samples shall be taken from a continuous length of conductor and subjected to all the tests specified in 5.1.4.2.2.

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

**5.1.4.1.2.1** Before despatch 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.

**5.1.4.1.2.2** 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.

**5.1.4.1.2.3** The routine tests shall be same as acceptance test and shall be carried out on each coil before and after standing.

**5.1.4.2 TESTS**

**5.1.4.2.1** The following tests shall be carried out as per this specification on a sample/samples of conductor.

**5.1.4.2.2 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 of "Individual wire"
e) Ductility test
f) Wrapping test
g) Resistance test on aluminium wires.
h) DC resistance test on composite conductor
i) Ultimate Breaking load test on stranded conductor.
j) Galvanizing test
k) Surface condition test
l) Stress Strain test
m) Breaking load test on welded 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.

**5.1.4.2.3 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 of "individual wire"
f) Ductility test
g) Wrapping test
h) Resistance test on aluminium wires.
i) DC resistance test on composite conductor
j) Breaking load test on welded Aluminium strands.
k) Galvanizing test

**5.1.4.2.4 Tests During Manufacture**

The following tests during manufacture shall be carried out.

a) Chemical analysis of zinc used for galvanising, as per cl. 5.1.4.16
b) Chemical analysis of aluminium used for making aluminium strands,as per cl. 5.1.4.15
c) Chemical analysis of steel used for making steel strands, as per cl. 5.1.4.15

**5.1.4.3 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.

**5.1.4.4 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.

**5.1.4.5 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.

**5.1.4.6 Breaking load test**

**5.1.4.6.1 Breaking load test on stranded conductor.**

Circles perpendicular to the axis of the conductor shall be marked at two places on a sample of conductor of minimum 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.

**5.1.4.6.2 Breaking load test on individual Aluminium and Galvanized steel wires.**

**5.1.4.6.2.1** 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 specified in the Section-II.

**5.1.4.7 Ductility Test**

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

**5.1.4.7.1 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.

**5.1.4.7.2 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 5.1.4.6.2.1 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.

**5.1.4.8 Wrapping Test**

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

**5.1.4.8.1 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 8turns. Six turns shall then be unwrapped and closely wrapped in the same direction as before. The wire shall not break or show any crack.

**5.1.4.8.2 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.

**5.1.4.9 RESISTANCE TEST ON ALUMINIUM WIRE**

**5.1.4.9.1** 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.

$$R_{20} = \frac{R_T}{1 + \text{alpha} \times (T-20)}$$

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 section-II.

**5.1.4.10 GALVANIZING TEST**

**5.1.4.10.1** 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 4826-1992.

**5.1.4.11 SURFACE CONDITION TEST**

A sample of the finished conductor for use in 132 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 as indicated in Section-II.

**5.1.4.12 STRESS-STRAIN TEST**

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

**5.1.4.12.2 TEST SET-UP**

**5.1.4.12.2.1** 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.

**5.1.4.12.2.2** 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 $\pm$ 0.1mm from the value before the test.

**5.1.4.12.2.3** 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.

**5.1.4.12.3 Test Loads for Complete Conductor**

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

**5.1.4.12.3.1** 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.

**5.1.4.12.3.2** 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.

**5.1.4.12.3.3** 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.

**5.1.4.12.3.4** 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.

**5.1.4.12.3.5** 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.

**5.1.4.12.3.6** 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.

**5.1.4.12.3.7** 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 described under Clause 5.1.4.14.3.6.

**5.1.4.12.4 Test Loads for steel core only**

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

**5.1.4.12.4.1** 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.

**5.1.4.12.4.2** 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.

**5.1.4.12.5 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 alongwith test results. The stress-strain data obtained during the test shall be corrected to the standard temperature i.e. 20 deg.C.

**5.1.4.13 DC Resistance Test on Composite Conductor**

On a conductor sample of minimum 5m length, two contact clamps shall be fixed with a pre determined bolt torque. The resistance of the sample shall be measured by a Kelvin Double bridge by placing the clamps initially zero meter and subsequently one meter apart. The test shall be repeated at least five times and average value recorded. The value obtained shall be corrected to the value at 20 deg C as per Clause 13.8 of IS:398 (Part V)-1992. The corrected resistance value at 20 deg C shall conform to the requirements of this specification.

**5.1.4.14 Breaking load 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.

**5.1.4.15 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.

**5.1.4.16 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.

**5.1.4.17 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.

**5.1.4.18 REJECTION AND RETEST**

**5.1.4.18.1** 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.

**5.1.4.18.2** 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.

**5.1.4.19 CHECKING AND VERIFICATION OF LENGTH OF CONDUCTOR**

**5.1.4.19.1** The contractor should arrange for inspection by the representative of the purchaser specially authorised 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 adopting the method at clause 5.1.6.6.

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.

**5.1.4.20 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.

**5.1.4.21 TESTING EXPENSES**

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

**5.1.4.21.2** 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.

**5.1.4.21.3** 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.

**5.1.4.21.4** 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.

**5.1.4.22 Test Reports**

**5.1.4.22.1** 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.

**5.14.22.2** Record of Routine test reports shall be maintained by the supplier at his works for periodic inspection by the Purchaser's representative.

**5.1.4.22.3** 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.

**5.1.4.23 Test Facilities**

**5.1.4.23.1** The following additional test facilites 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.

**5.1.5 REQUIREMENTS, DESIRED DELIVERY AND PRICES**

**5.1.5.1** The schedule of materials, desired deliveries and destinations are given in Section-II.

**5.1.5.2** The prices shall be furnished in Volume-1.

**5.1.5.3** The prices shall be variable and shall be based on the price variation clause given in Section - III

**5.1.5.4** The tenderer shall furnish the details of his past performance in respect of the materials' supplies made by him for the last five years in the prescribed proforma as per Section-III.

**5.1.6 INSPECTION**

**5.1.6.1** The Owner's representative shall, at all times, be entitled to have access to the works and all places of manufacture where conductor shall be manufactured and 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.

**5.1.6.2** 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.

**5.1.6.3** The contractor will intimate the purchaser about carrying out of the tests at least 45 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.

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

**5.1.6.5** 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.

**5.1.6.6** 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".

### 5.1.7 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, technical or commercial (section- III), otherwise it shall be presumed that the tenderer agrees to the provision/s of this specification and same shall be included in the purchase order and the contract in case of successful tenderers.

## 5.2 GALVANISED STRANDED STEEL GROUNDWIRE

### 5.2.1 SCOPE

This section covers, design, manufacture, testing before despatch, packing, supply and delivery of the high tensile galvanized stranded steel earthwire of size 7/3.15mm.

### 5.2.2 STANDARDS

**5.2.2.1** The galvanised stranded steel earth wies shall comply with IS:398 (Part-II)-1996 and IS:12776-2002 latest versions unless otherwise specified herein or any other International Standards which ensure equal or higher quality of material.

**5.2.2.2** The galvanised stranded steel earth wires shall also conform to the following latest standards. Whenever revised I.S. specifications are available, the same may be followed.

| Sl. No. | Indian Standard | Title |
|---|---|---|
| 1. | IS:209-1979 | Specification for zinc |
| 2. | IS:398 (Part-II)-1996 | Aluminium conductor steel reinforced. |
| 3. | IS:1521-1972 | Method of tensile testing of steel wire. |
| 4. | IS:1755-1961 | Specification for method for wrapping test of wires. |
| 5. | IS:1778-1980 | Reels and drums for barewire |
| 6. | IS:2629-1966 | Recommended practice for hot dip galvanising of iron and steel. |
| 7. | IS:2633-1972 | Method of testing of uniformity of coating on Zinc coated article. |
| 8. | IS:4826-1968 | Galvanised coatings on round steel wires. |
| 9. | IS:6745-1972 | Method of determination of weight of Zinc coating on Zinc coated iron and steel articles. |
| 10. | IS:2141-1979 | Specification for Galvanized stay strand. |
| 11. | IS:12776-2002 | Galvanised strand for earthing. |

**5.2.2.3** Offers conforming to standards other than the IS Specified above shall be accompanied by the English version of relevant standards in support of the guaranteed technical particulars to be furnished as per Section-III.

## 5.2.3 GENERAL TECHNICAL REQUIREMENTS

**5.2.3.1** The General Technical requirements are given in Section-II. The galvanised steel ground wire shall conform to these technical requirements.

**5.2.3.1.1** The Bidder shall furnish guaranteed technical particulars in Section-III.

**5.2.3.1.2** The details of the steel wire are tabulated below:

a) Stranding and wire diameter : 7/3.15mm. steel
b) Number of strands
   Steel core : 1
   Outer steel layer : 6
c) Total Sectional area : 54.55 sq. mm
d) Overall diameter : 9.45 mm
e) Approximate weight : 426 Kg/km
f) Minimum ultimate tensile strength : 57 KN
g) Direction of lay of outer layer : Right hand
h) Calculated D.C. resistance at 20 degree C. : 2.95 ohms/km.

## 5.2.3.2 WORKMANSHIP

**5.2.3.2.1** All steel strands shall be smooth, uniform and free from all imperfections such as spills and splits, die marks, scratches, abrasions and kinks after drawing and also after stranding. The groundwire shall be free from grease, metal particles, dirt etc.

**5.2.3.2.2** The finished material shall have minimum brittleness as it will be subjected to Appreciable vibration while in use.

**5.2.3.2.3** The steel strand shall be hot dip galvanised and shall have a minimum zinc coating of 240 gms/sq.m. after stranding on the uncoated wire surface. The zinc coating shall be smooth, continuous, of uniform thickness, free from imperfections and shall withstand three one minute and one half minute dips after stranding in Standard Preece test. The steel wire rod shall be of the such quality and purity that, when drawn to the size of the strands specified and coated with zinc, the finished strands shall be of uniform quality and have the same properties and characteristics, as specified in relevant Indian Standards Specification.

5.2.3.2.4 The steel strands shall be preformed and postformed in order to prevent the spreading of strands in case earthwire is cut. Care shall be taken to avoid damage to galvanisation during preforming and postforming operations.

5.2.3.2.5 To avoid susceptibility towards wet storage stains (with rust), the finished material shall be provided with a protective coating of boiled linseed oil.

**5.2.3.3 JOINTS IN WIRES**

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

**5.2.3.4 TOLERANCES**

The manufacturing tolerances to the extent of the following limits only shall be permitted in the diameter of the individual steel strands and lay length of the earthwire.

| | Standard | Maximum | Minimum |
|---|---|---|---|
| Diameter | 3.15mm | 3.23mm | 3.07mm |
| Lay Length | Min. 123 mm | | Max. 265mm |

**5.2.3.5 MATERIALS**

**5.2.3.5.1** The steel wire strands shall be drawn from high carbon steel rods and shall conform to the following requirements as to the chemical composition :

| Elements | %-Composition |
|---|---|
| Carbon | Not more than 0.55 |
| Manganese | 0.4 to 1.10 |
| Phosphorous | Not more than 0.05 |
| Sulphur | Not more than 0.05 |
| Silicon | 0.15 to 0.35 |

**5.2.3.5.2 Zinc**

The zinc used for galvanising shall be electrolytic High Grade Zinc of 99.95% purity. It shall conform to and satisfy all the requirements of IS:209-1979.

**5.2.3.6 STANDARD LENGTH**

**5.2.3.6.1** The standard length of the earthwire shall be 2000 meters. The tolerance on length shall be +/-5% on the standard length.

**5.2.3.6.2** Random lengths shall be accepted, provided that no length is less than 50% of the standard length and the total quality of random lengths shall not be more than 10% of the total quantity ordered.

**5.2.3.7 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.

**5.2.3.8** The contractor will intimate the purchaser about carrying out of the tests at least 30 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.

**5.2.4 TESTS**

**5.2.4.1** The tests on the individual strands constituting the groundwire shall be conducted before stranding by the manufacturer and all the test records shall be made available to the Purchaser as and when desired. Tests on the sample of the strands after stranding and complete groundwire taken from the groundwire drum shall be conducted in the presence of the Purchaser or his authorised representative before despatch of the groundwire.

**5.2.4.2** The test pieces from the coils, spools or drum selected for testing shall withstand the following tests.

**5.2.4.2.1 TESTS ON INDIVIDUAL STRANDS**

**5.2.4.2.1.1 TYPE TESTS**

| | | |
|---|---|---|
| a) | Verification of Diameter | Clause 6.1 of IS:12776-1989 |
| b) | Galvanizing test | Clause 8.5 of IS:12776-1989 |
| c) | Torsion test | As per IS:398 (Part 2) -1996 |
| d) | Elongation test | |
| e) | Wrap test | |
| f) | DC resistance test | As per cl. 5.2.4.4.6 of specification. |
| g) | Breaking load test | As per cl. 5.2.4.4.3 of specification. |

h) Chemical analysis of steel — As per cl. 5.2.4.4.4 of specification.

**5.2.4.2.1.2 ACCEPTANCE TESTS**

The acceptance test shall be same as type tests given in clause 5.2.4.2.1.1

**5.2.4.2.2 TESTS ON GROUNDWIRE**

**5.2.4.2.2.1 TYPE TESTS**

| | |
|---|---|
| a) Visual Examination | Clause 5.2.4.4.1 of specification |
| b) UTS Test | Clause 5.2.4.4.7 of specification |
| c) D C Resistance Test | Clause 5.2.4.4.8 of specification |
| d) Lay Length Check | Clause 5.2.4.4.11 of specification |
| e) Verification of length and weight of groundwire. | Clause 5.2.4.4.9 of specification. |
| f) Visual and dimensional Check on drum | Cl. 5.2.4.4.10 of this specification |

**5.2.4.2.2.2 ACCEPTANCE TESTS**

The acceptance tests shall be the same as type tests.

**5.2.4.2.2.3 ROUTINE TESTS**

(i) Visual Examination (ii) Lay Length Check.

**5.2.4.2.2.4 TESTS DURING MANUFACTURE**

| | |
|---|---|
| a) Chemical Analysis of Zinc used for galvanizing | As per cl.5.2.4.4.5 of specification |
| b) Chemical analysis of steel | As per cl. 5.2.4.4.4 of specification |

**5.2.4.3 TEST REPORTS**

**5.2.4.3.1** The tenderer shall submit six (6) copies of certificates of the type and acceptance tests. One copy each of test certificates shall be returned duly certified by the Purchaser.

**5.2.4.3.2** All the routine tests shall be carried out by the manufacturer and record shall be made available to the purchaser as and when desired.

**5.2.4.3.3 TESTING EXPENSES**

**5.2.4.3.3.1** The break up of the testing charges for the type tests specified shall be indicated separately.

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

**5.2.4.3.3.3** 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 Contractor's notice of testing, the Purchaser 's representative/Inspector does not find 'plant' to be ready for testing, the expenses incurred by the Purchaser for redeputation shall be deducted from the contract price.

**5.2.4.3.3.4** The entire cost of testing for the acceptance and routine tests specified herein shall be treated as included in the quoted unit price except for the expenses of the inspector/employer's representative.

**5.2.4.3.4 ADDITIONAL TESTS**

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

**5.2.4.4 PROCEDURE FOR CARRYING OUT TESTS**

**5.2.4.4.1 VISUAL EXAMINATION**

The individual strand and completed groundwire shall be examined visually for good workmanship and general surface finish.

**5.2.4.4.2 CHEMICAL ANALYSIS OF MATERIAL (Steel & Zinc)**

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

**5.2.4.4.3 TENSILE TEST-strands**

The breaking load of individual strand before and after stranding shall be determined by means of a 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 greater than 100 mm/min. The breaking load shall not be less than guaranteed failing load.

#### 5.2.4.4.4 CHEMICAL ANALYSIS OF STEEL

Samples taken from the steel ingot /coils / strands shall be chemically/spectrographically analyzed. The same shall be in conformity to the requirements stated in this specification.

#### 5.2.4.4.5 CHEMICAL ANALYSIS OF ZINC

Samples taken from the zinc ingot /coils / strands shall be chemically/spectrographically analyzed. The same shall be in conformity to the requirements stated in this specification.

#### 5.2.4.4.6 D.C. RESISTANCE TEST-strands

The test shall be carried out as per the relevant standard. The electrical resistance of individual strand shall be measured by a Kelvin double bridge or potentiometer. The value obtained shall be corrected to the value at 20 deg.c. The D.C. resistance value should not exceed the guaranteed d.c. resistance of the wire.

#### 5.2.4.4.7 ULTIMATE TENSILE STRENGTH TEST FOR GROUNDWIRE

Circles perpendiculer to the axis of the earthwire shall be marked at two places on a sample of earthwire of minimum 5m length suitably compressed with dead end clamps at either end. The load shall be increased at a steady rate upto 50% of 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 earthwire sample shall not fail during this period. The applied load shall then be increased until the failing load is reached and the value recorded.

#### 5.2.4.4.8 DC RESISTANCE TEST-COMPOSITE GROUNDWIRE

On composite groundwire of minimum five metre length, two contact clamps shall be fixed . The resistance 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 each metre length and the value recorded. The value obtained shall be corrected to the value at 20 deg. C. The resistance corrected to 20 deg.C. shall not exceed the guaranteed value.

**5.2.4.4.9 VERIFICATION OF LENGTH AND WEIGHT OF GROUNDWIRE**

Ten percent of the drums offered for inspection shall be checked for the length and weight of the groundwire declared by the supplier. One empty drum will be weighed and groundwire will be rewound on the empty drum and the wound drum will be reweighed. The length of the groundwire will be measured by using a certified measuring counter by appropriate weight and measurement authority. The cost towards unreeling of ground wire drums for verifying the groundwire length and weight shall be to the suppliers's account.

**5.2.4.4.10 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.

**5.2.4.4.11 LAY LENGTH CHECK**

The Lay Length shall be checked to ensure that it conforms to the requirements of this specification.

**5.2.4.5 SAMPLE BATCH FOR TYPE TESTING**

**5.2.4.5.1** The Contractor shall offer material for selection of samples for type testing only after getting Quality Assurance Plan approved by the Purchaser. The sample shall be manufactured strictly in accordance with the Quality Assurance Plan approved by the Purchaser.

**5.2.4.5.2** The Contractor shall offer at least three drums for selection of sample required for conducting all the type tests.

**5.2.4.5.3** The Contractor is required to carry out all the Acceptance tests successfully in the presence of Purchaser 's representative before sample selection.

**5.2.4.6 INSPECTION**

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

**5.2.4.6.2** The Contractor shall keep the Purchaser informed in advance of the time of starting and of the progress of manufacture of earthwire in its various stages so that arrangements can be made for inspecton.

**5.2.4.6.3** No material shall be despatched from its point of manufacture before it has been satisfactorily inspected and tested, unless the inspection is waived off by the Purchaser in writing. In the latter case also the earthwire shall be despatched only after satisfactory testing for all tests specified herein have been completed.

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

**5.2.4.7 TEST FACILITIES**

**5.2.4.7.1** The following additional test facilites shall be available at the contractor'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 earthwire 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 facilites shall have appropriate clutch system and be free of vibration, jerks, etc with traverse laying facilities.

**5.2.5 REJECTION AND RETEST**

**5.2.5.1** In case of failure in any type test, the Contractor 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 fresh lot is manufactured for testing then the lot already manufactured shall be rejected. The decision of the purchaser in this regard shall be final and binding on the Contractor.

**5.2.5.2** If the test pieces for tests on strands taken from finished groundwire on a drum selected for such tests fail in the retest,the

manufacturer shall test each and every drum and submit them for reinspection.

**5.2.5.3** All rejected material shall be suitably marked and segregated.

## 5.2.6 PACKING AND MARKING

The earthwire shall be supplied in non-returnable reels or drums of non-perishable or treated wood conforming to IS:1778-1980 (specification for reels and drums for bare wires), BS-1559 or other authoritative standard. Each drum shall be provided with a label fixed firmly on it bearing the following information.

a) Contract/purchase order No. & date.

b) Manufacturer's name and address.

c) Name and address of consignee.

d) Size of earthwire.

e) Drum Number, year of manufacture.

f) Length of earthwire in meters.

g) Gross weight of drum with earthwire.

h) Weight of empty drum with lagging.

i) Net weight of earthwire.

j) Arrow marking for unwinding.

k) Position of the earthwire ends.

l) Number of turns in the outermost layer.

m) Distance between outermost layer of earth wire and the inner surface of lagging.

n) Barrel diameter at three locations and an arrow marking at the location of measurement.

The steel wire shall be packed in the drums in such a way that the drums shall withstand the stresses and rough handling during transit, storing and stringing operations. The steel wire shall be protected from weather with water-proof paper before winding and after winding. There should not be more than one

standard length in a drum. Each drum shuld be provided with a triangular iron collar on either side of the axle hold for easy rolling and to protect the drum from damage during rolling/winding operation. Proper care should be taken to prevent the nails from damaging the steel wire.

**5.2.7.0** The tenderer shall furnish the details of his past performance in respect of the supplies made by him for the last 5 years in the prescribed proforma as per Section-III .

**5.2.8.0 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, (technical or commercial), Section-III, otherwise it shall be presumed that the tenderer agrees to the provision/s of this specification and same shall be included in the purchase order and the contract in case of successful tenderers.

## 5.3 CONDUCTOR & EARTHWIRE ACCESSORIES

### 5.3.1 SCOPE :

**5.3.1.1** This specification covers design, manufacture and testing before despatch at works, packing, supply and delivery of Accessories for the ACSR 'PANTHER' Conductor of size 30/7/3.00 mm and Earth wire of size 7/3.15 mm.

**5.3.2** The following are the items covered in this Specification :

**(A) CONDUCTOR ACCESSORIES**

1. Mid Span Compression joint.
2. Repair Sleeve
3. Vibration Damper
4. Preformed Armor Rod

**(B) EARTHWIRE ACCESSORIES:**

1. Mid span compression Joints
2. Vibration Damper
3. Earthwire Suspension Clamp
4. Earthwire Tension Clamp
5. Flexible Copper Bond

**5.3.3 STANDARDS :**

**5.3.3.1** The accessories of the ACSR 'PANTHER' Conductor and Earthwire shall conform to the following Indian Standards which shall mean latest revisions/Amendment changes adopted and published unless otherwise specified here in as well as to the provisions of this specification.

| Sl. No. | Indian Standard | Title |
|---|---|---|
| 1. | IS:209-1966 | Specification for Zinc |
| 2. | IS:398-1996 (PART – II) | Specification for Aluminium Conductors for over head Transmission purpose. AluminiumConductors Galvanised Steel Reinforced for Extra High Voltage (66 KV and above) |
| 3. | IS:1327-1966 | Method of determination of weight of the Tin coating on Tin Plate. |
| 4. | IS:1573-1976 | Electroplated coating of Zinc on Iron & Steel. |
| 5. | IS:2071-1974 | Method of high Voltage testing General definitions and test requirement |
| 6. | IS:2121-1981 | Specification for Conductors and earthwire acessories for overhead power lines |
| | Part - I | Armour Rods, binding wires and tapes for conductors. |
| | Part - II | Mid span joints and repair sleeves for conductor |
| 7. | IS:2629-1966 | Recommended practice for hot dip galvanizing of Iron and steel. |

| | | |
|---|---|---|
| 8. | IS:2633-1972 | Methods for testing Uniformity of zinc coating on zinc coated Articles. |
| 9. | IS:3138-1966 | Hexagonal bolts and nuts |
| 10. | IS:4218-1967 | ISO metric screw threads |
| 11. | IS:4826-1968 | Galvanised coating on Round steel wires. |
| 12. | IS:6745-1972 | Methods of Determination of weight of zinc coating on zinc coated Iron and Steel Articles. |
| 13. | IS:8263-1966 | Methods of Radio Interference Tests on High voltage Insulators |
| 14. | IS:9708-1993 | Specification for stock bridge vibration Dampers for overhead power lines. |
| 15. | IS:2982-1965 | Specification for copper conductor in insulated cables & cords |
| 16. | IS:5358-1969 | Specification for Hot-Dip Galvanised Coatings on Fasteners. |
| 17. | IS:8394-1977 | Specification for Soldering & Welded type terminals ends for conductors and insulated cables. |

**5.3.3.2** In the event of the supply of accessories conforming to any standard other than Indian standards listed above, the salient features of comparison shall be brought out and furnished along with the bid.

**5.3.3.3** The Accessories offered shall be suitable for operation in moderately polluted atmosphere.

## 5.3.4 MATERIALS/WORKMANSHIP

**5.3.4.1** All materials used in the manufacture of the equipments shall be of the first class quality of its kind available and except where modified by this specification, shall comply in all respects with the standards laid down by Bureau of Indian Standards.

**5.3.4.2** The material to be used in manufacture shall be selected as the best available for the purpose for which used, considering strength, durability and best engineering practice.

**5.3.4.3** All the material to be supplied shall be of recent manufacture, unused and free from defects. All the components of the same design shall be identical and like components shall be interchangeable.

### 5.3.4.4 WORKMANSHIP AND FINISH

All the equipments shall be of the latest design and conform to the best modern practice adopted in the extra high voltage field. The Bidder shall offer only such equipment as guaranteed by him to be satisfactory and suitable for 132 kV transmission line and will give continued good performance.

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

**5.3.4.6** All ferrous parts shall be hot dip galvanised, after all machining has been completed. Nuts may, however, be tapped (Threaded) after galvanising and the threads oiled. Spring washers shall be electro galvanised. The bolt threads shall be undercut to take care of increase in diameter due to galvanising. Galvanising shall be done in accordance with IS:2629-1966 and satisfy the test mentioned in IS:2633-1972. Fasteners shall withstand four dips while spring washers shall withstand three dips. Other galvanised materials shall be guaranteed to withstand at least six dips each lasting one minute under the standard preece test for galvanising unless otherwise specified.

**5.3.4.7** The zinc coating shall be perfectly adherent, of uniform thickness, smooth, reasonably bright, continuous and free from imperfections such as flux, ash, rust stains, bulky white deposits and blisters etc. The zinc used for galvanising shall be of grade Zn 99.95 as per IS:209-1979.

**5.3.4.8** The casting shall be free from all internal defects like shrinkage, inclusions, blow holes, cracks or other casting defects and the quality of products shall be uniform throughout.

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

**5.3.4.10** No equipment shall have sharp ends or edges, abrasions or projections etc. and shall not cause any damage to the conductor in any way during erection or during continuous operation which would produce high electrical and mechanical stresses in normal working. The design of adjacent metal parts and mating surfaces shall be such as to prevent corrosion of the contact surface and to maintain good electrical contact under all service conditions. All equipments shall have satisfactory corona performance so as to limit the losses and Radio Interference to acceptable level.

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

**5.3.4.12** The fasteners shall conform to the requirements of IS:4218 and IS:6639-1972. All fasteners and clamps shall have corona free locking arrangement to guard against vibration losening.

**5.3.4.13** Welding of aluminium shall be by an inert gas shielded tungston arc or inert gas shielded metal arc process. Welds shall be clean, sound, smooth uniform, without overlaps properly fused and completely sealed. There shall be no cracks, voids, incomplete penetrations, incomplete fusions under cutting or inclusions. Porosity shall be minimised so that the mechanical properties of the aluminium alloy are not effected. All welds shall be properly finished as per best engineering practices.

**5.3.5 MARKINGS**

**5.3.5.1** Assembly of each item shall be marked with trade mark of the manufacturer, the manufacturer's catalogue number and year of manufacture. The identifying letters and numerals shall be atleast 5 mm high. This shall be cast or die stamped on over or both sides of the assembly. The letters shall be distinct, durable and conspicuous.

**5.3.5.2** Die compression areas shall be clearly marked on each accessory. Accessories designed for continuous die compressions shall bear

the words "COMPRESS FIRST" near the point of each accessory where the compressions begin. Accessories designed for intermittent die compressions shall bear the identification marks "COMPRESSION ZONE" and "NON-COMPRESSION ZONE" distinctly with arrow mark showing the direction of compression and shall have the ends of each compression zone completely encircled, with knurled or etched bands. The letters, numerals and other makings on finished accessories shall be distinct and legible.

### 5.3.6 BID DRAWINGS

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

**5.3.6.2** The drawings shall include:

(i) Dimensions and dimensional tolerance.
(ii) Material, fabrication details including any weld details and any specified finishes and coatings. Regarding material, designations and reference of standards are to be indicated.
(iii) Catalogue No.
(iv) Marking
(v) Weight of Assembly
(vi) Installation instructions
(vii) Design installation torque for bolt or cap screw.
(viii) Withstand torque that may be applied to the bolt or cap screw without failure of component parts.
(ix) The compression die number with recommended compression pressure.
(x) All other relevant Technical details.

**5.3.6.3** Placement charts for vibration dampers.

**5.3.6.4** The above drawings shall be submitted in six copies with all the details as stated above alongwith the bid document. After the placement of award, the contractor shall again submit the drawings in four copies to the owner for approval. After owner's approval and successful completion of all type tests 30 more sets of drawings shall be submitted to owner for further distribution and field use at owner·s end.

**5.3.6.5 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 and 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.

**5.3.6.6 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, (technical or commercial) otherwise it shall be presumed that the tenderer agrees to the provision/s of this specification and same shall be included in the purchase order and the contract in case of successful tenderers.

**5.3.7. CONDUCTOR ACCESSORIES**

**5.3.7.1 GENERAL**

**5.3.7.2** This section details the technical particulars of the accessories for ACSR 'PANTHER' Conductor.

**5.3.7.3** 2.5% extra fasteners and retaining rods shall be provided.

**5.3.7.4** The technical particulars are given in Section-II of the specification.

**5.3.8 MID SPAN COMPRESSION JOINT**

**5.3.8.1** Mid Span Compression Joint shall be used for joining two lengths of conductor. The joint shall have a resistivity less than 75% of the resistivity of equivalent length of conductor. The joint shall not permit slipping off, damage to, or failure of the complete conductor or any part thereof at a load less than 95% of the ultimate tensile strength of the conductor.

**5.3.8.2** The joint shall be made of steel and aluminium sleeves for jointing the steel core and aluminimum wires respectively. The steel sleeve should not crack or fail during compression. The Brinnel Hardness of steel sleeve shall not exceed 160. The steel sleeve shall be hot dip galvanised. The aluminimum sleeve

shall have aluminimum of purity not less than 99.5%. Tapered aluminium filler plugs shall also be provided on the line of demarcation between compression and non-compression zone. The dimensions and dimensional tolerances of mid span compression joint shall be as per Section-II of the specification.

**5.3.9 REPAIR SLEEVE**

**5.3.9.1** Repair sleeve of compression type shall be used to repair conductor with not more than two strands broken in the outermost layer. The sleeves shall be manufactured from 99.5% pure aluminium and shall have smooth surface. The repair sleeve shall comprise of two pieces with a provision of seat for sliding of the keeper piece. The edges of the seat as well as the keeper piece shall be rounded so that the conductor strands are not damaged during installation. The dimensions and dimensional tolerances of repair sleeve shall be as per Section-II of the specification.

**5.3.10 VIBRATION DAMPER**

**5.3.10.1** Vibration dampers of 4R-stockbridge type with four (4) different resonances spread within the specified aeolian frequency band-width shall be used at suspension and tension points on each conductor in each span to damp out aeolian vibrations as mentioned hereinafter.

**5.3.10.2** Alternate damping systems or "Dogbone" dampers offering equivalent or better performance also shall be accepted provided the manufacturer meets the qualifying requirements stipulated in Technical specification. Relevant technical documents to establish the technical suitability of alternate systems shall be furnished by the bidder alongwith the bid.

**5.3.10.3** One damper minimum on each side per conductor for suspension points and two dampers minimum on each side per conductor for tension points shall be used for ruling span of 305 meters.

**5.3.10.4** The clamp of the vibration damper shall be made of high strength aluminium alloy of type LM-6 or equivalent. It shall be capable of supporting the damper and prevent damage or chafing of the conductor during erection or continued operation. The clamp shall have smooth and permanent grip to keep the damper in position on the conductor without damaging the strands or causing premature fatigue failure of the conductor under the clamp. The clamp groove shall be in uniform contact with the conductor over the entire clamping surface except for the rounded edges. The groove of the clamp body and clamp cap shall be smooth, free from projections, grit or other materials which

could cause damage to the conductor when the clamp is installed. Clamping bolts shall be provided with self locking nuts and designed to prevent corrosion of threads or loosening in service.

**5.3.10.5** The messenger cable shall be made of high strength galvanised steel/stainless steel with a minimum strength of 135 Kg/sq.mm. It shall be of preformed and postformed quality in order to prevent subsequent drop of weight and to maintain consistent flexural stiffness of the cable in service. The number of strands in the messenger cable shall be 19. The messenger cable other than stainless steel shall be hot dip galvanised in accordance with the recommendations of IS-4826-1979 for heavily coated wires.

**5.3.10.6** The damper mass shall be made of hot dip galvanised mild steel/cast iron .All castings shall be free from defects such as cracks, shrinkages, inclusions and blowholes etc. The surface of the damper masses shall be smooth.

**5.3.10.7** The damper clamp shall be casted over the messenger cable and offer sufficient and permanent grip on it. The messenger cable shall not slip out of the grip at a load less than the mass pull-off value of the damper. The damper masses shall be fixed to the messenger cable in a suitable manner in order to avoid excessive stress concentration on the messenger cables which shall cause premature fatigue failure of the same. The messenger cable ends shall be suitably and effectively sealed to prevent corrosion.

**5.3.10.8** The damper assembly shall be electrically conductive to reduce radio interference.

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

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

**5.3.10.11** The vibration clamps shall not have magnetic power loss more than 1 watt at 500 Amps, 50 Hz alternating current per sub-conductor.

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

| Sl.No. | Description | | Technical particulars |
|---|---|---|---|
| 1. | Configuration | : | Double Circuit: Single ACSR 'PANTHER' Conductor per phase in vertical formation |
| 2. | Span length in meters | | |
| | i) Ruling design span | : | 305 meters |
| | ii) Maximum span | : | 1100 meters |
| | iii) Minimum span | : | 100 meters |
| 3. | Tensile load in conductor | : | As per Sag Tension Calculations |
| | a) At minimum temperature of 0 deg.C and still air | : | |
| | b) At every day temperature of 32 deg. C and still air | : | |
| | c) At 85 deg C & No wind | : | |
| | d) At 0 deg. C and 36% full wind | : | |
| | e) At 32 deg C & Full wind | : | |
| | f) At 32 deg C & 75% Full wind | | |
| 4. | Armour rods used | : | Standard preformed armour rods/AG |
| 5. | Wind velocity | : | 39 m/sec |
| 6. | Max. permissible dynamic Strains | : | +/- 150 micro strains |

The bidder shall submit the sag-tension chart with the bid.

**5.3.10.13** The damper placement chart for spans ranging from 100 m to 1100 m shall be submitted by the Bidder. Placement charts should be duly supported with relevent technical documents.

**5.3.10.14** The damper placement charts shall include the following :

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

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

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

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

### 5.3.11 Factory Formed Armour Rods

**5.3.11.1** Factory formed armour rods suitable for steel cored aluminium conductor are proposed to be provided at all suspension points with a view to minimizing the strain developed in the conductor at suspension supports, usually from dynamic and static loads resulting from Aeolian vibrations, clamping, slipping of the conductors from the clamps etc.

**5.3.11.2** The armour rods shall withstand power arcs, chafing and abrasions from clamps and localized heating effect due to magnetic power losses from clamps as well as $I^2R$ losses of the conductor under the armour rods and clamps.

**5.3.11.3** Armour rods shall be made of high strength aluminium alloy which shall be properly heat treated during manufacturing procerr to develop the required strength.

**5.3.11.4** The factory formed armour rods shall be capable of being fixed by hand on the conductor without the aid of any tools or implements. The direction of spiral shall be right hand. The formed armour rods shall not lose their resilience even after five applications. The rods should be capable of providing high self-retaining strength and protection against vibration damage and fatigue failure of conductor.

**5.3.11.5** The surface of the armour rods when fitted on the conductor shall be smooth and free from projections, cuts, abrasions, etc.

**5.3.11.6** The armour rods use on Panther conductor shall be ball ended.

**5.3.11.7** Where armour grip suspension clamps shall be used, factory formed armour rods shall not be needed.

## 5.4 EARTHWIRE ACCESSORIES

### 5.4.1 GENERAL

**5.4.1.**1 This section details the technical particulars of the accessories for Galvanised Steel Earthwire as per Section - II of the specification.

**5.4.1.2** 2.5% extra fastener shall be supplied

### 5.4.1.2 MID SPAN COMPRESSION JOINT

Mid Span Compression Joint shall be used for joining two lengths of earthwire. The joint shall be made of mild steel with aluminium encasing. The steel sleeve should not crack or fail during compression. The Brinnel Hardness of stainless steel should not exceed 200. The steel sleeve shall be hot dip galvanised. The aluminium sleeve shall have aluminium of purity not less than 99.5%. Filler aluminium sleeve shall also be provided at the both ends. The joints shall not permit slipping off, damage to, or failure of the complete earthwire or any part thereof at a load not less than 95% of the ultimate tensile strength of the earthwire. The joint shall have resistivity less than 75% of resistivity of equivalent length of earthwire. The dimensions and the dimensional tolerances of the joint shall be as per the Section - II of the specification.

### 5.4.2 VIBRATION DAMPER

**5.4.2.1** Vibration dampers of 4R-Stockbridge type with four (4) different resonant frequencies spread within the specified aeolian frequency band-width shall be used for suspension and tension points on earthwire in each span to dampout aeolian vibrations as mentioned hereinafter.

**5.4.2.2** Alternate damping systems or "Dogbone" dampers offering equivalent or better performance also shall be acceptable provided the manufacturer meets the qualifying requirements stipulated in technical specification Vol-III. Relevant technical documents

to establish the technical suitability of alternate systems shall be furnished by the bidder alongwith the bid.

**5.4.2.3** One damper minimum on each side per earthwire at suspension points and two dampers on each side at tension points shall be used for ruling design span of 305 meters.

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

**5.4.2.**5 The messenger cable shall be made of high strength galvanised steel/stainless steel with a minimum strength of 135 kg/sq..mm. It shall be of preformed and post formed quality in order to prevent subsequent droop of weights and to maintain consistent flexural stiffness of the cable in service. The number of strands in the messenger cable shall be 19. The messenger cable ends shall be suitably and effectively sealed to prevent corrosion.

**5.4.2.6** The damper mass shall be made of hot dip galvanised mild steel/cast iron. All castings shall be free from defects such as cracks, shrinkages, inclusions and blow holes etc., The inside and outside surfaces of the damper masses shall be smooth.

**5.4.2.7** The vibration analysis of the system, with and without damper, dynamic characteristic of the damper as detailed under Annexure-A, shall have to be submitted by the Bidder alongwith his bid. The technical particulars for vibration analysis and damping design of the system are as follows :

| Sl.No. | Description | | Technical particulars |
|---|---|---|---|
| 1. | Configuration | | One galvanised steel earthwires |
| 2. | Span length in meters : | | |
| | i) | Rulling design span | 305 meters |
| | ii) | Maximum span | 1100 meters |
| | iii) | Minimum span | 100 meters |
| 3. | Tensile load in earthwire | | |
| | a) | At temperature of 0 deg.C and still air : | |
| | b) | At everyday temperature of 32 deg. C and still air : | |
| | c) | At 53 deg C & No wind : | |
| | d) | At 0 deg. C and 36% full wind : | |
| | e) | At 32 deg C Full wind : | |
| | f) | At 32 deg C and 75 % Full wind : | |
| 4. | Max. permissible dynamic strains | | +/-300 micro strains. |

The bidder shall submit the sag-tension chart with the bid.

**5.4.2.8** The damper placement chart for spans ranging from 100m to 1100m shall be submitted by the bidder. All the placement charts should be duly supported by relevant technical documents.

**5.4.2.9** The damper placement charts shall include the following :

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

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

3) Placement recommendation depending upon type of suspension clamps (viz, Free centre type/trunnion type etc.)

4) The influence of mid span compression joints in the placement of dampers.

**5.4.3 FLEXIBLE COPPER BOND**

The flexible copper bond shall be circular in cross-section of minimum 34 sq.mm equivalent copper area and not less than 500mm in length. It shall consist of 259 wires of 0.417 mm dia. tinned copper conductor. It shall be laid up as 7 stranded ropes, each of 37 bunched wires. The tinning shall be as per relevant Indian Standard. Two tinned copper connecting lugs shall be press jointed to either ends of the flexible copper cable. One lug shall be suitable for 12 mm. dia. bolt and the other for 16 mm dia. bolt. The complete assembly shall also include one 16 mm dia., 40 mm long HRH MS Bolt hot dip galvanised with nut and lock washer.

**5.4.4 SUSPENSION CLAMP**

**5.4.4.1** Standard twisted shackle for earthwire suspension clamp shall be supplied for attaching to the hanger having minimum thickness of 12 mm with a hole of 21.5 mm diameter

**5.4.4.2** At all suspension towers, suitable suspension clamps shall be used to support the earthwire of 7/3.15 mm size. The clamps shall be of either free-centre type or trunion type and shall provide adequate area of support to the earthwire. The groove of the clamp shall be smooth, finished in an uniform circular or oval shape and shall slope downwards in a smooth curve to avoid edge support and hence to reduce the intensity of bending moment on earthwire.

**5.4.4.3** There shall be no sharp point in the clamps coming in contact with earthwire. There shall not be any displacement in the configuration of the earthwire strands nor shall the strands be unduly stressed in final assembly during working conditions.

**5.4.4.4** The clamping piece and the clamp body shall be clamped by at least two U-bolts of size not less than 10 mm diameter having

one nut and one 3 mm thick washer on each of its limbs. Suspension clamps shall be provided with inverted type U-bolts. One limb of the U-bolt shall be long enough to accommodate the lug of the flexible copper bond.

**5.4.4.5** The Bidder shall supply all the components of the suspension assembly including shackles, bolts, nuts, washers, split pin etc. The total drop of the suspension assembly from the centre point of the attachment to the centre point of the earthwire shall not exceed 150 mm. The design of the assembly shall be such that the direction of run of the earthwire shall be same as that of the conductor.

**5.4.4.6** The complete assembly shall be guaranteed for slip strength of not less than 9 kN and not more than 14 kN. The breaking strength of the assembly shall not be less than 25 kN.

### 5.4.5 TENSION CLAMP

**5.4.5.1** At all tension towers suitable compression type tension clamps shall be used to hold 7/3.15 mm galvanised steel earthwire. Anchor shackle shall be supplied which shall be suitable for attaching the tension clamp to strain plates. The strain plates supplied with the towers will have a minimum thickness of 8 mm with a hole of 21.5 mm diameter.

**5.4.5.2** The clamps shall have adequate area of bearing surface to ensure positive electrical and mechanical contact and shall not permit any slip to the earthwire under working tension and vibration conditions. The angle of jumper terminal to be mounted should be 30 deg. with respect to the vertical line.

**5.4.5.3** The clamps shall be made of mild steel with Aluminium encasing. The steel should not crack or fail during compression. The brinnel hardness of steel sleeve shall not exceed 200. The steel sleeve shall be hot dip galvanised. The aluminium encasing shall have aluminium of purity not less than 99.5%. Filler aluminium sleeve shall also be provided at the end.

**5.4.5.4** The complete assembly shall be so designed as to avoid undue bending in any part of the clamp and shall not produce any hindrance to the movements of the clamps in horizontal or vertical directions.

**5.4.5.5** The slip strength of the assembly shall not be less than 95% of the ultimate strength of the earthwire.

**5.4.5.6** The clamps shall be complete with all the components including anchor shackle, bolts, nuts, washers, split pin, jumper arrangement etc.

## 5.4.6 TESTS AND STANDARDS

### 5.4.6.1 TESTS

The type, acceptance and routine tests and tests during manufacture shall be carried out on conductor and earthwire accessories, for the purpose of this clause:

**5.4.6.1.1** Type Tests shall mean those tests which are to be carried out to prove the design, process of manufacture and general conformity of the material to this specification/IS. These tests shall be carried out on samples prior to commencement of commercial production against relevant Indian Standards specification. The bidder shall indicate their schedule for carryig out these tests.

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

**5.4.6.1.**3 Routine Tests shall mean those tests, which are to be carried out on each item of the material to check requirements which are likely to vary during production.

**5.4.6.1.4** Tests During Manufacture shall mean those tests which are to be carried out during the process of manufacture and end inspection by the Contractor to ensure the desired quality of the end product to be supplied by him.

**5.4.6.1.5** The norms and procedure of sampling for these tests will be as per the applicable /standards.

**5.4.6.1.6** For all type and acceptance tests, the acceptance values shall be the values guaranteed by the bidder in the data requirement sheets of this proposal or the acceptance value specified in this specification, whichever is more stringent for that particular test.

**5.4.6.1.7** The contractor will intimate the purchaser about carrying out of the tests at least 45 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.

**5.4.7 TYPE TESTS**

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

| | | |
|---|---|---|
| a) | Visual examination | IS:2121-Part-II |
| b) | Dimensional verification | |
| c) | Galvanising test | |
| d) | Electrical Resistance Tests | |
| e) | Heating cycle test | |
| f) | Chemical analysis of materials | |
| g) | Slip strength Test | |

Note:- Test mentioned at (e), is not applicable to mid span compression joint for earthwire.

**5.4.7.2** Repair Sleeve for Conductor

| | | |
|---|---|---|
| a) | Visual examination | As per Annexure-A |
| b) | Dimensional verification | |
| c) | Chemical analysis of materials | |

**5.4.7.3** Flexible Copper Bond

| | | |
|---|---|---|
| a) | Visual examination | IS:2121-Part-II |
| b) | Dimensional verification | |
| c) | Slip Strength Test | As per Annexure-A |

**5.4.7.4** Vibration Damper for Conductor and Earthwire

| | | |
|---|---|---|
| a) | Visual examination | IS:9708-1993 |
| b) | Verification of Dimensions | |
| c) | Damper efficiency test | |
| d) | Galvanising/ electroplating test | |
| e) | Clamp bolt torque test | |

| | | |
|---|---|---|
| f) | Masspull off test | |
| g) | Resonance frequency test | |
| h) | Chemical analysis of materials. | |
| i) | Dynamic characteristics Test | |
| j) | Vibration Analysis | |
| k) | Clamp Slip Test | |
| l) | Fatigue Tests | As per Annexure-A |
| m) | Magnetic Power loss Test | |

Note :- Test mentioned at (m), is not applicable to dampers for earthwire.

**5.4.7.5** Earthwire Suspension Clamp Assembly

| | | |
|---|---|---|
| a) | Visual examination and Dimensional verification | IS:2121-1992 Part-III |
| b) | Galvanising Test | |
| c) | Chemical analysis of materials | |
| d) | Mechanical Strength Test | As per Annexure-A |
| e) | Clamp slip strength Vs Torque test for suspension assembly | |

**5.4.7.6** Earthwire tension clamp assembly

| | | |
|---|---|---|
| a) | Visual examination and Dimensional verification | IS:2121-1992 Part-III |
| b) | Galvanising Test | |
| c) | Chemical analysis of materials | |
| d) | Mechanical Strength Test (excluding clamp) | As per Annexure-A |

| | | | |
|---|---|---|---|
| | e) | Slip strength Test on Tension Assembly | |
| | f) | Electrical Resistance Test on Tension Clamp. | |

**5.4.7.7** Flexible copper bond

| | | | |
|---|---|---|---|
| | a) | Visual examination | IS:2121-1992 Part-III |
| | b) | Dimensional verification | |
| | c) | Slip strength test | As per Annexure-A |

## 5.4.8 ACCEPTANCE TESTS

**5.4.8.1** Mid Span Compression Joint for Conductor and Earthwire-Accesories

| | | | |
|---|---|---|---|
| | a) | Visual examination and Dimensional Verification | IS:2121-(Part-II)-1981 Clause 6.2, 6.3 & 6.7 |
| | b) | Galvanising Test | IS-2121-1992 (Part –III) |
| | c) | Slip strength Test | As per Annexure-B |
| | d) | Hardness Test | |

**5.4.8.2** Armour Rods

| | |
|---|---|
| Bend Test | As per Clause 7.10 of IS : 2121(pt I) 1981 |

**5.4.8.3** Repair Sleeve for Conductor

| | | | |
|---|---|---|---|
| | a) | Visual examination and Dimensional Verification | IS:2121-(Part-II)-1981 Clause 6.2, 6.3 |

**5.4.8.4** Flexible Copper Bond

| | | | |
|---|---|---|---|
| | a) | Visual examination and Dimensional Verification | IS:2121-(Part-II)-1981 Clause 6.2, 6.3 |
| | b) | Slip Strength Test | As per Annexure-B |

**5.4.8.5** Vibration Damper for Conductor and Earthwire

| | | |
|---|---|---|
| a) | Visual examination and Dimensional Verification | IS:9708-1993 |
| b) | Galvanising Test | As per Indian Standard |
| | i) on damper masses | |
| | ii) on messenger cable | |
| c) | Verification of Resonance frequencies | |
| d) | Clamp Slip Test | As per Annexure-B |
| e) | Clamp Bolt Torque Test | |
| f) | Strength of the Messenger cable | |
| g) | Mass Pull Off Test | |

**5.4.8.6** Earthwire Suspension clamp Assembly

| | | |
|---|---|---|
| a) | Visual examination and Dimensional Verification | IS:2121-(Part-III)-1992 |
| b) | Galvanising Test | As per Indian Standard |
| c) | Clamp Slip Strength Test | |
| d) | Mechanical Strength Test on each component | As per Annexure-A |
| e) | Chemical Analysis of materials | |

**5.4.8.7** Earthwire Tension Clamp Assembly

| | | |
|---|---|---|
| a) | Visual examination and Dimensional Verification | IS:2121-(Part-III)-1992 |
| b) | Galvanising Test | |
| c) | Hardness Test | |

| | | |
|---|---|---|
| d) | Mechanical Strength Test on each component (excluding clamp) | As per Annexure-A |
| e) | Slip strength Test for Tension clamp | |
| f) | Chemical Analysis of materials | |

**5.4.9 ROUTINE TESTS**

| | | |
|---|---|---|
| a) | Visual examination and Dimensional Verification | IS:2121-(Part-II)-1981 Clause 6.2, 6.3 |

**5.4.10 TEST DURING MANUFACTURE**

**5.4.10.1** Chemical analysis of zinc used for Galvanising. Samples taken from the zinc ingots shall be chemically analysed as per IS:209-1979.

**5.4.10.2** Test on Malleable Castings, Forgings and Fabricated Hardware.

The chemical analysis, mechanical and metllographic tests, inclusion rating and magnetic particle inspection for malleable castings, chemical analysis, hardness test, grain size and magnetic particle inspection for forgings and chemical analysis and mechanical tests for fabricated hardware will be based on heat number and heat treatment batch. The details regarding these tests will be as discussed and mutually agreed to by the Contractor and Owner in the quality assurance programme.

**5.4.11 SAMPLE BATCH FOR TYPE TESTING**

**5.4.11.1** The contractor shall offer at least three times the quantity of material required for conducting all the type tests during sample selection for type testing.

**5.4.11.2** The contractor is required to conduct all the acceptance tests successfully in presence of the Owner's representative.

**5.4.11.3** Sample selection should be done by the purchaser's representative.

**5.4.12 TESTING EXPENSES**

**5.4.12.1** Testing charges for all the type tests shall be indicated separately.

**5.4.12.2** Bidder shall indicate the laboratories in which they propose to conduct the type tests. They shall ensure that the tests can be completed in these laboratories within the time schedule guaranteed by them in the appropriate schedule of this specification.

**5.4.12.3** In case of failure in any type test, the bidder whose material has failed is either required to modify the design of the material and successfully complete the type tests in the modified design or to repeat all type tests in the modified design or to repeat all those particular type tests at least three times successfully at his own expenses. The decision of the Owner in this regard shall be final and binding.

**5.4.12.4** The entire cost of testing for acceptance and routine tests and test during manufacture specified herein shall be treated as included in the quoted unit price of accessories, except for the Purchaser's representative.

**5.4.13 ADDITIONAL TESTS**

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

**5.4.13.2** The Owner also reserves the right to repeat all type or acceptance tests on samples selected from lots supplied to owner wherever deemed necessary.

**5.4.14 TEST REPORTS**

**5.4.14.1** Copies of type test reports shall be furnished in atleast six copies alongwith one original. One copy shall be returned duly certified by the Owner only after which the commercial production of the concerned material shall start.

**5.4.14.2** Copies of acceptance test report shall be furnished in atleast six copies. One copy shall be returned, duly certified by the Owner only after which the materials will be despatched.

**5.4.14.3** Record of routine test report shall be maintained by the Contractor at his works for periodic inspection by the Owner's representative.

**5.4.14.4** Test certificates/record of tests carried out during manufacture and routine tests shall be maintained by the Contractor. These shall be produced for verification as and when desired by the Purchaser.

## 5.4.15 INSPECTION

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

**5.4.15.2** The Contractor shall keep the Purchaser informed in advance of the time of starting and of the progress of manufacture of the accessories in its various stages so that arrangements could be made for inspection.

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

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

## 5.4.16 PACKING AND MARKING

**5.4.16.1** All accessories shall be packed in strong, seasoned resistant wooden cases/crates. The gross weight of the packing shall not normally exceed 100 kg to avoid handling problems.

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

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

**5.4.16.4** Bolts, nuts, washers, cotter pins, security clips and split pins etc. shall be packed duly installed and assembled with the

respective parts and suitable measures shall be used to prevent their loss.

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

**5.4.16.6** All the packing cases shall be marked legibly and correctly so as to ensure safe arrival at their destination and to avoid the possibility of goods being lost or wrongly despatched on account of faulty packing and faulty or illegible markings. Each wooden case/crate shall have all the markings stencilled on it in indelible ink.

**ANNEXURE-A (TYPE TESTS)**

## 1. Mid Span Compression Joint for Conductor and Earthwire

a) SLIP STRENGTH TEST

The fitting compressed on conductor/earthwire shall not be less than one metre in length. The test shall be carried out as per IS:2121-(Part-II)-1981 clause 6.4 except that the load shall be steadily increased to 95% of minimum ultimate tensile strength of conductor/ earthwire and retained for one minute at this load. There shall be no movement of the conductor/earthwire relative to the fittings and no failure of the fittings during this one minute period.

## 2. Flexible Copper Bond

a) Slip Strength Test

On applying a load of 3 kN between the two ends, stranded flexible copper cable shall not come out of the connecting lugs and none of its strands shall be damaged. After the test, the lugs shall be cut open to ascertain that the gripping of cable has not been affected.

## 3. Vibration Damper for Conductor and Earthwire

a) Dynamic Characteristics Test

The damper shall be mounted with its clamp tightened with torque recommended by the manufacturer on shaker table capable of simulating sinusoidal vibration for Aeolian vibration frequency band of range from 5 to 45 Hz for damper for conductor and 15 to 75 Hz for damper for earthwire. The damper assembly shall be vibrated vertically with a +/-1 mm amplitude from 5 to 15 Hz frequency and beyond 15Hz +/- 0.5mm to determine the following characteristics with the help of suitable recording instruments :

i) Force Vs frequency

ii) Phase angle Vs frequency

iii) Power dissipation Vs frequency

The Force Vs frequency curve shall not show steep peak at resonance frequencies and deep troughs between the resonance frequencies. The resonance frequencies shall be suitably spread within the Aeolian vibration frequency – band between the lower and upper dangerous frequency limits determined by the vibration analysis of conductor / earth wire without dampers.

Acceptance criteria for vibration damper

The above dynamic characteristics test on five damper shall be conducted.

The mean reactance and phase angle Vs frequency curves shall be drawn with the criteria of best fit method.

The above mean reactance response curve should lie with 0.135f to 0.541f Kgf/mm limits for ACSR Panther conductor damper and 0.050f to 0.3 Kgf/mm limits for earthwire damper where 'f' is frequency in Hz.

The above mean phase angle response curve shall be between 25° to 130° with in the frequency range of interest.

If the above curve lies within the envelope, the damper design shall be considered to have successfully met the requirement.

Visual resonance frequencies of each mass of damper is to be recorded and to be compared with the guaranteed values.

b) Vibration Analysis

The vibration analysis of the conductor/earthwire shall be done with and without damper installed on the span. The vibration analysis shall be done on a digital computer using energy balance approach. The following parameters shall be taken into account for the purpose of analysis;

i) The analysis shall be done for single conductor/earthwire without armour rods as per the parameters given in section I & II. The tension shall be taken as 35 kN and 12 kN for conductor and earthwire respectively for a span ranging from 100m to 1100m.

ii) The self damping factor and flexural stiffness (El) for conductor and earthwire shall be calculated on the basis of experimental results. The details of experimental analysis with these data should be furnished.

iii) The power dissipation curve obtained from dynamic Characteristic Test shall be used for analysis with damper.

iv) Examine the Aeolian vibration level of the conductor/earthwire with and without vibration damper installed at the recommended location or wind velocity ranging from 0 to 30 km per hour, predicting amplitude, frequency and vibration energy input.

v) From vibration analysis of conductor/earthwire without damper, antinode vibration amplitude and dynamic strain levels at clamped span extremities as well as antinodes shall be examined and thus lower and upper dangerous frequency limits between which the aeolean vibration levels exceed the specified limits shall be determined.

vi) From vibration analysis of conductor/earthwire with damper/dampers installed at the recommended location, the dynamic strain level at the clamped span extremities, damper attachment point and the antinodes on the conductor/earthwire shall be determined. In addition to above damper clamp vibration amplitude and antinode vibration amplitudes shall also be examined.

The dynamic strain levels at damper attachment points, clamped span extremities and antinodes shall not exceed the specified limits. The damper clamp vibration amplitude shall not be more than that of the specified fatigue limits.

c) Clamp Slip and Fatigue tests

i) Test Set up

The clamp slip and fatigue tests shall be conducted on a laboratory set up with a minimum effective span length of 30 m. The conductor/earthwire shall be tensioned at 35 kN/12 kN and shall not be equipped with protective armour rods at any point. Constant tension shall be maintained within the span by means of lever arm arrangement. After the conductor/ earthwire has been tensioned, clamps shall be installed to support the conductor/earthwire at both ends and thus influence of connecting hardware fittings are eliminated from the free span. The clamps shall not be used for holding the tension on the conductor/earthwire. There shall be no loose parts, such as suspension clamps, U bolts, on the test span supported between clamps mentioned above. The span shall be equipped with vibration inducing equipment suitable for producing steady standing vibration. The inducing equipment shall have facilities for stepless speed control as well as stepless amplitude arrangement. Equipment shall be available for measuring the frequency, cumulative number of cycles and amplitude of vibration at any point along the span.

ii) Clamp Slip Test

The vibration damper shall be installed on the test span. The damper clamp, after tightening with the manufacturer's specified tightening torque, when subjected to a longitudinal pull of 2.5 KN

parallel to the axis of conductor/earthwire for a minimum duration of one minute shall not slip i.e, the permanent displacement between conductor/earthwire and clamp measured after removal of the load shall not exceed 1.0 mm. The load shall be further increased till the clamp starts slipping. The load at which the clamp slips shall not be more than 5 kN.

iii) Fatigue Test

The vibration damper shall be installed on the test span with the manufacturer's specified tightening torque. It shall be ensured that the damper shall be kept minimum three loops away from the shaker to eliminate stray signals influencing damper movement.

The damper shall then be vibrated at the highest resonant frequency of each damper mass. For dampers involving torsional resonant frequencies tests shall be done at torsional modes also in addition to the highest resonant frequencies at vertical modes. The resonance frequency shall be identified as the frequency at which each damper mass vibrates with the maximum amplitude on itself. The amplitude of vibration of the damper clamp shall be maintained not less than +/-25/f mm, where f is the frequency in Hz.

The test shall be conducted for minimum ten million cycles at each resonant frequency mentioned above. During the test if resonance shift is observed the test frequency shall be tuned to the new resonant frequency.

The clamp slip test as mentioned hereinabove shall be repeated after fatigue test without retorquing or adjusting the damper clamp, and the clamp shall withstand a minimum load equal to 80% of the slip strength for a minimum duration of one minute.

After the above tests, the damper shall be removed from conductor/earthwire and subjected to dynamic characteristics test. There shall not be any major deterioration in the characteristic of the damper. The damper then shall be cut open and inspected. There shall not be any broken, loose, or damaged part. There shall not be significant deterioration or wear of the damper. The conductor/earthwire under clamp shall also be free from any damage.

For the purpose of acceptance, the following criteria shall be applied :

1) There shall not be any frequency shift by more than +/-2 Hz at frequencies lower than 15 Hz and +/-3Hz for frequencies higher than 15 Hz.

2) The force response curve shall generally lie within guaranteed % variation in reactance after fatique test in comparison with that before fatique test by the supplier.

3) The power dissipation of the damper shall not be less than guaranteed % variation in power dissipation before fatigue test by the supplier. However, it shall not be less than minimum power dissipation which shall be governed by lower limits of reactance and phase angle indicated in the envelope.

**4. Magnetic Power Loss Test for Damper**

The sample involving ferrous parts shall be tested in a manner to simulate service conditions for 50 Hz pure sine-wave. The test should be carried out at various currents ranging from 300 amperes to 700 amperes and the magnetic power loss at various currents should be specified in tabulated graphical form. The difference between the power losses without and with sample at room temperature shall be limited to 1 watt for 500 amperes current (rms). The losses shall be determined by averaging the observations obtained from atleast four samples.

**5. Mechanical strength test of Earthwire Suspension/Tension Clamps**

a) The suspension assembly/tension assembly (excluding tension clamp) shall be subjected to a load equal to 50% of the specified minimum ultimate tensile strength (UTS) which shall be increased at a steady rate to 67% of the minimum UTS specified. This load shall be held for five minutes and then removed. After removal of the load, the components shall not show any visual deformation and it shall be possible to disassemble them by hand. Hand tools may be used to loosen the nuts initially. The assembly shall then be reassembled and loaded to 50% of UTS and the load shall be further increased at a steady rate till the specified minimum UTS is reached and held for one minute. No fracture should occur during this period. The applied load shall then be increased until the failing load is reached and the value recorded.

Clamp Slip Strength Vs Torque Test for suspension Assembly.

The suspension assembly shall be vertically suspended by means of a flexible attachment. A suitable length of 7/3.15 G.S. Earthwire shall be fixed in the clamp. The clamp slip strength at various tightening torques shall be obtained by gradually applying

the load at one end of the earthwire. The clamp slip strength versus torque curve shall be drawn. The clamp slip strength at the recommended tightening torque shall be more than 9 KN but less than 14 kN.

c) Slip Strength Test of Tension Clamp :
Tension clamps shall be compressed on a 5 m length of earthwire on both ends. The assembly shall be mounted on a tensile testing machine and anchored in a manner similar to the arrangement to be used in service. A tensile load of 50% of the specified breaking load of the earthwire shall be applied & the sample shall be marked in such a way that movement relative to the fitting can easily be detected. Without any subsequent adjustment of the fitting, the load shall be steadily increased to 95% of the specified breaking load and maintained for one minute. There shall be no movement of the earthwire relative to the fitting during this one minute period and no failure of the fitting also.

d) Electrical Resistance Test of Tension Clamp :
The tension clamp and the jumper shall be compressed on two suitable lengths of earhwire. The electrical resistance shall be measured between points on earthwire near the clamp and near the jumper mouth keeping 25 mm clearance of the fitting and should not exceed 75% of the measured resistance of equivalent length of earthwire. The test shall be conducted with direct current. The current connections shall be at a distance not less than 50 times the diameter of earthwire from the fitting and shall be made so that effective contact is ensured with all those strands of the earthwire which would be taken into account in calculating its equivalent resistance. The test shall be repeated with the polarity reversed and the average of the two results considered as the measured value.

## 6. Chemical Analysis Test

Chemical analysis of the material used for manufacture of items shall be conducted to check the conformity of the same with technical specification and approved drawing.

**ANNEXURE-B (ACCEPTANCE TESTS)**

## 1. Mid Span Compression Joint for Conductor and Earthwire

a) Hardness Test

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

## 2.. Flexible Copper Bond

a) Slip Strength Test

Same as Clause 2(a) of Annexure A.

## 3. Vibration Damper for Conductor and Earthwire

a) Verification of Reasonance Frequencies

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

b) Clamp Slip Test

Same as Clause 3 (c) (ii) of Annexure-A.

c) Clamp Bolt Torque Test

The clamp shall be attached to a section of the conductor/earthwire. A torque of 150 percent of the manufacturer's specified torque shall be applied to the bolt. There shall be no failure of component parts. The test set up is as described in clause 3 (c) (i), Annexure-A.

d) Strength of the Messenger Cable

The messenger cable shall be fixed in a suitable tensile testing machine and the tensile load shall be gradually applied until yield point is reached. The load shall be not less than the value guaranteed by the bidder.

e) Mass Pull Off Test

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

# CHAPTER – 6

# INSULATORS AND INSULATOR HARDWARES
# INSULATORS

## 6.1.1 Scope

**6.1.1.1** This section covers design, manufacture, stage testing, inspection, testing before despatch, packing, supply and delivery of insulators specified hereinunder.

a) 70 KN EM strength Porcelain Disc Insulators - nos. discs.
b) 90 KN EM strength Porcelain Disc Insulators - nos. discs.

**6.1.1.2** 70 KN EM strength Disc Insulators shall be used for suspension towers and angle towers in the following insulator strings along with hardware fittings:

1) Single "I" suspension insulator Strings(1x9).
2) Single suspension "pilot" insulator strings (1x9): for large angle type towers
3) Double suspension "II" Insulator strings (2x9) for crossings.

**6.1.1.3** 90 KN EM strength Disc Insulators shall be used in the following Insulator strings alongwith hardware fittings:

Single / Double Tension Insulator strings(1x10/2x10) for angle towers and Railway and other crossings.

## 6.1.2 STANDARDS

**6.1.2.1** The insulator strings and its components shall conform to the following Indian/International Standards which shall mean latest revision, with amendments/changes adopted and published, unless specifically stated otherwise in the specification.

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

| Sl.No | Indian Standards | TITLE | International standard |
|---|---|---|---|
| 1. | IS 731-1974 | Porcelain insulators for over head power lines with a nominal voltage greater than 1000V | BS:137-1982 (I & II)<br>IEC:383-(Part-I)-1993<br>(Part-II)-1992 |
| 2. | IS 209-1966 | Specification for Zinc | BS:3436-1986 |
| 3. | IS:406-1964 | Method for chemical Analysis of slab zinc | |
| 4. | IS 2071-1974 | Method of high voltage Testing | IEC 60-1-1989 |
| | part-(I)-1974 | General definitions and test requirements. | |
| | part-(II)-1974 | Test Procedure | |
| | part-(III)-1976 | Measuring devices | |
| 5. | IS:2629-1985 | Recommended practice for hot dip galvanising of iron and steel. | ISO-1461(E) |
| 6. | IS:2633-1986 | Method for testing of uniformity of coating of zinc coated articles. | |
| 7. | IS:3188-1980 | Dimensions for disc insulators | IEC:305-1978 |
| 8. | IS:6745-1972 | Methods of Determination of Weight of zinc coating on zinc coated iron and steel articles | BS:433-1969<br>ISO 1460-1973 |
| 9. | IS:385 | Specification for phosphor Bronze rods and Bars,sheet strip and wire | BS:2870 |
| 10. | IS:1570-1961 (Part-I) | Specification for wrought steels for general engineering purposes. Steel specified by tensile and/or yield properties | |

| | | | |
|---|---|---|---|
| 11. | IS:2004 | Carbon steel forgings for general engineering purposes | |
| 12. | IS:6603 | Stainless steel bars and flats | |
| 13. | IS:4759 | Hot dip zinc coating on structural steel and other allied products. | |
| 14. | IS:1573 | Electroplated coatings of zinc on iron and steel. | |
| 15. | IS:2121-1981 | Specification for Conductors and and earthwire accessories for overhead power lines. | |
| | Part-I | Armour Rods, binding wires and tapes for conductors. | |
| | Part-II | Mid span joints and repair sleeves for conductor. | |
| 16. | IS:4218- | ISO metric screw threads. | ISO/R 68-1969, 1976<br>R-26-1963,<br>R262-1969,<br>R965-1969. |
| 17. | IS:8263-1976 | Methods of RI test on HV insulators. | IEC:437-1973<br>NEMA PUBLICATION NO.107/1964<br>CISPR |
| 18. | IS:8269-1976 | Methods for switching impulse test on HV insulators. | IEC:506-1975 |
| 19. | | Thermal mechanical performance test and mechanical performance test on string insulator units. | IEC:575-1977 |
| 20. | IS:2486 | Specification for insulator fittings for overhead power lines with a nominal voltage greater than 1000V | |
| Part-I | | General requirements and tests | BS:3288-1979<br>1971 |
| Part-II | | Dimensional requirements | IEC:120-1984 |

| | | | |
|---|---|---|---|
| | 1974 | | |
| | Part-III 1975 | Locking Devices | IEC:372-1984 |
| 21. | IS:3138-1966 | Hexagonal bolts and nuts | ISO/R947 and ISO/R272 |
| 22. | IS:1367-1980 | Technical supply conditions for threaded steel fasteners. | |
| 23. | IS:2016- | Specification for Plain Washers | |
| 24. | IS:2070-1962 | Method of Impulse Voltage Testing | |
| 25. | IS:2107 -1977 | Specification for white heart malleable iron castings. | |
| 26. | IS:2108 -1977 | Specification for black heart malleable iron castings. | |
| 27. | IS:5358 -1969 | Specification for Hot dip Galvanised coatings on fasteners. | |
| 28. | Salt Fog Pollution Voltage withstand test. | | IEC:507-1991 |
| 29. | Residual Strength of String Insulator units of Glass or Ceramic Material for over-head lines after mechanical Damage of the Dielectric. | | IEC:797-1984 |
| 30. | Guide for the selection of insulators in respect of polluted conditions. | | IEC:815-1986 |

### 6.1.3 TECHNICAL DESCRIPTION

### 6.1.3.1 DETAILS OF DISC INSULATORS

**6.1.3.1.1** The Insulator of the strings shall consist of standard discs for a three phase,50 Hz, effectively earthed 132 kV Transmission system in a moderately polluted atmosphere. The discs shall be cap and pin, ball and socket type.

**6.1.3.1.2** Bidder shall quote for disc insulators made of electroporcelain in accordance with the clause 6.1.1 (Scope).

**6.1.3.1.3** The size of disc insulator, minimum creepage distance, the number to be used in different types of strings, their electromechanical strength and mechanical strength of insulator strings along with hardware fittings shall be as in Table below:

**PARTICULARS OF INSULATORS AND INSULATOR STRINGS**

| SL.NO. | PARTICULARS | SINGLE SUSPENSION & PILOT STRING | DOUBLE SUSPENSION STRING | SINGLE TENSION STRING | DOUBLE TENSION STRING |
|---|---|---|---|---|---|
| | | "I" | | "II" | |
| 1. | No. of standard discs | 9 | 2x9 | 1x10 | 2x10 |
| 2. | Size of disc-mm | 255/280 x145 | 255/280 x145 | 255/280 x145 | 255/280 x145 |
| 3 | E&M Strength of each string | 70 KN | 2x70 KN | 90 KN | 2x90KN |
| 4 | Ball and socket designation(mm) | 16 | 16 | 16 | 16 |
| 5 | Creepage distance of each disc( mm) | 292 | 292 | 292 | 292 |

**6.1.3.2 DIMENSIONS OF INSULATOR DISCS**

**6.1.3.2.1** It shall be ensured that the dimensions of the disc insulators are within the limits specified below:

| | | | | |
|---|---|---|---|---|
| a) | Diameter of disc (mm) | standard | Maximum | Minimum |
| | 70/90 KN Disc | 255/280 | 266/280 | 244/280 |
| b) | Ball to Ball spacing between discs (mm) | | | |
| | 70/90 KN Disc | 145 | 149 | 141 |

### 6.1.3.3 BID DRAWINGS

**6.1.3.3.1** The bidder shall furnish full description and illustration of the material offered.

**6.1.3.3.2** The Bidder shall furnish alongwith the bid the outline drawing (6 copies) of each insulator unit including a cross sectional view of the insulator shell. The drawing shall include but not be limited to the following information:

a) Shell diameter and ball to ball spacing with manufacturing tolerances.
b) Minimum creepage distance with positive tolerance.
c) Eccentricity of the disc
   i) Axial run out
   ii) Radial run out.
d) Unit mechanical and electrical characteristics.
e) Size and weight of ball and socket parts.
Weight of unit insulator disc.
g) Materials for the disc, cap and pin and standard to which conforming.
h) Identification mark.
i) Manufacturer's catalogue number.
j) Brief installation instructions.
k) Relevant technical details of significance.
l) Galvanisation Process, weight of zinc and no. and duration of dips.

**6.1.3.3.3** Drawings for complete Insulator strings may be furnished with following information.

a) Dimensional drawings for different insulator strings.
b) EMS
c) No. of insulator disc units in each string.
Weight of insulator discs, Hardware sets and total weight of insulator strings.
e) Tolerance if any.

**6.1.3.4** After placement of the award, the contractor shall submit fully dimensioned insulator drawings containing all the details as given in Clause No.6.1.3.3.2 and 6.1.3.3.3 above, in four (4) copies to owner for approval. After getting approval from owner and successful completion of all the type tests, the contractor shall submit 30 more copies of the same drawing to the owner for further distribution and field use at Owner's end.

After placement of award the supplier shall also submit fully dimensioned insulator crate drawing of different types of insulators.

### 6.1.4 GENERAL TECHNICAL REQUIREMENTS

#### 6.1.4.1 Porcelain

The porcelain used in the manufacture of the shells shall be ivory white, nonporous of high dielectric, mechanical and thermal strength, free from internal stresses, blisters, laminations, voids, foreign matter, imperfections or other defects which might render it in any way unsuitable for insulator shells.
Porcelain shall remain unaffected by climatic conditions, ozone, acid, alkalies, zinc or dust. The manufacturing shall be by the wet process and impervious character obtained by thorough vitrification.

**6.1.4.1.1** Porcelain Glaze
Surfaces to come in contact with cement shall be made rough by sanding. All other exposed surfaces shall be glazed with ceramic materials having the same temperature coefficient of expansion as that of the insulator shell. The thickness of the glaze shall be uniform throughout and the colour of the glaze shall be brown. The glaze shall have a good visible lusture, smooth on surface and be subject to satisfactory performance under extreme tropical climatic weather conditions and prevent ageing of the porcelain. The glaze shall remain under compression on the porcelain body throughout the working temperature range.

#### 6.1.4.2 METAL PARTS

**6.1.4.2.1** Cap and Ball Pins
Ball pins shall be made with drop forged steel and caps with malleable cast iron. They shall be in one single piece and duly hot dip galvanised. They shall not contain parts or pieces joined together, welded, shrink fitted or by any other process from more than one piece of material. The pins shall be of high tensile steel, drop forged and heat treated. The caps shall be cast with good quality black heart malleable, cast iron/spheroidal graphite iron/drop forged steel and annealed. Galvanising shall be by the hot dip process with a heavy coating of zinc of very high purity. The Bidder shall specify the grade, composition and mechanical properties of steel used for caps and pins.

**6.1.4.2.2** Security Clips

The R type security clips shall be made of good quality phosphor bronze or stainless steel.

### 6.1.4.3 FILLER MATERIAL

Cement to be used as a filler material shall be quick setting, fast curing portland cement. It shall not cause fracture by expansion or loosening by contraction. Cement shall not react chemically with metal parts in contact with it and its thickness shall be as small and as uniform as possible. Proper care shall be taken to correctly centre and locate individual parts during cementing.

### 6.1.4.4 MATERIAL DESIGN AND WORKMANSHIP

#### 6.1.4.4.1 GENERAL

i) All raw materials to be used in the manufacture of these insulators shall be subject to strict raw material quality control and to stage testing/ quality control during manufacturing stage to ensure the quality of the final end product. Manufacturing shall conform to the best engineering practices adopted in the field of extra high voltage transmission. Bidders shall therefore offer insulators as are guaranteed by them for satisfactory performance on 132 KV Transmission Lines.

ii) The design, manufacturing process and material control at various stages shall be such as to give maximum working load, highest mobility, best resistance to corrosion, good finish, elimination of sharp edges and corners to limit corona and radio interference voltages.

#### 6.1.4.4.2 INSULATOR SHELL

The design of the insulator shells shall be such that stresses due to expansion and contraction in any part of the insulator shall not lead to deterioration. Shells shall be dried under controlled conditions of humidity and temperature.

#### 6.1.4.4.3 METAL PARTS

i) The pin and cap shall be designed to transmit the mechanical stresses to the shell by compression and develop uniform mechanical strength in the insulator. The cap shall be circular with the inner and outer surfaces concentric and of such design that it will not yield or distort under loaded conditions. The head portion of the pin ball shall be suitably designed so that when the

insulator is under tension, the stresses are uniformly distributed over the pinhole portion of the shell. The pin ball shall move freely in the ball socket either during assembly of a string or during erection of a string or when a string is placed in position.

ii) Metal caps shall be free from cracks, seams, shrinks, air holes, blow holes and rough edges. All metal surfaces shall be perfectly smooth with no projecting parts or irregularities which may cause corona. All load bearing surfaces shall be smooth and uniform so as to distribute the loading stresses uniformly. Pins shall not show any microscopically visible cracks, inclusions and voids.

**6.1.4.4.4 GALVANISING**

All ferrous parts shall be hot dip galvanised in accordance with the latest edition of IS:2629.The zinc to be used for galvanising shall conform to grade Zn 99.5 as per IS:209.The zinc coating shall be uniform, smoothly adherent, reasonably bright, continuous and free from impurities such as flux, ash, rust stains, bulky white deposits and blisters. Before ball pins are galvanised, all die flashing on the shank and on the bearing surface of the ball shall be carefully removed without reducing the designed dimensional requirements. The galvanised metal parts shall be guaranteed to withstand at least six successive dips each lasting one minute duration under the standard preece test.

**6.1.4.4.5 CEMENTING**

The insulator design shall be such that the insulating medium shall not directly engage with the hard metal. The surfaces of porcelain and the metal parts shall be coated with resilient paint to offset the effect of difference in thermal expansions of these materials.

**6.1.4.4.6 SECURITY CLIPS (LOCKING DEVICES)**

**6.1.4.4.6.1** Socket fitting shall be provided with R-shaped security clip in accordance with IS:2486 (Parts III & IV) to provide positive locking against unintentional disengagement of socket from ball of the insulator. The security clip shall be humped to maintain the clip in the locked position and shall have prongs spread to prevent complete withdrawal from the socket .The clip end shall not project outside the recess of socket when the clip is in locked position. The locking device should be resilient, corrosion resistant and of suitable mechanical strength. There shall be no risk of the locking device being displaced accidentally or being rotated when in position. Under no circum-stances shall the locking device allow separation of insulator units of strings.

**6.1.4.4.6.2** The hole for the security clip shall be on the side of the socket opposite to the socket opening. The hole for the clip shall be countersunk. The clip eye shall be of such design that the same may be engaged by a hotline clip puller to provide for disengagement under energised conditions.

**6.1.4.4.6.3** The force required to pull the clip to its unlocked position shall not be less than 50 N or more than 500 N.

**6.1.4.4.6.4** The security clip shall be made of stainless steel of type AISI 302 or 304 or phosphor bronze as per IS:7814.

**6.1.4.4.7 BALL AND SOCKET DESIGNATION**

The dimensions of the balls and sockets for 70 KN and 90 KN discs shall be of 16mm designation respectively in accordance with the standard dimensions stated in IS:2486 (Part II).

**6.1.4.5 INTERCHANGEABILITY**

The insulators inclusive of the ball and socket fitting shall be of standard design suitable for use with hardware fittings of any make conforming to relevant Indian standards.

**6.1.4.6 CORONA AND RI PERFORMANCE**

All surfaces shall be clean, even, smooth, without cuts, abrasions or projections. No part shall be subjected to excessive localized pressure. The metal parts and Porcelain shall not produce any noise generating corona under all operating conditions.

**6.1.4.7 SUITABILITY FOR LIVE LINE MAINTENANCE**

The insulators shall be compatible for use with hot line or live line maintenance techniques so that usual hot line operations can be carried out with ease, speed and safety.

**6.1.4.8 METHODS AND PERIODICITY OF MAINTENANCE**

Bidders shall indicate the methods generally adopted in routine hot and cold line maintenance of EHV lines for similar disc insulators supplied by them. Bidders shall also indicate the recommended periodicity of such maintenance.

**6.1.4.9 FREEDOM FROM DEFECTS**

Insulators shall have none of the following defects :

i) Ball pin shake
ii) Cementing defects near the pin like small blow holes, small hair cracks, lumps, etc.,

iii) Sandfall defects on the surface of the insulator.

**6.1.4.10 INSULATOR STRINGS**

**6.1.4.10.1 TYPE AND RATING**

The insulator strings shall be formed with standard disc insulators described in this specification for use on three phase, 132 kV,50 Hz effectively earthed systems in a moderately polluted atmosphere. Suspension insulator strings for use with suspension/tangent towers are to be fitted with disc insulator units of 70 KN EMS rating while tension insulator strings for use with anchor/ tension towers are to be fitted with disc insulator units of 90 KN EMS rating.

**6.1.4.10.2 STRING SIZE**

The size of the disc insulator, the number to be used in different types of strings, their electromechanical strength with minimum nominal creepage distance shall be in accordance with Cl.No.6.1.3.1.3

**6.1.4.10.3** Insulator units after assembly shall be concentric and coaxial within limits as permitted by Indian Standards.

**6.1.4.10.4** The string design shall be such that when units are coupled together, there should not be contact between the shell of one unit and metal of the next adjacent unit. The design of the ribs shall be such that the security clip of the insulator can the engaged and disengaged easily with the hot stick without damaging the shell ribs.

**6.1.4.11** The manufacturer of the disc insulators shall guarantee an insulator failure rate not exceeding (One) per 10,000(Ten thousand) per year. In case the annual failure rate during the first ten years of service exceeds the above figure, under normal operating condition, as will be determined by check to be conducted as per mutually agreed procedure and conditions upto ten years (as permitted by the operating situation), the supplier shall supply to the purchaser free of cost spare insulators equal to 10 times the excess failure.

**6.1.4.12** The supplier shall guarantee that there shall not be any decapping/breaking of insulators on line under normal operating conditions. In the event of any decapping / breaking and subsequent line drop during the first ten years of service the supplier shall have to pay Rs.50,000/ (Rs.Fifty thousand only) per dropped string towards expenditure to be incurred by WAPCOS

Ltd., for this line repair.

**6.1.5 TESTS**

**6.1.5.1** The following tests shall be carried out on the insulator string and disc insulators.

**6.1.5.2 TYPE TESTS**

These shall mean those tests which are to be carried out to prove the design, process of manufacture and general conformity of the material and product with the intent of this specification. These tests shall be conducted on a representative number of samples prior to commencement of commercial production. The supplier shall indicate his schedule for carrying out these tests.

**6.1.5.3 ACCEPTANCE TESTS**

These shall mean those tests which are to be carried out on samples taken from each lot offered for pre-dispatch inspection for the purpose of acceptance of the lot.

**6.1.5.4 ROUTINE TESTS**

These tests shall mean those tests, which are to be carried out on each insulator to check the requirements which are likely to vary during production.

**6.1.5.5 STAGE TESTS DURING MANUFACTURE**

Stage tests during manufacture shall mean those tests which are to be carried out during the process of manufacture and end inspection by the Supplier to ensure the quality control such that the end product is of the desired quality conforming to the intent of this specification.

**6.1.5. 6 TEST VALUES**

For all type and acceptance tests, the acceptance values shall be the values guaranteed by the bidder in the Guaranteed Technical Particulars or the acceptance values specified in this specification or the relevant standard whichever is more stringent for that particular test.

**6.1.5.7 TEST PROCEDURES AND SAMPLING NORMS**

The norms and procedures of sampling for the above tests shall be as per the relevant Indian Standard or other internationally

accepted standards. This will be discussed and mutually agreed to between the supplier and the purchaser before placement of order. The standards and norms according to which these tests are to be carried out are listed against each test. Where a particular test is a specific requirement of this specification, the norms and procedures of the same shall be as per Clause 6.1.13 or as mutually agreed to between the Supplier and the Purchaser in the Quality Assurance Program.

**6.1.5.8.1 The following type tests shall be conducted on the disc Insulator units.**

1. Verification of dimensions : IS:13305
2. Dry lightning Impulse withstand voltage test
3. Wet power frequency withstand voltage test | AS PER IEC:383-1
4. Electromechanical failing load test (also cl.6.1.13.16) | -1993
5. Thermal Mechanical Performance test (also cl.6.1.13.14)
6. Verification of the displacements
7. Verification of the locking system
8. Temperature cycle test
9. Puncture withstand test | AS PER IEC 383-1
10. Porosity test | -1993
11. Galvanising test
12. Visual examination test : IS:731
13. Wet power frequency voltage flashover test. : BS:137

| | | |
|---|---|---|
| 14. | Visible discharge test | : IS:731-1971 |
| 15. | RIV test (dry) | : IEC:437-1973 |
| 16. | Metallurgical test | : IS:2108 & IS:2004 |
| 17. | Residual strength test | : As per cl.6.1.13.15 |
| 18 | Steep wave front test | : As per cl.6.1.13.13 |
| 19. | Mechanical Performance test | : As per IEC:575- 1977 1977 |

**6.1.5.8.2** The Thermal mechanical performance test and steep wave front test shall be repeated once for every supply of 25,000 nos. insulators. The samples shall be drawn randomly from any offered acceptance lot.

**6.1.5.9 ACCEPTANCE TESTS (ON DISC INSULATOR UNITS)**

| | | |
|---|---|---|
| 1. | Verification of dimensions | : IS:13305 |
| 2. | Verification of the displacements | \| |
| 3. | Verification of the locking system | \| |
| 4. | Temperature cycle test | \|As per IEC 383-1 |
| 5. | Electromechanical failing load test (also cl.6.1.13.17) | \| -1993 \| |
| 6. | Porosity test | \| |
| 7. | Galvanising test | \| |
| 8. | Visual examination test | : IS:731 |
| 9. | Residual strength test | :As per cl.no.6.1.13.15 |
| 10. | Metallurgical test | : IS:2108 & IS:2004 |
| 11. | Mechanical Performance test | : As per IEC:575-1977 |

**6.1.5.10 ROUTINE TESTS (DISC INSULATOR UNITS)**

| | | |
|---|---|---|
| 1. | Visual Inspection test | |
| 2. | Mechanical test | As per IEC 383-1 1993. |
| 3. | Electrical test | |

**6.1.5.11 The following TypeTests shall be conducted on complete insulator strings with hardware fittings.**

| | | |
|---|---|---|
| 1. | Wet power frequency voltage test | |
| 2. | Lightning impulse voltage test | As per IEC:383-2: 1992 |
| 3. | Wet switching impulse voltage test | |
| 4. | Visual Examination | : IS:731 |
| 5. | Voltage distribution test | : As per Cl.6.1.13.8 |
| 6. | RIV test | : As per Cl.6.1.13.10 |
| 7. | Mechanical strength test | : As per Cl.6.1.13.1 |
| 8. | Dynamic/Vibration test | : As per Cl.6.1.13.9 |
| 9. | Corona Extinction voltage test | : As per Cl.6.1.13.11 |
| 10. | Pollution withstand voltage test | : As per Cl.6.1.13.12 |

**6.1.5.11.1** (i) All the type tests given under clause 6.1.5.11 shall be conducted on single suspension and single tension insulator string alongwith hardware fittings

All the above tests except at Sl No. 8 shall also be conducted on single suspension pilot & double suspension insulator strings alongwith hardware fittings.

### 6.1.5.12 TESTS DURING MANUFACTURE (STAGE TESTS)

On all components as applicable

| | |
|---|---|
| a) Chemical analysis of Zinc used for galvanising | ) As per Cl.6.1.13.2 ) |
| b) Chemical analysis, mechanical and metallographic test and magnetic particle inspection for malleable castings. | ) ) As per Cl.6.1.13.4 ) ) |
| c) Chemical analysis, hardness test and magnetic particle inspection for forgings | ) ) As per Cl.6.1.13.3 ) |
| d) Hydraulic internal Pressure on shell | ) As per Cl.6.1.13.6 ) |
| e) Crack detection test for metal parts | ) As per Cl.6.1.13.7 |

### 6.1.5.13 ADDITIONAL TESTS

**6.1.5.13.1** The Purchaser reserves the right for carrying out any other tests of a reasonable nature at the works of the Supplier/ laboratory / research institute in addition to the above mentioned type, acceptance and routine tests at the cost of the Purchaser to satisfy that the material complies with the intent of this specification.

**6.1.5.13.2** For 132 kV insulator strings, the Contractor is required to produce type test reports to the satisfaction of the Purchaser.

**6.1.5.13.3** Repeat E&M strength test.
E&M test on 20 nos. of samples for every lot of 10,000 nos. received at site shall be conducted preferably at independent laboratory. Test charges have to be borne by the supplier and shall be included in quoted Ex-works price. In case of failure, it will be repeated on double nos. of samples and if it again fails, the whole lot should be rejected and shall be replaced by the supplier. The samples have to be taken at random after segregating insulators damaged in transportation or otherwise.

**6.1.5.13.4** The purchaser also reserves the right to conduct all the tests mentioned in this specification at his own expense on the samples drawn from the site at supplier's premises or at any other test centre. In case of evidence of non compliance, it shall be binding on the part of the supplier to prove the compliance of the items to the Technical Specifications by repeat test or correction of deficiencies or replacement of defective items, all without any extra cost to the Purchaser.

## 6.1.5.14 TEST CHARGES AND TEST SCHEDULE

### 6.1.5.14.1 TYPE TESTS

All the materials offered shall be fully type tested as per this specification and the Bidder shall furnish four sets of type test reports alongwith the offer. These tests must not have been conducted earlier than **five years.** The Purchaser reserves the right to demand repetition of some or all the type tests in the presence of Purchaser's representative. For this purpose, the Bidder may quote unit rates for carrying out each type test.These prices shall be taken into consideration for bid evaluation.For any change in the design/type offered against this specification,Purchaser reserves the right to demand repetition of tests without any extra cost. Bidder shall indicate unit type test charges for all the tests covered under Clause 6.1.5.8 and 6.1.5.11 separately, in the relevant schedule. Charges for each type test shall be separately indicated. Test charges indicated by the bidder shall be inclusive of repeat type tests envisaged in cl. No. 6.1.5.8.2.

In case of any failure during testing on complete insulator string, the test shall be repeated at the Contractor's cost.

In case of failure of any type test, the Contractor is either required to modify the design of the material and successfully carryout all the type tests as has been detailed out in Clauses 6.1.5.8 & 6.1.5.11 of this specification or to repeat that particular type test at least three times successfully at his own expenses. The decision of the purchaser in this regard shall be final and binding.

**6.1.5.14.4** Bidder shall indicate the laboratories in which they propose to conduct the type tests. They shall ensure that the tests can be completed in these laboratories within the time schedule guaranteed by him in the appropriate schedule.

**6.1.5.14.5** The entire cost of testing for acceptance and routine tests and tests during manufacture specified herein shall be treated as included in the quoted unit price of disc insulators except for the expenses of the Inspector/Owner's representative. All acceptance tests as stipulated herein shall be carried out by the supplier in the presence of purchaser's representative. The record of routine tests, as and when desired by the Purchaser shall be furnished by the contractor.

**6.1.5.14.6** In case of failure in any type test, if repeat 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 Contractor'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 the contract price.

**6.1.5.14.7** Immediately after finalisation of the programme of type/acceptance testing, the Supplier shall give sufficient advance intimation to the Purchaser, to enable him to depute his representative for witnessing the tests.

### 6.1.5.15 SAMPLE BATCH FOR TYPE TESTING

**6.1.5.15.1** The supplier shall offer material for sample selection for type testing only after getting Quality Assurance Programme approved by the Purchaser. The supplier shall offer at least three times the quantity of materials required for conducting all the type tests for sample selection.The sample for type testing will be manufactured strictly in accordance with the Quality Assurance Programme approved by the Purchaser.

**6.1.5.15.2** Before sample selection for type testing, the supplier shall be required to conduct all the acceptance tests successfully in presence of Purchaser's representative.

### 6.1.5.16 SCHEDULE OF TESTING

**6.1.5.16.1** The Bidder has to indicate the schedule of following activities in their bids:

a) Submission of drawing for approval
b) Submission of Quality Assurance Programme for approval
c) Offering of material for sample selection for type testing.
d) Type testing.

### 6.1.6 INSPECTION

i) The Purchaser and his representatives shall at all times be entitled to have access to the works and to all places of manufacturer, where the insulators are manufactured and the Supplier shall afford all facilities for unrestricted inspection of the works, inspection of materials, inspection of manufacturing process of insulators and for conducting necessary tests as specified herein.

ii) The Supplier shall keep the Purchaser informed in advance of the time of starting and of the progress of manufacture of insulators in its various stages so that arrangements could be made for inspection.

iii) No material shall be despatched from its point of manufacture unless the material has been satisfactorily inspected and tested.

iv) The acceptance of any quantity of insulators shall in no way relieve the Supplier of his responsibility for meeting all the requirements of this specification and shall not prevent subsequent rejection if such insulators are later found to be defective.

v) The material for final inspection shall be offered by the supplier only under packed condition as detailed earlier in the specification. The purchaser shall select sample at random from the packed lot for carrying out acceptance tests. Insulators shall normally be offered for inspection in lots not exceeding 5,000 nos. The lot should be homogeneous, and should contain insulators manufactured in the span of not more than 3-4 consecutive weeks.

**6.1.7 IDENTIFICATION MARKING**

**6.1.7.1** Each disc insulator unit shall be legibly and indelibly marked with the trade mark of the manufacturer, the year of manufacture, the guaranteed combined mechanical and electrical strength in Kilo-Newtons abbreviated by 'KN' to facilitate easy identification and proper use.

**6.1.7.2** The marking shall be on porcelain. The marking on the insulator shall be printed and not impressed and the same shall be applied before firing.

**6.1.7.3** One 10mm thick ring or 20mm thick spot of suitable quality of paint shall be marked on the cap of each insulator of particular strength for easy identification of the type of insulator. The paint shall not have any deteriorating effect on the insulator performance. Following codes shall be used as identification mark.

For 70 KN disc : Black
For 90 KN disc : Red

**6.1.8 QUALITY ASSURANCE PLAN**

**6.1.8.1** The Bidder shall invariably furnish the following information alongwith his offer, failing which the offer shall be liable for rejection. Information shall be separately given for individual type of equipment offered.

i) Statement giving list of important raw materials, names of sub suppliers for the raw material, list of standards according to which the raw material are tested, list of tests normally

carried out on raw material in presence of Bidder's representative and copies of test certificates.

ii) Information and copies of test certificates as in (i) above in respect of bought out items.

iii) List of manufacturing facilities available.

iv) Level of automation achieved and list of areas where manual processing exists.

v) List of areas in manufacturing process, where stage inspections are normally carried out for quality control and details of such tests and inspections.

vi) Special features provided in the hardware to make it maintenance free.

vii) List of testing equipment available with the Bidder for final testing of insulators specified and test plant limitation, if any, vis-a-vis the type, special, acceptance and routine tests specified in the relevant standards. These limitations shall be very clearly brought out in schedule of deviations from specified test requirements.

**6.1.8.2** The Supplier shall within 30 days of placement of order, submit the following information to the Purchaser.

i) List of raw material as well as bought out accessories and the name of the raw material as well as bought out accessories with the names of sub-suppliers selected from those furnished alongwith the offer.

ii) Type test certificates of the raw material and bought out accessories.

iii) Quality Assurance Plan (QAP) with customer hold points for Purchaser's inspection. The QAP and Purchaser's hold points shall be discussed between the Purchaser and the Supplier before the QAP is finalised.

The supplier shall submit the routine test certificates of bought out items and raw material at the time of routine testing of insulators.

**6.1.9 TEST REPORTS**

i) Four copies of type test reports shall be furnished to the Purchaser within one month of conducting the tests. One copy will be returned duly certified by the Purchaser to the Supplier within three weeks there afterwards and on receipt of the same Supplier shall commence with the commercial production of the concerned material.

ii) Four copies of acceptance test reports shall be furnished to the Purchaser. One copy will be returned, duly certified by the Purchaser and only thereafter shall the materials be despatched.

iii) All records of routine test reports shall be maintained by the Supplier at his works for periodic inspection by the Purchaser.

iv) All test reports of tests conducted during manufacture shall be main- tained by the Supplier. These shall be produced for verification as and when requested for by the Purchaser.

**6.1.10 COORDINATION FOR TESTING**

**6.1.10.1 The contractor shall take full responsibility for supply and testing of insulator discs with the required hardware fittings and shall have to also guarantee the test values and overall satisfactory performance of disc insulators with the hardware fittings.**

**6.1.11 PACKING AND FORWARDING**

i) All insulators shall be packed in strong seasoned wooden crates. The gross weight of the crates alongwith insulators shall not normally exceed 50 Kg to avoid handling problem.

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

iii) Suitable cushioning, protective padding, or dunnage or spacer shall be provided to prevent damage to or deformation during transit and handling.

iv) All packing cases shall be marked legibly and correctly so as to ensure their safe arrival at their destination and to avoid the pos -sibility of goods being lost or wrongly despatched on account of faulty packing or faulty or illegible markings. Each wooden case/crate shall have all the markings stenciled on it in indelible ink. All galvanised components shall be given a protective coating against formation of white rust.

**6.1.12 QUANTITY AND DELIVERY REQUIREMENTS**

The schedule of requirements and the desired delivery is set out in section-II

**6.1.13 TEST DETAILS**

**6.1.13.1 MECHANICAL STRENGTH TEST**

The complete insulator string alongwith its hardware fittings without arcing horn and suspension assembly / dead end assembly shall be subjected to a load equal to 50% of the specified minimum ultimate tensile strength (UTS) which shall be increased at a steady rate to 67% of the minimum

UTS specified. The load shall be held for five minutes and then removed. After removal of the load, the string components shall not show any visual deformation and it shall be possible to disassemble them by hand. Hand tools may be used to remove cotter pins and loosen the nuts initially. The string shall then be reassembled and loaded to 50% of UTS and the load shall be further increased at a steady rate to the specified minimum UTS and held for one minute. No fracture should occur during this period. The applied load shall then be increased until the failing load is reached and the value recorded.

### 6.1.13.2 CHEMICAL ANALYSIS OF ZINC USED FOR GALVANIZING

Samples taken from the zinc ingot shall be chemically analysed as per IS:209. The purity of zinc shall not be less than 99.5 %.

### 6.1.13.3 TESTS FOR FORGINGS

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

### 6.1.13.4 TESTS ON CASTINGS

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

### 6.1.13.5 ECCENTRICITY TEST

The insulator shall be vertically mounted on a fixture using dummy pin and socket. A vertical scale with horizontal slider shall be used for the axial run out. The pointer shall be positioned in contact with the bottom of the outermost petticoat of the disc. The disc insulators shall be rotated with reference to the fixture and the slider shall be allowed to move up and down on the scale but always maintaining contact with the bottom of the outermost petticoat. After one full rotation of the disc the maximum and minimum position the slider has

reached on the scale can be found out. Difference between the above two readings shall satisfy the guaranteed value for axial run out.

Similarly using a horizontal scale with vertical slider the radial run out shall be measured. The slider shall be positioned on the scale to establish contact with the circumference of the disc insulator and disc insulator rotated on its fixture always maintaining the contact. After one full rotation of the disc the maximum and minimum position of the slider reached on the scale are found out. The difference between the above readings shall satisfy the guaranteed value for radial run out.

### 6.1.13.6 HYDRAULIC INTERNAL PRESSURE TEST ON SHELLS

The test shall be carried out on 100% shells before assembly. The details regarding test will be as discussed and mutually agreed to by the supplier and purchaser in the Quality Assurance Programme.

### 6.1.13.7 CRACK DETCTION TEST

Crack detection test shall be carried out on each ball pin before assembly of disc unit. The manufacturer shall maintain complete record of having conducted such tests on each and every piece of ball pin. The bidder shall furnish full details of the equipment available with him for crack test and also indicate the test procedure in detail.

### 6.1.13.8 VOLTAGE DISTRIBUTION TEST

The voltage across each insulator unit shall be measured by sphere gap method. The result obtained shall be converted into percentage. The voltage across any disc shall not exceed 20% for suspension insulator strings and 22% for tension insulator strings.

### 6.1.13.9 VIBRATION TEST

The suspension string shall be tested in suspension mode and tension string in tension mode itself in laboratory span of minimum 30 metres. In the case of suspension string a load equal to 600 kg shall be applied along the axis of the suspension string by means of turn buckle. The insulator string along with hardware fittings and conductor tensioned at 35 KN shall be secured with clamps. The system shall be suitable to maintain constant tension on conductor throughout the duration of the test. Vibration dampers shall not be used

on the test span. The conductor shall be vertically vibrated at one of the resonance frequencies of the insulators string (more than 10 Hz) by means of vibration inducing equipment. The peak to peak displacement in mm of vibration at the antinode point nearest to the string shall be measured and the same shall not be less than $1000/f^{1.8}$ where f is the frequency of vibration in cycles/sec. The insulator string shall be vibrated for not less than 10 million cycles without any failure. After the test the disc insulators shall be examined for looseness of pins and cap or any crack in the cement. The hardware shall be examined for looseness for fatigue failure and mechanical strength test. There shall be no deterioration of properties of hardware components and disc insulators after the vibration test. The disc insulators shall be subjected to the following tests as per relevant standards:

| **Tests** | | **Percentage of discs to be tested.** |
|---|---|---|
| a. | Temperature cycle test followed by mechanical performance test | 60 |
| b. | Puncture test | 40 |

### 6.1.13.10 RIV TEST (Dry)

Under the conditions as specified under clause 6.1.13.11 below the insulator string alongwith complete hardware fittings shall have a radio interference voltage level below 1000 microvolts at one (1) MHz when subjected to 50 Hz AC voltage of 154 kV(rms) line to ground under dry conditions. The test procedure shall be in accordance with IS:8263-1976/IEC:437, or its latest revision thereof.

### 6.1.13.11 CORONA EXTINCTION VOLTAGE TEST

The complete insulator string when subjected to power frequency voltage shall have a corona extinction voltage of not less than 154 kV rms line to ground under dry conditions. There shall be no evidence of corona on any part of the samples when all sources of corona are photographed in a darkened room. The atmospheric conditions during testing shall be recorded and the test results shall be accordingly corrected to standard atmospheric conditions with suitable correction factor as stipulated in IEC:383.

### 6.1.13.12 POLLUTION WITHSTAND VOLTAGE TEST

The test shall be carried out in accordance with the clean fog test method (solid layer method)prescribed in Section 4 of IEC:507-1991.Test procedure is as follows:-
The test object is first contaminated by dipping in contaminant solution, which is composed of salt (NaCl), nonsoluble material (Kaolin) and water. Nonsoluble deposit density (NSDD) and salt deposit density are 0.1 mg/sq.cm and 0.03 mg/sq.cm, respectively. After having been contaminated and dried, the test object is installed in the fog chamber. The specified constant test voltage as per IEC-507 is applied to the test object and then artificial steam fog is generated. The applied voltage is maintained for 60 minutes or until flash over occurs within 60 minutes. The above procedure is repeated at least three (3) times on renewedly contaminated test object.

### 6.1.13.13 STEEP WAVE FRONT TEST

The following test shall be performed on 10 insulator units selected at random from the lot offered for selection for Type test.

(a) Each insulator unit shall be subjected to five successive positive and negative flashovers with a wave having minimum effective rate of rise
of 2500 kV per microsecond.

(b) Each unit shall then be subjected to three dry power frequency voltage flashovers.

**ACCEPTANCE CRITERIA**

An insulator shall be deemed to have met the requirement of this test if having been successfully subjected to the ten impulse flashovers, the arithmetic mean of the three subsequent dry power frequency voltage flashover values equals or exceeds 95% of the rated dry power frequency flashover voltage.

An insulator shall be deemed to have failed to meet the requirement of above testing if

(a) It has not flashed over when the oscillogram or peak voltage indicator shows a marked reduction in voltage.

or

(b) Any one of the subsequent three dry power frequency voltage flashover value is less than 80% of the value specified.

Failure of any one unit either in the steep front of wave or subsequent low frequency voltage test shall be cause for testing on double number of units.

### 6.1.13.14 THERMAL MECHANICAL PERFORMANCE TEST

Thermal Mechanical Performance Test shall be performed in accordance with IEC 383-1-1993 clause 20 with the following modifications:

(i) The applied mechanical load during this test shall be 70 % of the rated electromechanical or mechanical value.

(ii) The acceptance criteria shall be

(a) X greater than or equal to R+3S
where

X is Mean value of the individual mechanical failing load.

R is the Rated electro-mechanical/mechanical failing load.

S is the Standard deviation

(b) The minimum sample size shall be taken as 20 for disc insulator units.

(c) The individual electromechanical failing load shall be at least equal to the rated value. Also puncture shall not occur before the ultimate fracture.

### 6.1.13.15 RESIDUAL STRENGTH TEST

The above test shall be performed as per clauses 4.4 and 4.5 of IEC-797 preceded by the temperature cycle test. The sample size shall be 25 and the evaluation of the results and acceptance criteria shall be as per clause no. 4.6 of IEC :797.

### 6.1.13.16 ELECTROMECHANICAL FAILING LOAD TEST

This test shall be performed in accordance with clause 18 of IEC-383 with the following acceptance criteria:

(i) X greater than or equal R+3S
where
X Mean value of the electro-mechanical failing load.

R Rated electromechanical failing load
S Standard deviation.

(ii) The minimum sample size shall be taken as 20 for disc insulator units.
However, for larger lot size, IEC-591 shall be applicable.

(iii) The individual electro-mechanical failing load shall be at

least equal to the rated value. Also electrical puncture shall not occur before the ultimate fracture.

## 6.2 INSULATOR HARDWARE FITTINGS

### 6.2.1 SCOPE

**6.2.1.1** This section covers design, manufacture, stage testing, inspection and testing before despatch, packing, supply and delivery of hardware fittings, specified hereinunder for their satisfactory operation on 132 KV transmission lines.

**6.2.1.2** The following are the materials covered in this specification:
HARDWARE FITTINGS FOR INSULATORS

| | | |
|---|---|---|
| (1) | Single 'I' Suspension Insulator String, (1x9) | Nos. |
| (2) | Double Suspension "II" Insulator String, (2x9) | Nos. |
| (3) | Single Suspension pilot Insulator String, (1x9) | Nos. |
| (4) | Single Tension Insulator String, (1x10) | Nos. |
| (5) | Double Tension Insulator String, (2x10) | Nos. |

**6.2.1.3** For single "I" suspension insulator strings, single suspension "pilot" insulator string and double Suspension "II" insulator strings, disc insulator units of 70 KN EM strength shall be used.

**6.2.1.4** For Single/Double Tension Insulator String, disc insulator units of 90 KN EM strength shall be used.

### 6.2.2 STANDARDS

**6.2.2.1** The design, identification, manufacture and performance testing of the equipment shall comply with the latest editions and amendments of the relevant Indian Standards or International Standards. The tenderer shall clearly indicate in his tender the reference standards to which the design, manufacture and performance testing of the material offered shall comply.

Some of the applicable Standards, along with Internationally recognised standards to which these generally correspond are as given below.

| Sl. No. | Indian Standards(IS) | TITLE | International & Internationally recognised standard |
|---|---|---|---|
| 1. | IS 209-1966 | Specification for Zinc | BS:3436-1986 |
| 2. | IS 2071-1974 | Method of high voltage testing, general definitions and test requirement | BS:137-1982 (I & II)<br>IEC:274-1968<br>IEC:383-1993 (Parts I&II) |
| | part-I 1974 | General definitions and test requirements. | |
| | part-II | Test Procedure | |
| | part-III | Measuring devices. | |
| 3. | IS 731-1974 | Porcelain insulators for overhead power lines with a nominal voltage greater than 1000 V. | IEC 383 -1993 (Part I&II) |
| 4. | IS:2121-1981 | Specification for Conductors and earthwire accessories for overhead power lines. | |
| | Part-I | Armour Rods, binding wires and tapes for conductors. | |
| | Part-II | Mid span joints and repair sleeves for conductor. | |
| 5. | IS:2486 | Specification for insulator fittings for overhead power lines with a nominal voltage greater than 1000V. | |
| | Part-I:1971 | General requirements and Tests. | BS:3288-1979 |
| | Part-II: 1974 | Dimensional requirements. | IEC:120-1984 |
| | Part-III: 1975 | Locking Devices. | IEC:372-1984 |
| 6. | IS:2629-1985 | Recommended practice for hot dip galvanising of iron and steel. | |

| | | | |
|---|---|---|---|
| 7. | IS:2633-1986 | Method for testing of uniformity of coating of zinc coated articles. | |
| 8. | IS:3138-1966 | Hexagonal bolts and nuts. | ISO/R947 and ISO/R272 |
| 9. | IS:3188-1980 | Dimensions for disc insulators. | IEC:305-1978 |
| 10. | IS:4218-1976 | ISO metric screw threads. | ISO/R 68-1969, R-26-1963, -1969, R965-1969. |
| 11. | IS:6745-1972 | Determination of weight of zinc coating on zinc coated iron and steel articles. | BS:433-1969 ISO:1460(E) |
| 12. | IS:8263-1976 | Methods of RI test on HV insulators. | IEC:437-1973 NEMA PUBLICATION NO.107/1964 CISPR |
| 13. | IS:8269-1976 | Methods for switching impulse test on HV insulators. | IEC:506-1975 |
| 14. | | Thermal mechanical performance test and mechanical performance test on string insulator units | IEC:575 |
| | | Sampling rules | IEC:591-1978 |
| 15. | IS:6639-1972 | Hexagonal bolts for steel structures. | ISO/R272-1968 |
| 16. | | Ozone test on Elastomer. | ASTM-D1171 |
| 17. | IS:406 | Methods of Chemical Analysis of Slab zinc. | |

### 6.2.3 DETAILS OF HARDWARE FITTINGS

**6.2.3.1** The hardware fittings shall be as per the specification. Hardware fittings shall be suitable for single/double suspension insulator strings and single/double tension insulator strings.

Each hardware fitting shall be supplied complete in all respects and shall include all components indicated in the specification.

### 6.2.3.2 PARTICULARS OF INSULATORS AND INSULATOR STRINGS

| SL.NO. | PARTICULARS | SINGLE SUSPENSION STRING "I" & PILOT STRING | DOUBLE SUSPENSION STRING "II" | SINGLE TENSION STRING | DOUBLE TENSION STRING |
|---|---|---|---|---|---|
| 1. | No. of standard discs | 9 | 2x9 | 1x10 | 2x10 |
| 2. | Size of disc-mm | 255/280 x145 | 255/280 x145 | 255/280 x145 | 255/280 x145 |
| 3 | E&M Strength of each string | 70 KN | 2x70 KN | 90 KN | 2x90KN |
| 4 | Ball and socket designation(mm) | 16 | 16 | 16 | 16 |
| 5 | Creepage distance of each disc( mm) | 292 | 292 | 292 | 292 |

### 6.2.3.3 SPECIFICATION DRAWINGS

A list of specification drawings in respect of the hardware fittings is enclosed with the specification. These specification drawings are attached herewith for information and guidance of the Bidder only. The drawings to be furnished by the Bidder shall be as per his own design and manufacture and shall be distinct and separate from these specification drawings.

**6.2.3.3.1** The tenderer shall furnish full description and illustration of materials offered.

**6.2.3.3.2** Dimensioned drawings of the complete insulator strings and their component parts showing clearly the following arrangements shall be furnished in six (6) copies. Weight, material and fabrication details of all the components should be included in the drawings.

a) Attachment to the hanger or strain plate.
b) Suspension or dead end assembly.
c) Arcing horn attachment to the string as specified in this specification.
d) Yoke plates.
Hardware fittings of ball and socket type for interconnecting units to the top and bottom yoke plates.
f) Links with suitable fittings.
g) Any other.

**6.2.3.3.3** After placement of award, the contractor shall submit fully dimensioned drawings including all the components in six (6)copies to the owner for approval. After getting approval from the owner and successful completion of all the type tests, the contractor shall submit 30 more copies of the same drawings to the owner for further distribution and field use at owner's end.

**6.2.3.3.4** Material specifications, details of applicable standards and heat treatment details shall also be furnished.

**6.2.3.3.5** The details of manufacturing process also shall be furnished alongwith the component dra wings.

**6.2.3.3.6** The details of trade mark to be provided on the components shall also be furnished.

**6.2.4 GENERAL TECHNICAL REQUIREMENTS**:

**6.2.4.1 GENERAL**

This section details out the technical specification of the hardware fittings for 132 kV insulator strings suitable for PANTHER 'ACSR' conductor.

**6.2.4.2 DETAILS OF HARDWARE FITTINGS**

The hardware fittings shall be as per specification . Each set of hardware fittings shall be supplied complete in all respects and shall include following hardware parts :

a) Suitable yoke plate for single/double suspension and single/double tension strings complying with the specification given here-in-after.

b) Suitable arcing horn as specified in clause here-in-after.
c) Suspension clamp and tension i.e., dead-end clamp and armour rods to suit conductor sizes.
d) Other fittings necessary, for making the string assemblies complete such as eye links, ball-clevis, socket-clevis, clevis-eye, clevis-clevis, chain link and anchor shackles etc.
e) 2.5% extra fasteners and aluminium filler plugs.

**6.2.4.3 IMPORTANT DESIGN FEATURES**

**6.2.4.3.1** The insulator strings alongwith hardware fittings shall be used by attachment to tower in the following manner:

a) "I" type Suspension strings
A single "I" type suspension string shall consist of 9 nos. discs and double suspension string shall consist of 2 x 9 nos. discs of 70 KN EM strength. Each set of hardware fittings shall include anchor (D) shackles suitable for attachment to strain plate fixed to the tower.

b) Tension strings
Single/Double tension string shall consist of 1x10/2x10 nos. of 90 KN discs. Suitable anchor shackles shall be designed to accommodate the tower strain plates.

**6.2.4.3.2** Tolerance on overall length of the hardware fittings/complete insulator strings shall be $\pm$ 2% and on individual components $\pm$ 3%.

**6.2.4.4 INTERCHANGEABILITY**

The hardware together with ball and socket fittings shall be of standard design so that these hardwares are interchangeable with each other and suitable for use with disc insulators of any make conforming to relevant Indian/International standard.

**6.2.4.5 BALL AND SOCKET FITTINGS**

**6.2.4.5.1** The dimensions of the ball and socket shall be of designation 16mm for 70KN & 90KN for suspension string assembly and tension string assembly in accordance with standard dimensions stated in IS:2486 (Part-II)/IEC:120.

**6.2.4.5.2 Ball Fittings**

Ball fittings shall be made of class IV steel as per IS:2004 -1978 or steel of equivalent grade forged in one piece. They shall be normalised to achieve the minimum breaking strength. Before galvanisation of ball fittings, all die flashing on the shank and on the bearing surface of the ball shall be carefully removed without reducing the dimensions below the requirements.

**6.2.4.5.3 Socket Fittings**

**6.2.4.5.3.1** Socket fittings shall be made of class IV steel as per IS:2004-1978 or steel of equivalent grade and shall be forged in one piece. They shall be normalised to achieve the minimum breaking strength.

**6.2.4.5.3.2** Socket ends, before galvanising shall be of uniform contour. The bearing surface of socket ends shall be uniform about the entire circumference without depressions or high spots. The internal contours of socket ends shall be symmetrical with axis of the fittings as per relevant standards. The axis of the bearing surfaces of socket ends shall be co-axial with the axis of the fittings. There shall be no noticeable tilting of the bearing surfaces with the axis of the fittings.

**6.2.4.5.4 DIMENSIONS AND TOLERANCES**

**6.2.4.5.4.1** The dimensions and tolerances of pin balls and socket ends shall conform to IS:2486 Part-II/IEC120 and shall be checked by the gauge therein after galvanising.

**6.2.4.5.4.2** The pin balls shall be checked with the applicable 'GO' gauges in at least two directions, one of which shall be across the line of die flashing, and the other 90 deg to this line. "NO GO" gauges shall not pass in any direction.

**6.2.4.5.4.3** The bearing surfaces of balls and machined sockets, before galvanising, shall not have surface roughness more than 250 micro inches.

**6.2.4.5.4.4** The bearing surface of socket ends shall be uniform about the entire circumference without depressions or high spots. The internal contour of the socket ends shall be concentric with the axis of fittings. The axis of the bearing surface of socket ends shall be coaxial with the axis of fittings with no appreciable tilting.

**Security Clips and Split Pins**

The security clip shall be made of stainless steel as per AISI 302 or 304-L or phosphor bronze as per IS:7814-1985.

**6.2.4.6.1** Socket fittings shall be provided with R-shaped security clip in accordance with IS:2486 (Parts III & IV) to provide positive locking against unintentional disengagement of socket from the ball of the insulator. The security clip shall be humped to maintain the clip in the locked position and shall have both prongs spread to prevent complete withdrawal from the socket. The clip end shall not project outside the recess of socket when the clip is in locked position.

**6.2.4.6.2** The hole for the security clip shall be on the side of the socket opposite to the socket opening. The hole for the clip shall be counter sunk. The clip eye shall be of such design that the same may be engaged by a hotline clip puller to provide for disengagement under energised conditions.

**6.2.4.6.3** Split pins shall be used with cotter bolts.

**6.2.4.6.4** The force required to pull the clip to its unlocked position shall not be less than 50 N or more than 500 N.

**6.2.4.7 CORONA AND RI PERFORMANCE**

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

**6.2.4.8 ARCING HORN**

The arcing horn shall be either ball ended rod type or tubular type. The design of the arcing horn shall be such that effective operation under actual field conditions is ensured. The minimum arcing distance shall be as indicated in the drawings.

**6.2.4.9 YOKE PLATES/LINK PLATES**

**6.2.4.9.1** The yoke plates/link plate shall be made of mild steel or high tensile steel, hot dip galvanised.

**6.2.4.9.2** The strength of yoke plate shall be adequate to withstand the minimum ultimate tensile strength. The plates shall be either triangular or rectangular in shape. The design of yoke plate shall

take into consideration the most unfavorable loading conditions likely to be experienced as a result of dimensional tolerance for disc insulators as well as components of hardware fittings within the specified range. The plates shall have suitable holes for fixing arcing horn. All corners and edges shall be rounded with a radius of about 3 mm.

**6.2.4.9.3** Holes shall be cylindrical, clean cut and perpendicular to the plane of the material. The periphery of the holes shall be free from burrs. Design calculation i.e. for bearing and tensile strength for deciding dimensions of yoke plate shall be furnished by the bidder. The holes provided for bolts in the yoke plate should satisfy shear edge condition as per clause no. 8.10 of IS : 800-1984.

**6.2.4.10 SUSPENSION ASSEMBLY**

**6.2.4.10.1** The suspension assembly shall be suitable for ACSR PANTHER conductor.

**6.2.4.10.2** The suspension assembly shall include either free centre type suspension clamp alongwith a set of standard formed armour rods or one armour grip suspension clamp. For pilot insulator string only free centre type suspension clamp shall be used.

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

**6.2.4.10.4** The suspension clamp alongwith standard formed armour rods set shall have a slip strength between 16 to 24 KN.

**6.2.4.10.5** The suspension assembly shall be smooth without any cuts, grooves, abrasions, projections, ridges or excrescences which might damage the conductor.

**6.2.4.10.6** There shall be differential price loading for comparison of offers of Rs.67.5 per suspension assembly for each watt of magnetic power loss at a conductor current of 500 amps. The lowest losses quoted by any tenderer shall be used to arrive at the differential price loading to be applied for the tender. However, the offers of suspension assemblies with magnetic power loss more than 4 watts at a conductor current of 500 amps. shall be rejected. The tenderers are requested to enclose Test Certificates for magnetic power loss test alongwith the tender.

**6.2.4.10.7** In case, the magnetic power loss of the suspension assembly obtained during type testing of the same exceeds the value guaranteed by the tenderer in his tender, the material shall be rejected outright.

**6.2.4.10.8 Free Centre Type Suspension Clamp**

**6.2.4.10.8.1** The clamp body and keeper pieces shall be of high strength corrosion resistant and heat treated cast/forged aluminium alloy. The components such as cotter bolts, hangers, shackles, brackets and U-bolts etc., shall be of galvanized mild steel, drop forged steel or high strength aluminium alloy.

**6.2.4.10.8.2** The body of free centre type suspension clamp shall be smoothly rounded and curved into a bell mouth at the ends. The lip edges shall have rounded head. There shall be atleast two U-bolts for tightening of clamp-body and keeper pieces together.

**6.2.4.10.9 Formed Armour Rods set**

**6.2.4.10.9.1** The formed armour rods shall be made of high strength special aluminium alloy of type 6061 or equivalent duly heat treated during manufacturing process. The finished rod shall have a minimum tensile strength of 35 Kg/Sq.mm.

**6.2.4.10.9.2** The AGS formed Armour rod set suitable for ACSR PANTHER conductor shall be used to minimise the stress developed in the conductor due to different static and dynamic loads because of vibration due to wind, slipping of conductor from the suspension clamp as a result of unbalanced conductor tension in adjacent spans and broken wire conditions. It shall also withstand power arcs, chafing and abrasion from suspension clamp and localised heating effect due to magnetic power loss from Suspension clamp as well as ($I^2R$) resistance losses of the conductor.

**6.2.4.10.9.3** The formed armour rod set shall have right hand lay and the inside diameter of the helix shall be less than the outside diameter of the conductor to grip the same tightly. The surface of the armour rod when fitted on the conductor shall be smooth and free from projections, cuts and abrasions etc.

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

**6.2.4.10.9.5** The length and diameter of each rod shall be 2540mm ± 25 mm and 7.87 mm ± 0.1 mm respectively. The tolerance in length of the rods in completed set should be within 13 mm between the longest and shortest rod. The ends of armour rod shall be parrot billed.

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

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

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

**6.2.4.10.10 Armour Grip Suspension Clamp**

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

**6.2.4.10.10.2** The armour grip suspension clamp shall be so manufactured that it shall minimise the static and dynamic stress developed in the conductor under various loading conditions as well as during wind induced conductor vibrations. It shall allow slipping of the conductor under unbalanced conductor tension in adjacent spans and broken wire conditions. It shall also withstand power arcs and have required level of Corona/RIV performance. The AGS preformed rods shall be as detailed in clause 6.2.4.10.9.1 to 6.2.4.10.9.8 above except for the following:

The length of the formed rods shall be such that it shall ensure sufficient slipping strength as detailed in cl. 6.2.4.10.4 and shall not introduce unfavorable stress on the conductor under all operating conditions.

**6.2.4.10.10.3** Elastomer cushion shall be resistant to the effects of temperature up to + 75 deg C, ozone, ultraviolet radiations and other atmospheric contaminants likely to be encountered in service. The physical properties of the elastomer shall be of approved standard. It shall be electrically shielded by a cage of AGS formed rod set. The elastomer cushion shall be so designed that the curvature of the AGS rod shall follow the contour of the neoprene insert and shall not leave any gap between the two when installed.

**6.2.4.10.10.4** The tenderer may clearly indicate remedial measures to overcome the problem of external erosion if any arising from galvanic interaction between the graphite loaded rubber and the aluminium strands.

**6.2.4.11 Dead End Assembly**

**6.2.4.11.1** The dead end Assembly shall be suitable for ACSR PANTHER conductor.

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

**6.2.4.11.3** The assembly shall not permit slipping of, damage to or failure of the complete conductor or any part thereof at a load less than 95% of the minimum UTS of the conductor.

**6.2.4.11.4** The mechanical efficiency of the clamp shall not be affected by method of erection involving the use of 'come-along' or similar clamps before, during or after assembly and erection of tension clamps itself.

**6.2.4.11.5** The outer sleeve shall be made out of E.C. grade aluminium of purity not less than 99.5%

**6.2.4.11.6** The steel sleeve shall be made of mild/forged steel hot dip galvanized as per IS: 226-1975.

**6.2.4.11.7** The dimensions and dimensional tolerance of the cross section of aluminium and steel ends shall be as per table given below:

| No. | Dimension before compression | | Dimension after compression | |
|---|---|---|---|---|
| | Inner dia width (mm) | outer dia (mm) | Corner to Corner width (mm) | Face to Face (mm) |
| 1. Aluminium Sleeve | 23 ± 0.5 | 38 ± 1.0 | 37 ± 0.5 | 32 ± 0.5 |
| 2. Steel Sleeve | 9.3 ± 0.2 | 18 ± 0.5 | 15.2 ± 0.5 | 17.4 ± 0.5 |

**6.2.4.11.8 Compression Marking**

**6.2.4.11.8.1** Die compression length shall be clearly marked on each dead end assembly designed for continuous die compressions and shall bear the words 'COMPRESS FIRST' suitably inscribed near the point on each assembly where the compression begins. It shall bear identification marks 'COMPRESSION ZONE' and 'NON-COMPRESSION ZONE' distinctly with arrow marks showing the direction of compressions and knurling marks showing the end of the zones. Tapered aluminium filler plugs shall also be provided at the line of demarcation between compression and non-compression zone. The letters, number and other markings on the finished clamp shall be distinct and legible.

**6.2.4.12 FASTENERS : Bolts, Nuts and Washers**

**6.2.4.12.1** All fasteners shall conform to IS:6639-1972. All fasteners shall be hot dip galvanised. 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. All bolts and nuts shall be galvanised as per IS-1367-(Part 13)/IS-2629.

**6.2.4.12.2** Fully threaded bolt 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.

**6.2.4.12.3** Flat washers and spring washers shall be provided wherever necessary and shall be of positive lock type. Thickness of washers shall conform to IS:2016. Spring washers shall be electrogalvanised.

**6.2.4.12.4** To obviate bending stress in bolt, it shall not connect aggregate thickness more than three times its diameter.

**6.2.4.12.5** All bolts shall be threaded to take the full depth of the nuts and threaded enough to permit the firm gripping of the component parts but not further. It shall be ensured that the threaded portion of the bolt protrudes not less than 3 mm and not more than 8 mm when fully tightened. All nuts shall fit and tight to the point where shank of the bolt connects to the head.

**6.2.4.12.6** Bolts may have either rolled or cut threads. Nuts may be threaded after galvanising to ensure clean threads but bolts shall not be threaded or rethreaded after galvanising. Nut threads shall be tapped oversize to closely fit those of the galvanised bolt, with no unnecessary looseness but free enough to permit the nut to be turned freely with fingers over the entire threaded length.

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

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

**6.2.4.12.9** 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 ,size of holes and any other special details of this nature.

**6.2.4.12.10** To ensure effective in-process Quality Control it is essential that the manufacturer should have all the testing facilities for tests like weight of zinc coating, shear strength, other testing facilities etc, in house. The manufacturer should also have proper quality assurance system which should be in line with the requirements of this specification and IS-14000 Services Quality System Standard.

**6.2.4.12.11** Fastners of grade higher than 8.8 are not to be used and minimum grade for bolt shall be 5.6.

### 6.2.4.13 FORGED COMPONENTS

Forged components other than those covered in the clauses mentioned herein above shall be made out of class IV steel as per IS:2004 or equivalent.The components shall be hot dip galvanised.

The items shall be normalised to achieve the required tensile properties. The forged components shall not have sharp corners and edges so as to affect corona and RIV performance.

### 6.2.4.14 MATERIALS

The materials of the various components shall be as specified in clauses mentioned hereinabove/Section-II. However, components made of alternative materials giving equivalent or better performance shall also be considered. The Bidder shall indicate the material proposed to be used for each and every component of hardware fittings stating clearly the class, grade or alloy designation of the material and the reference standards. However the critical dimensions of components shall not be changed in relation to selection of different material.

### 6.2.4.15 OTHER MISCELLANEOUS PARTS

Socket ended, ball ended items and all shackles and links shall be made by drop forging process from suitable steel as per IS:2004-1978 or equivalent. These parts shall be hot dip galvanised after proper machining.

### 6.2.4.16 GALVANISING

**6.2.4.16.1** All ferrous parts shall be hot dip galvanised in accordance with IS:2629 and shall satisfy the tests mentioned in IS:2633. No material shall be galvanised until all shop operations have been completed except that the nuts may be threaded and oiled after galvanising. Minimum weight of zinc coating shall be 300 g/sq.m. for fasteners and 610 g/sq.m. for all other hot dip galvanised articles.

**6.2.4.16.2** Fasteners shall withstand four dips while spring washers shall withstand three dips each of one minute duration in the Standard Preece test. Other galvanised material shall withstand minimum six dips each of one minute duration in the standard preece test.

**6.2.4.16.3** The zinc coating shall be perfectly adherent, of uniform thickness, smooth, reasonably bright, continuous and free from

imperfections such as flux, ash, rust stains, bulky white deposits and blisters.

**6.2.4.16.4** The zinc used for galvanising shall be of grade 99.95% as per IS:209.

**6.2.4.17 WORKMANSHIP**

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

**6.2.4.17.2** The manufacturing process and quality control of all the materials shall be such as to give maximum possible working load, highest mobility, elimination of sharp edges and corners to limit corona and radio-interference, best resistance to corrosion and a good finish.

**6.2.4.17.3** Castings shall be uniform without sharp edges or corners, free from all defects like shrinkage, inclusion, blow holes, cracks etc. Pressure die casting shall not be used for casting of components with thickness more than 5 mm.

**6.2.4.17.4** Forgings shall be uniform in quality and condition, without sharp edges or corners, free from cracks, flakes or seams, laps, slag, silvers, scabs, rolled-in scale and fissures.

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

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

**6.2.4.17.7** All fasteners shall have suitable corona free locking arrangement and shall not loosen under vibration conditions.

**6.2.4.17.8** Welding of aluminium shall be by inert gas shielded tungsten arc or inert gas shielded metal arc process. Welds shall be clean, sound, smooth uniform without overlaps, properly fused and completely sealed. There shall be no cracks, voids, incomplete penetration, incomplete fusions, undercutting or inclusions.

Porosity shall be minimised so that mechanical properties of the aluminium alloys are not affected. All welds shall be properly finished as per good engineering practices.

**6.2.4.18 EQUIPMENT MARKING**

Each component of hardware shall be marked with the trade mark of the manufacturer. Marks shall be forged or stamped with a steel die before galvanising. The marks shall be distinct, durable, and conspicuous.

**6.2.4.19 HOT LINE MAINTENANCE**

**6.2.4.19.1** The equipment offered shall be suitable for hot line maintenance.

**6.2.4.19.2** To release the tension in insulator strings, specially designed tools may be necessary. The tenderers shall clearly indicate in their tender the type of tools to be used and shall make sure that fittings and/or yoke plates accommodate these tools. Tenderers shall also indicate the periodicity of maintenance.

**6.2.5 TESTS**

The following type, acceptance, routine tests and stage tests during manufacture shall be carried out on the hardware fittings.

**6.2.5.1 TYPE TESTS**

These are those tests which are to be carried out to prove the design, process of manufacture and general conformity of the material in accordance with these specifications. These tests shall be carried out on samples prior to commencement of commercial production against this specification.

**6.2.5.2 ACCEPTANCE TESTS**

These are those tests which are to be carried out during inspection prior to despatch for the purpose of acceptance of that lot.

**6.2.5.3 ROUTINE TESTS**

These are those tests which are to be carried out on each hardware fitting to check the requirements which are likely to vary during production.

**6.2.5.4 STAGE TESTS**

Stage tests during manufacture shall mean those tests which are to be carried out during the process of manufacture and end inspection by the Supplier to ensure the desired quality of the end product.

**6.2.5.5 TESTING VALUES**

For all type and acceptance tests, the acceptance values shall be those values guaranteed by the Supplier in the Guaranteed Technical Particulars or the acceptance values specified in the relevant standard whichever is more stringent for that particular test. The norms and procedures of sampling for these tests will be as per the Quality Assurance Programme to be mutually agreed to by the Supplier and the Purchaser.

The standards and norms to which these tests will be carried out are listed against them. Where a particular test is a specific requirement of this specification, the norms and procedures of these shall be as specified in Clause 6.2.11 of this specification or as mutually agreed to between the Supplier and the Purchaser in the Quality Assurance Program.

**6.2.5.6 TYPE TESTS**

The following type tests shall be conducted on not less than three fittings of each type as indicated in the enclosed drawings. Type tests shall be made on fittings that have passed the routine tests.

**6.2.5.7 TYPE TESTS**

**6.2.5.7.1 Type Tests on complete Insulator string alongwith Hardware fittings.**

| | | |
|---|---|---|
| 1. | Wet power frequency voltage test | \| |
| 2. | Lightning impulse voltage test | \| As per IEC:383-2: |
| 3. | Wet switching impulse voltage test | \| -1992 |
| 4. | Visual Examination | : IS:731 |
| 5. | Voltage distribution test | : As per Cl.6.2.11.2. |
| 6. | RIV test | : As per |

| | | |
|---|---|---|
| | | Cl. 6.2.11.4 |
| 7. | Mechanical strength test | : AS per Cl. 6.2.11.5 |
| 8. | Dynamic test | : As per Cl. 6.2.11.16 |
| 9. | Corona Extinction voltage test | : As per Cl. 6.2.11.3 |
| | Pollution withstand voltage test | \| As per \| Cl.6.1.13.12 of Insulator Specification. |

Note:(i) All the type tests given under clause 6.2.5.7.1 shall be conducted on single suspension and single tension insulator string alongwith hardware fittings
All the above tests except at Sl No. 8 shall also be conducted on single suspension pilot & double suspension insulator strings alongwith hardware fittings.

**6.2.5.7.2.1 On Suspension Hardware fitting only**

| | | |
|---|---|---|
| a. | Shore hardness test of elastomer cushion for AG suspension clamp | As per Cl. 6.2.11.10 |
| b. | Bend test for armour rod set | \| \| |
| c. | Resilience test for armour rods set | \| IS:2121 \| (Part-I) |
| d. | Conductivity test for armour rods set | \| |
| e. | Clamp slip strength versus torque test for suspension clamp | : As per : Cl. 6.2.11.15 |
| f. | Magnetic power loss test | \| As per \| Cl. 6.2.11.6 |
| g. | Mechanical strength test | \| As per Cl. 6.2.11.9 |
| h. | Mechanical strength test of welded joint | \| As per \| Cl. 6.2.11.8 |
| i. | Test on locking devices for ball and socket coupling | \| IEC-372(2) -1976 |
| j. | Mechanical strength test of each component | :As per Cl. 6.2.11.7 |

| | | |
|---|---|---|
| k. | Verification of dimensions | :IS:2486 (Part-I) |
| l. | Galvanising/Electroplating | : As per Cl. 6.2.11.11 |
| m. | Visual Examination | : IS:2486 (Part-I) |
| n. | Ozone test on elastomer | : As per Cl. 6.2.11.17 |

**6.2.5.7.2.2 On Tension Hardware Fittings only**

| | | |
|---|---|---|
| a. | Slip strength test for dead end assembly | \| |
| b. | Electrical resistance test for dead end assembly | \| IS:2486 (Part-I) |
| c. | Heating cycle test for dead end assembly | \| |
| d. | Mechanical strength tests | : As per Cl. 6.2.11.9 |
| e. | Verification of dimensions | : IS:2486 (Part-I) |
| f. | Galvanising/Electroplating | : As per Cl. 6.2.11.11 |
| g. | Visual examination | : IS:2486 (Part-I) |

**6.2.5.8 ACCEPTANCE TESTS**

**6.2.5.8.1 On both Suspension and Tension hardware fittings**

| | |
|---|---|
| a) Visual examination | : IS:2486 (Part-I) |
| b) Verification of dimensions | : IS:2486 (Part-I) |
| c) Galvanising / Electroplating test | ) As per ) Cl. 6.2.11.11 |
| d) Mechanical strength test of welded joint | ) As per ) Cl. 6.2.11.8 |
| e) Test on locking devices for ball and socket coupling | ) IEC:372(2) 1976 ) ) |

f) Mechanical strength test of each component(excluding arcing horn.) ) As per Cl. 6.2.11.7

g) Mechanical strength test on arcing horn. ) BS 3288 (Part-I)1979

**6.2.5.8.2 On Suspension Hardware Fittings only**

a) Shore hardness test of elastomer cushion for AG suspension clamp ) As per Cl. 6.2.11.10

b) Bend test for armour rod set ) IS:2121(PART-I)

c) Resilience test for armour rods set )

d) Conductivity test for armour rods set )

e) Clamp slip strength versus torque test for suspension clamp ) As per Cl. 6.2.11.15

**6.2.5.8.3 On Tension Hardware Fittings Only**

a) Slip strength test for dead-end assembly ) IS:2486(Part-I)

**6.2.5.9 ROUTINE TESTS**

a) Visual Inspection : IS:2486(Part-I)
b) Proof Load Test : As per Cl. 6.2.11.12

**6.2.5.10 TESTS DURING MANUFACTURE**

On all components as applicable

a) Chemical analysis of Zinc used for galvanising ) As per Cl. 6.2.11.13

b) Chemical analysis, hardness tests, grain size, inclusion rating and magnetic particle inspection for forgings/castings ) As per Cl. 6.2.11.14

c) Chemical analysis, and proof load test for fabricated hardware )

## 6.2.5.11 TEST CHARGES AND TEST SCHEDULE

### 6.2.5.11.1 Type Tests

All the equipments offered shall be fully type tested as per the relevant standards and the Bidder shall furnish four sets of type test reports alongwith the offer. These tests must not have been conducted earlier than **five years.** The Purchaser reserves the right to demand repetition of some or all the type tests in the presence of Purchaser's representative. For this purpose the Bidder may quote unit rates for carrying out each type test. These prices shall be taken into consideration for bid evaluation. For any change in the design/type already type tested and the design/type offered against this specification the Purchaser reserves the right to demand, repetition of tests without any extra cost.

For type tests which involve the tests on the complete insulator string with hardware fittings, the contractor shall arrange the necessary number of sets of hardware fittings at the place of testing free of cost.

In case of failure of the complete string in any type test, the contractor shall get the test repeated at his cost.

**6.2.5.11.4** In case of failure in any type test, the Bidder is either required to modify the design of the material and successfully carryout all the type tests as has been detailed out in Clause 6.2.5.7 of this specification or to repeat that particular type test at least three times successfully at his own expenses. The decision of the owner in this regard shall be final and binding.

**6.2.5.11.5** Bidder shall indicate the laboratories in which it is proposed to conduct the type tests. Bidder shall also ensure that the tests can be completed in these laboratories within the time schedule guaranteed by him in the appropriate schedule.

**6.2.5.11.6** The entire cost of testing for acceptance and routine tests and tests during manufacture specified herein shall be treated as included in the quoted unit price of hardware fittings, except for the expenses of the Inspector/Purchaser's representative. All acceptance tests shall be carried out by the supplier in the presence of purchaser's representative.

**6.2.5.11.**7 In case of failure in any type test , if repeat 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 Contractor's notice of testing, the Purchaser's representative does not find 'plant' to be ready for testing , the expenses incurred by the Purchaser for re deputation shall be deducted from contract price.

**6.2.5.11.8** Immediately after finalization of the programme of type/acceptance/routine testing, the Supplier shall give sufficient advance intimation to the Purchaser, to enable him to depute his representative for witnessing the tests.

### 6.2.5.12 SAMPLE BATCH FOR TYPE TESTING

**6.2.5.12.1** The Contractor shall offer material for sample selection for type testing only after getting Quality assurance Programme approved by the Employer. The Supplier shall offer at least three times the quantity of materials required for conducting all the type tests for sample selection. The sample for type testing will be manufactured strictly in accordance with the Quality Assurance Programme approved by the Employer.

**6.2.5.12.2** Before sample selection, the Supplier shall be required to conduct all the acceptance tests successfully in the presence of Purchaser's representative.

### 6.2.6 INSPECTION

(i) The Purchaser shall have access at all times to the works and all other places of manufacture, where the hardware fittings and its components are being manufactured and the Supplier shall provide all facilities for unrestricted inspection of the Supplier's works, raw materials, manufacture of all the accessories and for conducting necessary tests as detailed herein.

(ii) The Supplier shall keep the Purchaser informed in advance of the time of starting and of the progress of manufacture of accessories in its various stages so that arrangements could be made for inspection.

(iii) No material shall be despatched from its point of manufacture unless the material has been satisfactorily inspected and tested.

(iv) The acceptance of any quantity of accessories shall in no way relieve the Supplier of his responsibility for meeting all the requirements of this specification and shall not prevent subsequent rejection if such hardware fittings are later found to be defective.

(v) The material for final inspection shall be offered by the contractor only under packed condition. The engineer shall select sample at random from the packed lot for carrying out acceptance tests.

## 6.2.7.0 QUALITY ASSURANCE PLAN

**6.2.7.1** The Bidder shall invariably furnish the following information alongwith his offer, failing which the offer shall be liable for rejection. Information shall be separately given for individual type of equipment offered.

i) Statement giving list of important raw materials, names of sub-suppliers for the raw material, list of standards according to which the raw material are tested, list of tests normally carried out on raw material in presence of Bidder's representative, copies of test certificates.

ii) Information and copies of test certificates as in (i) above in respect of bought out items.

List of manufacturing facilities available.

iv) Level of automation achieved and list of areas where manual processing exists.

v) List of areas in manufacturing process, where stage inspections are normally carried out for quality control and details of such tests and inspections.

vi) Special features provided in the hardware to make it maintenance free.

vii) List of testing equipment available with the Bidder for final testing of hardware specified and test plant limitation, if any, vis-a-vis the type, special, acceptance and routine tests specified in the relevant standards. These limitations shall be very clearly brought out in schedule of deviations from specified test requirements.

**6.2.7.2** The Supplier shall within 30 days of placement of order submit the following information to the Purchaser.

i) List of raw material as well as bought out accessories and the name of the raw material as well as bought out accessories and the names of sub-suppliers selected from those furnished alongwith the offer.

ii) Type test certificates of the raw material and bought out accessories.

iii) Quality Assurance Plan (QAP) with customer hold points for Purchaser's inspection. The QAP and Purchaser's hold points shall be discussed between the Purchaser and the Supplier before the QAP is finalised.

iv) The Supplier shall submit the routine test certificates of bought out items and raw material at the time of routine testing of the fully assembled hardware.

## 6.2.8 DOCUMENTATION

**6.2.8.1** i) The Bidder shall furnish alongwith the bid the dimensional drawings of all types of hardware fittings.

ii) These drawings shall include the following informations.

a) Dimensions.
b) Tolerances on dimensions.
c) Material designation used for different components with reference to standards.
d) Fabrication details such as welds, finishes and coatings.
e) Catalogue or part numbers for each component and the total assembly with bill of materials.
f) Identification marking.
g) Weight of individual components and total assembled weight.

iii) The assembly drawings shall include the following:

a) Brief installation instructions.
b) Design installation torque for the bolt or cap screw.
c) Withstand torque that can be applied to the bolt or cap screw without failure of components or parts thereof.
d) Compression die number with recommended compression pressure.
e) Relevant technical details of significance.

**6.2.8.2 TEST REPORTS**

i) Four copies of type test reports shall be furnished to the Purchaser within one month of conducting the tests. One copy will be returned duly certified by the Purchaser to the Supplier within three weeks thereafterwards and on receipt of the same Supplier shall commence with the commercial production of the concerned material.

ii) Four copies of acceptance test reports shall be furnished to the Purchaser. One copy will be returned, duly certified by the Purchaser and only thereafter shall the materials be despatched.

iii) All records of routine test reports shall be maintained by the Supplier at his works for periodic inspection by the Purchaser.

iv) All test reports of tests conducted during manufacture shall be maintained by the Supplier. These shall be produced for verification as and when requested for by the Purchaser.

**6.2.8.3 The contractor shall take full responsibility for supply and testing of hardware fittings with insulator discs and shall have to also guarantee the test values and overall satisfactory performance of disc insulators with the hardware fittings.**

## 6.2.9 PACKING AND FORWARDING

i) All hardware fittings shall be packed in suitably sized strong and weather resistant wooden cases/crates. The gross weight of the packing shall not normally exceed 50 Kg. to avoid handling problems.
ii) Suitable cushioning, protective padding, or spacer shall be provided to prevent damage to or deformation of the hardwares during transit and handling.
iii) All identical items shall be despatched to destination duly assembled and packed. Bolts, nuts, washers, cotter pins, security clips and split pins etc. shall be packed duly installed and assembled with the respective parts and suitable measures shall be taken to prevent their transit loss.
iv) Each component part shall be legibly and indelibly marked with the trade mark of the manufacturer and year of manufacture.
v) All packing cases shall be marked legibly and correctly so as to ensure their safe arrival at their destination and to avoid the possibility of goods being lost or wrongly despatched on account of faulty or illegible markings. Each wooden case/crate shall have all the markings stencilled on it in inedible ink.
vi) The packing shall be of sufficient strength to withstand rough handling during transit (Sea, Rail and Road) storage at site and subsequent handling in the field.

## 6.2.10 QUANTITY AND DELIVERY REQUIREMENTS

i) This is set out in Section-II of this specification.
ii) The scope of supply shall include a supply of 2.5 % extra quantity of bolts, nuts, washers, split pins, cotter pins and such other small loose items free of cost.

## 6.2.11.0 DETAILS OF TESTS

## 6.2.11.1 ASSEMBLY TEST

This test shall be carried out to ensure that cotter pins, bolts, clamps etc., fit freely and properly.

### 6.2.11.2 VOLTAGE DISTRIBUTION TEST

The voltage across each insulator unit shall be measured by using either sphere gap or high impedance voltmeter. The result obtained shall be converted into percentage. The voltage across any disc shall not exceed the following values: 13% for suspension insulator strings and 14% for tension insulator strings.

### 6.2.11.3 CORONA EXTINCTION VOLTAGE TEST

The complete insulator string when subjected to power frequency voltage shall have a corona extinction voltage of not less then 154kV rms line to ground under dry conditions. There shall be no evidence of corona on any part of the samples when all sources of corona are photographed in a darkened room. The atmospheric conditions during testing shall be recorded and the test results shall be accordingly corrected to standard atmospheric conditions with suitable correction factor as stipulated in IEC : 383.

### 6.2.11.4 RIV TEST (DRY)

Under the conditions as specified under clause 6.2.11.3 above the insulator string alongwith complete hardware fittings shall have a radio interference voltage level below 1000 microvolts at one (1) MHz when subjected to 50 Hz AC voltage of 154 kV (rms) line to ground under dry conditions. The test procedure shall be in accordance with IS:8263-1976/IEC:437, or its latest revision thereof.

### 6.2.11.5 MECHANICAL STRENGTH TEST

The complete insulator string alongwith its hardware fittings without arcing horn and suspension assembly / dead end assembly shall be subjected to a load equal to 50% of the specified minimum ultimate tensile strength (UTS) which shall be increased at a steady rate to 67% of the minimum UTS specified. The load shall be held for five minutes and then removed. After removal of the load, the string components shall not show any visual deformation and it shall be possible to disassemble them by hand. Hand tools may be used to remove cotter pins and loosen the nuts initially. The strings shall then be reassembled and loaded to 50% of UTS and the load shall be further increased at a steady rate to the specified minimum UTS and held for one minute. No fracture should occur during

this period. The applied load shall then be increased until the failing load is reached and the value recorded.

### 6.2.11.6 MAGNETIC POWER LOSS TEST FOR SUSPENSION ASSEMBLY

One hollow aluminium tube of 29 mm diameter shall be placed. An alternating current of 50 Hz over the range of 300 to 700 amps. shall be passed through the tube. The reading of the wattmeter with and without suspension assembly shall be recorded. Not less than 3 suspension assemblies shall be tested. The average power loss for suspension assembly shall be plotted for each value of current. The value of the loss corresponding to 500 amp. shall be read off from the graph.

### 6.2.11.7 MECHANICAL STRENGTH TEST OF EACH COMPONENT

Each component shall be subjected to a load equal to the specified minimum ultimate tensile strength (UTS) which shall be increased at a steady rate to 67% of the minimum UTS specified. The load shall be held for five minutes and then removed. The component shall then again be loaded to 50% to UTS and the load shall be further increased at a steady rate till the specified UTS and held for one minute. No fracture should occur. The applied load shall then be increased until the failing load is reached and the value recorded.

### 6.2.11.8 MECHANICAL STRENGTH TEST OF WELDED JOINT

The welded portion of each component shall be subjected to a load of 2000 kgs. for one minute. Thereafter, it shall be subjected to die-penetration /ultrasonic test. There shall not be any crack at the welded portion.

### 6.2.11.9 MECHANICAL STRENGTH TEST FOR SUSPENSION/TENSION HARDWARE FITTINGS

The complete string (without insulators) excluding arcing horn, and suspension or dead end assembly shall be subjected to a load equal to 50% of the specified minimum ultimate tensile strength (UTS) which shall be increased at a steady rate upto 67% of the minimum UTS specified. This load shall be held for five minutes and then removed. After removal of the load, the string component shall not show any visual deformation and it shall be possible to disassemble them by hand. Hand tools may be used to remove cotter pins and loosen the nuts initially. The string then be reassembled and loaded to 50% of UTS and the load shall be further increased at a steady rate till the specified minimum UTS is reached and held for one minute. No fracture

should occur during this period. The applied load shall then be increased until the failing load is reached and the value recorded. This test shall be carried out for every 300 sets.

**6.2.11.10 SHORE HARDNESS TEST**

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

**6.2.11.11 GALVANISING/ELECTROPLATING TEST**

The test shall be carried out as per clause no. 5.9 of IS:2486 (Part-I)-1971 except that both uniformity of zinc coating and standard preece test shall be carried out and the results obtained shall satisfy the requirements of this specification.

**6.2.11.12 PROOF LOAD TEST**

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

**6.2.11.13 CHEMICAL ANALYSIS OF ZINC**

For the chemical analysis of the zinc used for galvanising, samples taken from zinc ingot shall be chemically analysed as per IS:209-1966. The purity of the zinc shall not be less than 99.95%.

**6.2.11.14 TESTS FOR FORGING/CASTING AND FABRICATED HARDWARE**

The chemical analysis, hardness test, grain size inclusion rating and magnet ic particle inspection for forging, casting and chemical analysis and proof load test for fabricated hardware will be as per the internationally recognised procedures for these tests. The sampling will be based on heat number and heat treatment batch. The details regarding test will be as in the Quality Assurance Plan.

### 6.2.11.15 CLAMP SLIP STRENGTH VS TORQUE TEST FOR SUSPENSION CLAMP

The suspension clamp shall be vertically suspended by means of a flexible attachment. A suitable length of ACSR conductor shall be fixed in the clamp. The clamp slip strength at various tightening torques shall be obtained by gradually applying the load at one end of the conductor. The clamp slip strength vs torque curve shall be drawn. The above procedure is applicable only for free centre type suspension clamp. For AG suspension clamp only clamp slip strength after assembly shall be found out. The clamp slip strength at the recommended tightening torque shall be more than 16 KN but less than 24 KN.

### 6.2.11.16 VIBRATION TEST

The suspension string shall be tested in suspension mode and tension string in tension mode itself in laboratory span of minimum 30 metres. In the case of suspension string a load equal to 600 kg shall be applied along the axis of the suspension string by means of turn buckle. The insulator string alongwith hardware fittings and conductor tensioned at 3500 Kg shall be secured with clamps. The system shall be suitable to maintain constant tension on conductor throughout the duration of the test. Vibration dampers shall not be used on the test span. The conductor shall be vertically vibrated at one of the resonance frequencies of the insulators string (more than 10 Hz) by means of vibration inducing equipment. The peak to peak displacement in mm of vibration at the antinode point nearest to the string shall be measured and the same shall not be less than $1000/f^{1.8}$ where f is the frequency of vibration in cycles/sec. The insulator string shall be vibrated for not less than 10 million cycles without any failure. After the test the disc insulators shall be examined for looseness of pins and cap or any crack in the cement. The hardware for looseness shall be examined for fatigue failure and mechanical strength test. There shall be no deterioration of properties of hardware components and disc insulators after the vibration test. The disc insulators shall be subjected to the following tests as per relevant standards:

| | Tests | Percentage of discs to be tested. |
|---|---|---|
| a. | Temperature cycle test followed by mechanical performance test | 60 |
| b. | Puncture test | 40 |

### 6.2.11.17 OZONE TEST ON ELASTOMER

This test shall be performed in accordance with ASTM D-1171 by the ozone chamber exposure method (method B). The test duration shall be 500 hours and the ozone concentration 50 PPHM. At the test completion, there shall be no visible crack under a 2 x magnification.

### 6.2.11.18 ADDITIONAL TESTS

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

**6.2.11.18.2** The Purchaser also reserves the right to conduct all the tests mentioned in this specification at his own expense on the samples drawn from the site at Supplier's premises or at any other test centre. In case of any failure, it shall be binding on the part of the Supplier to replace that particular lot completely, without any extra cost to the Purchaser.

## SECTION - II
## SPECIFIC TECHNICAL REQUIREMENTS

### 1.0 SCOPE

This section of the specification covers climatic and isoceraunic conditions, specific technical particulars, schedule of requirements & desired deliveries for towers and accessories, conductor, ground wire , conductor and ground wire accessories and insulators and hardware for **132 kV S/c Transmission lines on D/c Circuit towers** .

### CLIMATIC & ISOCERAUNIC CONDITIONS

| | | | | |
|---|---|---|---|---|
| **Maximum Temperature** | | | | |
| i) | Conductor | Deg. C | : | 85 |
| ii) | Ground Wire | Deg. C | : | 53 |
| Minimum Temperature | | Deg. C | : | 0 |
| Every day temperature | | Deg. C | : | 32 |
| Basic wind speed | | m/s | : | 47 |
| Relative humidity | | | | |
| | Maximum | | : | 100% |
| | Minimum | | : | 10% |
| Average rainfall (max.) per annum | | | : | 1087.7 mm |
| 2.7 | (i) Rainy months | | : | July to Oct. |
| | (ii) Rainy days in a year days | | : | 50-75 |
| | Average no. of thunderstorm per annum days | | : | 20-60 |
| | Altitude varying from sea level on | | : | 510-1634 |

2.12 Seismic Level:

| | | |
|---|---|---|
| (i) | Basic horizontal acceleration | : (horizontal)0.05 (g) |
| (ii) | Basic vertical acceleration | :(vertical) Acceleration Zone-4 |

**2.13 System Particulars:**

| | | | |
|---|---|---|---|
| (a) | System Voltage (kV) | : | 132 |
| (b) | Highest System Voltage (kV) | : | 145 |
| (c) | Number of circuits | : | 1 |
| (d) | Frequency (Hz) | : | 50 |
| (e) | Neutral | : | Effectively earthed |
| (f) | Basic Insulation level (BIL) kV (Peak) | : | 550 |
| (g) | Power frequency withstand voltage (kV) | : | 230 |
| (h) | Short-circuit level (kA) | : | 50 |

## 3.0 SPECIFIC TECHNICAL REQUIREMENTS

## 3.1 TOWERS AND ACCESSORIES

a) Configuration S/c- vertical

b) Span As given below

| Tower Type | Normal span | Wind Span | | Weight Span | | | |
|---|---|---|---|---|---|---|---|
| | Normal | Broken Wire Condition | Normal condition | | Broken wire condition | | |
| | | | Max. | Min. | Max. | Min. | |
| | (m) | (m) | (m) | (m) | (m) | (m) | (m) |
| A/SA | 305 | 305 | 183 | 458 | 244 | 275 | 147 |
| B/SB,C/SC&D/SD | 305 | 305 | 0 | 458 | -244 | 275 | -200/-300 |

c) Shielding angle (Deg.) : 30

d) Tower footing resistance (ohms) : 10

e) Clearances:-

i) Minimum ground clearances from lowest point of power conductor (mm). : 6100
Provision for ground undulation and sag error.(mm) +150

ii) Minimum vertical mid-span clearance between power Conductor and Ground Wire in still air (mm) : 6100

iii) Swing angles and minimum clearance from live parts to tower body and cross arms.

a) Suspension insulator string

| Swing Angle (Deg) | Min. Electrical Clearance (mm) |
|---|---|
| 0 | 1530 |
| 15 | 1530 |
| 30 | 1370 |
| 45 | 1220 |
| 60 | 1070 |

b) Jumper Swings

| Swing Angle (Deg) | Min. Electrical Clearance (mm) |
|---|---|
| 0 | 1530 |
| 10 | 1530 |
| 1070 | |
| 30 | 1070 |

c) Minimum width of Right-of-way (m) 27

d) Minimum clearance for crossing over power lines upto 400kV (mm) 5490

e) Minimum clearance for crossing over tele-communication lines (mm) 2750

## 3.2 CONDUCTOR

For 132 kV system

| | | |
|---|---|---|
| 1. Conductor | : | 'Panther' ACSR |
| 2. IS applicable | : | IS-398 (part-II)-1996 |
| 3. Wire diameter | | |
| Aluminium | : | 30/3.00 mm. |
| Steel | : | 7/3.00 mm. |
| 4. Number of strands: | | |
| Steel centre | : | 1 |
| 1st steel layer | : | 6 |
| 1st Aluminium layer | : | 12 |
| 2nd Aluminium layer | : | 18 |
| 5. Sectional Area of Aluminium | : | 212.10 Sq.mm. |
| 6. Total Sectional Area | : | 261.50 Sq.mm. |

| | | |
|---|---|---|
| 7. Overall diameter | : | 21.0 mm. |
| 8. Approximate weight | : | 974 Kg./Km. |
| 9. Calculated D.C. resistance : at 20 degrees C, maximum. | | 0.1390 - ohms/km. |
| 10. Ultimate tensile strength | : | 89.67 kN. |
| 11. Final modulas of elasticity : | | 80 $GN/m^2$ |
| 12. Coefficient of Linear expansion. | : | 17.80 x $10^{-6}$ per deg. C. |

| 13. Lay-Ratio | Maximum | Minimum |
|---|---|---|
| Steel core 6 wire layer | 28 | 13 |
| Aluminium | | |
| 1st layer (12 wire) | 16 | 10 |
| 2nd layer (18 wire) | 14 | 10 |

| 14. Technical particulars of Aluminium and steel strands: | Steel | Aluminium |
|---|---|---|
| a) Diameter | | |
| Nominal | 3.00 mm. | 3.00 mm. |
| Minimum | 2.94 mm. | 2.97 mm. |
| Maximum | 3.06 mm. | 3.03 mm. |
| b) Cross-sectional area of nominal diameter wire | : 7.069 sqmm | 7.069 sqmm |
| c) Weight | : 55.13 Kg./Km. | 19.11 Kg./Km. |
| d) Minimum breaking load | | |
| Before stranding | : 9.29 kN | 1.17 kN |
| After stranding | : 8.83 kN | 1.11 kN |

| | | |
|---|---|---|
| 15. D.C. Resistance at 20 degrees C. | : 4.079 Ohm/Km. | (Aluminium) |
| 16. Zinc coating of steel core | : | |
| a) Number of 1 minute dips | : 3 | |
| b) Minimum weight of Zinc Coating | : 240 gms/sqm | |
| c) Process of Galvanizing | : Hot dip. | |
| d) Quality of Zinc | : IS-209-1979 or latest edition. | |
| 17. Joints in strands | | |
| a) Steel | : Not permitted | |

b) Aluminium : No joint shall be permitted in the Aluminium wires in the outer most layer of the ACSR conductor.But permitted in the inner layer such that no two such joints are within 15 meters of each other in the complete stranded conductor.

c) Method of making joint : Cold pressure welding.

18. Chemical composition of high carbon steel wire :

| Element | % Composition |
|---|---|
| i) Carbon | 0.5 to 0.85 |
| ii) Manganese | 0.5 to 1.10 |
| iii) Phosphorus | Not more than 0.035 |
| iv) Sulphur | Not more than 0.045 |
| v) Silicon | 0.10 to 0.35 |

## 3.3 GALVANISED STRANDED STEEL EARTHWIRE

1. Material : STEEL
2. Chemical composition of high carbon steel wire

| Element | % Composition |
|---|---|
| i) Carbon | not more than 0.55 |
| ii) Manganese | 0.4 to 1.10 |
| iii) Phosphorus | Not more than 0.05 |
| iv) Sulphur | Not more than 0.05 |
| v) Silicon | 0.15 to 0.35 |

3. Stranding and wire diameter : 7/3.15 mm.

3a. No. of strands : steel core : 1
outer steel layer : 6

4. Weight : 428 Kg/Km.
5. Single wire before stranding :
   a) Diameter of wire strand : Standard : 3.15 mm
      Max 3.25 mm
      Min. :3.07 mm
   b) Minimum elongation in 200 mm length
      i) before stranding : 4%
      ii) after stranding : 3.5%
   c) Minimum breaking strength : 8.57 kN
   d) Minimum tensile strength
      i) before stranding : 1100 N / sq mm

ii) after stranding : 1050 N / sq mm

6. Stranded wire

a) Length of lay
Maximum : 265 mm
Minimum : 123 mm
b) Minimum breaking load : 56 KN.
c) Overall diameter : 9.45 mm
d) Modulus of elasticity : 1.933 x $10^6$ Kg/$cm^2$
e) Coefficient of linear expansion : 11.50 x $10^{-6}$ per degC.
f) D.C. resistance at 20 degC : 3.41 ohms/km.
g) Total sectional area : 54.55 sq. mm

7. Direction of lay of outer layer : Right hand

8. Zinc coating

a) Number of one minute dips : 3
b) Number of half minute dips : 1
c) Quality of Zinc : Zn 98 to IS : 209-1979/ Latest revision.
d) Weight of coating on wire : 240 gm./sq.m
e) Process of galvanising : Hot dip

9. Joints : There shall be no joint in any of the wire constituting the ground wire.

10. Oiling : The galvanised ground wire shall be dipped in boiled linseed oil.

11. Standard length : Standard length shall be one specific length of 2000 meters.

11(a) Random length : Not less than 50% of the standard length and the total quantity of random lengths shall not be more than 10% of the total qty ordered.

## 3.4 TECHNICAL PARTICULARS OF POWER CONDUCTOR ACCESSORIES

### 3.4.1 PANTHER CONDUCTOR

#### 3.4.1.1 MID SPAN COMPRESSION JOINT

1. Type : Compression
2. Material outer sleeve : Aluminium of purity not less than 99.5 % purity.

3. Tapered plug for
   a) Outer sleeve : Aluminium rod of 99.5% purity.
   b) Inner sleeve : Extruded tube mild steel hot dip galvanized.

4. Brinnel hardness of steel sleeve : Shall not exceed 160

5. Shape of cross section :
   a) Before compression : Round
   b) After compression : Hexagonal

6. Minimum failing load (kN): 95% of UTS of conductor

7. Electrical resistance of the joint after installation : 75% of measured resistance of the length of conductor.

8. Dimensions and dimensional tolerances of mid span compression joint for PANTHER conductor

| | **Before compression** | **After compression** |
|---|---|---|
| Aluminum sleeve | | |
| Inner dia (mm) | 23±0.5 | - |
| Outer dia (mm) | 38±1 | 37±0.5 (corner to corner)<br>32±0.5 (Face to face) |
| Length (mm) | 610±5 | 655±5 (approx) |
| Steel Sleeve | | |
| Inner dia (mm) | 9.5±0.5 | - |
| Outer dia (mm) | 18±0.5 | 17.4±0.5 (corner to corner)<br>15.1±0.5 (Face to face) |
| Length (mm) | 203±5 | 241±5 (approx) |

### 3.4.1.2 REPAIR SLEEVE

1. Type : Compression type in two parts with provision of seat for sliding of keeper piece.
2. Application : To be used only for not more than one sixth of strands in the outer most layer have been served

| | | |
|---|---|---|
| 3. | Material | Aluminium (Extruded Tube) of 99.5% purity. |
| 4. | Shape of Cross-Section | |
| | Before Compression | Generally Round |
| | After Compression | Hexagonal |
| 5. | Minimum Failing load | 95% of UTS of conductor |
| 6. | Electrical resistance of the repaired portion of the conductor. | 75% of measured resistance of equivalent length |

Dimensions

| | **Before Compression** | **After Compression** |
|---|---|---|
| Outer Dia (mm) | 38±1 | 37±0.5 (corner to corner)<br>32.1±0.5 (face to face) |
| 8. Length (mm) | 241±5 | 265±5 (approx.) |

### 3.4.1.3 VIBRATION DAMPERS

| | | 'Panther' Conductor |
|---|---|---|
| i) | Type | Stockbridge |
| ii) | Material | |
| | a) Clamp | Permanent mould cast high strength aluminum alloy. |
| | b) Messenger | High strength steel wire of cable strength not less than the strength of steel core of 'Panther' conductor (preferably) 135 kg/sq. mm.) |
| | c) Weights | Hot dip galvanised mild steel/ Cast Iron |
| iii) | Galvanisation | |
| | a) Spring washers | Electro-galvanized as per IS:1573-1970 |
| | b) Other ferrous parts | Hot dip galvanized |

| | | |
|---|---|---|
| | c) Castings | As per BS:729-1961 |
| | d) Wires | As per IS:4826-1968 |
| | e) Bolts and Nuts | As per IS:5358-1969 |
| iv) | Slip strength of clamp kg | (a) Not less than 255 when an untested vibration damper is installed at the recommended bolt torque on the conductor.<br>(b) Not less than 200 kg. without retightening the bolts, after conducting the fatigue test. |
| v) | Maximum permissible dynamic strain on the conductor with the damper. | 150 micro strains |
| vi) | Minimum no. of cycles for fatigue performance. | Ten (10) million |
| vii) | Amplitude for fatigue test | 25/f, where f is the highest resonant frequency in Hz. |

### 3.4. 1.4 ARMOUR RODS

| | | | |
|---|---|---|---|
| 1. | Type | : | Preformed/ Formed |
| 2. | Material outer sleeve | : | Aluminium alloy designation 65032 conforming to IS :739-1966. |
| 3. | Minimum ultimate Strength (kg/mm²) | : | 35 |
| 4. | Conductivity | : | Not less than 39% of IACS |
| 5. | Direction of lay | : | Right Hand |

| | | | |
|---|---|---|---|
| 6. | Shape of end | : | Ball |
| 7. | No. of armour rods in each set | : | Eleven(11) |
| 8. | Radio interference at Phase to ground voltage of 266kV (rms) dry and frequency 1 MHz. | : | |
| 9. | Corona extinction voltage (kV) (rms) | : | |
| 10. | Markiting | : | Central line to be marked with Indelible black paint. |

11. Dimensions
Armour rods for 'Panther' Conductor

| | | | |
|---|---|---|---|
| a) | Length of each rod (mm) | : | 1930 ± 25. |
| b) | Diameter of each rod (mm). | : | 6.35 ± 0.1 |
| c) | Tolerance in length of complete set (longest and Shortest length) | | :Not more than 13mm between the longest and the shortest rod in a set. |

## 3.5 GROUNDWIRE ACCESSORIES

3.5.1 Mid Span Compression Joints

For 7/3.15mm; 110 kgf/sq. mm. quality ground wire

| | | |
|---|---|---|
| i) | Type | Compression |
| ii) | Material | Malleable cast iron/forged steel hot dip galvanised high strength steel. |
| iii) | Minimum failing load (kg) | |

Dimensions

| Sl.No. | Item | Before compression | After compression |
|---|---|---|---|
| 1. | Aluminum Sleeve | | |
| | Internal Dia. (mm) | 22±0.5 | - |
| | External Dia. (mm) | 30±1 | 29.4±0.5 (Corner to Corner)<br>25± 0.5 (Face to Face) |
| 2. | Steel Sleeve | | |
| | Internal Dia. (mm) | 10±0.2 | - |
| | External Dia. (mm) | 21±0.5 | 20.2±0.5 (Corner to Corner)<br>17.5± 0.5 (Face to Face) |
| | Length (mm) | 230±5 | - |

**3.5.2 SUSPENSION CLAMPS**

for 110 kgf/sq. mm quality groundwire

| | | |
|---|---|---|
| i) | Type | Conventional |
| ii) | Material | MCI/Forged steel |
| iii) | Slip strength (kN) | Not less than 9 kN<br>Not greater than 14 kN |
| iv) | Minimum failing load (KN) | 57 |
| v) | Galvanisation spring washers | Electrogalvanised |
| vi) | Other ferrous parts | Hot-dip galvanised |

**3.5.3 TENSION CLAMPS**

| | | |
|---|---|---|
| i) | Type | Compression |
| ii) | Material | |
| | a) Body | Forged steel |
| | b) Bolts & Nuts | Galvanised steel |
| iii) | Minimum failing load (kg) | 5425 |

| | | |
|---|---|---|
| iv) | Minimum slip strength (kg) | 5139 |
| v) | Galvanisation | |
| | a) Spring washers | Electrogalvanised |
| | b) Other ferrous parts | hot-dip galvanised- |

**3.5.4 FLEXIBLE COPPER BONDS**

| | | |
|---|---|---|
| i) | Material | Tinned Copper |
| ii) | Strand & Wire diameter | 37/7/0.417mm |
| iii) | Length | 500mm (approx.) |
| iv) | Connecting lugs suitable for | One for 12mm dia bolt and other for 16mm dia bolt |
| v) | HRH MS bolt hot-dip galvanised with nut & lock washer | 16mm dia and 40mm long |

**3.5.5 VIBRATION DAMPERS**

| | | |
|---|---|---|
| i) | Type | 4R stockbridge |
| ii) | Material | |
| | a) Clamp | Aluminium alloy |
| | b) Messenger cable | High strength steel strand with strength not less than 135 kg/sq mm. |
| | c) Weights | Hot dip galvanised mild steel/ Cast iron. |
| iii) | Galvanisation | |
| | Spring washers | Electrogalvanised as per IS:1573-1970 |
| | Other ferrous parts | Hot-dip galvanised |
| | Castings | As per BS:729-1961 |
| | Wires | As per IS:4826-1968 |
| | Bolts & Nuts | As per IS:5358-1969 |
| iv) | Maximum permissible dynamic strain on the groundwire with the damper. | +/-150 micro strains |
| v) | Minimum no. of cycles for fatigue performance. | Ten million |

vi) Amplitude for fatigue test — 25/f, where f is the highest resonant frequency in Hz.

## 3.6 INSULATOR DISCS AND STRINGS

1.0 TECHNICAL PARTICULARS OF INSULATOR DISCS AND STRINGS :

1.1 Disc Insulator units

1.1.1 Physical Characteristics

| | | |
|---|---|---|
| a) | Type | Ball and Socket |
| b) | Colour (Porcelain insulator) | Brown |
| c) | Surface | Glazed |
| d) | Locking device | R type security clip |
| e) | Diameter(mm) | |
| i) | Suspension insulator | 255/280 |
| ii) | Tension insulator | 255/280 |
| f) | Spacing(mm) | |
| i) | Suspension insulator | 145 |
| ii) | Tension insulator | 145 |
| g) | Size and designation of pin ball shank(mm) | |
| i) | Suspension insulator(m) | 16 |
| ii) | Tension insulator | 16 |
| h) | Minimum creepage distance(mm) | |
| i) | Suspension insulator | 292 |
| ii) | Tension insulator | 292 |
| i) | Minimum Electro-mechanical | |

strength (KN)

i) Suspension insulator(mm) 70 kN

ii) Tension insulator 90 kN

1.1.2 Electrical characteristics

| | | (70 kN) | (90 kN) |
|---|---|---|---|
| a) | Minimum impulse dry withstand test voltage (+Ve Wave) kV (peak) | 110 | 110 |
| b) | Minimum power freqency puncture withstand test voltage kV (rms) | 120 | 120 |
| c) | Minimum power freqency one minute withstand voltage | | |
| | i) Dry-kV (rms) | | 70 |
| 70 | | | |
| | ii) Wet-kV (rms) | | 40 |
| 40 | | | |
| d) | Minimum visible discharge test voltage kV (rms) | | 18 |
| 18 | | | |
| e) | Maximum RIV at 10 kV (rms) (in microvolts) | | 50 |
| 50 | | | |

1.1.3 Complete insulator strings

| | Suspension | Tension |
|---|---|---|
| a) Number of Insulator discs | | |
| i) Single suspension string | 9 | 10 |
| ii) Double suspension string | 2x9 | |
| iii) Single tension string | 1x10 | |

iv) Double tension string

2x10

| | | |
|---|---|---|
| b) Lightning impulse withstand voltage kV (peak) | 650 | 650 |
| c) Power frequency wet one minute withstand voltage kV (rms) | 275 | 275 |
| d) Corona extinction voltage kV (rms) | 154 | 154 |
| e) RIV at 1 MHZ for complete string i.e, including grading/corona rings,arcing horns,clamps etc.,at 154 kV (rms) (in micro-volts) (not exceeding) | 1000 | 1000 |

f) Mechanical failing load (kg)

| | | |
|---|---|---|
| Single I Suspension | 70 kN | |
| Double I Suspension | 2x70 kN(each limb 70 kN) | |
| Single Tension | 1x90 kN | |
| Double Tension | 2x90 kN (each limb 90 kN) | |
| g) No deformation load (kg) | 67% of UTS | |
| h) Total creepage distance (mm)- | 2628 (Suspension) | 2920 (Tension) |
| i) Maximum length of suspension string from ball hook attachment at hanger to centre line of conductor (approx.) | | |
| i) Single suspension | As per drawing attached | |
| ii) Double suspension 'II' | As per drawing attached | |

k) Tension strings from tower attachment point to jumper take off point(approx.)

| | | |
|---|---|---|
| Single/Double tension | As per drawings (attached) | |
| l) Maximum voltage across any disc. | Not more than 20% | 22% |

## 3.7 INSULATOR HARDWARES

| | | | | |
|---|---|---|---|---|
| 1.i) | Free centre type Suspension clamp | Material | Process | Reference Standard |
| a) | Clamp Body/ keeper piece | High strength Al.Alloy 4600 LM-6 OR 6061/65032 | Casted or forged & Heat treated | IS:617 OR ASTM-B429 |
| b) | Cotter bolts Hangers, Shackles, Brackets | Mild Steel | Hot dip galvanised | IS:226-1975/ IS:2062-1992 |
| c) | U Bolts | Stainless Steel or High Stren-gth Al. alloy 6061/6063 or 65032/63400 | Forged & Heat treated | AISI 302 OR 304-L,ASTM B429 |
| ii) | Preformed Armour Rods(Min. tensile strength of 35 kg/mm$^2$.) | High Strength Al. alloy type 6061/ 65032 | Heat Treat-ment during manufacturing | ASTM-B429 |
| iii)a) | AGS Clamp (a)Supporting House | High strength Corrosion resistant Al. alloy LM6 4600 or 6061/ 65032 | Cast/forged heat treated | IS:617 or ASTM-B429 |
| b) | Al. Insert & retaining strap | High Strength Al. alloy of type 6061/ 65032 | forged & heat treated | ASTM-B429 |

| | | |
|---|---|---|
| c) Elastomer Cushion | Moulded on Al. reinforcement. | |

2 Tension Clamp

| | | |
|---|---|---|
| a) Type | Compression | |
| b) Material | | |
| i) Outer sleeve | EC Grade Aluminium tube formed by extrusion process. | |
| ii) Inner sleeve | Mild steel/Galvanised low carbon forged steel hot dip galvanized. | |
| c) Minimum failing load (No deformation) | 95% of the breaking load of conductor. | |

3. Arcing Horns

| | | |
|---|---|---|
| a) Type | Loop or ball ended | |
| b) Material | Galvanised mild steel tube /rod hot dip galvanised. | As per IS-226 |

4. Other String Hardwares

| | | |
|---|---|---|
| a) Material | | |
| i) Socket ended items | Forged steel/Malleable cast iron hot-dip galvanised. | |
| ii) Ball ended components, U-clevis and chain link | Class IV steel or equivalent, drop forged and normalized. | As per IS:2004 -1978 |
| iii) Yoke plates | Mild steel hot-dip galvanised. | As per IS-226-1975/ IS-2062-1992 |
| b) Security clips | | |
| i) Type | R | |
| ii) Material | -Phosphor bronze or non-magnetic stainless steel. | AISI 302 or 304-L as per IS:226-1975 |

## 3.8 FOUNDATION

**a) Type of Soil**: Normal soil

Depending on the location of sub soil water the foundation in each type of soil shall be further categorized as under:-

(i) Dry
(ii) Wet
(iii) Partially Submerged (PS)
(iv) Fully Submerged (FS)

**b) Limiting bearing capacity:**

| | **Type of Soil Foundation**) | **Limiting Bearing Capacity (Kg/Sqm) (Dry Foundations)** | **(Wet, PS & FS** |
|---|---|---|---|
| i) | Normal soil | 25000 | 12500 |

**c) Angle of internal friction of soil:**

| | **Type of Soil Foundation)** | **Angle of internal friction of soil (Dry Foundations)** | **(Wet, PS & FS** |
|---|---|---|---|
| i) | Normal soil | 30 deg. | 15 deg. |

**d) Unit weight of soil:**

| | **Type of Soil Foundation )** | **Unit weight of soil (Kg/cum) (Dry Foundations)** | **(Wet, PS & FS** |
|---|---|---|---|
| i) | Normal soil | 1440 | 940 |

**e) Concrete Mix:**

i) RCC Slab and Pads : M-25 Gr. conforming to IS:456 with 20mm nominal size aggregate.

ii) Pyramid Type : M-20 Gr. conforming to IS:456 with 20mm

| | | |
|---|---|---|
| | | nominal size aggregate. |
| iii) | Chimney : with | M-25 Gr. concrete conforming to IS:456<br>20 mm nominal size aggregate for slab type RCC foundation.<br>M-20 Gr. concrete conforming to IS:456 with<br>20 mm nominal size aggregate for Pyramid type foundation. |
| iv) | Lean concrete sub base IS:456 | M-10(1:3:6) concrete conforming to<br>with 40mm nominal size aggregate. |

**f) Weight of Concrete:**

| **Type of concrete** | **Unit weight of concrete (Kg/cum)** | |
|---|---|---|
| | **Dry Foundations** | **Below water table in Wet, PS & FS foundation** |
| i) Plain cement concrete | 2300 | 1300 |
| ii) Reinforced cement concrete | 2400 | 1400 |

**g) Partial Safety Factors for Foundation Design:**

a) Towers up to angle of deviation of 15 deg. : 1.10

b)Towers with angle of deviation above 15 deg. : 1.20

**GROUNDING OF TOWERS**

| | | |
|---|---|---|
| a) | Maximum tower footing resistance (ohms) | 10 |
| b) | Length of Conductors of counterpoise per leg | 30 m (approx.) |

Note:-The above indicated minimum ground clearance and electrical clearances from live parts are applicable to the altitude upto 1000m. As the lines traverse the altitude upto 1634 m, necessary altitude correction factors are to be taken into account for calculating the minimum ground clearance and electrical clearances from live parts.

**ANNEXURE-I**

**SCHEDULE OF ERECTION, TESTING AND COMMISSIONING OF 132 kV S/C TRANSMISSION LINES ON D/C TOWERS FROM RAXAUL – PARWANIPUR & KATAIYA - KUSAHA**

| SL.NO | DESCRIPTION | PROVISIONAL QUANTITY | DESIRED COMPLETION PERIOD |
|---|---|---|---|
| | 132 Kv S/C Transmission Lines on D/c towers from Raxaul – Parwanipur & Kataiya - Kusaha | (21.713+15.718) km | Within 24 months from the date of signing of Contract Agreement |

**ANNEXURE-II**

## SCHEDULE OF REQUIREMENTS AND DESIRED DELIVERY FOR 132kV TOWERS AND TOWER ACCESSORIES

| Sl.no. | Description | unit | Quantity Provisional | Free at site Destination Site/stores | Delivery in months from placement of Purchaser order/ Award of Contract |
|---|---|---|---|---|---|
| 1. | 2. | 3. | 4. | 5. | 6. |
| | Towers and Accessories | | | | The delivery of all stubs and stubsetting templates commence within 8(Eight) months and complete within 6 (Six) months thereafter. |
| | 1.Tangent towers | | | | |
| | a) Super structure | No. | | | The delivery of Super Structures and Extension shall commence within 10 (Ten) months and complete within 6 (Six) months thereafter at a minimum rate of 25 (twenty five ) towers per month and to deliver the tower parts in such a way that the towers and extensions are in full shape as completed tower along with accessories. |
| | b) Stub (set of 4) | sets | | | |
| | 2. Small angle tension tower | | | | |
| | a) Super structure | No. | | | |
| | b) Stub (set of 4) | sets | | | |
| | 3. Medium angle tension towers | | | | |
| | a) Super structure | No | | | |
| | b) Stub (set of 4) | sets | | | |
| | 4. Large angle & dead end towers | | | | |
| | a) Super Structure | No | | | |
| | b) Stub (set of 4) | sets | | | |
| | 5. 3-metre extension for | | | | |
| | a) Tangent tower | No. | | | |
| | b) Small angle tension towers | No. | | | |
| | c) Medium angle tension towers | No. | | | |
| | d) Large angle & dead end towers | No. | | | |
| | 6. 6-metre extension for | | | | |
| | a) Tangent towers | No. | | | |
| | b) Small angle tension towers | No. | | | |
| | c) Medium angle tension towers | No. | | | |
| | d) Large and & dead end towers | No. | | | |
| | 7. 9-metre extensions for | | | | |
| | a) Tangent towers | No. | | | |
| | b) Small angle tension towers | No. | | | |

c) Medium angle tension towers No.
d) Large angle and dead end towers No.

8. 18 & 25-metre extensions for
Tangent towers No.
9 Adjustable stub setting template for 3m, 6m & 9 m extensions.
a) Tangent towers No.
b) Small angle tension towers No.
c) Medium angle tension towers No.
d) Large angle & dead end towers No.
10 Adjustable stub setting template for 18m & 25 m extensions.
for Tangent towers No.
11 Special Structures
a) Super Structure No.
b) Stub Set of Four No.
12. Number plates with bolts,nuts and washers
13. Danger plates with bolts, nuts and washers
14. Phase plates with bolts,nuts No.
and washers (set of three)
15. Anti climbing devices
a) Tangent towers No.
b) Small angle tension towers No.
c) Medium angle tension towers No.
d) Large angle and dead end towers No.
16. Bird guards complete with bolts, nuts and washers
(saw tooth type)
17. Earthing material Sets
a) Pipe type earthing
b) Counter poise earthing (120 m per tower) i.e. per set.

**ANNEXURE-III**

**SCHEDULE OF FOUNDATION PRACTICULARS OF 132 kV S/C TRANSMISSION LINES ON D/C TOWERS FROM RAXAUL – PARWANIPUR & KATAIYA - KUSAHA**

| Sl.no. | TYPE OF TOWER | TYPES OF FOUNDATIONS DRY | WET | Partially Submerged | Fissured Rock | Hard rock | Total |
|---|---|---|---|---|---|---|---|
| I. | TANGENT TOWERS | | | | | | |
| | Normal tower | | | | | | |
| | 3 mt. extensions | | | | | | |
| | 6 mt. extensions | | | | | | |
| | 9 mt. extensions | | | | | | |
| | 18 mt. extensions | | | | | | |
| | 25 mt. extensions | | | | | | |
| II. | SMALL ANGLE TOWERS | | | | | | |
| | Normal Towers | | | | | | |
| | 3 mt. extensions | | | | | | |
| | 6 mt. extensions | | | | | | |
| | 9 mt. extensions | | | | | | |
| III. | MEDIUM ANGLE TOWERS | | | | | | |
| | Normal towers | | | | | | |
| | 3 mt. extensions | | | | | | |
| | 6 mt. extensions | | | | | | |
| | 9 mt. extensions | | | | | | |
| IV. | LARGE ANGLE & DEAD END TOWER | | | | | | |
| | Normal towers | | | | | | |
| | 3 mt. extensions | | | | | | |
| | 6 mt. extensions | | | | | | |
| | 9 mt. extensions | | | | | | |

**ANNEXURE-IV**

## SCHEDULE OF LINE MATERIALS AND DESIRED DELIVERIES

### A. POWER CONDUCTOR

| Sl. No. | MATERIAL Description | Quantity (KM) | Destination Stores/Site | Delivery To commence delivery from the 10th month of date of Award of contract and complete in 6 (Six) months |
|---|---|---|---|---|
| 1. | 30/7/3.00 mm 'PANTHER' ACSR Conductor | 116 | KM per month | |

**B. GROUND WIRE**

| Sl. No. | Description | F.O.R. Destination | Tentative Qty. in Km. |
|---|---|---|---|
| 1. | Ground Wire as per IS/IEC latest editions/amendments. 9.45 MM Diameter | | 38.56 |

Note :

1. Desired delivery : To commence within 10th month from the date of order and complete in 6 (Six) months.

2. The material shall be delivered at the stores indicated above as per the requirement of the purchaser.

3. Exact quantities to be delivered at stations indicated above shall be informed to the successful tenderer well in advance before the actual despatch of material starts.

## C. CONDUCTOR & GROUND WIRE ACCESSORIES

| Sl. No. | Description | Quantity<br>Desired by the Purchaser | Desired delivery<br>Desired by the Purchaser | Destination Stores/Site |
|---|---|---|---|---|
| 1. | Mid span compression joint for ACSR PANTHER | | To commence with in 8th months from the date of award of contract and complete in 6 months there after at the rate of not less than 20% per month | |
| 2. | Repair sleeve for ACSR PANTHER | | | |
| 3. | Armour Rods for ACSR PANTHER | | of contract and complete in 6 months there after at the rate of not less than 20% per month | |
| 4. | Vibration Damper for ACSR 'PANTHER' Conductor & Ground Wire | | - do - | |
| 5. | Suspension clamp for Ground Wire | | - do - | |
| 6. | Tension Clamp/Dead End Assembly for Ground Wire | | - do - | |
| 7. | Flexible Copper Bond | | - do - | |

Note:-

1. The material shall be delivered in any of Stores/Site mentioned above as per the requirement of the purchaser.
2. For Foreign Supplier the port of entry will be Madras.
3. The mode of Transport in India is Road or Rail.

## D. ELECTROPORCELAIN DISC INSULATORS

| Sl.No. | Material | Quantity | Destination Stores/Site | Desired Delivery |
|---|---|---|---|---|
| 1. | 2. | 3. | 4. | 5. |
| 1. | 70 KN E.M.Strength Disc Insulators of Size 255/280x145 mm | | | To commence within 10th month from the date of award of contract and complete in 6 (Six) months thereafter. |
| 2. | 90 KN E.M.Strength Disc Insulators of Size 280x145 mm | | -do- | |

Note :

1. The mode of Transport in India is Road or Rail.

2. 2.5 % extra security clips, bolts & nuts, split pins etc. shall be supplied.

## E. HARDWARE FITTINGS FOR PORCELAIN DISC INSULATORS

| Sl.No. | Material | QUANTITY (Nos.) | Destination Stores/Site | Desired Delivery (To commence within 10th month from the date of award of contract and complete within 6 (Six) months.) |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |
| | HARDWARE FITTINGS FOR: | | | |
| 1. | Single I Suspension Insulator String of (1x9) | | | Nos. per month |
| 2. | Single Suspension pilot Insulator Strings(1x9) | | | Nos. per month |
| 3. | Double I Suspension Insulator String (2x9) | | | Nos. per month |
| 4. | Single Tension Insulator String of (1x10) | | | Nos. per month |
| 5. | Double Tension Insulator String of (2x10) | | | Nos. per month |

**Note :**

1. Hardware fittings at items (1),(2)&(3) will be used in Insulator String comprising Disc insulators of size 255/280x145 mm of 70 KN and for item (4 & 5) of Disc insulators of size 280x145 mm of 90 KN.

2. The mode of Transport in India is Road or Rail.

# GOVERNMENT OF INDIA
# MINISTRY OF EXTERNAL AFFAIRS

# GUARANTEED TECHNICAL PARTICULARS
# OF
# 132 KV TRANSMISSION LINES
# FOR
# STRENGTHENING OF INDIA-NEPAL
# POWER TRANSMISSION
# INTERCONNECTION

## VOLUME-3

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**SEWA BHAWAN ,**
**R.K.PURAM,**
**NEW DELHI-01**


**June, 2014**

**BIDDING DOCUMENT FOR**
**ENGINEERING, PROCUREMENT AND CONSTRUCTION ON TURNKEY BASIS OF 132KV S/C TRANSMISSION LINES ON D/C TOWERS IN INDIA & NEPAL**

# GURANTEED TECHNICAL PARTICULARS

# OF

# TRANSMISSION LINES

# VOLUME – 3

## Table of Contents

**SCHEDULE-A**

**GUARANTEED TECHNICAL PARTICULARS FOR SUPPLY OF TOWERS & ACCESSORIES & FOUNDATION**
**(TO BE FILLED IN AND SIGNED BY THE TENDERER)**

## I. TOWERS & TOWER ACCESSORIES

1. Line voltage
2. Number of circuits
3. Name of Manufacturer and country of origin
   i) Steel
   ii) Bolts, nuts and washers
   iii) Tower accessories
4. Name and address of:
   i) Tower Fabricator
   ii) Galvaniser
5. Guaranteed (Ceiling Steel Weight)

| | Standard | Extensions | | |
|---|---|---|---|---|
| | | 3m | 6m | 9m |
| | (1) | (2) | (3) | (4) |
| 5.1 | Tower Weight (kgs) | | | |
| 5.1.1 | Tangent Tower (0 deg.-2 deg.) | | | |
| | a) Fabricated parts (Black) | | | |
| | b) Stub-set of 4 (Black) | | | |
| | c) Nuts and bolts (Galvanised) | | | |
| | d) Total Weight | | | |
| 5.1.2 | Small Angle Tension Tower (0-15 deg.) | | | |
| | a) Fabricated Parts (Black) | | | |
| | b) Stub-set of 4 (Black) | | | |

c) Nuts and bolts (Galvanised)
d) Total Weight

5.1.3 Medium Angle Tension Tower (15-30 deg.)

a) Fabricated Parts (black)
b) Stub-set of 4 (Black)
c) Nuts and bolts (Galvanised)
d) Total Weight

5.1.4 Large Angle and Dead end tower (30- 60 deg/dead end)

a) Fabricated Parts (Black)
b) Stub-set of 4(Black)
c) Nuts and bolts (galvanised)
d) Total weight

6. Maximum working stresses employed in Design.

6.1 Tension on net Sectional area (N/sq.mm)

6.2 Compression on gross sectional area (N/sq.mm)

6.3 Shearing stress on bolts (N/sq.mm)

6.4 Bearing stress on bolts(N/sq.mm)

6.5 Strut formula adopted for determining crippling stress in design

6.6 Other particulars

6.6.1 Maximum Slenderness Ratio used in design

a) Leg members
b) Lattice members having calculated stresses
c) Redundant members or members having nominal stresses
d) Members under tension only

6.7 Standard Specification according to which the properties of sections have been adopted in design

6.8 Standard specifications according to which the quality of steel for the sections have been assumed in design

6.9 Standard to which fabrication, galvanising etc. will conform

6.10 Minimum sheared edge distance (mm)

6.11 Minimum rolled edge distance (mm)

6.12 Quality of zinc used for galvanising (Purity) (%)

6.13 Size of bolts and bolt holes (mm)

6.14 Standard to which the bolts and nuts will conform

6.15 Over load factor for foundations

6.16 SAGS AND TENSIONS Conductor Ground Wire

Every day temperature, nil wind (initial condition)

Full design wind pressure on conductor/Ground Wire at every day temperature.

Thirty Six (36) percent Full Design Wind Pressure on conductor/ Ground Wire at Minimum Temperature.

Minimum Temperature, Nil Wind

85°/53° C, Nil wind

6.17 Clearances and Tolerances

6.17.1 Minimum ground Clearance under Maximum temperature and nil wind (mm)

6.17.2 Provision for creep compensation (mm)

6.17.3 Provision for ground undulation and sag error (mm)

6.17.4 Maximum live metal clearances

Single suspension Insulator String

| **Swing Angle (Deg)** | **Min. Electrical Clearance (mm)** |
|---|---|
| 0 | |
| 15 | |
| 30 | |
| 45 | |
| 60 | |

Jumper Swings

| **Swing Angle (Deg)** | **Min. Electrical Clearance (mm)** |
|---|---|
| 0 | |
| 10 | |
| 20 | |
| 30 | |

6.17.5 Minimum mid span clearance between Ground Wire and nearest conductor at

(0) deg. C and -20$^{o}$C still wind (mm)

6.17.6 Shield angle (degrees.)

6.17.7 Tolerance in sag for stringing errors (%)

6.17.8 Tolerance over maximum calculated conductor tension for which towers are designed, if any

6.17.9 Maximum tolerance in verticality

## II. ACSR 'PANTHER' CONDUCTOR

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 :

   3rd Aluminium layer :

8. Sectional Area of Aluminium in $mm^2$ :

9. Total Sectional Area in $mm^2$ :

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) :

14. Radio interference voltage :

15. Ultimate tensile strength, kg/kN :

16. Final modulus of elasticity :

17. Co-efficient of Linear expansion :

18. Lay-Ratio Maximum Minimum

Steel core 6 wire layer
Aluminium
1st layer (12 wire)
2nd layer (18 wire)
3rd layer (24 wire)

**STRANDS**

19. 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 :

20. D.C. Resistance at :

20 degrees C in ohms/Km

21. Zinc coating of steel wire in gms/$m^2$ :

a) Number of 1 minute dips. :
b) Minimum weight of Zinc :
c) Coating
d) Process of Galvanizing :
e) Quality of Zinc :

22. Joints in strands

a) Steel :
b) Aluminium :
c) Method of making joint :
d) Ultimate tensile strength of joint :

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

24. Standard length of each piece in Km. :

25. a) Tolerance if any on standard lengths :

b) Details of random lengths :

26. No. of standard length in one reel :

27. Type of Drums and IS applicable :

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

29. Weight of the Drum in kg :
with conductor :
empty Drum with lagging :

30. Details of marking on :
conductor drum

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

32. Standard according to :
which the conductor
will be manufactured
and tested

a) Certification Mark if any :

b) Test certificate enclosed : Yes/No

33. Chemical composition of :
high carbon steel wire

34. Initial & Final sag and Tension
charts Furnished :

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

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

37. Other details if any :

## III. GROUND WIRE

1. Maker's Name, address :

and country

a) Steel wires/rods :

b) Zinc :

c) Galvanised stranded :
steel wire/ Ground Wire

2. No. of cores :

3. Weight (kg/km) :

4. 24 core Ground Wire :

   a) Minimum breaking load (kg or KN) :

   b) Overall diameter (mm :

   c) Modulus of elasticity (kg/sq mm) :

      i) Initial :
      ii) Final :

   d) Coefficient of linear expansion (per degC) :

   e) D.C. resistance at 20 degC (ohms/km) :

   f) Total sectional area (sq.mm) :

   g) Overall weight (kg/Km) :

5. Standard length (m) :

6. Tolerance if any on standard length (+/- % ) :

7. Standard length of Ground Wire in each drum (m) :

8. No. of standard lengths in each drum :

9. (a) Random lengths (m) :

10. (b) No. of random lengths (No) :

11. Standard weight of drum (kg) :

12. Type of drum and IS/IEC applicable :

13. Dimensions of the drum in cm. :
(Drawing shall be enclosed)

14. Weight of the Drum
- with Ground Wire (kg.) :
- empty drum with lagging (kg.) :

15. Details of marking on :
Ground Wire drum

16. Drums suitable for :
tension stringing

17. Standards according to :
which the Ground Wire will be

a) Manufactured :
b) Tested :
c) Types of tests :

18. Other details if any :

## IV. CONDUCTOR ACCESSORIES

### A. MID SPAN COMPRESSION JOINTS

1. Maker's name and country :

2. Type :

3. Suitable for (Conductor size) (mm) :

4. Materials of joint with reference of ISS to which it conforms

a) Aluminium sleeve :

b) Steel sleeve :

5. Shape of cross-section

a) Before compression

b) After compression

6. Outside diameter of sleeves

a) Before compression

i) Aluminium (mm)

ii) Steel (mm)

b) After compression

Aluminium Steel

i) Corner to corner (mm)

ii) Surface to surface steel (mm)

7. Inside diameter of sleeves

a) Before compression

i) Aluminium (mm)

ii) Steel (mm)

8. Length of sleeves

a) Before compression

i) Aluminium (mm)

ii) Steel (mm)

b) After compression

i) Aluminium (mm)

ii) Steel (mm)

9. Weight of sleeve in

i) Aluminium (kg.)

ii) Steel (kg.)

| | | |
|---|---|---|
| | iii) Total | (kg.) |
| 10. | Breaking strength of the mid span joint as percentage of ultimate tensile strength of conductor | (%) |
| 11. | Conductivity of the compression joint expressed as percentage of the conductivity of equivalent length of the conductor | (%) |
| 12. | No. of dips of 1 minute duration which the steel sleeve shall withstand under 'Preece Test' | |
| 13. | Quality of zinc and standard to which zinc conforms. | |
| 14. | Galvanisation | |
| | a) process | |
| | (b) weight of zinc (gm/sq m.) | |
| | (c) no. of 1/2 minute dips. | |
| 15. | Whether compression and non-compression joints marked on the sleeves. | |
| 16. | Slip strength of mid span compression joints expressed as % of UTS of conductor. | |
| 17. | Details of die set required for making joint. | |
| 18. | Type of greece and capacity of Hydraulic compressor for making joints. | |
| 19. | Suitable for passing through the sleeve of stringing block. | |
| 20. | Reference of manufacturers' drawing and catalogue no. etc. | |
| 21. | Reference of ISS or any other international standard to which the midspan joints conform, if any | |

22. Certification Mark (ISI/BS/or Any other International Standard)

23. Packing details

**B. REPAIR SLEEVE**

1. Maker's name and country

2. Type

3. Suitable for Conductor size (mm)

4. Shape of cross-section

   a) Before compression

   b) After compression

5. Inside diameter of sleeves (mm)
   Before compression

6. Outside diameter of sleeve

   a) Before compression (mm)

   b) After compression

      i) Corner to corner

      ii) Surface to surface

7. Length of sleeve

   a) Before compression (mm)

   b) After compression (mm)

8. Weight of sleeve

9. Conductivity of the repair (%)
   sleeve expressed as percentage
   of the equivalent
   length of Bare conductor

10. Material and standard to which conforming

11. Breaking strength as % of UTS of conductor

12. Resistance as percentage of measured resistance of equivalent length of conductor

13. Details of die set for making joint

14. Capacity of compressor for making joint

15. Whether suitable to pass through stringing blocks when installed on conductor during tension stringing if not state the protective device needed to make it suitable.

16. Certification mark (ISI/BS/Any International Institution.

17. Reference of ISS or any other international standard specification to which the repair sleeves shall conform, if any

18. Reference of drawing and catalogue no. etc.

19. Packing details,

**C. VIBRATION DAMPERS**

1. Maker's name & Country

2. Type

3. Suitable for conductor size (mm)

4. Total weight of each damper (kg)

5. Dimension of balancing weights (mm)

6. Weight of each balancing weight (kg)

7. Tolerance in balancing weights (+/- %)

8. Messenger cable

   (a) Stranding and wire diameter

   (b) UTS of each strand

(c) Ultimate bending strength

9. Slipping strength of cable w.r.t. each balancing weight

10. Natural frequency of the damper (hz)

(a) First resonance

(b) Second resonance

(c) Third resonance

(d) Fourth resonance

11. The number of damper required per span (suspension/tension)

| (a) Span lengths (mtrs) | 100 | 250 | 390 | 400 | 440 | 1100 |
|---|---|---|---|---|---|---|
| (b) Nos. of dampers (nos.) | | | | | | |

12. Position of fixing damper on the conductor from the clamp mouth

(a) At tension points

i. First damper (mm)
ii. Second damper, (mm)
iii. Third damper (mm)

(b) At suspension points

i. First damper (mm)
ii. Second damper, (mm)
iii. Third damper (mm)

13. Clamping torque (kg m)

14. Minimum fatigue strength in no. of cycles at +/-1 mm amplitude at

(a) Resonant frequency of line conductor

(b) Highest resonent frequency of vibration damper

15. Clamp slipping strength of vibration damper (kg)

    (a) Before fatigue test

    (b) After under going fatigue test without re-torquing the bolts.

16. (a) Diagram showing power dissipated by the damper in watts for various vibration frequencies & amplitudes (watts)

    (b) Diagram showing the vibration energy for conductor bundle for various frequencies under varied winds and spans

17. Magnetic power loss per damper (watts) at 600 amp. 50 Hz AC current

18. Material and standards to which conforming

    a) Clamp

    b) Messenger cable

    c) Damper weight

19. Quantity of zinc and standard to which conforming

20. Galvanization

    (a) method of galvanization

        i) Spring washers

        ii) Other spare parts

    (b) no. of dips

        i) One minute

        ii) Half minute

(c) minimum weight of zinc coating (g/sq. m)

i) Casting

ii) Wires

21. Certification Mark (ISI/BS/or any other International Standard)

22. Packing details

i) Marking

ii) Standard to which conforming

## V. GROUND WIRE ACCESSORIES

### A. SUSPENSION ASSEMBLY

1. Manufacturer's name & address

2. Type

3. Material

4. Drawing no. (give complete details and dimension including no. of components)

5. Reference of Indian Standard specification to which conform

6. Minimum slip strength with respect to Ground Wire

7. Minimum ultimate breaking strength

8. Galvanising

(a) Spring washers

(b) Other ferrous parts

(c) weight of zinc (g/sq. m)

(d) no. of dips

i) one minute

ii) half minute

(e) Quality of zinc and standard to which conforming

9. Fixing arrangement of clamp on the Ground Wire / Ground Wire

10. Whether the limb of the U-bolt has been long enough to accommodate the leg of the flexible copper bond (Y/N)

11. Total drop of the suspension assembly from the centre point of the attachment to the centre point of the Ground Wire (mm)

12. Certification Mark (ISI/BS/Any other International Standard)

13. Total weight of assembly (kg)

14. Method of manufacture adopted

e.g. forging or casting

15. Packing details

16. Other details, if any

**B. TENSION ASSEMBLY / DEAD END ASSEMBLY**

1. Manufacturer's name & address

2. Type

3. Material

(a) Body

(b) Bolts and nuts

4. Drawing no. (give complete details and dimension and no. of components)

5. Reference of Indian Standard Specification / IEC to which conforms

6. Minimum slip strength

7. Minimum ultimate breaking strength

8. Brinnel hardness of steel

9. Galvanising

(a) Spring washers

(b) Other ferrous parts

(c) weight of zinc (g/sq. m)

(d) no. of dips

i) one minute

ii) half minute

e) Quality of zinc and standard to which conforming

10. Total weight of complete assembly (kg)

11. Breaking strength of tension clamp as % of breaking load of Ground Wire

12. Resistivity as % of equivalent length of Ground Wire

13. Whether lugs along with necessary nuts and bolts for jumper connections will be supplied (Y/N)

14. Angle of Jumper terminal with the vertical plate (degree)

15. Whether the bolt holding the jumper is sufficiently long and will be provided with washers, nuts and locking nuts etc., for fixing one lug of the flexible copper bond (Y/N0)

16. Certification Mark (ISI/BS/or Any other International Standard)

17. Packing details

18. Other details, if any

**C. VIBRATION DAMPERS**

1. Maker's name & Country

2. Type

3. Suitable for earthwire of size (mm)

4. Material with reference of ISS to which it conforms

   (a) Clamp

   (b) Messenger cable

   (c) Weight

5. Reference of manufacturer's drawing and catalogue no. etc.

6. Total weight of each damper (kg)

7. Dimensions of balancing weights (mm)

8. Length of each balancing weight (mm)

9. Weight of each balancing weight (kg)

10. Tolerance in balancing weights (+ %)

11. Messenger cable

   (a) Stranding and wire diameter (mm)

   (b) Ultimate tensile strength (kg)

   (c) Ultimate bending strength (kg m)

12. Slipping strength of stranded messenger cable with respect to balancing weight (kg)

13. (a) Diagram showing power dissipated by the damper in watts for various vibration frequencies & amplitudes (watts)

(b) Diagram showing the vibration energy for various frequencies under varied winds and spans.

14. Natural frequency of the damper

(a) Ist (Hz)

(b) IInd (Hz)

(c) IIIrd (Hz)

(d) IVth (Hz)

15. The number of dampers required per span for various span length

(a) Span lengths (mtrs) 250m 390m 400m 440m 1100m

(b) Nos. of dampers

i) Suspension span

ii) Tension span

16. Position of fixing damper on the earthwire from the clamp mouth

(a) At tension points

i) First damper (mm)

ii) Second damper (mm)

iii) Third damper (mm)

(b) At suspension points

i) First damper (mm)

ii) Second damper, (mm)

iii) Third damper (mm)

17. Clamping torque (kg m)

18. Maximum possible dynamic strain on the earthwire with recommended number of dampers

19. Minimum fatigue strength at amplitude of +/- 0.5 mm in nos. of cycles at

(a) Resonant frequency of Ground Wire

(b) Highest frequency of vibration dampers

20. Clamp slipping strength of vibration damper

(a) Before fatigue test

(b) After fatigue test for 10 million cycles

21. Weight of zinc coating in ($gms/m^2$)

(a) Spring washers

(b) Bolts and nuts

(c) Weights

(d) Clamp

(e) Messenger cable

22. No. of dips of 1 minute duration which the damper withstands under 'Preece Test'

(a) Spring washers

(b) Bolts and nuts

(c) Weights

(d) Clamp

(e) Messenger cable

23. Packing details

24. Certificate Marks (ISI/BS/or Any other International Standard)

## D. MIDSPAN COMPRESSION JOINT

Maker's name & address
Type
Inside diameter of sleeve before compression
Outside dimension of sleeve
Before compression (mm)
After compression (mm)
Corner to corner (mm)
Surface to surface (mm)
Length of sleeve
- a) Before compression (mm)
- b) After compression (mm)

Weight of sleeve (kg)
Slipping strength of mid span (%)
joint, expressed as a percentage of
Ultimate tensile strength
Resistance of the compressed
Unit expressed as a percentage
of the Resistance of equivalent
length of bare earth wire
Material of sleeves
Material
Standard to which conform
Whether annealed properly
Brinnel Hardness of material
Galvanization
- Process
- Weight of zinc (g/sq. m)
- No. of dips
  - i) one minute
  - ii) half minute
- Quality of zinc and standard to which conforming

Whether compression and non compression
joints marked on the sleeve (Y/N)

Breaking strength of Mid span joint as %
of the breaking load of ground wire
Details of die set for making joint
Whether suitable to pass through
stringing block when installed on
ground wire during tension stringing
if not state the protective device

needed to make it suitable.
Capacity of Hydraulic compressor for making joint
Certification mark (ISI/BS/Any international Institution
Drum no. and details and no. of components
Packing details

### E. FLEXIBLE COPPER BONDS

Maker's name & address
Governing Standard
Material & Standard
No. of Strands
Length
Weight
Slipping strength of lugs provided
on either end of earthing bond without
any damage to earthing bond
Certification mark (ISI/BS/Any international Institution
Packing details (No. of bonding pices per package and gross weight)

## VI. INSULATOR DISCS AND COMPLETE STRINGS

### I. SINGLE DISC INSULATOR

1. Type of insulator

2. Maker's name, address and country

3. Material and Governing standard

4. Detailed dimensional drawing
indicating tolerances for each
type of insulator disc enclosed (YES/NO)

5. Dimensions (Indicate tolerances also)
   a) Diameter (mm)

      i) Suspension

      ii) Tension

   b) Spacing (mm)

      i) Suspension

      ii) Tension

c) Creepage distance (mm)

i) Suspension

ii) Tension

6. Pin-ball-shank diameter (mm)

a) Suspension insulator

b) Tension insulator

7. Colour

a) Suspension

b) Tension

8. Electromechanical strength (KN)

a) Suspension

b) Tension

9. Mechanical breaking strength (KN)

a) Suspension

b) Tension

10. Power frequency one-minute withstand voltage -KV (rms)

a) Dry

i) Suspension

ii) Tension

b) Wet

i) Suspension

ii) Tension

11. Impulse 1.2x50 microsecond withstand voltage -KV (peak)

    a) +ve Wave

        i) Suspension

        ii) Tension

    b) -ve Wave KV (peak)

        i) Suspension

        ii) Tension

12. Power frequency flashover voltage -KV (rms)

    a) Dry

        i) Suspension

        ii) Tension

    b) Wet KV (rms)

        i) Suspension

        ii) Tension

13. Impulse 1.2x50 microsecond flashover voltage KV (peak)

    a) +ve Wave

        i) Suspension

        ii) Tension

    b) -ve Wave

        i) Suspension

        ii) Tension

14. (i). Power frequency puncture voltage KV (rms)

    a) Suspension

    b) Tension

15. RIV at 10 KV (rms)

    a) Suspension

       (microvolts)

    b) Tension

16. Weight of the Insulator disc (kg)

    a) Suspension

    b) Tension

17. Locking device

    a) Type

       i) Suspension

       ii) Tension

    b) Material

       i) Suspension

       ii) Tension

    c) Standard to which conforming

18. Socket and ball ended component

    a) Standard to which conforming

    b) Material and
       Standard to which conforming

    c) Galvanising process

    d) Quality of zinc and Standard
       to which conforming

    e) Weight of zinc ($g/m^2$)

    f) Number of one-minute dips

19. Packing details (No. of disc insulators
    of each type per package and gross weight)

20. Certification mark (BIS/BS/Any National Institution)

## II. INSULATOR STRINGS

1. No. of insulator discs
   a) Single suspension 'I'
   b) Double suspension 'II'
   c) Single Tension
   d) Double Tension
2. E.M. Strength - KN
   a) Single suspension
   b) Double suspension
   c) Single Tension
   d) Double Tension
3. Power frequency one minute withstand voltage KV (rms)
   Dry/Wet
   i) Suspension
   1) Single
   2) Double
   ii) Tension
   1) Single
   2) Double
4. Power frequency flashover voltage KV (rms)
   Dry/Wet
   i) Suspension
   1) Single
   2) Double
   ii) Tension
   1) Single
   2) Double

5. Impulse withstand voltage (dry) KV (peak)

Positive wave

i) Suspension

Single

Double

ii) Tension

Single

Double

Negative wave

i) Suspension

Single

Double

ii) Tension

Single

Double

6. Impulse flashover voltage (dry)

Positive wave - KV (peak)

i) Suspension

Single

Double

ii) Tension

Single

Double

Negative wave - KV (peak)

i) Suspension

Single

Double

ii) Tension

Single

Double

7. Maximum RIV for complete string i.e. including arcing horns,clamps etc. at 154 KV (rms) (in microvolt)

a) Single Suspension

b) Single Tension

8. Creepage distance of complete string

a) Single suspension

b) Double suspension

c) Single Tension

d) Double Tension

9. Detailed Dimensional drawing for insulator strings with tolerances attached for:

a) Single Suspension (I) YES/NO

b) Double Suspension (II) YES/NO

c) Single Tension YES/NO

d) Double Tension YES/NO

10. Weight (kg.)

a) Single Suspension (I)

b) Double Suspension (II)

c) Single Tension

d) Double Tension

11. Maximum percentage of line to earth voltage across insulator discs of insulator string for single (I), double(II) suspension and double tension.

a) Ist insulator disc from line side

b) 2nd insulator disc from line side

c) 14th insulator disc from line side

d) 15th insulator disc from line side.

12. Mechanical strength of complete insulator string alongwith hardware fittings.

a) Single Suspension insulator strings (I)

b) Double Suspension insulator strings (II)

c) Single Tension insulator strings

d) Double Tension insulator strings

13. Whether end user certificate in support of performance attached. (YES/NO)

14. Certification Mark (BIS/BS/Any National Institution)

## VII. HARDWARE FITTINGS

### I. SUSPENSION CLAMP ASSEMBLY

1. Type

2. Manufacturer's Name, address and country

3. Suitable for (Conductor size)

4. Governing standard

5. Detailed dimensioned drawings of each component showing tolerances, material and the standard to which conforming enclosed. YES/NO

6. Weight of suspension clamp (kg.)

   a) Body

   b) Supporting and clamping components

   c) Total

7. Galvanisation and standard to which conforming.

   a) Spring washers

   b) Other ferrous parts

   c) Weight of zinc $g/m^2$

   d) Number of one-minute dips

   e) Quality of zinc and standard to which conforming

8. Minimum failing load (No deformation) (kg.) & (KN)

9. Slip strength at recommended tightening torque (KN)

10. Whether clamp torque Vs slip curve enclosed YES/NO

11. Magnetic power loss at:

    a) 500 amps Watts

12. Whether a graph showing relation between power losses in watts against current in amperes is enclosed YES/NO

13. Formed armour rod set

    a) Type

    b) Manufacturer's name, address and country

    c) Suitable for (Conductor size)

    d) No. of rods per set (No.)

    e) Direction of lay

    f) Overall length after fitting on conductor (mm)

    g) Actual length of each rod along its helix (mm)

    h) Diameter of each rod (mm)

    i) Tolerance in

        i) Diameter of each rod (+/- mm)

        ii) Length of each rod (+/- mm)

        iii) Difference of length between the longest and shortest rod in a set (+/- mm)

j) Type of aluminium alloy used for manufacture of Formed armour rod set and standard to which conforming.

k) UTS of each rod (kg/mm$^2$)

14. Elastomer for AGS clamps

a) Supplier

b) Type

c) Moulded on insert YES/NO

d) Shore hardness

e) Temp. range for which designed (deg.C)

15. Particulars of insert

a) Type of aluminium alloy used for manufacturing of insert and standard to which conforming.

b) Manufacturing process

16. Packing details (No. of suspension clamp/formed armour rod set/ elastomer etc. per package and gross weight of each package)

17. Whether end user certificate in support of performance enclosed YES/NO

18. Certification mark (BIS/BS/Any National Institution).

## II. TENSION CLAMP ASSEMBLY

1. Type

2. Manufacturer's name address and country

3. Suitable for (conductor size)

4. Governing standard

5. Detailed dimensioned drawings of each component showing tolerances, material and standard to which conforming enclosed YES/NO

6. Materials composition and standard to which conforming.

    a) Outer sleeve

    b) Inner sleeve

7. Slip strength (KN)

8. Minimum failing load (KN)

    (No deformation)

9. Shape of cross section

    a) Before compression (mm)

        i) Aluminium

        ii) Steel

    b) After compression

        i) Aluminium

        ii) Steel

10. Dimensions of sleeve (mm)

    a) Before compression (mm)

        i) Aluminium sleeve

        ii) Steel sleeve

    b) After compression (mm)

        i) Aluminium sleeve

        ii) Steel sleeve

11. Length of sleeve

    a) Before compression (mm)

        i) Aluminium sleeve

ii) Steel sleeve

b) After compression (mm)

i) Aluminium sleeve

ii) Steel sleeve

12. Galvanisation

a) Process

b) Weight of zinc (g/sq.m)

c) No. of dips

i) 1 minute

ii) 1/2 minute

d) Quality of zinc and standard to which conforming.

13. Whether compression and non-compression zones marked on the sleeves (YES/NO)

14. Electrical resistance of tension clamp as a % of equivalent length of conductor.

15. Details of dies and hydraulic compressor required for compressing sleeves of tension clamp.

16. Packing details (Nos. of tension clamp assembly per package and gross weight)

17. Whether end user certificate in support of performance enclosed YES/NO

18. Certification mark (BIS/BS/Any National Institution)

## III. OTHER HARDWARE FITTINGS

1. Manufacturer's name, address and country.

2. Material, composition, mechanical strength and standard to which conforming.

a) Anchor shackle

b) Chain link

c) Yoke plate

d) Arcing horn

e) Split pin

f) Socket clevis

g) Ball clevis

h) Clevis-Clevis

i) Clevis eye

j) Ball hook

k) Socket eye horn holder type

l) Ball eye

m) Twisted shackle

3. Galvanisation and Standard to which conforming.

a) Spring washers

b) Other ferrous parts

c) Weight of zinc g/sq.m

d) No. of one minute dips

e) No. of 1/2 minute dips.

4. Quality of zinc and standard to which conforming.

5. Detailed dimensioned drawing of each fitting showing tolerances, weight, strength etc. enclosed (YES/NO)

6. Whether components are interchangeable. (YES/NO)

7. Packing details of each fitting per package and gross weight

8. Whether end user certificate in support of performance enclosed YES/NO

9. Certification mark (BIS/BS/Any National Institution.)

## VIII. FOUNDATIONS OF 132 kV S/C TRANSMISSION LINES ON D/C TOWERS FROM RAXAUL – PARWANIPUR & KATAIYA - KUSAHA

| Sl.No. | Description | Guaranteed lean concrete(M-10 Grade) volume per tower (cubic metres) | Guaranteed structural concrete(M-15Grade) volume per tower (cubic metres) | Guaranteed weight of steel reinforce-ment (M.T.) | Guaranteed excavation volume per tower(cubic metres) |
|---|---|---|---|---|---|
| 1. | 2. | 3. | 4. | 5. | 6. |
| 1. | Small Angle Tension Tower | | | | |
| | i) Hard / Dense soil | | | | |
| | ii) Wet soil | | | | |
| | iii) Soft / disintegrated Rock | | | | |
| | iv) Hard Rock | | | | |
| 2. | Medium Angle Tension Tower | | | | |
| | i) Hard / Dense soil | | | | |
| | ii) Wet soil | | | | |
| | iii) Soft / disintegrated Rock | | | | |
| | iv) Hard Rock | | | | |
| 3. | Large Angle Tension Tower and Dead - end Towers | | | | |
| | i) Hard / Dense soil | | | | |
| | ii) Wet soil | | | | |
| | iii) Soft / disintegrated Rock | | | | |
| | iv) Hard Rock | | | | |
| 4. | Properties of Concrete used | | | | |
| | i) Effective weight in dry locations | kg | | | |

ii) Effective weight in wet locations kg

iii) Limiting bond stress kg

iv) Limiting shear stress kg

5. Minimum concrete cover over the extreme edge of stubs mm

a) Dry

b) Wet, partially submerged, fully submerged.

6. I) Small Angle Tension Tower mm

i)

ii)

iii)

iv)

v)

vi)

II) Medium Angle Tension Tower mm

i)

ii)

iii)

iv)

v)

vi)

III) Large Angle and Dead end Tower mm

i)

ii)

iii)

iv)

v)

vi)

7. Minimum size of chimney mm

i) In Wet Location mm

ii) In Dry Location mm

8. Formula adopted for calculating side - thrust.

9. Cement Consumption for Different Type of Concrete mix.

a) For M-20 concrete

(1:1-/2:3 nominal mix)

(KG /cum)

b) For M-15 concrete

(1:2:4 nominal mix) -

(KG/cum)

c) For M-10 concrete

(1:3:6 nominal mix).

(kg/cum).

d) For 1:6 random rubble

stone masonary

(KG/cum)

NOTE:- Individual schedules shall be furnished for all types of towers with and without extensions.

Signature

Name

Status

Date: Whether authorised attorney of the tendering company

Place: Name of the tendering company

Date

Address

Company

**SCHEDULE – B**

## (TO BE FILLED IN AND SIGNED BY THE TENDERER)
## I - PERFORMANCE SCHEDULE - FOR SUPPLY OF TOWERS

Purchaser's Specification no. :

Details of equipment offered :

Name of the Manufacturer :

Name of the Tenderer :

Following is the list of orders executed/being executed by us in support of past performance as sought in the purchaser's above cited specification for supply of towers, special tower 132 kV and above transmission lines.

| Sl.no. | Order no & date. | Description of material | Name of customer | Quantity ordered completion of supply | date of indicating date of supply | quantity supplied and date | balance quantity | name of manu-facturer | line voltage rating | remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 1. | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
| | | | | | | | | | | |

Date :
Place :

Signature
Name
Status
Whether authorised attorney of the tendering company
Name of the tendering company
Date
Address
Company

**SCHEDULE –B**

## GROUND WIRE PERFORMANCE SCHEDULE FOR II - CONDUCTOR, GROUND WIRE, CONDUCTOR & GROUND WIRE ACCESSORIES, INSULATORS, INSULATORS & HARDWARE

Purchaser's Specification:

Details of equipment offered:

Name of the Manufacturer:

Name of the Tenderer:

Following is the list of orders executed/being executed by us in support of past performance as sought in the Purchaser's above cited specification for suspension and tension insulator strings comprising of porcelain insulator discs.

| Sl. No. | Order No. & date | Description of material | Name of Customer | Quantity Ordered | Date of completion of supply | Quantity supplied indicating date | Balance quantity and expected date of supply | Name of Manufacturer | Line rating | voltage | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|
| --1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | |

Signature :

Date:

Name :

Place:

Status :

Whether authorised attorney of the tendering company :

Name of the tendering company:

**SCHEDULE – B**

## III - PERFORMANCE SCHEDULE FOR ERECTION OF 132 kV LINES

| Sl. No. | Description of the 132 kV transmission lines erected and commissioned | Number and date of order | Name of customer | Line length (km) | Dates since when the erected lines are in service | Remarks |
|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |

Name :

Date : Signature :

Place : Status :

Whether authorized attorney of the

tendering company :

Name of the tendering Company:

Date :

Address :

Company :

**SCHEDULE – C**

## (TO BE FILLED IN AND SIGNED BY THE TENDERER)
## SCHEDULE OF DEVIATION

We/I have carefully gone through the Technical Specification and General Conditions of contract and have satisfied ourselves/myself and hereby conform that our / my offer strictly conforms to the requirements of the Technical Specification and General Conditions of contract except for the deviations which are given below:

| Section | Chapter | Clause No. | Page No. | Statement of Deviation / Variation |
|---|---|---|---|---|
| | | | | |

Signature

Name

Status

Whether authorised attorney of the Tendering Company

Name of the Tendering Company

Date

Address

Company

Date :

Place :

**SCHEDULE –D**

## (TO BE FILLED IN AND SIGNED BY THE TENDERER)
## SCHEDULE FOR PRICE ADJUSTMENT

The tendered prices are variable. The bidder shall quote the price variation formulae as specified in Schedule - G.

| Sl.No. | Price variation formula, description of indices and basic rates assumed for the raw materials and freight. | Ceiling on price variation | Remarks |
|---|---|---|---|

Signature :

Date : Name :

Place : Status :

Whether authorised attorney of the tendering company.:

Name of the Tendering Company:

Date :

Address :

Company :

**SCHEDULE-E**

## (TO BE FILLED IN AND SIGNED BY THE TENDERER)

## SCHEDULE OF PLANT & MACHINERY

| S. No. | Description of plant /machinery | No. | Make | Age & condition | Location where installed | Remarks |
|---|---|---|---|---|---|---|

Signature:

Date :

Name:

Place :

Status:

Whether authorised attorney of the tendering company:

Name of the tendering company:

Date:

Address:

Company:

**SCHEDULE –F**

## (TO BE FILLED IN AND SIGNED BY THE TENDERER)
## SCHEDULE OF TECHNICAL PERSONNEL OF TENDERER

Specification no:
Details and work for which tendered:
Name and address of Tenderer:

| S. No. | Description | Name | Length of service in firm | Qualification | Professional experience and details of work carried out | Remarks |
|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |

Name :

Name of Tendering Company:

Signature : Date :

Date : Status: Address:

Place : Whether authorised attorney of Company:

the Tendering Company:

**SCHEDULE -G**

# PRICE ADJUSTMENT FORMULA

## I – TOWERS

Price payable to the supplier as stated in the contract shall be subject to adjustment during performance of the contract to reflect change as in the cost of labour and material components in accordance with the formula below.

$$P = \frac{Po}{100}\left(20 + 55\,\frac{Sl}{So} + 15\,\frac{Z1}{Zo} + 10\,\frac{L1}{Lo}\right) - Po$$

P= Adjustment amount payable to the supplier.

Po= Quoted Ex-factory price for the fabricated tower parts (including Bolts &Nuts). based on per tonne rate for fabricated tower parts (derived by dividing total ex-works price of fabricated tower parts by total guaranteed black weight of tower parts.)

S,Z,&L= Published price indices of steel, zinc and labour respectively .

Subscript 'O' refers to indices as on 30 days prior to bid closing date.

Subscript '1' refers to indices as on 60 days prior to the date to delivery.

For the purpose of this clause the date of delivery shall mean the contract date of delivery or actual date of delivery whichever is advantageous to the purchaser.

The bidders should submit along with their bids the published indices (Base date indices and extracts from the publication) to be applied to the formula in respect of material and labour with justification for their use. The indices/representative prices to be applied shall be as published from time to time by the Governments or by well recognised trade or commerce institutions. Wherever provision exists for variation the price of non-ferrous metals in the formula, the bidders may use the London metal exchange prices in respect of various metals. The tenderers should note that in the absence of complete information as indicated above the bids will be rejected.

NOTE: The above price adjustment formula shall be invoked by either party subject to the following further conditions:

a) Price adjustment will be applied only if the resulting increase or decrease is more than 5% of the Contract Price;

b) No Price increase shall be allowed beyond the original delivery dates unless specifically stated in the extension letter. As a rule no price adjustment shall be allowed for periods of delay for which Supplier is entirely responsible. The Purchaser will however be entitled to any decrease in the Contract Price.

c) The total adjustment under this clause shall be subject to a ceiling of plus or minus 20% of the Contract Price.

## PRICE ADJUSTMENT FORMULA

## II - ACSR PANTHER CONDUCTOR

Price payable to the supplier as stated in the contract shall be subject to adjustment during the performance of the contract to reflect changes in the cost of labour and material in accordance with the formula:

$$P = \frac{Po}{100}\left\{15 + 65\frac{A1}{Ao} + 13\frac{S1}{So} + 2\frac{Zl}{Zo} + 5\frac{L1}{LO}\right\} - Po$$

in which

P = Adjustment amount payable to the supplier per Km.

Po = Quoted Ex-factory price of Indian origin/FOB price of Non-Indian origin in the currency of the bid, shipment wise.

A = Published price indices of E.C. grade Aluminium ingots.

S = Published price indices of high Carbon Steel rods of 8mm dia with carbon content from 0.5% to 0.85 %.

Z = Published price indices of high grade electrolytic Zinc.

L = Published price indices of Labour.

Subscript ‘o’ refers to indices as on 30 days prior to bid closing date.

Subscript 'l' refers to indices as on 60 days prior to the date of delivery.

The “date of delivery" shall be the date on which the ACSR "PANTHER" Conductor actually ready for inspection as notified by the supplier or contracted

delivery date including any agreed extension there to or actual date of delivery whichever is advantageous to the purchaser.

The Bidders should submit along with their bids the published indices to be applied to the formula in respect of material and labour with justification for their use. The indices/representative prices to be applied shall be as published from time to time. The tenderers should note that in the absence of complete information as indicated above the bids will be rejected.

**NOTE:-**

The above price adjustment formula shall be invoked by either party subject to the following conditions:

a) Price adjustment will be applied only if the resulting increase or decrease is more than 5% of the contract price.

b) No price increase shall be allowed beyond the original delivery dates unless specifically stated in the extension letter. As a rule no price adjustment shall be allowed for periods of delay for which supplier is entirely responsible. The purchaser will however be entitled to any decrease in the contract price.

c) The total adjustment under this clause shall be subject to a ceiling of plus or minus 20% of the contract price.

d) Any claim for payment arising out of the price adjustment formula shall become payable only on completion of the 'Phase-wise' supplies.

## PRICE ADJUSTMENT FORMULAE FOR ERECTION
## III - ERECTION

$$PV = EO \left( \frac{10}{100} \cdot \frac{[x1-xo]}{Xo} + \frac{20}{100} \cdot \frac{[M1-Mo]}{Mo} + \frac{50}{100} \right) \frac{[L1-Lo]}{Lo}$$

Where PV= Price variation payable for the month.

E= Value of work done during the month, based on the contractual rates.

X= Rate of HSD oil prevailing at Gedu, Bhutan (as given in Indian Oil Corporation monthly circular).

M= Revised index number of the wholesale prices in India, as applicable for Miscellaneous products (base 1981-82=100) as published in their monthly bulletin by the Economic Advisor, Ministry of Industry Govt. of India.

L= All India consumer price index for industrial workers/General Index (base 1982=100 as published in India Labour, Journal, Labour Bureau, Ministry of Labour, Govt. of India.

Subscript 'O' will correspond to indices 30 days prior to the date to opening of bids. Subscript '1' will correspond to the month of billing.

For the purpose of this clause, the billing period shall mean, the billing period as per work schedule or actual period whichever is advantageous to the purchaser. The billing period for various erection activities will be as per agreed erection bar chart indicating monthly schedule of erection activities for completion of line.

Note: The above price adjustment formula shall be invoked by either party subject to the following further condition.

a) Price adjustment will be applied only if the resulting increase or decrease is more than 5% of the contract price.

b) No price increase shall be allowed beyond the original contractual period unless specifically stated in the extension letter.

c) The total adjustment under this clause shall be subject to a ceiling of plus or minis 20% of the contract price.

As rule, no price adjustment shall be allowed for periods of delay for which bidder is entirely responsible. The purchaser, will however, the entitled to decrease in the contract price

d) Any increase in the contract price due to above adjustment shall be payable on presentation of invoices alongwith calculations and supporting documents

e) Reduction in contract price as per price adjustment provision given here shall be effected by recovering 100% of immediately due for payment.

Except for the above, no price variation claim shall be admitted on any other account what so ever. Further no deviation in the price variation claims/formulae stipulated above shall be considered by the Board.

The prices for detailed survey, check survey, pipe and counterpoise earthing etc. to be quoted shall be firm. Price variation and no Price adjustment shall be applicable on the same.

# GOVERNMENT OF INDIA
# MINISTRY OF EXTERNAL AFFAIRS

# PRICE SCHEDULE

# OF

# 132 kV TRANSMISSION LINES

# FOR

# STRENGTHENING OF INDIA-NEPAL POWER TRANSMISSION INTERCONNECTION

## VOLUME-4

## Consultants:


**WAPCOS LIMITED**
**(A Govt. of India Undertaking)**
**PLOT NO. 76-C**
**SECTOR-18, INSTITUTIONAL AREA**
**GURGAON-122015,**
**HARYANA, INDIA**
**Ph.No: 91-124-2349416**
**Fax No: 91-124-2349184**
**E-mail: em@wapcos.gov.in**

**CENTRAL ELECTRICITY AUTHORITY,**
**SEWA BHAWAN ,**
**R.K.PURAM,**
**NEW DELHI-01**


**June, 2014**

**ABSTRACT OF PRICE SCHEDULE FOR CONSTRUCTION OF 132KV S/C TRANSMISSION LINE ON DOUBLE KATAIYA-KUSAHA AND RAXAUL - PARWANIPUR TRANSMISSION LINE**

## ABSTRACT OF PRICE SCHEDULE

| Sr. No. | NAME OF SUB-STATION | PRICE IN INR |
|---|---|---|
| | | |
| | CONSTRUCTION OF 132KV S/C TRANSMISSION LINE ON DOUBLE CIRCUIT TOWERS: | |
| 1 | KATAIYA-KUSAHA TRANSMISSION LINE | |
| 2 | RAXAUL - PARWANIPUR TRANSMISSION LINE | |
| TOTAL | | |

# KATAIYA – KUSAHA TRANSMISSION LINE

**ABSTRACT OF PRICE SCHEDULE FOR CONSTRUCTION OF 132KV S/C TRANSMISSION LINE ON DOUBLE CIRCUIT TOWERS:**

**LINE ROUTE: KATIYA - KUSAHA TRANSMISSION LINE (15.718 KM)**

**Price in Rs.**

| Item No. | Description | Total Prices (Exclusive of Taxes & Duties) |
|---|---|---|
| 1. | Tower Accessories (Schedule - A) | |
| 2. | Power Conductor, Ground Wire, Insulator Strings Complete Hardware, power Conductor accessories & Ground Wire Accessories (Schedule - B) | |
| 3. | Detailed Survey, Check Survey and Geotechnical Investigation (Schedule - C) | |
| 4. | Foundation Work (Schedule - D1) | |
| 5. | Site Clearance, Bench Cutting and Tower Protection Works (Schedule - D 2) | |
| 6. | Pile Foundation (Schedule - D 3) | |
| 7 | Erection Work (Schedule - D 4) | |
| 8 | Type Test Charges (Schedule - E) | |

| | | |
|---|---|---|
| 9 | Insurance Charges (Schedule - F) | |
| 10 | Unit Rates for Supply (Schedule - G1) | |
| 11 | Unit Rates for Erection (Schedule - G 2) | |
| | **Total Cost (1+2+3+4+5+6+7+8+9+10+11)** | |

**P R I C E  S C H E D U L E - A**

**CONSTRUCTION OF 132KV S/C TRANSMISSION LINE ON DOUBLE CIRCUIT TOWERS:**

**LINE ROUTE: KATIYA - KUSAHA TRANSMISSION LINE (15.718 KM)**

**A Towers & Accessories**

| Sl. No. | Description of item / Work | Unit | Qty. (Nos.) | Unit Weight (MT) | Total weight (MT) | Unit Price Ex-Works (including packing & forwarding) (Rs) | Taxes & Duties, if any (Rs.) | Transportation upto Project site (Rs) | Total Unit price at site (Rs) (7+8+9) | Total Price at site (Rs) (4x10) | Rate per MT at site (Rs) (10/5) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| 1 | Tangent towers (0° - 2°) (including design, fabrication, galvanising, complete with nuts, bolts & washers etc.) | | | | | | | | | | |
| a) | Superstructure | No | 40 | | | | | | | | |
| b) | Stub (set of 4) | Set | 40 | | | | | | | | |
| 2 | Small angle tension towers (2° - 15°) (including design, fabrication, galvanising, complete with nuts, bolts & washers etc.) | | | | | | | | | | |
| a) | Superstructure | No | 4 | | | | | | | | |
| b) | Stub (set of 4) | Set | 4 | | | | | | | | |
| 3 | Medium angle tension towers 15°-30°) (including design, fabrication, galvanising, complete with nuts, bolts & washers etc.) | | | | | | | | | | |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| a) | Superstructure | No | 4 | | | | | | | | |
| b) | Stub (set of 4) | Set | 4 | | | | | | | | |
| 4 | Large angle tension towers (30° - 60° and Dead end) (including design, fabrication, galvanising, complete with nuts, bolts & washers etc.) | | | | | | | | | | |
| a) | Superstructure | No. | 4 | | | | | | | | |
| b) | Stub (set of 4) | Set | 4 | | | | | | | | |
| 5 | Stub setting templates for standard tower and suitable for use with their 3m, 6m & 9m extensions for supply to Purchaser Stores. | | | | | | | | | | |
| a) | Tangent towers | No. | 1 | | | | | | | | |
| b) | Small angle tension towers | No. | 1 | | | | | | | | |
| c) | medium angle tension towers | No. | 1 | | | | | | | | |
| d) | large angle tension towers | No. | 1 | | | | | | | | |
| 6 | Design and destruction tests including the cost of materials after allowing rebate for scrap value of steel of destroyed tower with 9m extension. | | | | | | | | | | |
| 6.1 | Tangent Towers (0° - 2°) | | | | | | | | | | |
| a) | Design Load Tests | No. | 1 | | | | | | | | |
| b) | Destruction Test | No. | 1 | | | | | | | | |
| 6.2 | Small angle tension towers (2° - 15°) | | | | | | | | | | |
| a) | Design Load Tests | No. | 1 | | | | | | | | |
| b) | Destruction Test | No. | 1 | | | | | | | | |
| 6.3 | Medium angle tension towers (15° - 30°) | | | | | | | | | | |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| a) | Design Load Tests | No. | 1 | | | | | | | | |
| b) | Destruction Test | No. | 1 | | | | | | | | |
| 6.4 | Large angle tension towers (30° - 60° and Dead end) | | | | | | | | | | |
| a) | Design Load Tests | No. | 1 | | | | | | | | |
| b) | Destruction Test | No. | 1 | | | | | | | | |
| 7 | 3 metre extensions | | | | | | | | | | |
| a) | Tangent Tower | No. | 3 | | | | | | | | |
| b) | Small angle tension towers | No. | 1 | | | | | | | | |
| c) | Medium angle tension towers | No. | 1 | | | | | | | | |
| d) | Large angle & Dead end tension towers | No. | 1 | | | | | | | | |
| 8 | 6 metre extensions (complete). | | | | | | | | | | |
| a) | Tangent Tower | No. | 3 | | | | | | | | |
| b) | Small angle tension towers | No. | 1 | | | | | | | | |
| c) | Medium angle tension towers | No. | 1 | | | | | | | | |
| d) | Large angle & Dead end tension towers | No. | 1 | | | | | | | | |
| 9 | 9 metre extensions (complete). | | | | | | | | | | |
| a) | Tangent Tower | No. | 3 | | | | | | | | |
| b) | Small angle tension towers | No. | - | | | | | | | | |
| c) | Medium angle tension towers | No. | - | | | | | | | | |
| d) | Large angle & Dead end tension towers | No. | - | | | | | | | | |
| 10 | Number plates with bolts, nuts and washers. | No. | 52 | | | | | | | | |
| 11 | Danger Plates with bolts, nuts and washers. | No. | 52 | | | | | | | | |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 12 | Phase plates with bolts, nuts and washers (set of three) | Set | 52 | | | | | | | | |
| 13 | Circuit Plate (set of two) | Set | 0 | | | | | | | | |
| 14 | Anti-climbing devices for | | | | | | | | | | |
| a) | Tangent Tower | No. | 40 | | | | | | | | |
| b) | Small angle tension towers | No. | 4 | | | | | | | | |
| c) | Medium angle tension towers | No. | 4 | | | | | | | | |
| d) | Large angle & Dead end tension towers | No. | 4 | | | | | | | | |
| 15 | Bird Guard (Set of Three) | Set | 40 | | | | | | | | |
| 16 | Earthing of towers | | | | | | | | | | |
| a) | Pipe Type | No. | 42 | | | | | | | | |
| b) | Counterpoise earthing material complete with necessary bolts, nuts and washers with 120m length wire. | Set | 10 | | | | | | | | |
| | **Total - A** | | | | | | | | | | |
| | NA - Not applicable | | | | | | | | | | |

**P R I C E  S C H E D U L E - B**

**CONSTRUCTION OF 132KV S/C TRANSMISSION LINE ON DOUBLE CIRCUIT TOWERS:**

**LINE ROUTE: KATIYA - KUSAHA TRANSMISSION LINE (15.718 KM)**

**B POWER CONDUCTOR, GROUND WIRE, INSULATOR STRINGS COMPLETE WITH HARDWARE, POWER CONDUCTOR ACCESSORIES & GROUND WIRE ACCESSORIES**

| Sl. No. | Description of item / Work | Make | Unit | Qty. (Nos.) | Unit Price Ex-Works (including packing & forwarding) (Rs) | Taxes & Duties, if any (Rs) | Transportation upto Project site (Rs) | Total Unit price at site (Rs) (6+7+8) | Total Price at site (Rs) (5x9) |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| 1 | ACSR 'Panther' Conductor 30/3.00 mm Al+7/3.00 mm St. | | km | 49 | | | | | |
| 2 | GROUNDWIRE:<br>Groundwire 7/3.15mm, 110kg/sq.mm Quality GSS. | | km | 16.2 | | | | | |
| 3 | Single Suspension Strings complete with hardware fittings & with 1x9 Nos., 70 KN Insulators | | Sets | 120 | | | | | |
| 4 | Double Suspension Strings complete with hardware fittings & with 2x9 Nos., 70 KN Insulators | | Sets | 6 | | | | | |
| 5 | Single Tension Strings complete with hardware fittings & with 1x10 Nos. 90 KN Insulators | | Sets | 72 | | | | | |
| 6 | Double Tension Strings complete with hardware fittings & with 2x10 Nos. 90 KN Insulators | | Sets | 4 | | | | | |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **7** | Single Suspension Pilot Strings complete with hardware & with 1x9 Nos. 70 KN Insulators | | Sets | 12 | | | | | |
| **8** | Power Conductor Accessories | | | | | | | | |
| **a)** | Preformed Armour Rod Set | | Sets | 120 | | | | | |
| **b)** | Mid span compression joint | | No. | 48 | | | | | |
| **c)** | Repair Sleeves | | No. | 48 | | | | | |
| **d)** | Vibration Damper | | No. | 312 | | | | | |
| **9** | Groundwire Accessories | | | | | | | | |
| **a)** | Mid span compression joint | | No. | 9 | | | | | |
| **b)** | Suspension clamp | | No. | 40 | | | | | |
| **c)** | Compression type tension clamp | | No. | 24 | | | | | |
| **d)** | Copper bonding pieces | | No. | 64 | | | | | |
| **e)** | Vibration Damper | | No. | 104 | | | | | |
| | **TOTAL - B** | | | | | | | | |

NA - Not applicable

**P R I C E  S C H E D U L E - C**

**CONSTRUCTION OF 132KV S/C TRANSMISSION LINE ON DOUBLE CIRCUIT TOWERS**

**LINE ROUTE: KATAIYA - KUSAHA TRANSMISSION LINE (15.718 KM)**

**DETAILED SURVEY, CHECK SURVEY and GEOTECHNICAL INVESTIGATION.**

| Item No. | Description | Unit | Qty. | Price | |
|---|---|---|---|---|---|
| | | | | Unit Price | Total |
| -1 | -2 | -3 | -4 | -5 | -6 |
| 1 | Tree cutting of all sizes (trees of girth size ≥ 0.2m). | No. | 30 | | |
| | | | | | |
| 2 | **Detailed Survey** | | | | |
| | Profiling & Tower Spotting | km | 15.718 | | |
| 3 | **Geotechnical Investigation** | | | | |
| 3.1 | Carrying out Standard Penetration Tests at tower locations in Bore holes at 1.5m, 3m, 6m, 9m, 12m, 15m depths (in case of Shallow foundations). | No. | 12 | | |
| 3.2 | Carrying out Standard Penetration Tests at tower location in Bore holes at 2m, 5m, 8m, 11m, 14m, 17m, 20m, 23m, 26m, 29m, 30m depths (in case of Pile foundation). | No. | 12 | | |
| 3.3 | Collection of Disturbed soil samples at tower location in Bore holes at 1.0m, 2.5m, 4.5m, 7.5m, 10.5m, 13.5 m depths (in case of Shallow Foundations). | No. | 72 | | |

| | | | | | |
|---|---|---|---|---|---|
| 3.4 | Collection of Disturbed soil samples at tower location in Bore holes at 1.5m, 3.5m, 6.5m, 9.5m, 12.5m, 15.5 m, 18.5m, 21.5m, 24.5m, 27.5m (in case of Pile Foundations). | No. | 120 | | |
| 3.5 | Collection of Undisturbed soil samples in Bore holes at 1.5m, 3m, 6m, 9m, 12m, 15m depths (in case of Shallow Foundations). | No. | 72 | | |
| 3.6 | Collection of Undisturbed soil samples in Bore holes at 2m, 5m, 8m, 11m, 14m, 17m, 20m, 23m, 26m, 29m, 30m depths (in case of Pile Foundations). | No. | 132 | | |
| 3.7 | Carrying out following laboratory tests as per technical specifications, relevant BIS code & instructions of Purchaser on disturbed / undisturbed soil samples collected at different depths in boreholes. | | | | |
| 3.7.1 | **For Disturbed soil sample:-** Soil classification: Grain size Analysis (Gradation) sieve/hydrometer analysis.<br>-Specific gravity. -<br>Consistency limits.(liquid limit, plastic limit)<br>-In situ properties : bulk density, dry density, natural moisture content, void ratio.<br>-OMC (optimum moisture content)<br>-Maximum Dry Density at OMC. | | | | |
| | (a) Shallow Foundations | No. | 72 | | |
| | (b) Pile Foundations | No. | 120 | | |
| 3.7.2 | **For Undisturbed soil sample:-** -Shear strength parameters for Cohesive soil: cohesion and angle of internal friction, Compression index, Consolidation parameters, unconfined compressive strength.<br>-Shear strength parameters for Cohesion less soil: angle of internal friction, direct shear strength. | | | | |

| | | | | | |
|---|---|---|---|---|---|
| | -Normal soil types: cohesion and angle of internal friction. | | | | |
| | (a) Shallow Foundations | No. | 72 | | |
| | (b) Pile Foundations | No. | 132 | | |
| **4** | Check Survey, Pegging of Tower centers, pit marking at site etc. | km | 15.718 | | |
| | **TOTAL - C** | | | | |

| PRICE SCHEDULE - D | | | | | | | |
|---|---|---|---|---|---|---|---|
| **CONSTRUCTION OF 132KV S/C TRANSMISSION LINE ON DOUBLE CIRCUIT TOWERS:** | | | | | | | |
| **LINE ROUTE: KATIYA - KUSAHA TRANSMISSION LINE (15.718 KM)** | | | | | | | |
| **D.** | **ERECTION OF 132 KV SINGLE CIRCUIT TRANSMISSION LINE** | | | | | | |
| **D1** | **FOUNDATION WORK** | | | | | | |
| | | | | | | **Figures in Rupees** | |
| **Item No.** | **Description** | **No. of Towers** | **Unit** | **To be quoted by bidder** | | | |
| | | | | **Guaranteed quantity per Tower** | **Total Quantity** | **Price** | |
| | | | | | | **Unit Price** | **Total** |
| **(1)** | **(2)** | **(3)** | **(4)** | **(5)** | **(6) =(3)*(5)** | **(7)** | **(8) =(6)*(7)** |
| 1 | **Earth work in excavation in all types of soil including backfilling, compacting and disposal of extra earth with all leads and lifts, including the cost of dewatering, charges for plant & equipment, labour etc. complete in all respect as per approved foundation drawing, technical specifications and direction of purchaser.** | | | | | | |
| 1.1 | **For 'A' Type Towers (0 - 2°)** | | | | | | |
| 1.1.1 | Normal Dry soil type | 3 | Cu-m | | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1.1.2 | Normal soil Wet type | 11 | Cu-m | | | | |
| 1.1.3 | Normal soil Partially submerged type | 9 | Cu-m | | | | |
| 1.1.4 | Normal soil Fully submerged type | 5 | Cu-m | | | | |
| | | | | | | | |
| 1.2 | **For 'A' type Towers with 3.0 m, 6.0 m & 9.0 m body extensions (0 - 2°)** | | | | | | |
| 1.2.1 | Normal Dry soil type | 1 | Cu-m | | | | |
| 1.2.2 | Normal soil Wet type | 3 | Cu-m | | | | |
| 1.2.3 | Normal soil Partially submerged type | 2 | Cu-m | | | | |
| 1.2.4 | Normal soil Fully submerged type | 2 | Cu-m | | | | |
| | | | | | | | |
| 1.3 | **For 'B' Type Towers(2° - 15°)** | | | | | | |
| 1.3.1 | Normal Dry soil type | 0 | Cu-m | | | | |
| 1.3.2 | Normal soil Wet type | 1 | Cu-m | | | | |
| 1.3.3 | Normal soil Partially submerged type | 1 | Cu-m | | | | |
| 1.3.4 | Normal soil Fully submerged type | 0 | Cu-m | | | | |
| | | | | | | | |
| 1.4 | **For 'B' type Towers with 3.0 m, 6.0 m & 9.0 m body extensions(2° - 15°)** | | | | | | |
| 1.4.1 | Normal Dry soil type | 0 | Cu-m | | | | |
| 1.4.2 | Normal soil Wet type | 1 | Cu-m | | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1.4.3 | Normal soil Partially submerged type | 1 | Cu-m | | | | |
| 1.4.4 | Normal soil Fully submerged type | 0 | Cu-m | | | | |
| | | | | | | | |
| 1.5 | **For 'C' Type Towers(15°-30°)** | | | | | | |
| 1.5.1 | Normal Dry soil type | 0 | Cu-m | | | | |
| 1.5.2 | Normal soil Wet type | 1 | Cu-m | | | | |
| 1.5.3 | Normal soil Partially submerged type | 1 | Cu-m | | | | |
| 1.5.4 | Normal soil Fully submerged type | 0 | Cu-m | | | | |
| | | | | | | | |
| 1.6 | **For 'C' type Towers with 3.0 m, 6.0 m & 9.0 m body extensions (15°-30°)** | | | | | | |
| 1.6.1 | Normal Dry soil type | 0 | Cu-m | | | | |
| 1.6.2 | Normal soil Wet type | 1 | Cu-m | | | | |
| 1.6.3 | Normal soil Partially submerged type | 1 | Cu-m | | | | |
| 1.6.4 | Normal soil Fully submerged type | 0 | Cu-m | | | | |
| | | | | | | | |
| 1.7 | **For 'D' Type Towers(30°-60°)** | | | | | | |
| 1.7.1 | Normal Dry soil type | 0 | Cu-m | | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1.7.2 | Normal soil Wet type | 1 | Cu-m | | | | |
| 1.7.3 | Normal soil Partially submerged type | 1 | Cu-m | | | | |
| 1.7.4 | Normal soil Fully submerged type | 0 | Cu-m | | | | |
| | | | | | | | |
| 1.8 | **For 'D' type Towers with 3.0 m, 6.0 m & 9.0 m body extensions ($30^{o}$-$60^{o}$)** | | | | | | |
| 1.8.1 | Normal Dry soil type | 0 | Cu-m | | | | |
| 1.8.2 | Normal soil Wet type | 1 | Cu-m | | | | |
| 1.8.3 | Normal soil Partially submerged type | 1 | Cu-m | | | | |
| 1.8.4 | Normal soil Fully submerged type | 0 | Cu-m | | | | |
| | | | | | | | |
| 2 | **Providing Lean concrete of M10 grade below tower foundations including the cost of all materials, labour, hiring charges for plant & equipment POL,transportation etc. complete in all respect as per approved foundation drawings, technical specification and instructions of purchaser** | | | | | | |
| 2.1 | **For 'A' Type Towers (0 - $2^{o}$)** | | | | | | |
| 2.1.1 | Normal Dry soil type | 3 | Cu-m | | | | |
| 2.1.2 | Normal soil Wet type | 11 | Cu-m | | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 2.1.3 | Normal soil Partially submerged type | 9 | Cu-m | | | | |
| 2.1.4 | Normal soil Fully submerged type | 5 | Cu-m | | | | |
| | | | | | | | |
| 2.2 | **For 'A' type Towers with 3.0 m, 6.0 m & 9.0 m body extensions (0 - 2°)** | | | | | | |
| 2.2.1 | Normal Dry soil type | 1 | Cu-m | | | | |
| 2.2.2 | Normal soil Wet type | 3 | Cu-m | | | | |
| 2.2.3 | Normal soil Partially submerged type | 2 | Cu-m | | | | |
| 2.2.4 | Normal soil Fully submerged type | 2 | Cu-m | | | | |
| | | | | | | | |
| 2.3 | **For 'B' Type Towers(2° - 15°)** | | | | | | |
| 2.3.1 | Normal Dry soil type | 0 | Cu-m | | | | |
| 2.3.2 | Normal soil Wet type | 1 | Cu-m | | | | |
| 2.3.3 | Normal soil Partially submerged type | 1 | Cu-m | | | | |
| 2.3.4 | Normal soil Fully submerged type | 0 | Cu-m | | | | |
| | | | | | | | |
| 2.4 | **For 'B' type Towers with 3.0 m, 6.0 m & 9.0 m body extensions(2° - 15°)** | | | | | | |
| 2.4.1 | Normal Dry soil type | 0 | Cu-m | | | | |
| 2.4.2 | Normal soil Wet type | 1 | Cu-m | | | | |
| 2.4.3 | Normal soil Partially submerged type | 1 | Cu-m | | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 2.4.4 | Normal soil Fully submerged type | 0 | Cu-m | | | | |
| | | | | | | | |
| 2.5 | **For 'C' Type Towers(15°-30°)** | | | | | | |
| 2.5.1 | Normal Dry soil type | 0 | Cu-m | | | | |
| 2.5.2 | Normal soil Wet type | 1 | Cu-m | | | | |
| 2.5.3 | Normal soil Partially submerged type | 1 | Cu-m | | | | |
| 2.5.4 | Normal soil Fully submerged type | 0 | Cu-m | | | | |
| | | | | | | | |
| 2.6 | **For 'C' type Towers with 3.0 m, 6.0 m & 9.0 m body extensions (15°-30°)** | | | | | | |
| 2.6.1 | Normal Dry soil type | 0 | Cu-m | | | | |
| 2.6.2 | Normal soil Wet type | 1 | Cu-m | | | | |
| 2.6.3 | Normal soil Partially submerged type | 1 | Cu-m | | | | |
| 2.6.4 | Normal soil Fully submerged type | 0 | Cu-m | | | | |
| | | | | | | | |
| 2.7 | **For 'D' Type Towers(30°-60°)** | | | | | | |
| 2.7.1 | Normal Dry soil type | 0 | Cu-m | | | | |
| 2.7.2 | Normal soil Wet type | 1 | Cu-m | | | | |
| 2.7.3 | Normal soil Partially submerged type | 1 | Cu-m | | | | |
| 2.7.4 | Normal soil Fully submerged type | 0 | Cu-m | | | | |
| | | | | | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 2.8 | **For 'D' type Towers with 3.0 m, 6.0 m & 9.0 m body extensions (30°-60°)** | | | | | | |
| 2.8.1 | Normal Dry soil type | 0 | Cu-m | | | | |
| 2.8.2 | Normal soil Wet type | 1 | Cu-m | | | | |
| 2.8.3 | Normal soil Partially submerged type | 1 | Cu-m | | | | |
| 2.8.4 | Normal soil Fully submerged type | 0 | Cu-m | | | | |
| | | | | | | | |
| 3 | **Concreting in tower foundations with M 25 grade concrete including the cost of all materials, shuttering/formwork, charges for plant & equipment, labour, POL,transportation etc. complete in all respect as per approved tower foundation drawings, technical specifications and direction of purchaser.** | | | | | | |
| 3.1 | **For 'A' Type Towers (0 - 2°)** | | | | | | |
| 3.1.1 | Normal Dry soil type | 3 | Cu-m | | | | |
| 3.1.2 | Normal soil Wet type | 11 | Cu-m | | | | |
| 3.1.3 | Normal soil Partially submerged type | 9 | Cu-m | | | | |
| 3.1.4 | Normal soil Fully submerged type | 5 | Cu-m | | | | |
| | | | | | | | |
| 3.2 | **For 'A' type Towers with 3.0 m, 6.0 m & 9.0 m body extensions (0 - 2°)** | | | | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 3.2.1 | Normal Dry soil type | 1 | Cu-m | | | | |
| 3.2.2 | Normal soil Wet type | 3 | Cu-m | | | | |
| 3.2.3 | Normal soil Partially submerged type | 2 | Cu-m | | | | |
| 3.2.4 | Normal soil Fully submerged type | 2 | Cu-m | | | | |
| | | | | | | | |
| 3.3 | **For 'B' Type Towers($2^{o}$ - $15^{o}$)** | | | | | | |
| 3.3.1 | Normal Dry soil type | 0 | Cu-m | | | | |
| 3.3.2 | Normal soil Wet type | 1 | Cu-m | | | | |
| 3.3.3 | Normal soil Partially submerged type | 1 | Cu-m | | | | |
| 3.3.4 | Normal soil Fully submerged type | 0 | Cu-m | | | | |
| | | | | | | | |
| 3.4 | **For 'B' type Towers with 3.0 m, 6.0 m & 9.0 m body extensions($2^{o}$ - $15^{o}$)** | | | | | | |
| 3.4.1 | Normal Dry soil type | 0 | Cu-m | | | | |
| 3.4.2 | Normal soil Wet type | 1 | Cu-m | | | | |
| 3.4.3 | Normal soil Partially submerged type | 1 | Cu-m | | | | |
| 3.4.4 | Normal soil Fully submerged type | 0 | Cu-m | | | | |
| | | | | | | | |
| 3.5 | **For 'C' Type Towers($15^{o}$-$30^{o}$)** | | | | | | |
| 3.5.1 | Normal Dry soil type | 0 | Cu-m | | | | |
| 3.5.2 | Normal soil Wet type | 1 | Cu-m | | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 3.5.3 | Normal soil Partially submerged type | 1 | Cu-m | | | | |
| 3.5.4 | Normal soil Fully submerged type | 0 | Cu-m | | | | |
| | | | | | | | |
| 3.6 | **For 'C' type Towers with 3.0 m, 6.0 m & 9.0 m body extensions ($15^{o}$-$30^{o}$)** | | | | | | |
| 3.6.1 | Normal Dry soil type | 0 | Cu-m | | | | |
| 3.6.2 | Normal soil Wet type | 1 | Cu-m | | | | |
| 3.6.3 | Normal soil Partially submerged type | 1 | Cu-m | | | | |
| 3.6.4 | Normal soil Fully submerged type | 0 | Cu-m | | | | |
| | | | | | | | |
| 3.7 | **For 'D' Type Towers($30^{o}$-$60^{o}$)** | | | | | | |
| 3.7.1 | Normal Dry soil type | 0 | Cu-m | | | | |
| 3.7.2 | Normal soil Wet type | 1 | Cu-m | | | | |
| 3.7.3 | Normal soil Partially submerged type | 1 | Cu-m | | | | |
| 3.7.4 | Normal soil Fully submerged type | 0 | Cu-m | | | | |
| | | | | | | | |
| 3.8 | **For 'D' type Towers with 3.0 m, 6.0 m & 9.0 m body extensions ($30^{o}$-$60^{o}$)** | | | | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 3.8.1 | Normal Dry soil type | 0 | Cu-m | | | | |
| 3.8.2 | Normal soil Wet type | 1 | Cu-m | | | | |
| 3.8.3 | Normal soil Partially submerged type | 1 | Cu-m | | | | |
| 3.8.4 | Normal soil Fully submerged type | 0 | Cu-m | | | | |
| | | | | | | | |
| 4 | **Supply, cutting, bending, placing,tieing of reinforcement steel of Fe415/ Fe 500 grade in tower foundations and preparation of bar bending schedule, including the cost of all materials, hiring charges for plant/equipment, binding, cost of binding wire, labour, POL, transportation etc. complete in all respect as per approved foundation drawings, technical specifications and direction of purchaser.** | | | | | | |
| 4.1.0 | **For 'A' Type Towers (0 - 2°)** | | | | | | |
| 4.1.1 | Normal Dry soil type | 3 | MT | | | | |
| 4.1.2 | Normal soil Wet type | 11 | MT | | | | |
| 4.1.3 | Normal soil Partially submerged type | 9 | MT | | | | |
| 4.1.4 | Normal soil Fully submerged type | 5 | MT | | | | |
| | | | | | | | |
| 4.2 | **For 'A' type Towers with 3.0 m, 6.0 m & 9.0 m body extensions (0 - 2°)** | | | | | | |
| 4.2.1 | Normal Dry soil type | 1 | MT | | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 4.2.2 | Normal soil Wet type | 3 | MT | | | | |
| 4.2.3 | Normal soil Partially submerged type | 2 | MT | | | | |
| 4.2.4 | Normal soil Fully submerged type | 2 | MT | | | | |
| | | | | | | | |
| 4.3 | **For 'B' Type Towers($2^{o}$ - $15^{o}$)** | | | | | | |
| 4.3.1 | Normal Dry soil type | 0 | MT | | | | |
| 4.3.2 | Normal soil Wet type | 1 | MT | | | | |
| 4.3.3 | Normal soil Partially submerged type | 1 | MT | | | | |
| 4.3.4 | Normal soil Fully submerged type | 0 | MT | | | | |
| | | | | | | | |
| 4.4 | **For 'B' type Towers with 3.0 m, 6.0 m & 9.0 m body extensions($2^{o}$ - $15^{o}$)** | | | | | | |
| 4.4.1 | Normal Dry soil type | 0 | MT | | | | |
| 4.4.2 | Normal soil Wet type | 1 | MT | | | | |
| 4.4.3 | Normal soil Partially submerged type | 1 | MT | | | | |
| 4.4.4 | Normal soil Fully submerged type | 0 | MT | | | | |
| | | | | | | | |
| 4.5 | **For 'C' Type Towers($15^{o}$-$30^{o}$)** | | | | | | |
| 4.5.1 | Normal Dry soil type | 0 | MT | | | | |
| 4.5.2 | Normal soil Wet type | 1 | MT | | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 4.5.3 | Normal soil Partially submerged type | 1 | MT | | | | |
| 4.5.4 | Normal soil Fully submerged type | 0 | MT | | | | |
| | | | | | | | |
| 4.6 | **For 'C' type Towers with 3.0 m, 6.0 m & 9.0 m body extensions (15°-30°)** | | | | | | |
| 4.6.1 | Normal Dry soil type | 0 | MT | | | | |
| 4.6.2 | Normal soil Wet type | 1 | MT | | | | |
| 4.6.3 | Normal soil Partially submerged type | 1 | MT | | | | |
| 4.6.4 | Normal soil Fully submerged type | 0 | MT | | | | |
| | | | | | | | |
| 4.7 | **For 'D' Type Towers(30°-60°)** | | | | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 4.7.1 | Normal Dry soil type | 0 | MT | | | | |
| 4.7.2 | Normal soil Wet type | 1 | MT | | | | |
| 4.7.3 | Normal soil Partially submerged type | 1 | MT | | | | |
| 4.7.4 | Normal soil Fully submerged type | 0 | MT | | | | |
| | | | | | | | |
| 4.8 | **For 'D' type Towers with 3.0 m, 6.0 m & 9.0 m body extensions (30°-60°)** | | | | | | |
| 4.8.1 | Normal Dry soil type | 0 | MT | | | | |
| 4.8.2 | Normal soil Wet type | 1 | MT | | | | |
| 4.8.3 | Normal soil Partially submerged type | 1 | MT | | | | |
| 4.8.4 | Normal soil Fully submerged type | 0 | MT | | | | |
| | | | | | | | |
| | **Note :** | | | | | | |
| 1 | Carriage of all materials like cement, coarse & fine aggregates, stub by mechanical means (or as the case may be) etc. to site of work shall be included in the rates of relevant items of works. | | | | | | |
| 2 | Any other item of supply of material or erection etc. along with its cost required for successful completion/ commissioning of the work is to be duly specified by the bidder. | | | | | | |
| 3 | Bidder shall quote the guaranteed quantities for various items of foundation work and their unit rates in the above schedule. | | | | | | |
| 4 | Necessary access to the Tower Location shall be prepared by the contractor & nothing extra shall be paid for it. | | | | | | |

**PRICE SCHEDULE - D**

**CONSTRUCTION OF 132KV S/C TRANSMISSION LINE ON DOUBLE CIRCUIT TOWERS:**

**LINE ROUTE: KATIYA - KUSAHA TRANSMISSION LINE (15.718 KM)**

**D. ERECTION OF 132 KV SINGLE CIRCUIT TRANSMISSION LINE**

**D2 SITE CLEARANCE,BENCH CUTTING AND TOWER PROTECTION WORKS**

**Figures in Rupees**

| Item No. | Description | Unit | Qty. | Price | |
|---|---|---|---|---|---|
| | | | | Unit Price | Total |
| (1) | (2) | (3) | (4) | (5) | (6) |
| 1 | Site clearance including removal of bush and including tree cutting of girth size of <0.2m as per site requirement and instruction of purchaser. | Per tower loc. | 50 | | |
| 2 | Earthwork in excavation in Bench cutting in all type of soil as per site requirement for tower foundations , complete in all respects as per approved foundation drawings, technical specification and instruction of purchaser. | cum | 100 | | |
| | | | | | |
| **3** | **Protection works** | | | | |

| | | | | | |
|---|---|---|---|---|---|
| 3.1 | Earth work in excavation in all types of soil for Tower Protection Works including backfilling, compacting and disposal of extra earth with all leads and lifts, including the cost of dewatering, charges for plant & equipment, labour etc. complete in all respect as per approved foundation drawing, technical specifications and direction of purchaser. | | | | |
| | a) In dry soil | Cum | 220 | | |
| | b) Extra over item 3.1(a) for excavation below water table | Cum | 100 | | |
| 3.2 | Providing Lean concrete of M10 grade below Retaining wall / Breast wall including the cost of all materials, labour, charges for plant & equipment POL, transportation etc. complete in all respect as per approved foundation drawings, technical specification and instructions of purchaser. | Cum | 25 | | |
| 3.3 | Providing and laying random rubble masonry with hard stone in Retaining /Breast Walls in cement mortar 1:5 and pointing/ plastering with cement mortar 1:3 (1 cement :3 sand) including 100 mm thick PCC M-15 coping at the top of retaining /breast wall, weep holes @ 300 mm x 300 mm including the charges for plant & equipment, labour etc. complete in all respect as per approved foundation drawing, technical specifications and direction of purchaser. | Cum | 150 | | |

| | | | | | |
|---|---|---|---|---|---|
| 3.4 | Providing and laying brick masonry in Retaining /Breast Walls in cement mortar 1:5 and pointing/ plastering with cement mortar 1:3 (1 cement :3 sand) including 100 mm thick PCC M-15 coping at the top of retaining /breast wall, weep holes @ 300 mm x 300 mm including the charges for plant & equipment, labour etc. complete in all respect as per approved foundation drawing, technical specifications and direction of purchaser. | Cum | 150 | | |
| | ***Sub Total*** | | | | |

**Note :**

1 Carriage of all materials like cement, coarse & fine aggregates, stub etc. to site of work shall be included in the rates of relevant items of works.

2 Any other item of supply of material or erection etc. along with its cost required for successful completion/ commissioning of the work is to be duly specified by the bidder.

**P R I C E S C H E D U L E - D**

**CONSTRUCTION OF 132KV S/C TRANSMISSION LINE ON DOUBLE CIRCUIT TOWERS:**

**LINE ROUTE: KATIYA - KUSAHA TRANSMISSION LINE (15.718 KM)**

**D.** **ERECTION OF 132 KV SINGLE CIRCUIT TRANSMISSION LINE**

**D3 PILE FOUNDATION**

| Item No. | Description | Unit | Qty. | Price | |
|---|---|---|---|---|---|
| | | | | Unit Price | Total |
| -1 | -2 | -3 | -4 | -5 | -6 |
| | **Providing Pile foundation for towers using 400mm mm dia Bored Cast-in-Situ Concrete Piles of specified length, including pile cap and chimney:** | | | | |
| 1 | Earth work in excavation in all types of soil for Pile Caps including backfilling, compacting, disposal of extra earth with all leads and lifts, the cost of dewatering, labour, charges of plant/equipment etc. complete in all respect as per approved foundation drawing, technical specifications and direction of Engineer-In -Charge. | cum | 260 | | |

| | | | | | |
|---|---|---|---|---|---|
| 2 | Boring for pile in all types for soil including charges for plant & equipment, labour, bentonite slurry, POL, etc. complete in all respect as per approved foundation drawings, technical specification and direction of Purchaser. | RM | 960 | | |
| 3 | Providing Reinforcement of Fe-415/500 grade steel in piles and pile caps including the cost of cutting, bending, placing, binding etc. including cost of all materials, charges of plant/equipment , labour, POL, transportation etc. complete in all respect as per approved foundation drawings, technical specification and instructions of Purchaser. | | | | |
| | (i) Pile | MT | 4 | | |
| | (ii) Pile Cap with Chimney | MT | 3 | | |
| 4 | Concreting in piles and pile caps with M-25 grade concrete including the cost of all materials, charges of plant/equipment, labour, POL, transportation etc. complete in all respect as per approved foundation drawings, technical specification and instructions of Purchaser | | | | |
| | (i)Pile | cum | 130 | | |
| | (ii) Pile Cap with Chimney | cum | 80 | | |

| | | | | | |
|---|---|---|---|---|---|
| 5 | Providing Lean concrete of M10 grade below Pile Caps including the cost of all materials, labour, charges of plant/equipment, POL, transportation etc. complete in all respect as per approved foundation drawings, technical specification and instructions of Purchaser. | cum | 10 | | |

**Note :**

1 As transmission line is passing through Kosi flood plain the provision of pile foundation has been considered which may /may not be required as per actual site conditions encountered during construction of the transmission line.

2 The payment for pile foundation shall be made as per actual quantity executed and measured at site and unit rates quoted by the contractor.

3 Carriage of all materials like cement, coarse & fine aggregates, stub by mechanical means or (as the case may be) etc. to site of work shall be included in the unit rates of relevant items of works.

4 Any other item of supply of material or erection etc. along with its cost required for successful completion/ commissioning of the work is to be duly specified by the bidder.

5 Necessary access to the Tower Location shall be provided by the contractor & nothing extra shall be paid for it.

**P R I C E  S C H E D U L E - D**

**CONSTRUCTION OF 132KV S/C TRANSMISSION LINE ON DOUBLE CIRCUIT TOWERS:**

**LINE ROUTE: KATIYA - KUSAHA TRANSMISSION LINE (15.718 KM)**

**D.**

**ERECTION OF 132 KV SINGLE CIRCUIT TRANSMISSION LINE**

**D4 ERECTION WORK EXCLUDING CIVIL WORKS**

| Sl. No. | Description | Unit | Tower Type | Qty. | Unit Rate (Rs) | Amount (Rs) | Rate per MT (Rs) |
|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| 1 | Setting of stubs for all type of towers excluding cost of foundation, excavation and concreting for 52 sets | Set | A | 40 | | | |
| | | Set | B | 4 | | | |
| | | Set | C | 4 | | | |
| | | Set | D | 4 | | | |
| 2 | Superstructure erection of all types of towers (complete) including danger plate, number plate, phase plate, bird guards & ant climbing devices and tack welding of all nuts upto bottom cross arm level of the tower for 52 towers. | No. | A | 40 | | | |
| | | No. | B | 4 | | | |
| | | No. | C | 4 | | | |
| | | No. | D | 4 | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 3 | Mounting of single suspension insulator string, double suspension insulator string and single tension insulator string, double tension insulator string(with pilot string also wherever necessary) on D- Type towers and stringing of Single Circuit line with Panther power conductor per phase including laying, jointing, tensioning, sagging and clamping etc. for spans upto 800 m | km | | 15.718 | | | |
| 4 | Stringing of one no. 7/3.15 mm dia ground wire laying, jointing, tensioning, etc. with necessary accessories. | km | | 15.718 | | | |
| 5 | Earthing of transmission line towers | | | | | | |
| a) | Pipe Type | No. | | 42 | | | |
| b) | Counterpoise earthing sets with 120m length of counterpoise wires excluding cost of materials. | Set | | 10 | | | |
| 6 | Erection of body extensions for each type of towers | | | | | | |
| | Extension - 3 m | No. | A | 3 | | | |
| | | No. | B | 1 | | | |
| | | No. | C | 1 | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | No. | D | 1 | | | |
| | Extension - 6 m | No. | A | 3 | | | |
| | | No. | B | 1 | | | |
| | | No. | C | 1 | | | |
| | | No. | D | 1 | | | |
| | Extension - 9 m | No. | A | 3 | | | |
| | | No. | B | - | | | |
| | | No. | C | - | | | |
| | | No. | D | - | | | |
| | **Total D4** | | | | | | |

**PRICE SCHEDULE - E**

**CONSTRUCTION OF 132KV S/C TRANSMISSION LINE ON DOUBLE CIRCUIT TOWERS:**

**LINE ROUTE: KATIYA - KUSAHA TRANSMISSION LINE (15.718 KM)**

**E TYPE TEST CHARGES**

| **Sl. #** | **Description** | **Name & Address of the Testing Laboratory** | **Prices (Rs)** | **Period of Testing (Days)** | **Time taken by testing Laboratory to accepts sample for testing (months)** |
|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 |
| 1 | Power Conductor | | | | |
| 2 | Earthwire | | | | |
| 3 | Power Conductor and Earthwire accessories | | | | |
| 4 | Insulator, Insulator String with Hardware fittings | | | | |
| 5 | Suspension and Tension Hardware fittings | | | | |
| | Total - E | | | | |

## PRICE SCHEDULE - F

### CONSTRUCTION OF 132KV S/C TRANSMISSION LINE ON DOUBLE CIRCUIT TOWERS:

### LINE ROUTE: KATIYA - KUSAHA TRANSMISSION LINE (15.718 KM)

### F INSURANCE CHARGES

| Sl. # | Description | Amount (Rs) |
|---|---|---|
| 1 | 2 | 3 |
| 1 | Insurance charges during transporation upto the place of installation including Storage | |
| 2 | Insurance charges during erection, testing and commissioning. | |
| 3 | Insurnace charges during Defects Liability Period. | |
| | Total - F | |
| | Grand Total = (A + B + C + D + E + F) | |

**P R I C E S C H E D U L E - G**

**CONSTRUCTION OF 132KV S/C TRANSMISSION LINE ON DOUBLE CIRCUIT TOWERS:**

**LINE ROUTE: KATIYA - KUSAHA TRANSMISSION LINE (15.718 KM)**

**G1 UNIT RATES FOR SUPPLY**

| **Sl. #** | **Description of item / Work** | **Unit** | **Rate per MT/ Unit (Rs)** | **Unit Price Ex-Works (including packing & forwarding) (Rs)** | **Taxes & Duties, if any (Rs)** | **Transportation upto Project site (Rs)** | **Transit Insurance upto project site including storage (Rs)** | **Total Unit price free at site (Rs) (5+6+7+8)** |
|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| | | | | | | | | |
| 1 | Stub setting templates for tangent tower (0 deg - 2 deg) suitable for 18m and 25m extensions | No. | | | | | | |
| 2 | Superstructure with 90 deg. Rotating X-arm for Large Angle tension towers (30 deg - 60 deg and Dead end) including design, fabrication, galvanising complete with nuts & bolts etc.) Superstructure with 90 deg. Rotating X-arm | No. | | | | | | |
| 3 | 3 metre extensions (complete) | | | | | | | |
| a) | Tangent Towers | No. | | | | | | |
| b) | Small angle tension towers | No. | | | | | | |
| c) | Medium angle tension towers | No. | | | | | | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| d) | Large angle and dead end towers | No. | | | | | | |
| 4 | 6 metre extensions (complete) | | | | | | | |
| a) | Tangent Towers | No. | | | | | | |
| b) | Small angle tension towers | No. | | | | | | |
| c) | Medium angle tension towers | No. | | | | | | |
| d) | Large angle and dead end towers | No. | | | | | | |
| 5 | 9 metre extensions (complete) | | | | | | | |
| a) | Tangent Towers | No. | | | | | | |
| b) | Small angle tension towers | No. | | | | | | |
| c) | Medium angle tension towers | No. | | | | | | |
| d) | Large angle and dead end towers | No. | | | | | | |
| 6 | 18 metre extensions for tangent towers | No. | | | | | | |
| | 25 metre extensions for tangent towers | No. | | | | | | |
| 7 | 1.5 m Leg extensions | | | | | | | |
| a) | Tangent Towers | No. | | | | | | |
| b) | Small angle tension towers | No. | | | | | | |
| c) | Medium angle tension towers | No. | | | | | | |
| d) | Large angle and dead end towers | No. | | | | | | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 8 | 3.0 m Leg extensions | | | | | | | |
| a) | Tangent Towers | No. | | | | | | |
| b) | Small angle tension towers | No. | | | | | | |
| c) | Medium angle tension towers | No. | | | | | | |
| d) | Large angle and dead end towers | No. | | | | | | |
| 9 | 4.5 m Leg extensions | | | | | | | |
| a) | Tangent Towers | No. | | | | | | |
| b) | Small angle tension towers | No. | | | | | | |
| c) | Medium angle tension towers | No. | | | | | | |
| d) | Large angle and dead end towers | No. | | | | | | |
| 10 | 6.0m Leg extensions | | | | | | | |
| a) | Tangent Towers | No. | | | | | | |
| b) | Small angle tension towers | No. | | | | | | |
| c) | Medium angle tension towers | No. | | | | | | |
| d) | Large angle and dead end towers | No. | | | | | | |
| 11 | Ladder for special structure | No. | | | | | | |
| 12 | Earthing of towers-counterpoise earthing with material complete with necessary bolts, nuts and washers | set | | | | | | |
| i) | Counterpoise wire length 120m | set | | | | | | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| ii) | Counterpoise wire length 280m | set | | | | | | |
| 13 | Aviation set including Markers Night marking/Painting installation | No. | | | | | | |
| 14 | Earthing of transmission line towers by pipe type earthing sets including cost of coke | Set | | | | | | |
| 15 (i) | Hardware fittings for double tension strings | No. | | | | | | |
| (ii) | 90 KN Insulator disc | No. | | | | | | |
| 16 (i) | Hardware fittings for double suspension strings | No. | | | | | | |
| (ii) | 70 KN Insulator disc | No. | | | | | | |
| 17 (i) | Hardware fittings for single suspension pilot strings | No. | | | | | | |
| (ii) | 70 KN Insulator disc | No. | | | | | | |

Note

i) * Leg Extension Price includes one corner only

ii) NA - Not applicable

iii) The unit price under items 12, 13 and 14 is inclusive of the cost of erection

**PRICE SCHEDULE - G**

**CONSTRUCTION OF 132KV S/C TRANSMISSION LINE ON DOUBLE CIRCUIT TOWERS:**
**LINE ROUTE: KATIYA - KUSAHA TRANSMISSION LINE (15.718 KM)**

**G2 UNIT RATES FOR ERECTION**

| Sl. # | Description of Item / Work | Unit | Unit Price for Erection (Rs) |
|---|---|---|---|
| 1 | 2 | 3 | 4 |
| 1 | Erection of Leg extension for each type of towers | | |
| | Extension of 1.5m | No. | |
| | Extension of 3m | No. | |
| | Extension of 4.5m | No. | |
| | Extension of 6m | No. | |
| 2 | Erection of special towers in river/valley crossing including extensions and tack welding of nuts upto bottom cross-arm level | MT | |
| 3 | Stringing of Single Circuit (long crossing) with panther conductor and earth wire | | |
| | Span 801 - 1200m | No. | |

Note - The above unit prices include insurance charges during erection, testing and commissioning.

# RAXAUL – PARWANIPUR TRANSMISSION LINE

**ABSTRACT OF PRICE SCHEDULE FOR CONSTRUCTION OF 132KV S/C TRANSMISSION LINE ON DOUBLE CIRCUIT TOWERS:**

**LINE ROUTE: RAXAUL - PARWANIPUR TRANSMISSION LINE (21.713 KM)**

**Price in Rs.**

| Item No. | Description | Total Prices (Exclusive of Taxes & Duties) |
|---|---|---|
| 1. | Tower Accessories (Schedule - A) | |
| 2. | Power Conductor, Ground Wire, Insulator Strings Complete Hardware, power Conductor accessories & Ground Wire Accessories (Schedule - B) | |
| 3. | Detailed Survey, Check Survey and Geotechnical Investigation (Schedule - C) | |
| 4. | Foundation Work (Schedule - D1) | |
| 5. | Site Clearance, Bench Cutting and Tower Protection Works (Schedule - D 2) | |
| 6. | Pile Foundation (Schedule - D 3) | |
| 7 | Erection Work (Schedule - D 4) | |
| 8 | Type Test Charges (Schedule - E) | |
| 9 | Insurance Charges (Schedule - F) | |
| 10 | Unit Rates for Supply (Schedule - G1) | |
| 11 | Unit Rates for Erection (Schedule - G 2) | |
| | **Total Cost** | |

**P R I C E S C H E D U L E - A**

**CONSTRUCTION OF 132KV S/C TRANSMISSION LINE ON DOUBLE CIRCUIT TOWERS:**

**LINE ROUTE: RAXAUL - PARWANIPUR TRANSMISSION LINE (21.713 KM)**

**A Towers & Accessories**

| Sl. No. | Description of item / Work | Unit | Qty. (Nos.) | Unit Weight (MT) | Total weight (MT) | Unit Price Ex-Works (including packing & forwarding) (Rs) | Taxes & Duties, if any (Rs.) | Transportation upto Project site (Rs) | Total Unit price at site (Rs) (7+8+9) | Total Price at site (Rs) (4x10) | Rate per MT at site (Rs) (10/5) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| 1 | Tangent towers (0° - 2°) (including design, fabrication, galvanising, complete with nuts, bolts & washers etc.) | | | | | | | | | | |
| a) | Superstructure | No | 51 | | | | | | | | |
| b) | Stub (set of 4) | Set | 51 | | | | | | | | |
| 2 | Small angle tension towers (2° - 15°) (including design, fabrication, galvanising, complete with nuts, bolts & washers etc.) | | | | | | | | | | |
| a) | Superstructure | No | 6 | | | | | | | | |
| b) | Stub (set of 4) | Set | 6 | | | | | | | | |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 3 | Medium angle tension towers 15°-30°) (including design, fabrication, galvanising, complete with nuts, bolts & washers etc.) | | | | | | | | | | |
| a) | Superstructure | No | 2 | | | | | | | | |
| b) | Stub (set of 4) | Set | 2 | | | | | | | | |
| 4 | Large angle tension towers (30° - 60° and Dead end) (including design, fabrication, galvanising, complete with nuts, bolts & washers etc.) | | | | | | | | | | |
| a) | Superstructure | No. | 12 | | | | | | | | |
| b) | Stub (set of 4) | Set | 12 | | | | | | | | |
| 5 | Stub setting templates for standard tower and suitable for use with their 3m, 6m & 9m extensions for supply to Purchaser Stores. | | | | | | | | | | |
| a) | Tangent towers | No. | 1 | | | | | | | | |
| b) | Small angle tension towers | No. | 1 | | | | | | | | |
| c) | medium angle tension towers | No. | 1 | | | | | | | | |
| d) | large angle tension towers | No. | 1 | | | | | | | | |
| 6 | Design and destruction tests including the cost of materials after allowing rebate for scrap value of steel of destroyed tower with 9m extension. | | | | | | | | | | |
| 6.1 | Tangent Towers (0° - 2°) | | | | | | | | | | |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| a) | Design Load Tests | No. | 1 | | | | | | | | |
| b) | Destruction Test | No. | 1 | | | | | | | | |
| 6.2 | Small angle tension towers (2° - 15°) | | | | | | | | | | |
| a) | Design Load Tests | No. | 1 | | | | | | | | |
| b) | Destruction Test | No. | 1 | | | | | | | | |
| 6.3 | Medium angle tension towers (15° - 30°) | | | | | | | | | | |
| a) | Design Load Tests | No. | 1 | | | | | | | | |
| b) | Destruction Test | No. | 1 | | | | | | | | |
| 6.4 | Large angle tension towers (30° - 60° and Dead end) | | | | | | | | | | |
| a) | Design Load Tests | No. | 1 | | | | | | | | |
| b) | Destruction Test | No. | 1 | | | | | | | | |
| 7 | 3 metre extensions | | | | | | | | | | |
| a) | Tangent Tower | No. | 4 | | | | | | | | |
| b) | Small angle tension towers | No. | 1 | | | | | | | | |
| c) | Medium angle tension towers | No. | 1 | | | | | | | | |
| d) | Large angle & Dead end tension towers | No. | 2 | | | | | | | | |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 8 | 6 metre extensions (complete). | | | | | | | | | | |
| a) | Tangent Tower | No. | 4 | | | | | | | | |
| b) | Small angle tension towers | No. | 1 | | | | | | | | |
| c) | Medium angle tension towers | No. | - | | | | | | | | |
| d) | Large angle & Dead end tension towers | No. | 1 | | | | | | | | |
| 9 | 9 metre extensions (complete). | | | | | | | | | | |
| a) | Tangent Tower | No. | 4 | | | | | | | | |
| b) | Small angle tension towers | No. | 1 | | | | | | | | |
| c) | Medium angle tension towers | No. | - | | | | | | | | |
| d) | Large angle & Dead end tension towers | No. | - | | | | | | | | |
| 10 | Number plates with bolts, nuts and washers. | No. | 71 | | | | | | | | |
| 11 | Danger Plates with bolts, nuts and washers. | No. | 71 | | | | | | | | |
| 12 | Phase plates with bolts, nuts and washers (set of three) | Set | 71 | | | | | | | | |
| 13 | Circuit Plate (set of two) | Set | 0 | | | | | | | | |
| 14 | Anti-climbing devices for | | | | | | | | | | |
| a) | Tangent Tower | No. | 51 | | | | | | | | |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| b) | Small angle tension towers | No. | 6 | | | | | | | | |
| c) | Medium angle tension towers | No. | 2 | | | | | | | | |
| d) | Large angle & Dead end tension towers | No. | 12 | | | | | | | | |
| 15 | Bird Guard (Set of Three) | Set | 51 | | | | | | | | |
| 16 | Earthing of towers | | | | | | | | | | |
| a) | Pipe Type | No. | 60 | | | | | | | | |
| b) | Counterpoise earthing material complete with necessary bolts, nuts and washers with 120m length | Set | 11 | | | | | | | | |
| | Total - A | | | | | | | | | | |
| | NA - Not applicable | | | | | | | | | | |

**P R I C E  S C H E D U L E - B**

**CONSTRUCTION OF 132KV S/C TRANSMISSION LINE ON DOUBLE CIRCUIT TOWERS:**

**LINE ROUTE: RAXAUL - PARWANIPUR TRANSMISSION LINE (21.713 KM)**

**B POWER CONDUCTOR, GROUND WIRE, INSULATOR STRINGS COMPLETE WITH HARDWARE, POWER CONDUCTOR ACCESSORIES & GROUND WIRE ACCESSORIES**

| Sl. No. | Description of item / Work | Make | Unit | Qty. (Nos.) | Unit Price Ex-Works (including packing & forwarding) (Rs) | Taxes & Duties, if any (Rs) | Transportation upto Project site (Rs) | Total Unit price at site (Rs) (6+7+8) | Total Price at site (Rs) (5x9) |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| 1 | ACSR 'Panther' Conductor 30/3.00 mm Al+7/3.00 mm St. | | km | 67 | | | | | |
| 2 | GROUNDWIRE:<br>Groundwire 7/3.15mm, 110kg/sq.mm Quality GSS. | | km | 22.36 | | | | | |
| 3 | Single Suspension Strings complete with hardware fittings & with 1x9 Nos., 70 KN Insulators | | Sets | 153 | | | | | |
| 4 | Double Suspension Strings complete with hardware fittings & with 2x9 Nos., 70 KN Insulators | | Sets | 8 | | | | | |
| 5 | Single Tension Strings complete with hardware fittings & with 1x10 Nos. 90 KN Insulators | | Sets | 120 | | | | | |
| 6 | Double Tension Strings complete with hardware fittings & with 2x10 Nos. 90 KN Insulators | | Sets | 6 | | | | | |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **7** | Single Suspension Pilot Strings complete with hardware & with 1x9 Nos. 70 KN Insulators | | Sets | 36 | | | | | |
| **8** | Power Conductor Accessories | | | | | | | | |
| **a)** | Preformed Armour Rod Set | | Sets | 153 | | | | | |
| **b)** | Mid span compression joint | | No. | 66 | | | | | |
| **c)** | Repair Sleeves | | No. | 66 | | | | | |
| **d)** | Vibration Damper | | No. | 426 | | | | | |
| **9** | Groundwire Accessories | | | | | | | | |
| **a)** | Mid span compression joint | | No. | 12 | | | | | |
| **b)** | Suspension clamp | | No. | 51 | | | | | |
| **c)** | Compression type tension clamp | | No. | 40 | | | | | |
| **d)** | Copper bonding pieces | | No. | 91 | | | | | |
| **e)** | Vibration Damper | | No. | 142 | | | | | |
| | TOTAL - B | | | | | | | | |

NA - Not applicable

**P R I C E  S C H E D U L E - C**

**CONSTRUCTION OF 132KV S/C TRANSMISSION LINE ON DOUBLE CIRCUIT TOWERS**

**LINE ROUTE: RAXAUL-PARWANIPUR TRANSMISSION LINE (21.713 KM)**

**DETAILED SURVEY, CHECK SURVEY and GEOTECHNICAL INVESTIGATION.**

| Item No. | Description | Unit | Qty. | Price | |
|---|---|---|---|---|---|
| | | | | Unit Price | Total |
| -1 | -2 | -3 | -4 | -5 | -6 |
| 1 | Tree cutting of all sizes (trees of girth size ≥ 0.2m). | No. | 42 | | |
| | | | | | |
| 2 | **Detailed Survey** | | | | |
| | Profiling & Tower Spotting | km | 21.713 | | |
| 3 | Geotechnical Investigation | | | | |
| 3.1 | Carrying out Standard Penetration Tests at tower locations in Bore holes at 1.5m, 3m, 6m, 9m, 12m, 15m depths (in case of Shallow foundations). | No. | 17 | | |
| 3.2 | Carrying out Standard Penetration Tests at tower location in Bore holes at 2m, 5m, 8m, 11m, 14m, 17m, 20m, 23m, 26m, 29m, 30m depths (in case of Pile foundation). | No. | 17 | | |
| 3.3 | Collection of Disturbed soil samples at tower location in Bore holes at 1.0m, 2.5m, 4.5m, 7.5m, 10.5m, 13.5 m depths (in case of Shallow Foundations). | No. | 102 | | |
| 3.4 | Collection of Disturbed soil samples at tower location in Bore holes at 1.5m, 3.5m, 6.5m, 9.5m, 12.5m, 15.5 m, 18.5m, 21.5m, 24.5m, 27.5m (in case of Pile Foundations). | No. | 170 | | |
| 3.5 | Collection of Undisturbed soil samples in Bore holes at 1.5m, 3m, 6m, 9m, 12m, 15m depths (in case of Shallow Foundations). | No. | 102 | | |
| 3.6 | Collection of Undisturbed soil samples in Bore holes at 2m, 5m, 8m, 11m, 14m, 17m, 20m, 23m, 26m, 29m, 30m depths (in case of Pile Foundations). | No. | 187 | | |

| | | | | | |
|---|---|---|---|---|---|
| 3.7 | Carrying out following laboratory tests as per technical specifications, relevant BIS code & instructions of Engineer-in-Charge on disturbed / undisturbed soil samples collected at different depths in boreholes. | | | | |
| 3.7.1 | **For Disturbed soil sample:-** Soil classification: Grain size Analysis (Gradation) sieve/hydrometer analysis.<br>-Specific gravity.<br>-Consistency limits.(liquid limit, plastic limit)<br>-Insitu properties : bulk density, dry density, natural moisture content, void ratio.<br>-OMC (optimum moisture content)<br>-Maximum Dry Density at OMC. | | | | |
| | (a) Shallow Foundations | No. | 102 | | |
| | (b) Pile Foundations | No. | 170 | | |
| 3.7.2 | **For Undisturbed soil sample:-** -Shear strength parameters for Cohesive soil: cohesion and angle of internal friction, Compression index, Consolidation parameters, unconfined compressive strength.<br>-Shear strength parameters for Cohesion less soil: angle of internal friction, direct shear strength. | | | | |
| | -Normal soil types: cohesion and angle of internal friction. | | | | |
| | (a) Shallow Foundations | No. | 102 | | |
| | (b) Pile Foundations | No. | 187 | | |
| **4** | Check Survey, Pegging of Tower centers, pit marking at site etc. | km | 21.713 | | |
| | TOTAL - C | | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | **P R I C E S C H E D U L E - D** | | | | | | |
| | | | | | | | |
| | **CONSTRUCTION OF 132KV S/C TRANSMISSION LINE ON DOUBLE CIRCUIT TOWERS:** | | | | | | |
| | **LINE ROUTE: RAXAUL - PARWANIPUR TRANSMISSION LINE (21.713 KM)** | | | | | | |
| **D.** | **ERECTION OF 132 KV TRANSMISSION LINE** | | | | | | |
| **D1** | **FOUNDATION WORK** | | | | | | |
| | | | | | | **Figures in Rupees** | |
| **Item No.** | **Description** | **No. of Towers** | **Unit** | **To be quoted by bidder** | | | |
| | | | | **Guaranteed quantity per Tower** | **Total Quantity** | **Price** | |
| | | | | | | **Unit Price** | **Total** |
| **(1)** | **(2)** | **(3)** | **(4)** | **(5)** | **(6) =(3)*(5)** | **(7)** | **(8) =(6)*(7)** |
| 1 | **Earth work in excavation in all types of soil including backfilling, compacting and disposal of extra earth with all leads and lifts, including the cost of dewatering, charges for plant & equipment, labour etc. complete in all respect as per approved foundation drawing, technical specifications and direction of purchaser.** | | | | | | |
| 1.1 | **For 'A' Type Towers (0 - 2°)** | | | | | | |

| | | | | | | Figures in Rupees | |
|---|---|---|---|---|---|---|---|
| **Item No.** | **Description** | **No. of Towers** | **Unit** | **To be quoted by bidder** | | | |
| | | | | **Guaranteed quantity per Tower** | **Total Quantity** | **Price** | |
| | | | | | | **Unit Price** | **Total** |
| 1.1.1 | Normal Dry soil type | 4 | Cu-m | | | | |
| 1.1.2 | Normal soil Wet type | 16 | Cu-m | | | | |
| 1.1.3 | Normal soil Partially submerged type | 11 | Cu-m | | | | |
| 1.1.4 | Normal soil Fully submerged type | 8 | Cu-m | | | | |
| | | | | | | | |
| 1.2 | **For 'A' type Towers with 3.0 m, 6.0 m & 9.0 m body extensions (0 - 2°)** | | | | | | |
| 1.2.1 | Normal Dry soil type | 1 | Cu-m | | | | |
| 1.2.2 | Normal soil Wet type | 5 | Cu-m | | | | |
| 1.2.3 | Normal soil Partially submerged type | 4 | Cu-m | | | | |
| 1.2.4 | Normal soil Fully submerged type | 2 | Cu-m | | | | |
| | | | | | | | |
| 1.3 | **For 'B' Type Towers(2° - 15°)** | | | | | | |

| | | | | | | Figures in Rupees | |
|---|---|---|---|---|---|---|---|
| **Item No.** | **Description** | **No. of Towers** | **Unit** | **To be quoted by bidder** | | | |
| | | | | **Guaranteed quantity per Tower** | **Total Quantity** | **Price** | |
| | | | | | | **Unit Price** | **Total** |
| 1.3.1 | Normal Dry soil type | 0 | Cu-m | | | | |
| 1.3.2 | Normal soil Wet type | 1 | Cu-m | | | | |
| 1.3.3 | Normal soil Partially submerged type | 1 | Cu-m | | | | |
| 1.3.4 | Normal soil Fully submerged type | 1 | Cu-m | | | | |
| | | | | | | | |
| 1.4 | **For 'B' type Towers with 3.0 m, 6.0 m & 9.0 m body extensions(2° - 15°)** | | | | | | |
| 1.4.1 | Normal Dry soil type | 0 | Cu-m | | | | |
| 1.4.2 | Normal soil Wet type | 1 | Cu-m | | | | |
| 1.4.3 | Normal soil Partially submerged type | 1 | Cu-m | | | | |
| 1.4.4 | Normal soil Fully submerged type | 1 | Cu-m | | | | |
| | | | | | | | |
| 1.5 | **For 'C' Type Towers(15°-30°)** | | | | | | |

| | | | | | | Figures in Rupees | |
|---|---|---|---|---|---|---|---|
| **Item No.** | **Description** | **No. of Towers** | **Unit** | **To be quoted by bidder** | | | |
| | | | | **Guaranteed quantity per Tower** | **Total Quantity** | **Price** | |
| | | | | | | **Unit Price** | **Total** |
| 1.5.1 | Normal Dry soil type | 0 | Cu-m | | | | |
| 1.5.2 | Normal soil Wet type | 1 | Cu-m | | | | |
| 1.5.3 | Normal soil Partially submerged type | 0 | Cu-m | | | | |
| 1.5.4 | Normal soil Fully submerged type | 0 | Cu-m | | | | |
| | | | | | | | |
| 1.6 | **For 'C' type Towers with 3.0 m, 6.0 m & 9.0 m body extensions (15°-30°)** | | | | | | |
| 1.6.1 | Normal Dry soil type | 0 | Cu-m | | | | |
| 1.6.2 | Normal soil Wet type | 1 | Cu-m | | | | |
| 1.6.3 | Normal soil Partially submerged type | 0 | Cu-m | | | | |
| 1.6.4 | Normal soil Fully submerged type | 0 | Cu-m | | | | |
| | | | | | | | |
| 1.7 | **For 'D' Type Towers(30°-60°)** | | | | | | |
| 1.7.1 | Normal Dry soil type | 1 | Cu-m | | | | |

| | | | | | | Figures in Rupees | |
|---|---|---|---|---|---|---|---|
| **Item No.** | **Description** | **No. of Towers** | **Unit** | **To be quoted by bidder** | | | |
| | | | | **Guaranteed quantity per Tower** | **Total Quantity** | **Price** | |
| | | | | | | **Unit Price** | **Total** |
| 1.7.2 | Normal soil Wet type | 3 | Cu-m | | | | |
| 1.7.3 | Normal soil Partially submerged type | 3 | Cu-m | | | | |
| 1.7.4 | Normal soil Fully submerged type | 2 | Cu-m | | | | |
| | | | | | | | |
| 1.8 | **For 'D' type Towers with 3.0 m, 6.0 m & 9.0 m body extensions (30°-60°)** | | | | | | |
| 1.8.1 | Normal Dry soil type | 0 | Cu-m | | | | |
| 1.8.2 | Normal soil Wet type | 1 | Cu-m | | | | |
| 1.8.3 | Normal soil Partially submerged type | 1 | Cu-m | | | | |
| 1.8.4 | Normal soil Fully submerged type | 1 | Cu-m | | | | |
| | | | | | | | |

| | | | | | | Figures in Rupees | |
|---|---|---|---|---|---|---|---|
| **Item No.** | **Description** | **No. of Towers** | **Unit** | **To be quoted by bidder** | | | |
| | | | | **Guaranteed quantity per Tower** | **Total Quantity** | **Price** | |
| | | | | | | **Unit Price** | **Total** |
| 2 | **Providing Lean concrete of M10 grade below tower foundations including the cost of all materials, labour, hiring charges for plant & equipment POL,transportation etc. complete in all respect as per approved foundation drawings, technical specification and instructions of purchaser** | | | | | | |
| 2.1 | **For 'A' Type Towers (0 - 2°)** | | | | | | |
| 2.1.1 | Normal Dry soil type | 4 | Cu-m | | | | |
| 2.1.2 | Normal soil Wet type | 16 | Cu-m | | | | |
| 2.1.3 | Normal soil Partially submerged type | 11 | Cu-m | | | | |
| 2.1.4 | Normal soil Fully submerged type | 8 | Cu-m | | | | |
| | | | | | | | |
| 2.2 | **For 'A' type Towers with 3.0 m, 6.0 m & 9.0 m body extensions (0 - 2°)** | | | | | | |
| 2.2.1 | Normal Dry soil type | 1 | Cu-m | | | | |

| | | | | | | Figures in Rupees | |
|---|---|---|---|---|---|---|---|
| **Item No.** | **Description** | **No. of Towers** | **Unit** | **To be quoted by bidder** | | | |
| | | | | **Guaranteed quantity per Tower** | **Total Quantity** | **Price** | |
| | | | | | | **Unit Price** | **Total** |
| 2.2.2 | Normal soil Wet type | 5 | Cu-m | | | | |
| 2.2.3 | Normal soil Partially submerged type | 4 | Cu-m | | | | |
| 2.2.4 | Normal soil Fully submerged type | 2 | Cu-m | | | | |
| | | | | | | | |
| 2.3 | **For 'B' Type Towers(2° - 15°)** | | | | | | |
| 2.3.1 | Normal Dry soil type | 0 | Cu-m | | | | |
| 2.3.2 | Normal soil Wet type | 1 | Cu-m | | | | |
| 2.3.3 | Normal soil Partially submerged type | 1 | Cu-m | | | | |
| 2.3.4 | Normal soil Fully submerged type | 1 | Cu-m | | | | |
| | | | | | | | |
| 2.4 | **For 'B' type Towers with 3.0 m, 6.0 m & 9.0 m body extensions(2° - 15°)** | | | | | | |
| 2.4.1 | Normal Dry soil type | 0 | Cu-m | | | | |
| 2.4.2 | Normal soil Wet type | 1 | Cu-m | | | | |

| | | | | | | Figures in Rupees | |
|---|---|---|---|---|---|---|---|
| **Item No.** | **Description** | **No. of Towers** | **Unit** | **To be quoted by bidder** | | | |
| | | | | **Guaranteed quantity per Tower** | **Total Quantity** | **Price** | |
| | | | | | | **Unit Price** | **Total** |
| 2.4.3 | Normal soil Partially submerged type | 1 | Cu-m | | | | |
| 2.4.4 | Normal soil Fully submerged type | 1 | Cu-m | | | | |
| | | | | | | | |
| 2.5 | **For 'C' Type Towers(15°-30°)** | | | | | | |
| 2.5.1 | Normal Dry soil type | 0 | Cu-m | | | | |
| 2.5.2 | Normal soil Wet type | 1 | Cu-m | | | | |
| 2.5.3 | Normal soil Partially submerged type | 0 | Cu-m | | | | |
| 2.5.4 | Normal soil Fully submerged type | 0 | Cu-m | | | | |
| | | | | | | | |
| 2.6 | **For 'C' type Towers with 3.0 m, 6.0 m & 9.0 m body extensions (15°-30°)** | | | | | | |
| 2.6.1 | Normal Dry soil type | 0 | Cu-m | | | | |
| 2.6.2 | Normal soil Wet type | 1 | Cu-m | | | | |
| 2.6.3 | Normal soil Partially submerged type | 0 | Cu-m | | | | |

| | | | | | | Figures in Rupees | |
|---|---|---|---|---|---|---|---|
| **Item No.** | **Description** | **No. of Towers** | **Unit** | **To be quoted by bidder** | | | |
| | | | | **Guaranteed quantity per Tower** | **Total Quantity** | **Price** | |
| | | | | | | **Unit Price** | **Total** |
| 2.6.4 | Normal soil Fully submerged type | 0 | Cu-m | | | | |
| | | | | | | | |
| 2.7 | **For 'D' Type Towers(30°-60°)** | | | | | | |
| 2.7.1 | Normal Dry soil type | 1 | Cu-m | | | | |
| 2.7.2 | Normal soil Wet type | 3 | Cu-m | | | | |
| 2.7.3 | Normal soil Partially submerged type | 3 | Cu-m | | | | |
| 2.7.4 | Normal soil Fully submerged type | 2 | Cu-m | | | | |
| | | | | | | | |
| 2.8 | **For 'D' type Towers with 3.0 m, 6.0 m & 9.0 m body extensions (30°-60°)** | | | | | | |
| 2.8.1 | Normal Dry soil type | 0 | Cu-m | | | | |
| 2.8.2 | Normal soil Wet type | 1 | Cu-m | | | | |
| 2.8.3 | Normal soil Partially submerged type | 1 | Cu-m | | | | |
| 2.8.4 | Normal soil Fully submerged type | 1 | Cu-m | | | | |

| | | | | | | Figures in Rupees | |
|---|---|---|---|---|---|---|---|
| **Item No.** | **Description** | **No. of Towers** | **Unit** | **To be quoted by bidder** | | | |
| | | | | **Guaranteed quantity per Tower** | **Total Quantity** | **Price** | |
| | | | | | | **Unit Price** | **Total** |
| | | | | | | | |
| 3 | **Concreting in tower foundations with M 25 grade concrete including the cost of all materials, shuttering/formwork, charges for plant & equipment, labour, POL,transportation etc. complete in all respect as per approved tower foundation drawings, technical specifications and direction of purchaser.** | | | | | | |
| 3.1 | **For 'A' Type Towers (0 - 2°)** | | | | | | |
| 3.1.1 | Normal Dry soil type | 4 | MT | | | | |
| 3.1.2 | Normal soil Wet type | 16 | MT | | | | |
| 3.1.3 | Normal soil Partially submerged type | 11 | MT | | | | |
| 3.1.4 | Normal soil Fully submerged type | 8 | MT | | | | |
| | | | | | | | |

| | | | | | | Figures in Rupees | |
|---|---|---|---|---|---|---|---|
| **Item No.** | **Description** | **No. of Towers** | **Unit** | **To be quoted by bidder** | | | |
| | | | | **Guaranteed quantity per Tower** | **Total Quantity** | **Price** | |
| | | | | | | **Unit Price** | **Total** |
| 3.2 | **For 'A' type Towers with 3.0 m, 6.0 m & 9.0 m body extensions (0 - 2°)** | | | | | | |
| 3.2.1 | Normal Dry soil type | 1 | MT | | | | |
| 3.2.2 | Normal soil Wet type | 5 | MT | | | | |
| 3.2.3 | Normal soil Partially submerged type | 4 | MT | | | | |
| 3.2.4 | Normal soil Fully submerged type | 2 | MT | | | | |
| | | | | | | | |
| 3.3 | **For 'B' Type Towers(2° - 15°)** | 3 | | | | | |
| 3.3.1 | Normal Dry soil type | 0 | MT | | | | |
| 3.3.2 | Normal soil Wet type | 1 | MT | | | | |
| 3.3.3 | Normal soil Partially submerged type | 1 | MT | | | | |
| 3.3.4 | Normal soil Fully submerged type | 1 | MT | | | | |
| | | | | | | | |

| | | | | | | Figures in Rupees | |
|---|---|---|---|---|---|---|---|
| **Item No.** | **Description** | **No. of Towers** | **Unit** | **To be quoted by bidder** | | | |
| | | | | **Guaranteed quantity per Tower** | **Total Quantity** | **Price** | |
| | | | | | | **Unit Price** | **Total** |
| 3.4 | **For 'B' type Towers with 3.0 m, 6.0 m & 9.0 m body extensions($2^{o}$ - $15^{o}$)** | | | | | | |
| 3.4.1 | Normal Dry soil type | 0 | MT | | | | |
| 3.4.2 | Normal soil Wet type | 1 | MT | | | | |
| 3.4.3 | Normal soil Partially submerged type | 1 | MT | | | | |
| 3.4.4 | Normal soil Fully submerged type | 1 | MT | | | | |
| | | | | | | | |
| 3.5 | **For 'C' Type Towers($15^{o}$-$30^{o}$)** | | | | | | |
| 3.5.1 | Normal Dry soil type | 0 | MT | | | | |
| 3.5.2 | Normal soil Wet type | 1 | MT | | | | |
| 3.5.3 | Normal soil Partially submerged type | 0 | MT | | | | |
| 3.5.4 | Normal soil Fully submerged type | 0 | MT | | | | |
| | | | | | | | |

| | | | | | | Figures in Rupees | |
|---|---|---|---|---|---|---|---|
| **Item No.** | **Description** | **No. of Towers** | **Unit** | **To be quoted by bidder** | | | |
| | | | | **Guaranteed quantity per Tower** | **Total Quantity** | **Price** | |
| | | | | | | **Unit Price** | **Total** |
| 3.6 | **For 'C' type Towers with 3.0 m, 6.0 m & 9.0 m body extensions (15°-30°)** | | | | | | |
| 3.6.1 | Normal Dry soil type | 0 | MT | | | | |
| 3.6.2 | Normal soil Wet type | 1 | MT | | | | |
| 3.6.3 | Normal soil Partially submerged type | 0 | MT | | | | |
| 3.6.4 | Normal soil Fully submerged type | 0 | MT | | | | |
| | | | | | | | |
| 3.7 | **For 'D' Type Towers(30°-60°)** | | | | | | |
| 3.7.1 | Normal Dry soil type | 1 | MT | | | | |
| 3.7.2 | Normal soil Wet type | 3 | MT | | | | |
| 3.7.3 | Normal soil Partially submerged type | 3 | MT | | | | |
| 3.7.4 | Normal soil Fully submerged type | 2 | MT | | | | |
| | | | | | | | |

| | | | | | | Figures in Rupees | |
|---|---|---|---|---|---|---|---|
| **Item No.** | **Description** | **No. of Towers** | **Unit** | **To be quoted by bidder** | | | |
| | | | | **Guaranteed quantity per Tower** | **Total Quantity** | **Price** | |
| | | | | | | **Unit Price** | **Total** |
| 3.8 | **For 'D' type Towers with 3.0 m, 6.0 m & 9.0 m body extensions (30°-60°)** | | | | | | |
| 3.8.1 | Normal Dry soil type | 0 | MT | | | | |
| 3.8.2 | Normal soil Wet type | 1 | MT | | | | |
| 3.8.3 | Normal soil Partially submerged type | 1 | MT | | | | |
| 3.8.4 | Normal soil Fully submerged type | 1 | MT | | | | |
| | | | | | | | |
| 4 | **Supply, cutting, bending, placing,tieing of reinforcement steel of Fe415/ Fe 500 grade in tower foundations and preparation of bar bending schedule, including the cost of all materials, hiring charges for plant/equipment, binding, cost of binding wire, labour, POL, transportation etc. complete in all respect as per approved foundation drawings, technical specifications and direction of purchaser.** | | | | | | |

| | | | | | | Figures in Rupees | |
|---|---|---|---|---|---|---|---|
| **Item No.** | **Description** | **No. of Towers** | **Unit** | **To be quoted by bidder** | | | |
| | | | | **Guaranteed quantity per Tower** | **Total Quantity** | **Price** | |
| | | | | | | **Unit Price** | **Total** |
| 4.1.0 | **For 'A' Type Towers (0 - 2°)** | | | | | | |
| 4.1.1 | Normal Dry soil type | 4 | Cu-m | | | | |
| 4.1.2 | Normal soil Wet type | 16 | Cu-m | | | | |
| 4.1.3 | Normal soil Partially submerged type | 11 | Cu-m | | | | |
| 4.1.4 | Normal soil Fully submerged type | 8 | Cu-m | | | | |
| | | | | | | | |
| 4.2 | **For 'A' type Towers with 3.0 m, 6.0 m & 9.0 m body extensions (0 - 2°)** | | | | | | |
| 4.2.1 | Normal Dry soil type | 1 | Cu-m | | | | |
| 4.2.2 | Normal soil Wet type | 5 | Cu-m | | | | |
| 4.2.3 | Normal soil Partially submerged type | 4 | Cu-m | | | | |
| 4.2.4 | Normal soil Fully submerged type | 2 | Cu-m | | | | |
| | | | | | | | |
| 4.3 | **For 'B' Type Towers(2° - 15°)** | | | | | | |

| | | | | | | Figures in Rupees | |
|---|---|---|---|---|---|---|---|
| **Item No.** | **Description** | **No. of Towers** | **Unit** | **To be quoted by bidder** | | | |
| | | | | **Guaranteed quantity per Tower** | **Total Quantity** | **Price** | |
| | | | | | | **Unit Price** | **Total** |
| 4.3.1 | Normal Dry soil type | 0 | Cu-m | | | | |
| 4.3.2 | Normal soil Wet type | 1 | Cu-m | | | | |
| 4.3.3 | Normal soil Partially submerged type | 1 | Cu-m | | | | |
| 4.3.4 | Normal soil Fully submerged type | 1 | Cu-m | | | | |
| | | | | | | | |
| 4.4 | **For 'B' type Towers with 3.0 m, 6.0 m & 9.0 m body extensions(2° - 15°)** | | | | | | |
| 4.4.1 | Normal Dry soil type | 0 | Cu-m | | | | |
| 4.4.2 | Normal soil Wet type | 1 | Cu-m | | | | |
| 4.4.3 | Normal soil Partially submerged type | 1 | Cu-m | | | | |
| 4.4.4 | Normal soil Fully submerged type | 1 | Cu-m | | | | |
| | | | | | | | |
| 4.5 | **For 'C' Type Towers(15°-30°)** | | | | | | |
| 4.5.1 | Normal Dry soil type | 0 | Cu-m | | | | |

| | | | | | | Figures in Rupees | |
|---|---|---|---|---|---|---|---|
| **Item No.** | **Description** | **No. of Towers** | **Unit** | **To be quoted by bidder** | | | |
| | | | | **Guaranteed quantity per Tower** | **Total Quantity** | **Price** | |
| | | | | | | **Unit Price** | **Total** |
| 4.5.2 | Normal soil Wet type | 1 | Cu-m | | | | |
| 4.5.3 | Normal soil Partially submerged type | 0 | Cu-m | | | | |
| 4.5.4 | Normal soil Fully submerged type | 0 | Cu-m | | | | |
| | | | | | | | |
| 4.6 | **For 'C' type Towers with 3.0 m, 6.0 m & 9.0 m body extensions (15°-30°)** | | | | | | |
| 4.6.1 | Normal Dry soil type | 0 | Cu-m | | | | |
| 4.6.2 | Normal soil Wet type | 1 | Cu-m | | | | |
| 4.6.3 | Normal soil Partially submerged type | 0 | Cu-m | | | | |
| 4.6.4 | Normal soil Fully submerged type | 0 | Cu-m | | | | |
| | | | | | | | |
| 4.7 | **For 'D' Type Towers(30°-60°)** | | | | | | |
| 4.7.1 | Normal Dry soil type | 1 | Cu-m | | | | |
| 4.7.2 | Normal soil Wet type | 3 | Cu-m | | | | |
| 4.7.3 | Normal soil Partially submerged type | 3 | Cu-m | | | | |
| 4.7.4 | Normal soil Fully submerged type | 2 | Cu-m | | | | |

| | | | | | | Figures in Rupees | |
|---|---|---|---|---|---|---|---|
| **Item No.** | **Description** | **No. of Towers** | **Unit** | **To be quoted by bidder** | | | |
| | | | | **Guaranteed quantity per Tower** | **Total Quantity** | **Price** | |
| | | | | | | **Unit Price** | **Total** |
| | | | | | | | |
| 4.8 | **For 'D' type Towers with 3.0 m, 6.0 m & 9.0 m body extensions ($30^{o}$-$60^{o}$)** | | | | | | |
| 4.8.1 | Normal Dry soil type | 0 | Cu-m | | | | |
| 4.8.2 | Normal soil Wet type | 1 | Cu-m | | | | |
| 4.8.3 | Normal soil Partially submerged type | 1 | Cu-m | | | | |
| 4.8.4 | Normal soil Fully submerged type | 1 | Cu-m | | | | |
| | | | | | | | |
| | **Note :** | | | | | | |
| 1 | Carriage of all materials like cement, coarse & fine aggregates, stub by mechanical means (or as the case may be) etc. to site of work shall be included in the rates of relevant items of works. | | | | | | |
| 2 | Any other item of supply of material or erection etc. along with its cost required for successful completion/ commissioning of the work is to be duly specified by the bidder. | | | | | | |
| 3 | Bidder shall quote the guaranteed quantities for various items of foundation work and their unit rates in the above schedule. | | | | | | |
| 4 | Necessary access to the Tower Location shall be prepared by the contractor & nothing extra shall be paid for it. | | | | | | |

**P R I C E  S C H E D U L E - D**

**CONSTRUCTION OF 132KV S/C TRANSMISSION LINE ON DOUBLE CIRCUIT TOWERS:**

**LINE ROUTE: RAXAUL - PARWANIPUR TRANSMISSION LINE (21.713 KM)**

**D. ERECTION OF 132 KV TRANSMISSION LINE**

**D2 SITE CLEARANCE, BENCH CUTTING AND TOWER PROTECTION WORKS**

**Figures in Rupees**

| Item No. | Description | Unit | Qty. | Price | |
|---|---|---|---|---|---|
| | | | | Unit Price | Total |
| (1) | (2) | (3) | (4) | (5) | (6) |
| 1 | Site clearance including removal of bush and including tree cutting of girth size of <0.2m as per site requirement and instruction of purchaser. | **Per tower loc.** | 50 | | |
| 2 | Earthwork in excavation in Bench cutting in all type of soil as per site requirement for tower foundations , complete in all respects as per approved foundation drawings, technical specification and instruction of purchaser. | cum | 100 | | |
| | | | | | |
| **3** | **Protection works** | | | | |
| 3.1 | Earth work in excavation in all types of soil for Tower Protection Works including backfilling, compacting and disposal of extra earth with all leads and lifts, including the cost of dewatering, charges for plant & equipment, labour etc. complete in all respect as per approved foundation drawing, technical specifications and direction of purchaser. | | | | |
| | a) In dry soil | Cum | 300 | | |

| | | | | | |
|---|---|---|---|---|---|
| | b) Extra over item 3.1(a) for excavation below water table | Cum | 100 | | |
| 3.2 | Providing Lean concrete of M10 grade below Retaining wall / Breast wall including the cost of all materials, labour, charges for plant & equipment POL, transportation etc. complete in all respect as per approved foundation drawings, technical specification and instructions of purchaser. | Cum | 35 | | |
| 3.3 | Providing and laying random rubble masonry with hard stone in Retaining /Breast Walls in cement mortar 1:5 and pointing/ plastering with cement mortar 1:3 (1 cement :3 sand) including 100 mm thick PCC M-15 coping at the top of retaining /breast wall, weep holes @ 300 mm x 300 mm including the charges for plant & equipment, labour etc. complete in all respect as per approved foundation drawing, technical specifications and direction of purchaser. | Cum | 200 | | |
| 3.4 | Providing and laying brick masonry in Retaining /Breast Walls in cement mortar 1:5 and pointing/ plastering with cement mortar 1:3 (1 cement :3 sand) including 100 mm thick PCC M-15 coping at the top of retaining /breast wall, weep holes @ 300 mm x 300 mm including the charges for plant & equipment, labour etc. complete in all respect as per approved foundation drawing, technical specifications and direction of purchaser. | Cum | 200 | | |
| | ***Sub Total*** | | | | |

**Note :**

1 Carriage of all materials like cement, coarse & fine aggregates, stub by mechanical means (or as the case may be) etc. to site of work shall be included in the rates of relevant items of works.

2 Any other item of supply of material or erection etc. along with its cost required for successful completion/ commissioning of the work is to be duly specified by the bidder.

**P R I C E  S C H E D U L E - D**

**CONSTRUCTION OF 132KV S/C TRANSMISSION LINE ON DOUBLE CIRCUIT TOWERS:**

**LINE ROUTE: RAXAUL - PARWANIPUR TRANSMISSION LINE (21.713 KM)**

**D. ERECTION OF 132 KV TRANSMISSION LINE**

**D3 ERECTION WORK**

| Sl. No. | Description | Unit | Tower Type | Qty. | Unit Rate (Rs) | Amount (Rs) | Rate per MT (Rs) |
|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| 1 | Setting of stubs for all type of towers excluding cost of foundation, excavation and concreting for 52 sets | Set | A | 51 | | | |
| | | Set | B | 6 | | | |
| | | Set | C | 2 | | | |
| | | Set | D | 12 | | | |
| 2 | Superstructure erection of all types of towers (complete) including danger plate, number plate, phase plate, bird guards & anticlimbing devices and tack welding of all nuts upto bottom cross arm level of the tower for 52 towers. | No. | A | 51 | | | |
| | | No. | B | 6 | | | |
| | | No. | C | 2 | | | |
| | | No. | D | 12 | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 3 | Mounting of single suspension insulator string, double suspension insulator string and single tension insulator string, double tension insulator string(with pilot string also wherever necessary) on D- Type towers and stringing of Single Circuit line with Panther power conductor per phase including laying, jointing, tensioning, sagging and clamping etc. for spans upto 800 m | km | | 21.713 | | | |
| 4 | Stringing of one no. 7/3.15 mm dia ground wire laying, jointing, tensioning, etc. with necessary accessories. | km | | 21.713 | | | |
| 5 | Earthing of transmission line towers | | | | | | |
| a) | Pipe Type | No. | | 60 | | | |
| b) | Counterpoise earthing sets with 120m length of counterpoise wires excluding cost of materials. | Set | | 11 | | | |
| 6 | Erection of body extensions for each type of towers | | | | | | |
| | Extension - 3 m | No. | A | 4 | | | |
| | | No. | B | 1 | | | |
| | | No. | C | 1 | | | |
| | | No. | D | 2 | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | Extension - 6 m | No. | A | 4 | | | |
| | | No. | B | 1 | | | |
| | | No. | C | - | | | |
| | | No. | D | 1 | | | |
| | Extension - 9 m | No. | A | 4 | | | |
| | | No. | B | 1 | | | |
| | | No. | C | - | | | |
| | | No. | D | - | | | |
| | Sub - Total D2 | | | | | | |
| | Sub - Total - D1 | | | | | | |
| | | | | | | | |
| | Total - D | | | | | | |

**PRICE SCHEDULE - E**

**CONSTRUCTION OF 132KV S/C TRANSMISSION LINE ON DOUBLE CIRCUIT TOWERS:**

**LINE ROUTE: RAXAUL - PARWANIPUR TRANSMISSION LINE (21.713 KM)**

**E TYPE TEST CHARGES**

| **Sl. No.** | **Description** | **Name & Address of the Testing Laboratory** | **Prices (Rs)** | **Period of Testing (Days)** | **Time taken by testing Laboratory to accepts sample for testing (months)** |
|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 |
| 1 | Power Conductor | | | | |
| 2 | Earthwire | | | | |
| 3 | Power Conductor and Earthwire accessories | | | | |
| 4 | Insulator, Insulator String with Hardware fittings | | | | |
| 5 | Suspension and Tension Hardware fittings | | | | |
| | Total - E | | | | |

**PRICE SCHEDULE - F**

**CONSTRUCTION OF 132KV S/C TRANSMISSION LINE ON DOUBLE CIRCUIT TOWERS:**

**LINE ROUTE: RAXAUL - PARWANIPUR TRANSMISSION LINE (21.713 KM)**

**F INSURANCE CHARGES**

| Sl. No. | Description | Amount (Rs) |
|---|---|---|
| 1 | 2 | 3 |
| 1 | Insurance charges during transportation upto the place of installation including Storage | |
| 2 | Insurance charges during erection, testing and commissioning. | |
| 3 | Insurance charges during Defects Liability Period. | |
| | Total - F | |
| | Grand Total = (A + B + C + D + E + F) | |

**P R I C E  S C H E D U L E - G**

**CONSTRUCTION OF 132KV S/C TRANSMISSION LINE ON DOUBLE CIRCUIT TOWERS:**

**LINE ROUTE: RAXAUL - PARWANIPUR TRANSMISSION LINE (21.713 KM)**

**G1 UNIT RATES FOR SUPPLY**

| Sl. No. | Description of item / Work | Unit | Rate per MT/ Unit (Rs) | Unit Price Ex-Works (including packing & forwarding) (Rs) | Taxes & Duties, if any (Rs) | Transportation upto Project site (Rs) | Transit Insurance upt project site including storage (Rs) | Total Unit price free at site (Rs) (5+6+7+8) |
|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| | | | | | | | | |
| 1 | Stub setting templates for tangent tower (0 deg - 2 deg) suitable for 18m and 25m extensions | No. | | | | | | |
| 2 | Superstructure with 90 deg. Rotating X-arm for Large Angle tension towers (30 deg - 60 deg and Dead end) including design, fabrication, galvanising complete with nuts & bolts etc.) Superstructure with 90 deg. Rotating X-arm | No. | | | | | | |
| 3 | 3 metre extensions (complete) | | | | | | | |
| a) | Tangent Towers | No. | | | | | | |
| b) | Small angle tension towers | No. | | | | | | |
| c) | Medium angle tension towers | No. | | | | | | |
| d) | Large angle and dead end towers | No. | | | | | | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 4 | 6 metre extensions (complete) | | | | | | | |
| a) | Tangent Towers | No. | | | | | | |
| b) | Small angle tension towers | No. | | | | | | |
| c) | Medium angle tension towers | No. | | | | | | |
| d) | Large angle and dead end towers | No. | | | | | | |
| 5 | 9 metre extensions (complete) | | | | | | | |
| a) | Tangent Towers | No. | | | | | | |
| b) | Small angle tension towers | No. | | | | | | |
| c) | Medium angle tension towers | No. | | | | | | |
| d) | Large angle and dead end towers | No. | | | | | | |
| 6 | 18 metre extensions for tangent towers | No. | | | | | | |
| | 25 metre extensions for tangent towers | No. | | | | | | |
| 7 | 1.5 m Leg extensions | | | | | | | |
| a) | Tangent Towers | No. | | | | | | |
| b) | Small angle tension towers | No. | | | | | | |
| c) | Medium angle tension towers | No. | | | | | | |
| d) | Large angle and dead end towers | No. | | | | | | |
| 8 | 3.0 m Leg extensions | | | | | | | |
| a) | Tangent Towers | No. | | | | | | |
| b) | Small angle tension towers | No. | | | | | | |
| c) | Medium angle tension towers | No. | | | | | | |
| d) | Large angle and dead end towers | No. | | | | | | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 9 | 4.5 m Leg extensions | | | | | | | |
| a) | Tangent Towers | No. | | | | | | |
| b) | Small angle tension towers | No. | | | | | | |
| c) | Medium angle tension towers | No. | | | | | | |
| d) | Large angle and dead end towers | No. | | | | | | |
| 10 | 6.0m Leg extensions | | | | | | | |
| a) | Tangent Towers | No. | | | | | | |
| b) | Small angle tension towers | No. | | | | | | |
| c) | Medium angle tension towers | No. | | | | | | |
| d) | Large angle and dead end towers | No. | | | | | | |
| 11 | Ladder for special structure | No. | | | | | | |
| 12 | Earthing of towers-counterpoise earthing with material complete with necessary bolts, nuts and washers | set | | | | | | |
| i) | Counterpoise wire length 120m | set | | | | | | |
| ii) | Counterpoise wire length 280m | set | | | | | | |
| 13 | Aviation set including Markers Night marking/Painting installation | No. | | | | | | |
| 14 | Earthing of transmission line towers by pipe type earthing sets including cost of coke | Set | | | | | | |
| 15 (i) | Hardware fittings for double tension strings | No. | | | | | | |
| (ii) | 90 KN Insulator disc | No. | | | | | | |
| 16 (i) | Hardware fittings for double suspension strings | No. | | | | | | |
| (ii) | 70 KN Insulator disc | No. | | | | | | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 17 (i) | Hardware fittings for single suspension pilot strings | No. | | | | | | |
| (ii) | 70 KN Insulator disc | No. | | | | | | |

Note

i) * Leg Extension Price includes one corner only

ii) NA - Not applicable

iii) The unit price under items 12, 13 and 14 is inclusive of the cost of erection

## PRICE SCHEDULE - G

**CONSTRUCTION OF 132KV S/C TRANSMISSION LINE ON DOUBLE CIRCUIT TOWERS:**

**LINE ROUTE: RAXAUL - PARWANIPUR TRANSMISSION LINE (21.713 KM)**

**G2 UNIT RATES FOR ERECTION**

| Sl. # | Description of Item / Work | Unit | Unit Price for Erection (Rs) |
|---|---|---|---|
| 1 | 2 | 3 | 4 |
| 1 | Erection of Leg extension for each type of towers | | |
| | Extension | | |
| | 1.5m | No. | |
| | 3m | No. | |
| | 4.5m | No. | |
| | 6m | No. | |
| 2 | Erection of special towers in river/valley crossing including extensions and tack welding of nuts upto bottom cross-arm level | MT | |
| 3 | Stringing of Single Circuit (long crossing) with panther conductor and earth wire | | |
| | Span 801 - 1200m | No. | |

Note - The above unit prices include insurance charges during erection, testing and commissioning.