

REC TRANSMISSION PROJECTS COMPANY LIMITED



On Behalf of KERALA STATE ELECTRICITY BOARD LIMITED

Office of the Deputy Chief Engineer with full powers of Chief Engineer,
TransGrid (North)

Vydyuthi Bhavanam, Kallippadam P.O

Shoranur - 679 122

As Bid Process Coordinator

(Invites bid through e-tendering mode only)

FOR

TURNKEY CONTRACT PACKAGE

**KOLATHUNADU LINES STRENGTHENING PACKAGE & NORTH
MALABAR LINES PACKAGE**

**Construction / Up gradation of 220/110kV line using Narrow base MCMV
Towers**

- **KLSP Project A: Construction of 9 kM 220kV Double circuit line from Kanhirod to Mundayad**
- **KLSP Project B: Construction of 81 kM 220kV /110kV Multi circuit Multi voltage (MCMV) line from Mundayad to Mylatty**

- **NMLP Project A: Construction of 22.236 kM 220/110 kV Multi Circuit Multi Voltage Line (MCMV) from Mundayad to Thalassery**
- **NMLP Project B: Conversion of 7.66 kM of 110 kV DC line to 220kV /110kV Multi circuit from Areacode – Kaniyambetta tap point to Kunnamangalam Substation through Existing Agasthimuzhi 110 kV line route.**

Tender No. BPC/BD/KSEBL/2018-19 /01

July 2018

REC Transmission Projects Company Limited
(A wholly owned subsidiary of REC, a 'Navratna CPSE'
Under the Ministry of Power, Govt. of India)
ECE House, 3rd Floor, Annexe – II,
28 A, K G MARG, NEW DELHI – 110 001
Website: www.rectpcl.in

**VOLUME I –Qualification Requirement and General
Conditions of contract**

Disclaimer

This Invitation for Bid (IFB) is not an agreement and is neither an offer nor invitation by the Authority to the prospective Bidders or any other person. The purpose of this IFB is to provide interested parties with information that may be useful to them in making their financial offers (Bids) pursuant to this IFB. This IFB includes statements, which reflect various assumptions and assessments arrived at by the Authority in relation to the Project. Such assumptions, assessments and statements do not purport to contain all the information that each Bidder may require. This IFB may not be appropriate for all persons, and it is not possible for the Authority, its employees or advisors to consider the investment objectives, financial situation and particular needs of each party who reads or uses this IFB. The assumptions, assessments, statements and information contained in the Bidding Documents, especially the Feasibility Report, may not be complete, accurate, adequate or correct. Each Bidder should, therefore, conduct its own investigations and analysis and should check the accuracy, adequacy, correctness, reliability and completeness of the assumptions, assessments, statements and information contained in this IFB and obtain independent advice from appropriate sources.

Information provided in this IFB to the Bidder(s) is on a wide range of matters, some of which may depend upon interpretation of law. The information given is not intended to be an exhaustive account of statutory requirements and should not be regarded as a complete or authoritative statement of law. The Authority accepts no responsibility for the accuracy or otherwise for any interpretation or opinion on law expressed herein.

The Authority, its employees and advisors make no representation or warranty and shall have no liability to any person, including any Applicant or Bidder under any law, statute, rules or regulations or tort, principles of restitution or unjust enrichment or otherwise for any loss, damages, cost or expense which may arise from or be incurred or suffered on account of anything contained in this IFB or otherwise, including the accuracy, adequacy, correctness, completeness or reliability of the IFB and any assessment, assumption, statement or information contained therein or deemed to form part of this IFB or arising in any way for participation in this Bid Stage.

The Authority may in its absolute discretion, but without being under any obligation to do so, update, amend or supplement the information, assessment or assumptions contained in this IFB.

The issue of this IFB does not imply that the Authority is bound to select a Bidder or to appoint the Selected Bidder or Concessionaire, as the case may be, for the Project and the Authority reserves the right to reject all or any of the Bidders or Bids without assigning any reason whatsoever.

The Bidder shall bear all its costs associated with or relating to the preparation and submission of its Bid including but not limited to preparation, copying, postage, delivery fees, expenses associated with any demonstrations or presentations which may be required by the Authority or any other costs incurred in connection with or relating to its Bid. All such costs and expenses will remain with the Bidder and the Authority shall not be liable in any manner whatsoever for the same or for any other costs or other expenses incurred by a Bidder in preparation or submission of the Bid, regardless of the conduct or outcome of the Bidding Process.

TABLE OF CONTENTS

Sl No.	Description	Page No.
VOLUME I -Qualification Requirement and General Conditions of contract		
Section 1	General	8
	a. Tender Notice	9
	b. Application Form	13
	c. Invitation for Bids	14
Section 2	Instructions to Bidders	20
Annexure-2A	Methodology & Registration process of e-bidding portal	57
Section 3	Qualification Formats and other Schedules to be Filled in by the Bidder	68
Section 4	Sample Forms	100
Section 5	General Conditions of Contract	122
Section 6	Contract Data	176
Section 7	Annexures	179
VOLUME II - Special Instructions & Technical specifications		
Part A	Technical Conditions of Contract	5
Section 1	General Information and Scope of the Work	6
Section 2	General Technical Conditions	19
Section 3	Site Access	30
Part B	Technical Specifications of Materials	34
Section 4	Technical Specifications of Tower & Accessories	35
Section 5	Technical Specifications of Conductors	51
Section 6	Technical Specifications of OPGW	82

Section 7	Technical Specifications of Polymeric insulators	136
Section 8	Technical Specifications of Hardware & Accessories for Conductor & Insulator	171
Part C	Execution of the Package	197
Section 9	Tower Foundation, Erection, Stringing and Installation of Line Materials	198
Part D	Documentation and Deliverable	230
Part E	Drawings	238
	Annexure A Block diagram representation of Kolathunadu Lines Package & North Malabar Lines Package	283
	Annexure B Bill of Quantities for Material, Spares , Labour and Dismantled item (Attached Separately)	
	Annexure C Approximate Tower Quantity (Attached Separately)	
VOLUME-III – Price bid		
Section 1	Price Bid Instructions.	
Price Schedule1	Price Schedule – Foundation, Erection and stringing for Kolathunad Lines Package (Project-A & B) & North Malabar Lines Package (Project A & B)	
Price Schedule 2	Price Schedule – Materials and Spares for Kolathunad Lines Package (Project A & B) & North Malabar Lines Package(Project A & B)	
Price Schedule 3	Price Schedule – Dismantled Materials	
Summary Sheet	Summary Sheet	

SECTION -1
GENERAL

Section 1A - TENDER NOTICE

E- Tender No. BPC/BD/KSEBL/2018-19/01

Table-1

Name of work	<p>Construction / Up gradation of 220/110kV line using Narrow base MCMV Towers</p> <ol style="list-style-type: none"> 1. KLSP Project A: Construction of 9 km 220kV Double circuit line from Kanhirod to Mundayad 2. KLSP Project B: Construction of 81 km 220kV /110kV Multi circuit Multi voltage (MCMV) line from Mundayad to Mylatty 3. NMLP Project A: Construction of 22.236 km 220/110 kV Multi Circuit Multi Voltage Line (MCMV) from Mundayad to Thalassery. 4. NMLP Project B: Conversion of 7.66 km of 110 kV DC line to 220kV /110kV Multi circuit from Areacode - Kaniyambetta tap point to Kunnamangalam Substation through Existing Agasthimuzhi 110 kV line route.
Date of Publishing of Notice Inviting Tender	01/08/2018
Tender documents download Start date	01/08/2018
Tender documents download End date	2 Days Prior Bid Submission Date
Pre-bid meeting (Date , Time & Place)	16/08/2018 at 11:30 AM at Office of the Deputy Chief Engineer, Kerala State Electricity Board, Transmission Circle-Kannur, Vidyuthi Bhavanam ,

	Caltex Junction, Kannur, Kerala (Ph:9446008389)
Last Date for Seeking Clarification by Bidders	21/08/2018 upto 5:00 PM
Reply to Bidders Clarification	31/08/2018
Start of Registration on MSTC Portal	01/09/2018
Closing of Registration on MSTC Portal	2 Days Prior Bid Submission Date
Submission of Bids (Online and Offline)Start date	7 days Prior to Bid Submission Date &Time
Bid Submission (Online and Offline) End date & time	15/09/2018 at 11:00 hrs
Date & Time of Technical Bid opening	15/09/2018 at 12:00 hrs
Earnest Money Deposit	Rs. 5,00,000.00 (Rs. Five Lakhs only)
Tender Fee	Rs. 15,000/-+GST@18%. Also, the bidder has to register for MSTC portal at their own cost.
Availability of Tender documents	http://www.mstcecommerce.com/eprochome/rec tpcl
Date of opening of Financial Bid	Shall be intimated separately to eligible bidders.
Commencement of e-Reverse Auction	Shall be intimated separately to eligible bidders.
Address for Bid submission/EMD (Hard Copy)	Addl. CEO, REC Transmission Projects Company Limited ECE House, 3rd Floor, Annexe - II, 28 A, K G MARG, NEW DELHI - 110 001 Tel: 011 - 47964705, Fax : 011-47964704 Email- bgupta@reclnic.in

Contact Person	Shri. Arun Kumar Chaturvedi Manager (Technical). REC Transmission Projects Company Limited, ECE House, 3rd Floor, Annexe – II, 28 A, K G MARG, NEW DELHI – 110 001 Tel: 09650130505 Email- arun.k.chaturvedi78@gmail.com
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In order to select suitable agency to complete the scope of work elaborated in this Bid Document, a Single Stage Two Envelope Bidding Procedure will be adopted and will proceed as detailed in the Bidding Documents.

Soft Copy Part of the Bids must be uploaded on the e-bidding portal at or before 11:00 hours on 15/09/2018. The e-Procurement system would not allow any late submission of bids through the portal after due date & time as specified.

Hard Copy Part of the Bids must be submitted under Single Stage Two Envelope Bidding Procedure at the address given in Table at Section-1A Tender Notice at or before 11:00 Hours on **15/09/2018**. **The Price Bid shall not be sent as hard copy.** In case Hard copy part of the bid is not received by the BPC till the deadline for submission of the same prescribed by the BPC, but the bidder has uploaded the soft copy part of the bid, the bid will be considered as late bid. Such bids will be rejected during preliminary examination.

For Purpose of evaluation soft copy uploaded on e-bidding portal shall be considered.

First Envelope i.e. **Techno -Commercial Part** shall be opened **on scheduled date** and time or extended date and time as the case may be, in the presence of the bidders' representatives who choose to attend in person at the address given in Table at Section-1A Tender Notice .

Second Envelope i.e. **Price Bid** of those bidders who are meeting the qualification requirement, shall be opened through e-bidding portal on a date and time to be intimated later to the bidders.

The scanned copy of Bid form as per Sample Form-B Section-4 of Volume - I of Technical Qualification Bid, prepared in bidders letter head and Tender Agreement as per Sample Form- A of Section-4 of Volume - I of Technical Qualification Bid, executed in Kerala Government stamp paper worth Rs.200/- are to be attached along with the bid in First

Envelope Cover- 1 of the e-bidding portal. All other existing conditions related to the bids of KSEBL will be applicable in this bid also.

Originals of **Tender Agreement executed in Kerala Government stamp paper worth Rs.200/- & Bid form executed in bidders letter head** shall be submitted to the Addl. CEO, REC Transmission Projects Company Limited, in a single sealed envelope as a part of First Envelope of Hard Copy super scribed as **E- Tender No. BPC/BD/KSEBL/2018-19/01 along** with a Techno-Commercial bid.

All bidders participating in the Bid should have a valid Digital Signature Certificate availed from an approved certifying authority.

Note: - In case the due date of opening of documents happens to be a holiday, the due date will be extended to the next working day and time given for this. No separate intimation in this regard will be issued.

Addnl. CEO

REC Transmission Projects Company Limited

SECTION - 1 B

APPLICATION FORM

(To be filled in by the applicant)

To

Addl. CEO,

REC Transmission Projects Company Limited

ECE House, 3rd Floor, Annexe - II,

28 A, K G MARG, NEW DELHI - 110 001

Sir,

Sub: - **Execution of Kolathunadu Lines Package & North Malabar Lines Package on turnkey basis as detailed in the bidding document as per reference no. mentioned below**

Ref: Tender No. BPC/BD/KSEBL/2018-19/01 We are interested for the subject cited works.

Enclosed please find the Technical formats and GTP duly filled in along with the documents

listed below for perusal and consideration. We agree to abide by the terms and conditions as

stipulated in these documents and to be prescribed by the K.S.E.B Ltd. from time to time in this respect.

List of documents enclosed:

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		Name and Address of Bidder
Place:		
Date:		

SECTION - 1C

INVITATION FOR BIDS

(SINGLE STAGE TWO ENVELOPE BIDDING)

Through e-bidding process

1. This invitation for bids follows the e-procurement notice (Invitation for Bids) for the subject packages which appeared in National and Regional Newspapers on **30.04.2018**. The tender document is available at e-bidding portal (<http://www.mstcecommerce.com/eprochome/rectpcl>). Interested bidders may view, download the e- Bid document, seek clarification and submit their e-Bid online up to the date and time mentioned in the table at Section-1A Tender Notice.

2. **Kerala State Electricity Board Limited** hereinafter referred to as 'KSEBL/'Owner'/'Employer'.

3. **INTRODUCTION:**

National policy and the Electricity Act 2003 have put emphasis on the development of transmission sector through adequate and timely investments by preparing an efficient and coordinated action plan to develop a robust and integrated power system. The transmission system is expected to be capable of meeting the demand at any part of the network without any overloading / constraints in a secure, reliable, efficient and economic manner even under contingency conditions.

A major thrust with a focused effort was adopted in planning and developing a transmission network to meet the challenges expected in transferring power to entire state and for evacuating power from the proposed high capacity Inter State Transmission System (ISTS) projects. Also new technologies needs to be adopted for strengthening the reliability of intrastate sub transmission network for transferring power from intra-State power stations and that received at the ISTS touch points in an effective and economical manner. Kerala state is highly inhabited and the entire state has to be treated as an extended metro city for all purposes of transmission planning. Considering the severe Right of Way (ROW) issues that can permeate in future due to this demographical nature of the state, it was proposed that all new lines on important corridors needs to be planned with higher capacity conductors on multi circuit towers (Narrow based) taking into consideration the expected load growth in the concerned areas.

In consideration to the planning philosophy adopted to embrace the latest technological innovations including innovative business models and alternative construction methods available in the sector with a mission to enhance system reliability and security with minimum disturbance to environment and public at large

and a green vision for better energy management through reduction in system losses, the revised Long Term Transmission Plan was christened as **Trans Grid 2.0**, the future grid of the State.

The projects are planned for execution under two phases. The elements which are critical to the system for relieving congestion and constraint free power evacuation from the HVDC and other ISTS/Generation nodes are listed as **Trans Grid 2.0-Phase-1** works and Phase – II works needs to be executed within five year time frame. These works which are intended for execution are in the form of various packages based on the nature and area of work.

Present Scope of Work under Trans grid 2.0 covered in this Bidding Documents is for **Kolathunadu lines strengthening package & North Malabar lines package.**

4. KSEBL has appointed RECTPCL as Bid Process Coordinator for the aforesaid Project which is a wholly owned subsidiary of Rural Electrification Corporation Limited, a Navratna Public Sector Undertaking, and was incorporated on 8 January 2007 as Public Limited Company. RECTPCL's registered office is situated at Core-4, SCOPE Complex, 7, Lodhi Road, New Delhi-110003, India and Corporate office is at (hereinafter referred to as '**RECTPCL**/'**BPC**'). The Ownership of the project shall, however, remain vested with KSEBL. The project shall be implemented and supervised by **KSEBL** or an agency appointed by KSEBL.

Therefore, RECTPCL, on behalf of KSEBL, invites bids from eligible bidders for the aforesaid projects on Domestic Competitive Bidding basis through single stage two envelope e-bidding process. This Invitation for Bids extended through media, website or written communication or by any other means, shall not be construed to mean that the prospective bidders to whom the Invitation for Bids has been extended is deemed to be an eligible bidder. The eligibility of the bidders shall be determined as per the provisions of Bidding Documents.

5. **Brief description of "Brief of Works" and "Completion Period" under the project is as follows. (Detailed Scope of Work is Mentioned in Section-1 Volume-II)**

Sl No	E-tender No.	Brief of work	Completion period
1.	DCE/ TransGrid (N)/05/2017-18	<p><u>Kolathnadu Lines Package : Project A</u> Construction of 9 km 220kV Double circuit line on 220/110 kV Multi Circuit towers from Kanhirode SS to Mundayad SS using the existing RoW of 66 kV and 110 kV Feeder. (1.5 km 220kV Multi Circuit line from Kanhirode SS to Puravoor + 7.5 km 220kV Double circuit line from Puravoor to Mundayad SS) which includes dismantling of existing conductor, earthwire, towers and all accessories, Supplying Towers and ACSR conductor with accessories, polymeric suspension / tension insulators of approved type and capacity, OPGW with all accessories etc., erection of towers, stringing the line and OPGW, supply of spares as per the specifications and other allied works as per the tower schedule and design provided by KSEBL and technical support and training for KSEBL staff and officers for O&M of the line, up to the full satisfaction of KSEBL on Turnkey Contract Basis.</p>	<p>The period of completion of work shall be 12 months reckoned from the official date of commencement, which is 15 days after the date of issue of work order or the date of the agreement whichever is earlier.</p>
2		<p><u>Kolathnadu Lines Package: Project B</u> Construction of 81 km of 220kV/110kV Multi Circuit Multi Voltage(MCMV) line using multi circuit narrow base towers from Mundayad Substation to Mylaty Substation using the existing RoW of 110 kV SC feeder and which includes dismantling of existing conductor, earth-wire, towers and all accessories, Supplying Towers and ACSR conductor with accessories, polymeric suspension / tension insulators of approved type and capacity, OPGW with all accessories etc., erection of towers, stringing the line and OPGW, supply of spares as per the specifications and other allied works as per the tower schedule and design provided by KSEBL and technical support and training for KSEBL staff and officers for O&M of the line, up to the full satisfaction of KSEBL on Turnkey Contract Basis.</p>	<p>The project has two phases and the total period of completion of work shall be 30 months reckoned from the official date of commencement, which is 15 days after the date of issue of work order or the date of the agreement whichever is earlier.</p>

3	<p><u>North Malabar Lines Package: Project A</u></p> <p>Construction of 22.236 km 220/110 kV Multi Circuit Multi Voltage Line (MCMV) from Mundayad to Thalassery using the existing 110 kV DC and 66 kV RoW which includes dismantling of existing conductor, earth wire, towers and all accessories, Supplying Towers and ACSR conductor with accessories, polymeric suspension / tension insulators of approved type and capacity, OPGW with all accessories etc., erection of towers, stringing the line and OPGW, supply of spares as per the specifications and other allied works as per the tower schedule and design provided by KSEBL and technical support and training for KSEBL staff and officers for O&M of the line, up to the full satisfaction of KSEBL on Turnkey Contract Basis.</p>	<p>The project has two phases and the total period of completion of work shall be 24 months reckoned from the official date of commencement, which is 15 days after the date of issue of work order or the date of the agreement whichever is earlier.</p>
4	<p><u>North Malabar Lines Package: Project B</u></p> <p>Conversion of 7.66 km of 110 kV DC line to 220kV /110kV Multi circuit from Areacode – Kaniyambetta feeder tap point to Kunnamangalam Substation through existing Agasthimuzhi 110 kV DC line route which includes dismantling of existing conductor, earth-wire, towers and all accessories, Supplying Towers and ACSR conductor with accessories, polymeric suspension / tension insulators of approved type and capacity, OPGW with all accessories etc., erection of towers, stringing the line and OPGW, supply of spares as per the specifications and other allied works as per the tower schedule and design provided by KSEBL and technical support and training for KSEBL staff and officers for O&M of the line, up to the full satisfaction of KSEBL on Turnkey Contract Basis.</p>	<p>The project has two phases and the total period of completion of work shall be 12 months reckoned from the official date of commencement, which is 15 days after the date of issue of work order or the date of the agreement whichever is earlier.</p>

6. The detailed Qualifying Requirements (QR) is given in the Bidding Document **(ITB Clause No. 3)**.

7. Interested bidders have to necessarily register themselves on the e-bidding portal of MSTC and are strongly recommended to go through the e-Bidding Methodology & Registration process on e-bidding portal provided in the **Annexure-2A** of the Bidding

Document.

In case of any query regarding e-bidding portal bidders may also contact

S.no	Name	Email	Contact number
1.	Shishupal Yadav	syadav@mstcindia.co.in	8826562675
2.	S D Sharma	sdsharma@mstcindia.co.in	7878055855
3.	Chirag Sindhu	chiragsindhu@mstcindia.co.in	9830336290

The bidders are requested to refer Annexure-2A to ITB MSTC Registration for details.

Bidders are advised to deposit the transaction fee for participation towards the bidding process on e-bidding portal at least two days before the last date of submission and to submit their bids least one day before the last day of submission to avoid any complications at last moment.

For proper uploading of the bids on the portal namely **<http://www.mstcecommerce.com/eprochome/rectpcl>** (*hereinafter referred to as the 'e-bidding portal'*), it shall be the sole responsibility of the bidders to apprise themselves adequately regarding all the relevant procedures and provisions as detailed at the portal as well as by contacting from M/s MSTC Limited, New Delhi directly, as and when required, for which contact details are mentioned above. The Owner&BPC in no case shall be responsible for any issues related to improper uploading/non-submission/postal delays of the bid .

8. BID SECURITY (EMD) and TENDER FEES

- 8.1. The Bid EMD and Tender Fees shall be an amount mentioned in the table under Section-1A Tender Notice.
- 8.2. Bid EMD must accompany the Tender agreement in sample form (A) in section 4 given in the Bid Documents, failing which the Bid shall be rejected.

9. BID ISSUE AND RECEIPT BY BPC

- 9.1 Bid documents and other details may be downloaded from the website <http://www.mstcecommerce.com/eprochome/rectpcl>.
- 9.2 No extension of Bid due date shall be considered on account of delay in receipt of Bid documents online. The bidder is advised to submit the bids well before the stipulated

time and date to avoid any kind of network issues, traffic congestion etc. In this regard the BPC shall not be responsible for any kind of such issues.

- 9.3 KSEBL/RECTPCL reserves the right to cancel/withdraw the bid without assigning any reason for such decision. Such decision will not incur any liability whatsoever on the part of KSEBL/RECTPCL consequently.
10. All correspondence with regard to the above shall be to the following address.

Additional Chief Executive Officer,
REC Transmission Projects Company Limited
ECE House, 3rd Floor, Annexe - II,
28 A, K G MARG, NEW DELHI - 110 001
Tel: 011 - 47964705, Fax : 011-47964704
Email- bgupta@reclnic.in

For more information on RECTPCL, visit our site at: <http://www.rectpcl.in>

For more information on the portal, visit on site of M/s MSTC Limited, New Delhi at:
<http://www.mstcecommerce.com/eprhome/rectpcl>

Sd/-

Addnl. CEO

REC Transmission Projects Company Limited

SECTION - 2

INSTRUCTIONS TO BIDDERS

TABLE OF CLAUSES

Clause No.	Description
I	General
1.	Scope of Bid
2.	Source of Funds
3.	Eligibility and Qualification of Intended Bidders
4.	Other Conditions to be Fulfilled by Bidders
5.	Qualification of the Prospective Bidder - Information & Documents to be Furnished
6.	Cost of Bidding
7.	Pre-bid Meeting
8.	Site Visit
9.	General information
II	Bidding documents
10.	Contents of Bidding documents

11.	Clarification of Bidding Documents
12.	Amendment of Bidding Documents
III	Preparation of Bids
13.	Language of Bid
14.	Documents Comprising the Bid
15.	Deviations
16.	Bid Prices and Bid Currency
17.	Bid Validity
18.	Tender Document Fees and Earnest Money Deposit (EMD)
19.	Alternative Proposals by Bidders
20.	Format and Signing of Bid
IV	Submission of Bids
21.	Submission of Bids

22.	Dead line for submission of bids
23.	Late bids
V	Bid Opening and Evaluation
24.	Opening of bids
25.	Original bid document
26.	Acceptance or rejection of bid
27.	Process to be confidential
28.	Clarification of Bids
29.	Preliminary Examination of First Envelope
30.	Evaluation of Qualification Requirement of Bidders
31.	Evaluation of Techno-Commercial Part (First Envelope)
32.	Opening of Second Envelope
33.	Evaluation of Second Envelope

34.	Correction of Errors
35.	Currency for Bid Evaluation
36.	E-Reverse Auction
37.	Acceptance of bid and award of contracting
38.	Performance guarantee and contract agreement
Annexure - 2A	Methodology and registration Process of e-bidding portal

SECTION - 2

INSTRUCTIONS TO BIDDERS

I. GENERAL

1. SCOPE OF BID

1.1 The RECPTCL on behalf of KSEBL invites e-tenders from interested bidders for the following works as detailed below.

Construction / Up gradation of 220/110kV line using Narrow base MCMV Towers:

1. **KLSP Project A:** Construction of 9 km 220kV Double circuit line from Kanhirode to Mundayad.
2. **KLSP Project B:** Construction of 81 km 220kV /110kV Multi circuit Multi voltage (MCMV) line from Mundayad to Mylatty.
3. **NMLP Project A:** Construction of 22.236 km 220/110 kV Multi Circuit Multi Voltage Line (MCMV) from Mundayad to Thalassery.
4. **NMLP Project B:** Conversion of 7.66 km of 110 kV DC line to 220kV /110kV Multi circuit from Areacode – Kaniyambetta feeder tap point to Kunnamangalam Substation through Existing Agasthimuzhi 110 kV line route.

Note: Please refer to the sketch/ scheme attached as **Annexure A in Part E of Volume II** for better understanding of the above phases.

The successful bidder for the above work on Turnkey Basis should fully satisfy the KSEBL requirements, specifications etc. and hand over the fully constructed line to KSEBL with required guarantee and warranty agreements.

All Bids shall be prepared and submitted online and offline strictly in accordance with these instructions.

1.2 The period of completion of work shall be **as given in Section 1.C Clause No. 5**, reckoned from the official date of commencement, which is 15 days after the date of issue of work

order or the date of agreement whichever is earlier.

1.3 Bids not covering entire scope of the project shall be treated as incomplete and hence, are liable to be rejected.

2. SOURCE OF FUNDS:

The project will be implemented by Kerala State Electricity Board Limited with its own allocated funds or funds mobilized through funding agencies. This project is funded by Kerala Infrastructure Investment Fund Board (KIIFB) of Government of Kerala.

3. ELIGIBILITY AND QUALIFICATIONS OF INTENDED PROSPECTIVE BIDDER

This invitation for Bids, issued by BPC is open to eligible prospective Bidders.

The following parameters will be evaluated thoroughly for technically-qualifying the bidders for Implementation of Transmission lines under Trans grid 2.0 Projects by a KSEBL/RECTPCL which is constituted specifically for Trans Grid 2.0

The intending prospective bidders shall be either a company incorporated as per Indian Companies Act or International Company having registered office in India and shall interalia meet the following conditions to qualify.

NOTE:

In case the bidder is a holding company, the experience for meeting the Qualification Requirement shall be of holding company only (i.e. excluding its subsidiary/group companies).

In case the bidder is subsidiary of holding company the experience for meeting the qualification requirement shall be of that subsidiary company only. (i.e. excluding its holding company)

1. Manufacturing Experience:

The bidder shall be a conductor or Tower manufacturer having manufacturing facilities either in India or abroad who has designed, manufactured, tested (as per relevant IS/IEC/ Eq. Standards) and successfully supplied anywhere in India ;

- a. At least 25000 MT Tower for 220kV or higher voltage level in Last 5 Years , out of which 10000MT shall be successfully installed in India and in service for last two years as on originally scheduled date of bid opening.

OR

- b. At least 2250 km ACSR Panther conductor or higher size in last 5 Years ,out of which 900 kM shall be in successful operation in India for last two years as on originally scheduled date of bid opening.

OR

- c. In case the bidder is not a manufacturer of items under 1(a) or 1(b), he shall be an EPC contractor or a Transmission system developer who is having required installation / development experience related to transmission line projects described under clause (2) below and shall have written understanding with a tower /conductor manufacturers who satisfy the conditions mentioned in clause 1(a) or1(b) Bidder is free to choose their supplier provided they should satisfy the bidding terms and conditions listed above. Such tower and conductor supplier should be either from the List enclosed along with this tender (Annexure-IV of Annexures) or from the list of approved vendors/manufacturers by PGCIL
- d. For the bids with Optical Ground Wire (OPGW),the bidder shall satisfy condition 1(a) or 1(b)or 1(c) above and shall be an Indian / global manufacturer of OPGW (Optical Ground Wire) or shall supply the OPGW (Optical Ground Wire) from an Indian / global manufacturer, who should have designed, manufactured, tested (as per relevant IS/IEC/ Eq. Standards) and supplied 250kMs of OPGW (Optical Ground Wire) in last 5 years out of which 100kM should have been in satisfactory operation on 110 kV class or above voltage grade line in India for a minimum period of two (2) years as on originally scheduled date of bid opening. Manufacturers' Authorization format duly signed & stamped to be submitted with the bid.
- e. For the bids with OPGW terminal equipment, the bidder shall satisfy condition 1 (a) or 1(b) or 1(c) above and shall be an Indian / global manufacturer of OPGW Terminal Equipment or shall supply the equipment from an Indian / global manufacturer for tele-protection and SDH/PDH equipment who have supplied tele-protection and SDH/PDH equipment for 400/220/110 KV substations in last 5 years with satisfactory operation for a minimum period of 2 years as on originally scheduled date of bid opening. The tele-protection equipment should be of same make as SDH/PDH equipment being offered. Manufacturers' Authorization format duly signed & stamped to be submitted with the bid.

2. Installation Experience:

- a) For bids with Lattice Tower and ACSR conductor and the bidder satisfies clause 1(a) or 1(b) or 1(c) above with respect to manufacturing experience, the bidder shall also have installation/development experience of 250 circuit-kM (Number of circuits x route length) of new transmission lines using Lattice Towers & ACSR conductors of Transmission lines of 220KV or above in India within previous five years and out of which 100 circuit-kM of the transmission line should be in satisfactory operation for a period of last 2 years as on originally scheduled date of bid opening.
- b) For the bids with OPGW Stringing, the bidder satisfying Clause 1(a) or 1(b) or 1(c) and 1(d) shall also have experience of 250kM of stringing of OPGW for new lines/ Live line Stringing of OPGW for upgrading of lines, in India in last 5years and out of which 100kM OPGW line should be in satisfactory operation for a period of 2 years as on originally scheduled date of bid opening.

NOTE:

The bidders who are not having installation experience as mentioned clause 2(b) can propose one or more suitable agencies for execution of such works that are satisfying the conditions mentioned in the clause 2(b) pertaining to the installation works related to that agency. Such proposals shall be submitted along with the bid for approval of KSEBL. A new agency, other than those proposed in the bid, cannot be engaged for the work during the execution of work.

3. The Bidder/Manufacturer/Developer should not have been black listed/debarred by any Indian Utility in any supply of works carried out by them.
4. The prospective bidders shall meet the following minimum financial criteria.
 - Minimum Average Annual Turnover *(MAAT) for best three years i.e. 36 months out of last five financial years of the bidder should be Rs. 300 Crores (Indian Rupees Three Hundred Crores Only).
 - Net worth for last 3 financial years should be at least equal to Rs. 150 Crores (Indian Rupees One Hundred and Fifty Crores Only).
 - Solvency certificate issued within 6 months prior to the date of originally scheduled submission of bid shall be a minimum of Rs. 150 Crores (Indian Rupees One Hundred and Fifty Crores Only).
 - The bidder should have executed or under execution of similar works in Power transmission for last three years for the value at least 50% of the Turnover mentioned above per year

*** Note-**

- Annual total income as incorporated in the profit & loss account excluding nonrecurring income, i.e., sale of fixed assets.

4. OTHER CONDITIONS TO BE FULFILLED BY BIDDERS:

- 4.1 The Prospective Bidder must have necessary Tools and Plants (duly calibrated/certified) for execution of Transmission projects of these kinds.
- 4.2 The Prospective Bidder must have engineers and supervisory staff sufficiently qualified and experienced to execute such works, details of which shall be furnished along with the bid.
- 4.3 Technical competence in Design, engineering, manufacturing, construction, erection, Testing and Commissioning of the Bidder or its subsidiary must be proven with Testimonials and necessary documentary evidence for evaluation.
- 4.4 Prospective Bidder must agree to supply the materials and equipment that they may use for the projects under Trans Grid 2.0 from specific manufacturers/vendors as per the approved list of manufacturers/vendors that will be provided along with the Tender. The material /Equipment from the list of approved vendors/manufacturers by the Central Transmission Utility (PGCIL) or from the list enclosed by KSEBL along with Tender for Trans Grid works would be final and any other vendor/manufacturer proposed by the bidder will not be permitted.
- 4.5 Prospective Bidder must agree for the inspection of the offices, capabilities, production units, testing facilities etc. of bidder, manufacturer by the client representatives for verification at any stage of evaluation of Bids.
- 4.6 Prospective Bidder's capability in bringing in innovation, new technology, etc. will also be considered during evaluation and innovative and technically feasible alternatives will be considered positively during the Bids. Hence prospective bidders may provide the proof of the innovations implemented by them in the Power Transmission system.
- 4.7 The evaluation of bids done by KSEBL/RECTPCL will be final and challenging the decision taken by KSEBL/RECTPCL by any prospective bidder will not be entertained.
- 4.8 The prospective Bidders not accepting payment terms, penalty and delivery conditions will be liable for rejection.
- 4.9 The Prospective bidder and its Manufacturers shall agree to provide guarantee for 7 years against manufacturing defect/defective workmanship from the date of

Commissioning and Handing over Date (CHD). The performance Bank Guarantee equivalent to 10% of the contract value shall be provided by the bidder and maintained during the entire guarantee period. Usually the defect notice period will be one month prior to the warranty expiry or as specified in the Tender documents.

- 4.10 Upon Commissioning and Handing over, the bidder must provide technical support and training for KSEBL staff and officers for Operation & Maintenance of the line as the conditions stipulated in tender documents.

5. QUALIFICATION OF THE PROSPECTIVE BIDDER - INFORMATION AND DOCUMENTS TO BE FURNISHED

The Prospective Bidder shall include the following information and documents with their bids :-*(As per Section-III-Qualification Formats and other Schedules to be filled by the bidder)*

- a. Copies of original documents defining the constitution or legal status, place of Registration and principal place of business, written power of attorney of the authorized signatory of the Prospective Bidder to commit the bid.-**Format-A-Section-1.1.**
- b. Total annual turnover expressed as total volume of construction work performed by the Prospective Bidder in his own name (not by any other company whose name has subsequently been changed so as to form the current prospective Bidder) in each of the three years considered for evaluation out of previous five years.-**Format-A-Section-1.2**
- c. Experience of the prospective Bidder in executing similar contract (nature and volume)for the last 5 years, and details of work in hand and contractual commitments; clients who may be contacted for further information on those contracts;-**Format-A-Section-1.3**
- d. Major items of construction / manufacturing equipments proposed for carrying out the contract; **Format-A-Section-1.4**
- e. Qualifications and experience of key site management and technical personnel (having minimum 3 years' experience) proposed for the contract; **Format-A-Section-1.5**
- f. Proposed Contractors and Technology Partners; **Format-A-Section-1.6**
- g. Reports on the financial standing of the prospective Bidder, such as profit and loss statements and auditor's reports for the past three years; audited financial statements submitted by foreign firms prepared and presented in Rupee terms for proper

verification, attested by the notary public or concerned embassy officials; **Format-A-Section-1.7**

- h. In case the annual accounts for the latest financial year are not audited and therefore the applicant could not make it available, the Applicant shall give an undertaking to this effect and the statutory auditor shall certify the same. In such a case, the Applicant shall provide the un-audited annual accounts (with schedule) for the latest financial year, duly certified by the Statutory Auditor as well as Audited Reports for three years preceding the latest financial year; **Format-A-Section-1.7**
- i. Evidence of adequacy of working capital for this contract, i.e., evidence of access to line(s) of credit and availability of other financial resources. Solvency limit is specified as 50% of MAAT; **Format-A-Section-1.8**
- j. Authority to seek reference from the prospective Bidder's bankers; **Format-A-Section-1.9**
- k. Information regarding any current litigation in which the prospective Bidder is involved, the parties concerned, and disputed amount; **Format-A-Section-1.10**
- l. Bidders Information-**Format B**
- m. A declaration establishing that the prospective Bidder is not associated, nor has been associated in the past, directly or indirectly, with the expert or any other entity having prepared the design, specification and other bidding documents for the project or being proposed as Engineer for the contract.-**Format-C**
- n. A declaration establishing that the prospective Bidder has not been debarred/blacklisted from undertaking similar work in any Govt./Public undertaking. -**Format-D**
- o. Authorization/Undertaking **Format-Format-E.**
- p. Net worth and Solvency Certificate-**Format-F.**
- q. Bidder's Experience-**Format-G.**
- r. Details of Work -**Format-H.**
- s. List of Material supplied by the manufacturer/technical collaborator for last five years.-**Format-I.**

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- t. The deviations on any clauses if unavoidable shall be furnished as per Bidder has to the **Formats-J, K&L**. Deviations submitted at any other place/formats other than Formats mentioned shall not be considered and it shall be construed that the bidder shall comply completely with all the requirements of the specifications. The Deviations if not acceptable by Owner shall be withdrawn by the Bidders failing which offer of such bidders shall be rejected.
- u. Local Representation-**Format-M**
- v. List of Proposed Vendor/Supplier for Equipment/Materials -**Format-N**.
- w. Activity Time Schedule-**Format-O**
- x. It shall be explicitly noted that the requirements/criteria covered under sub-clauses above shall strictly apply to the prospective Bidder offering the bid and not to his associated companies or group of companies or companies taken over by him. If the main bidder is the parent company and the bidder is furnishing the consolidated financial statement including that of their subsidiary company, duly prepared by company's Chartered Accountant, then the turnover mentioned in the Consolidated Financial Statement will be considered.
- y. The bidding documents and formats in soft copy will be available on the e-bidding portal. The prospective bidder shall use the downloaded soft copy to enter all details, sign, and submit hard copy and soft copy to bid inviting authority.

6. COST OF BIDDING

The Bidder shall bear all costs associated with the preparation and submission of his Bid and KSEBL/RECTPCL will in no case be responsible or liable for those costs.

7. PRE-BID MEETING

Bidders are advised to attend the pre-bid meeting so as to have better understanding of the works. The time and venue are specified in the Table under Section-1 A Tender Notice. The purpose of the meeting will be to clarify any issues regarding the e-procurement method, the Bidding Documents in general and the Technical Specifications in particular. The Bidder is requested, as far as possible, to submit any question in writing, to reach the Employer not later than one week before the meeting. It may not be practicable at the meeting to answer questions received late, but questions and responses will be transmitted as indicated hereafter. Minutes of the meeting, including the text of the questions raised (without identifying name of the bidders) and the responses given, together with any responses prepared after the meeting, will be transmitted without delay through the e-bidding portal only. Any

modification of the Bidding Documents, which may become necessary as a result of the pre-bid meeting shall be made by the Employer exclusively through the issue of an Addendum pursuant to ITB Clause 12 and not through the minutes of the pre-bid meeting.

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

8. SITE VISIT

The Bidder is advised to visit and examine the sites of works and their surroundings and obtain for himself on his own responsibility and at his own risk/cost all information that may be necessary for preparing the bid and entering into a contract for the work. The costs of visiting the sites shall be at the bidder's own expense. He may contact the **Deputy Chief Engineer with Full Powers of Chief Engineer, Transgrid (N) North, KSEBL, Vidyuthi Bhavanam, Kallippadam P.O. Shoranur - 679 122**, for any assistance in this regard.

8.1 KSEBL/RECTPCL shall not entertain any claim at any stage from the bidder on the plea of having him not acquainted sufficiently to the site conditions.

8.2 The Bidder and any of its personnel or agents will be granted permission by the Owner to enter upon its premises and lands for the purpose of such inspection, but only upon the express condition that the Bidder, its personnel and agents will release and indemnify the Owner and its personnel and agents from and against all liability in respect thereof and will be responsible for death or personal injury, loss of or damage to property and any other loss, damage, costs and expenses incurred as a result of the inspection.

9. GENERAL INFORMATION:

9.1 Owner's Right to Accept any Bid and to Reject any or all Bids

The decision of BPC/KSEBL in acceptance of tender will be final and without appeal. BPC/KSEBL will not be bound to give any reason for the acceptance or rejection of any firm/ contractor on any account, whatsoever.

9.2 The bidders are required to give complete information as asked for in the format attached.

9.3 In case of imported materials/items, the bidder shall make his own arrangements and any import duty will be to the account of the contractor and KSEB Ltd i.e. Owner shall

not render any assistance in this regard.

- 9.4 All tender documents should be submitted as per provisions of Bidding Document, after digitally signing with a valid Digital Signature Certificate (DSC) availed from an approved Certifying Authority. By submitting digitally signed Bid documents; the Bidder accepts that they have clearly understood and agreed all the terms and conditions of this Tender.
- 9.5 For evaluation of price bid, the grand total of supply part and labour part together will be taken. **Mentioning of price details at any place other than the designated place shall disqualify the bid and the bid shall summarily be rejected.**
- 9.6 The quantities specified in the schedule are tentative. The supply and work as per actual requirement may be carried out at the time of execution of work.
- 9.7 Prospective Bidder must agree to supply the materials and equipment that may be required for this project from specific manufacturers/vendors as per the approved list of manufacturers /vendors that is provided along with the Tender as per **Annexure III** of this volume. List of suppliers/ vendors for other equipment and materials shall be provided by the bidder during the bidding stage for evaluation of the bids, as per the **format - N of section 3. The items which are not mentioned in Annexure III, bidders are advised to submit their options for supply of the items which are as per standards and approved by KSEBL to be procured from approved vendors of PGCIL along with details of supply, manufacturers' experience and authorization from manufacturer shall also be submitted in the Format E.**
- 9.8 Prospective Bidder must agree for the inspection of the offices, capabilities, production units, testing facilities etc. of the prospective bidder manufacturer by the client's representatives for verification at any stage of evaluation of Bids or execution.
- 9.9 Any formation of cartel and Monopolist and Restricted Trade Practices followed by the bidder at any stage of bidding will lead to disqualification of the bidder.
- 9.10 Prospective bidder must agree for setting up their office in Kerala in a suitable location and to assign contact person to interact with KSEBL during the execution stage.

9.11 The Bidder is responsible for all Taxes, insurance, workmen compensation, duties and bank charges in connection with LC/BG etc. in connection with the execution of the concerned project by a bidder.

9.12 During bidding stage if any material used in this project is new and not type tested earlier the contractor shall undertake the type testing in NABL approved laboratory in the event of award of contract.

9.13 The project is taken up under EPC Turnkey mode. The Bid price arrived based on the individual item wise quote for materials and labour by each bidder will be compared to determine ranking of bidders

9.14 The dismantled scrap shall be purchased by the successful bidder at the rates quoted by the bidder as per Price Schedule-3 (for dismantled materials in Vol. III) of this bid. The bidder shall quote not less than the minimum rate approved by KSEBL for the scrap materials. The minimum rates approved by KSEBL for the scrap materials are as under:

Dismantled ACSR/AAAC conductor	- Rs. 84,000 per MT
Dismantled Copper conductor	- Rs. 3, 15,000 per MT
Dismantled 7/9 or 7/10 stranded Galvanized steel earthwire	-Rs. 14,000 per MT
Dismantled Insulators and accessories, Power conductor accessories, Earth conductor accessories	- Rs. 5,000 per MT

Dismantled Galvanized Tower parts -Scrap iron - Rs. 14,000 per MT

9.15 However, KSEBL is at liberty to decide whether the dismantled materials are disposed at the rates quoted by the bidder. The taxes on sale of scrap shall be to the account of the bidder.

9.16 The decision of KSEBL/RECTPCL on this tender shall be final and binding on all parties concerned. KSEBL/RECTPCL shall not be bound to give any reason for the acceptance or rejection of tender of any firm / prospective Bidder on any account.

II. BIDDING DOCUMENTS

10 CONTENT OF BIDDING DOCUMENTS

10.1 The facilities required, bidding procedures, contract terms and technical requirements are prescribed in the Bidding Documents. The Bidding Documents comprise of the following and shall include amendments, if any, thereto:

VOLUME – I: Qualification Requirement and General Conditions of Contract

Section 1 General

Section 1-A Tender Notice.

Section 1-B-Application Form

Section-1-C- Invitation for Bids

Section 2-Instruction to Bidders

Section-2-A- Annexure-A- e-Tendering Methodology & Registration process of e- bidding portal.

Section 3-Qualification Formats and Other Schedules to be filled by the Bidder.

Section-4-Sample Forms.

Section-5-General Conditions of Contract.

Section-6-Contract Data.

Section-7-Annexures.

VOLUME – II: Special Instructions and Technical Specifications

PART A-Technical Conditions of Contract

Section-1- General Information and Scope of Work.

Section-2-General Technical Conditions.

Section-3-Site Access.

PART-B- TECHNICAL SPECIFICATIONS OF MATERIALS

Section-4-Technical Specifications of Tower and Accessories.

Section-5-Technical Specifications of Conductors.

Section-6-Technical Specifications of OPGW.

Section-7-Technical Specifications of Polymeric Insulators.

Section-8-Technical Specifications of Hardware and Accessories for Conductor & Insulator.

Part-C-Execution of the Package.

Section-9-Tower Foundation, Erection, Stringing and Installation of Line Materials.

Part-D-Documentation and Deliverables.

Part-E-Drawings

Annexure-A-Block Diagram representation of Kolathunad Lines Package and North Malabar Line Package.

Annexure-B-List of Materials and Spares.

Annexure-C-Approximate Tower Quantity

Volume-III-Price Bid

Section-I-Price Bid Instructions

Section 1 Price Bid Instructions.

Price Schedule 1 Price Schedule – Foundation, Erection and stringing for Kolathunad Lines Package (Project-A & B) & North Malabar Lines Package (Project A & B)

Price Schedule 2 Price Schedule – Materials and Spares for Kolathunad Lines Package (Project A & B) & North Malabar Lines Package (Project A & B)

Price Schedule 3 Price Schedule – Dismantled Materials

Summary Sheet (Consisting Final prices of Price Schedule1, 2&3 against Field Name Total Evaluated Price) Summary Sheet

10.2 The Bidder is expected to examine all instructions, forms, terms, specifications and other information in the Bidding Documents. Failure to furnish all information required by the Bidding Documents or submission of a bid not substantially responsive to the Bidding at the Bidder's risk Documents in every respect will be and may result in rejection of its bid.

11 CLARIFICATION OF BIDDING DOCUMENTS

11.1 A prospective bidder requiring any clarification of the bidding documents may notify RECTPCL Concerned Person as per details mentioned in Table Under Section-1A in writing or by e-mail at the RECTPCL's address indicated in the Tender notice before the date of closure of Bid Clarifications as mentioned in Table Under Section-1A Tender Notice.

11.2 RECTPCL shall provide its reply to clarifications through e-bidding portal.

11.3 Request for clarification or any delay in complying with such request by RECTPCL, shall not in any way affect the obligation on the part of the bidder to send the complete bid by the deadline indicated.

11.4 **Local Representation:** -The Bidder shall indicate in his bid, under a separate covering letter, the name of the person or the firm who will be acting as his representative for the purpose of his bid. He shall also state, the service facilities which he or his representatives have as per sample **format M of section 3** in this volume.

12 AMENDMENT OF BIDDING DOCUMENTS

12.1 Before the deadline for the submission of bids, RECTPCL may modify the bidding documents by issuing corrigendum.

12.2 All amendments/corrigendum shall be published on the website <http://www.mstcecommerce.com/eprochome/rectpcl>. RECTPCL and KSEBL shall not be responsible for bidder's negligence in checking the website regularly for any updates on this tender. The amendments to the Bidding Documents shall be binding on the bidders and notification of the amendment through portal shall be deemed to construed that such

amendment(s) to the Bidding Documents have been taken into account by the Bidder in the bid.

12.3 In case it is not possible to open the tender on the specified time and date due to any reason, the revised time and date will be published on the website <http://www.mstcecommerce.com/eprochome/rectpcl>.

III. PREPARATION OF BIDS

13 LANGUAGE OF BID

All documents relating to the bid shall be in the English language.

14 DOCUMENTS COMPRISING THE BID

14.1 HARD COPY PART

Hard copy part of the bid shall comprise the following documents to be submitted in a sealed envelope, as part of the First Envelope.

- (i) Demand Draft Towards Tender Document Fees (Original)
- (ii) Bid Security (in Original), in separate envelope in accordance with clause 18 of ITB and as per Sample Form-F of Section-4
- (iii) Power of Attorney.
- (iv) Tender Agreement (in Original) as per Sample Form-A of Section-4 and as per clause 14.2 (a)-iii Soft Copy Part
- (v) Bid Form (in Original) as per Sample Form-B of Section-4 and as per clause 14.2 (a) -iv.
- (vi) Bidder shall submit signed and stamped copy of bid document along with all clarifications/ amendments/ addendums thereof issued in the e-bidding portal.
- (vii) Any other document further specified in the Bidding Document duly signed and stamped on each page

Bidders are requested to note necessarily that Price Bid is not to be submitted in Hard Copy. In case of submission of Price Bid as Hard Copy by any bidder, the Bid of such bidder shall be rejected outright.

14.2 Soft Copy Part

Soft copy part of the bid shall comprise of following documents to be uploaded on the portal as per provisions therein.

(a) As part of First Envelope (Cover-1 of the e-bidding portal)

- (i) Scanned copy of Demand Draft towards Tender Document Fees.
- i) Scanned Copy of Bid Security.
- ii) Scanned Copy of Power of Attorney.
- iii) Scanned Copy of Tender Agreement

Tender Agreement shall be executed in Kerala Government Stamp Paper worth Rs. 200/- as per Sample Form A of Section-4.

- iv) Scanned Copy of Bid Form

Bid Form shall be prepared by the bidders on the Bidder's letterhead as per Sample Form-B of Section-4.

- v) Scanned Copy of signed and stamped copy of bid document along with all clarifications/ amendments/ addendums thereof issued in the e-bidding portal.
- vi) Scanned Copy of any other document further specified in the Bidding Document duly signed and stamped on each page.
- vii) Duly signed and stamped scanned copy of any other document in support of the Bidder's Qualification and mentioned anywhere in the Bid Document

b) As part of First Envelope (Cover-2 of the e-Bidding Portal):

- (i) Duly Filled Signed and Stamped Formats in Section-3 of Vol-1. (To be uploaded as PDF Document)
- (ii) Any other Scanned Documents/Certificates mentioned elsewhere in the bid documents sufficing the requirement of the Eligibility and Qualification of the Bidders of the bidding document duly signed. (To be Uploaded as Single PDF Document)
- (iii) Duly filled and signed Guaranteed Technical Particulars as per Sample Forms in Volume-II of the Bidding Document. (The Bidder has to ensure that he has

filled all the GTP's mentioned at different Sections of Volume-II of the Bidding Document) (To be uploaded as PDF Document)

c) As a part of Second Envelope (Cover-3 of the e-Bidding Portal):

Price Bid (Volume-III)

- (i) The blank price bid should be downloaded and saved on bidder's computer without changing file-name otherwise price bid will not get uploaded. The bidder should fill in the details in the same file and upload the same back to the e-bidding portal.
- (ii) Tenders/Bids shall be accepted only through online mode in the website and no manual submission shall be entertained.
- (iii) **If the Bidder has wrongly submit the bid within due date and time, the Bidder can Delete the bid by clicking on delete button in the e-bidding portal and then resubmit the fresh bid again at <http://www.mstcecommerce.com/eprochome/rectpcl> within due date and time.**

15 DEVIATIONS

The deviations on any clauses if unavoidable shall be furnished by the bidder as per Formats in Section-3. Deviations submitted at any other place/formats other than this shall not be considered and it shall be construed that the bidder shall comply completely with all the requirements of the specifications. BPC in accordance with the Owner reserves the right to accept or reject any variation or Deviation. Variation and deviation and other factors which are in excess of the requirements of the bidding documents or otherwise results in unsolicited benefits of the Owner, shall not be taken into account in bid evaluation and the Deviations if not acceptable by Owner/BPC shall be withdrawn by the Bidders failing which offer of such bidders shall not be acceptable.

16 BID PRICES AND BID CURRENCY

16.1 The Contract shall be for "Brief of Works" as described in Clause 5 of Section 1.C and as per Price Schedule provided in Volume III of the bidding document. The bidder has to quote for all works. **Partial quotation for any site will not be permitted.**

The items of work, quantity, etc., mentioned in price bid are only tentative. The bidder

has to execute the work/supply of materials needed for actual completion of work. Rate quoted shall apply for all quantities required for completion irrespective of variation of quantity **and the payment will be made as per actual executed quantity at the quoted rates.** The Bidder shall fill in the rate and prices for all items of the work /material described in the specifications and listed in the Price Bid (Price Schedule – Volume III). The price quoted by the bidder shall be **inclusive of all cost** of inspection and testing of equipment/ material for each batch of equipment/ material manufactured, in the presence of representatives of KSEBL.

16.2 For Supply of material:-

All statutory taxes, insurance, freight charges etc. and other levies payable by the contractor under the contract, or for any other cause, shall be indicated equipment/material wise separately in detail in the bid submitted by the bidder as per Price Schedule format. In case of any increase in taxes as a result of change in law, it will be reimbursed by KSEBL up to the period of the scheduled date of completion of the work. For the portion of the work executed after the scheduled date of completion, no extra claim will be considered by the KSEBL. In respect of any reduction in tax, the benefit is to be passed on to KSEBL. No tax other than that mentioned in the price bid (Price Schedule-Volume III) shall be paid. Taxes on the cost of materials will be reimbursed to the contractor, provided, the contractor furnishes split up details of such taxes in the bid, if any, subject to the conditions mentioned below.

“The reimbursement shall be done on production of documentary evidence to prove that the contractor has actually remitted such taxes. Whenever concessional duties or taxes are applicable to the project, the contractor shall avail such benefits and only such reduced rates of taxes shall be applied during the course of this contract.”

In case of imported equipment's, the bidder shall make his own arrangements and any import duty will be to the account of the contractor and KSEBL shall not render any assistance in this regard.

For Labour:

As regards Income Tax, Surcharge on Income Tax, Kerala Construction Workers Welfare

Fund (KCWWF), KSEBL shall not bear any tax liability whatsoever, irrespective of the mode of contract. The bidder shall be liable and responsible for payment of such taxes attracted under the provision of law. Tax will be deducted at source wherever required. GST applicable as per rules at the time of preferring the claim will be reimbursed as per actuals. In case of any increase in tax from the prevailing rate at the time of bidding as a result of change in law, it will be reimbursed by KSEBL up to the period of the scheduled date of completion of the work. For the portion of the work executed after the scheduled date of completion, no extra claim will be considered by the KSEBL. In respect of any reduction in tax, the benefit is to be passed on to KSEBL. The contractor should produce the required certificates from the Tax department specifying the rates for such deductions. The bidders shall produce GST/PAN and other relevant tax registration number.

The rates quoted for all supply of materials, if any, and Civil/Electrical works shall include, the conveyance of all materials, and items with all lifts and leads, all labour charges for centring, concreting, form work, scaffolding charges, masonry works, plastering, painting, curing at all levels, required T&P etc., complete.

16.3 Price shall be quoted in Indian Rupees Only.

17 BID VALIDITY

17.1 Bid shall remain valid for a period of **180 days from the date of opening of PQ bid (Envelope 1) or 120 days from the date of opening of price bid whichever is earlier.**

17.2 In exceptional circumstances, RECTPCL/KSEBL may request the Bidder to extend the period of validity for a specified additional period. The request and the bidder's responses shall be made in writing or by fax. If the Bidder accepts to extend the period of bid validity, the bid security shall also be suitably extended. A Bidder may refuse the request without forfeiting its bid security. A Bidder granting the request will not be required or permitted to modify its bid.

18 TENDER FEE AND EARNEST MONEY DEPOSIT (EMD)

18.1 The Bidder shall furnish, as part of its bid, Tender Fees and Earnest Money Deposit or Bid Security in the amount and currency stipulated in Table under Section-1A Tender Notice. The Bid security is required to protect the owner against risk of Bidder's conduct, which

would warrant the forfeiture of EMD. The Bid Security must be submitted in the manner and format provided in the Bidding Documents.

18.2 The Tender Fees shall be in the form of bank draft in favour of ***Deputy Chief Engineer with full powers of Chief Engineer, Trans Grid North, Kerala State Electricity Board Limited, payable at Shoranur*** from a scheduled bank selected by the bidder except Indus Ind Bank .The Bid Security shall, at bidder's option, be in the form of crossed bank draft/pay order /banker certified cheque or a bank guarantee in favor of ***Deputy Chief Engineer with full powers of Chief Engineer, Trans Grid North, Kerala State Electricity Board Limited, payable at Shoranur*** from a scheduled bank selected by the bidder except Indus Ind Bank. The format of the bank guarantee shall be in accordance with the form of bid security included in the Bidding Documents. Bid security shall remain valid for a period of thirty (30) days beyond the original bid validity period, and beyond any extension subsequently requested under ITB Clause 17.

18.3 Any Bid not accompanied by an original bid agreement and adequate EMD with correct bid reference in original shall be rejected by RECTPCL/KSEBL. Also the originals of all the Agreements in stamp paper, enclosed in sealed envelope indicating E Tender No. BPC/BD/KSEBL/2018-19 /..... shall be submitted to Addnl. CEO,REC Transmission Projects Company limited on or before bid submission end date and time considering the amendment if any..

18.4 The EMD of the successful bidder will be discharged when the bidder has signed the contract Agreement and furnished the required performance security.

18.5 The EMD will be forfeited in the following situations:

- a) If the bidder withdraws his bid during the period of bid validity; also no interest will be paid.
- b) If the bidder does not accept the correction of his bid price pursuant to clause 34.
- c) In the case of successful bidder, if he fails within the specified time limit to sign the agreement and furnish required performance security.

18.6 No interest shall be payable by the Owner on the above Bid Security.

19 ALTERNATIVE PROPOSAL BY BIDDERS

Bidders shall submit offers which comply with the requirements of the bidding document, including the basic technical design as indicated in the specifications. Alternatives will not be considered.

20 FORMAT AND SIGNING OF BID

20.1 The bidder shall prepare and furnish the documents the bid in the manner indicated in Section-2 Instruction to bidders clause No. 14.

20.2 The bid shall be digitally signed by a person duly authorized to sign on behalf of the bidder pursuant to the rules and regulations as the case may be, with a valid Digital Signature Certificate (DSC) availed from an approved certifying authority. By submitting digitally signed bid documents, the bidder accepts that they have clearly understood and agreed all the terms and conditions of this tender.

20.3 The Bidder should furnish complete information in the prescribed format of the bid documents itself.

21 SUBMISSION OF BIDS:

The bid shall be submitted in the manner specified in Section-2 Instruction to Bidders clause no. 14 Documents comprising the bid

22 DEADLINE FOR SUBMISSION OF BIDS

(i) All the Tender documents are to be submitted online only in the designated covers/envelopes on the website <http://www.mstcecommerce.com/eprochome/rectpcl>. Tenders/ bids shall be submitted on or before the time specified in the Tender Notice. Hard Copy as mentioned in clause no.14 of ITB must be received by BPC at an address mentioned in the **Table under Section-1 a Tender Notice under Description:** Address for Bid submission/EMD (Hard Copy). **Late Tenders will not be accepted.**

(II) BPC may extend the deadline for Bids by issuing Amendment(s) /Corrigendum(s). BPC also reserves the right to extend the bid issue and submission dates without assigning any reason. In such case(s) all rights and obligations of BPC and that of the Bidders, which were subjected to the original deadline will be the new deadline.

23 LATE BIDS

Any Bid received by RECTPCL after the deadline prescribed in Clause 22 (i) above shall be rejected.

V. BID OPENING AND EVALUATION

24 OPENING OF BIDS. (Opening of First Envelope)

A. Tender Agreement, Bid Form, DD towards Tender Fees, EMD, Signed and Stamped Copy of Bid Documents along with all clarifications/ amendments/ addendums thereof issued in the e-bidding portal, Any other document further specified in the Bidding Document duly signed and stamped on each page (Cover I) (As mentioned in 14 of ITB):-The BPC in presence of Owner and the bidders designated representatives who chose to attend at the time and date and location specified will open the First Envelope (Cover-1) Hard copy. In case of non-submission of Bid Security in Cover-1 bid submitted shall be rejected.

B. First Envelope Cover-2 (Cover 2):- Bid enclosed in cover II on e-bidding portal will be opened only for those who have satisfied the conditions in clause 24.A above. The technical requirements, GTP, Drawings and other documents will be examined for the compliance to Technical requirements of the Projects.

Opening of Second Envelope

C. Price Bids (Cover 3):- The date of opening of Price Bid shall be intimated later to the technically qualified bidders.

25 ORIGINAL BID DOCUMENT

25.1 The original Tender agreement as per sample form A executed in Kerala Govt. Stamp paper worth Rs.200/ and Bid form as per sample form B of section 4 prepared in Bidder's letter head, EMD and any other documents as mentioned in Section-2 Instruction to bidders Clause 14 shall be submitted to the Addnl. CEO, RECTPCL in a single sealed envelope super scribed as E Tender No. BPC/BD/KSEBL/2018-19.....The envelope containing the above should reach RECTPCL office on or before the bid opening date & time, failing which the bid is liable to be rejected. KSEB Limited/RECTPCL shall not be responsible for any kind of postal/courier service delay or any other delay. All bids received without the scanned copies of documents mentioned above will be summarily rejected. The bidder shall produce the original copies of documents mentioned elsewhere in the bid documents during bid evaluation, in physical format, if required by the Department for verification.

26 ACCEPTANCE OR REJECTION OF BID

The KSEBL/RECTPCL reserves the right to accept or reject any bid without assigning any reason whatsoever. The fact that bid is prima facie found qualified on Scrutiny will not in any manner, take away the right of the bidding authority/KSEBL for further detailed consideration and verification of the qualification of the bidders such as his experience, financial stability, tools and plants, all other relevant matters etc. even after the price bid is opened and considered, but before a final decision is taken regarding the award of contract, and the bidder will not have any right to question the act of the bidding authority/KSEBL in considering against qualification etc. of the bidder.

27 PROCESS TO BE CONFIDENTIAL

Information relating to the examination, clarification, evaluation and comparison of bids and recommendations for the award of contract shall not be disclosed to bidder or any other persons not officially concerned with such process until the award to the successful bidder has been announced. Any effort by a bidder to influence KSEBL's/RECTPCL

processing of bids or award decision shall result in the rejection of his bid.

28 CLARIFICATION OF BIDS

To assist in the examination, evaluation and comparisons of bids, RECTPCL/KSEBL may, at its discretion, ask any bidder for clarification of his bid, including breakdown of the prices in the BOQ. The request for clarification and the response shall be in writing or by email, but 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 noted by KSEBL in the evaluation of the bid in accordance with clause 34.

29 PRELIMINARY EXAMINATION OF FIRST ENVELOPE

29.1 The BPC will examine the bids to determine whether they are complete, whether required sureties have been furnished, whether the documents have been properly signed, and whether the bids are generally in order.

In case of non-submission of bid in the portal (soft copy part of the bid) within the stipulated deadline, then even if the bidder has submitted the specific documents in hard copy part in original within the stipulated deadline pursuant to ITB 22, its bid shall be considered as incomplete bid, which shall be summarily rejected.

Similarly, in case of non-submission of Hard copy part of the bid, but the bidder has uploaded the soft copy part of the bid, the bid will be considered as incomplete bid. Such bids will be rejected during preliminary examination.

29.2 The Employer may waive any minor informality, nonconformity or irregularity in a bid that does not constitute a material deviation, whether or not identified by the Bidder in Formats of Deviations Of Section-3 to its bid, and that does not prejudice or affect the relative ranking of any Bidder as a result of the technical and commercial evaluation, pursuant to ITB Clause 33.

29.3 Prior to the detailed evaluation, the BPC will determine whether each bid is of acceptable quality, is complete and is substantially responsive to the Bidding Documents. Any deviations, conditionality or reservation introduced in Formats of

Deviations under Section-3 and/or in the Bid Form, Technical Data Sheets and covering letter, or in any other part of the bid will be reviewed to conduct a determination of the substantial responsiveness of the bidder's bid.

For purposes of this determination, a genuine and substantially responsive bid is one that:

A genuine bid shall be one which contains.

- a) Authenticated Documents and data.
- b) Legally enforceable Undertaking/ agreements wherever required.

A responsive bid:

- a) Shall be properly signed and dated.
- b) Shall contain required bid securities in the prescribed manner.
- c) Shall satisfy to the requirements of the terms and conditions and specifications of the bid documents without material deviation or reservation
- d) Shall be provided with all clarifications or substantiation that the BPC may require at time of Technical Bid Evaluation.
- e) Shall contain precisely the details and data required to be furnished under Formats in Section-3 and Sample Forms in Section-4 of Volume-1 and all the GTP's or any other formats in Volume-2.
- f) Shall be furnished with prescribed agreements executed, Proforma filled in and declarations signed.
- g) Shall confirm to all terms, conditions and specifications of the bid documents without material deviation or reservation.
- h) Mentioning the price details at any other place than the designated place shall disqualify the bid and the bid shall be summarily rejected.
- i) The bidder is advised to submit the bids well before the stipulated time and date to avoid any kind of network issues, traffic congestion etc. In this regard KSEBL shall not be responsible for any kind of such issues.

A material deviation or reservation is one;

- a) which affects in the scope, quality or performance of the work

-
- b) which is inconsistent with the bid documents and limits the Board's right or the bidder's obligation under the contract
- c) Whose rectification would affect unfairly the competitive position of other bidders submitting substantially responsive bids.

Only the genuine and responsive bid will be considered for further evaluation for pre-qualification and comparison for selection of this successful bidder.

29.4 The Bids containing deviations with respect to Payment Terms mentioned in the Bidding Document are not acceptable and are liable for rejection.

30 Evaluation of Qualification Requirement of Bidders:

30.1 The BPC/Owner will ascertain to its satisfaction whether Bidders determined having submitted substantially responsive bids are qualified, as per the Qualification Requirement specified in Section-2 Instruction to bidders, Clause No.3 to satisfactorily perform the contract. The BPC in accordance with the Owner shall be the sole judge in this regard and the BPC interpretation of the Qualification Requirement in accordance with the Owner shall be final and binding.

30.2 The BPC in accordance with the Owner may waive any minor informality, nonconformity or irregularity in a bid that does not constitute a material deviation, affecting the capability of the Bidder to perform the Contract.

31 Evaluation of Techno-Commercial Part (First Envelope)

31.1 The BPC will carry out a detailed evaluation of the bids of the qualified bidders in order to determine whether the technical aspects are in accordance with the requirements set forth in the Bidding Documents. In order to reach such a determination, the BPC will examine the information supplied by the bidders, pursuant to ITB Clause14, and other requirements in the Bidding Documents, taking into account the following factors:

- (a) overall completeness and compliance with the Technical Specifications and Drawings; deviations from the Bidding Documents terms and Conditions, technical Specifications as identified in specified in Section-3 to the bid and those deviations not so identified; suitability of the facilities offered in relation to the environmental and climatic conditions

prevailing at the site; and quality, function and operation of any process control concept included in the bid. The bid that does not meet minimum acceptable standards of completeness, consistency and detail will be rejected for non-responsiveness.

32 Opening of Second Envelope (Cover-III of the e-bidding Portal)

The Second Envelope i.e., Price Part of only technically qualified bidder shall be opened. The Price Bids shall be opened in the presence of Bid Opening Committee and bidders shall not be permitted to witness the same as in order to carry out reverse auction, it is necessary that bidders should not know the price of other bidders.

33 Evaluation of Second Envelope (Price Part on e-bidding portal)

Cover 3 (Second Envelope of e-bidding Portal) containing the schedule of prices offered by the qualified bidders will be opened. In further evaluation, price bid of the bidders will be evaluated as per relevant clauses provided elsewhere in this document. For selecting the best bid, the prime criterion is the lowest offer. The Bid price arrived based on the individual item wise quote for materials, labour, spares and dismantled items by each bidder i.e. ***The Price Quoted under Price Schedules 1 to 3 (which is further reflecting in Summary Sheet against Total Evaluated Price)*** will be compared for finding out the L-1 bidder among the technically qualified bidders. Thus arrived L-1 price shall be considered as ceiling price to start Reverse Auction. After completion of online Reverse Auction, L-1 Bidder shall be considered as successful bidder. Acceptance of the lowest tender rest with Kerala State Electricity Board Ltd, which is not bound to accept lowest or any other tender.

Illustration of Price Bid Evaluation to fix the Ceiling Price for Reverse Auction:

S.No.	Name of price Schedule	Value Quoted by Bidder (INR)			
		Bidder-1	Bidder-2	Bidder-3	Bidder-4
A	Price Schedule-1 (Labour for	100	120	110	90

S.No.	Name of price Schedule	Value Quoted by Bidder (INR)			
	Complete scope of Work)				
B	Price Schedule-2 (Supply of Material and Spares for Complete scope of Work)	70	110	90	110
C	Price Schedule-3 (Dismantled Material for Complete Scope of Work) (In compliance to requirement of Clause 9.14)	10	20	15	20
D=A+B-C	Total Evaluated Price (reflecting in Summary Sheet)	160	210	185	180
Ranking of Bidder		L-1 (Lowest)	L-4 (Highest)	L-3	L-2

34 CORRECTION OF ERRORS

34.1 Bids determined to be substantially responsive will be checked by RECTPCL for any arithmetic errors. Errors will be corrected by RECTPCL as follows: - where there is a discrepancy between the amount in figures and in words, the amount in words will

govern.

34.2 The amount stated in the form of bid will be adjusted by RECTPCL 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 shall be rejected and the EMD will be forfeited in accordance with clause 18 in this section.

35 CURRENCY FOR BID EVALUATION

Bid price is the sum of all payments to be made to the bidder. Prices should be quoted in Indian Rupees only.

36 E-Reverse Auction

36.1 Reverse Auction (e-RA) shall be carried out in the manner as indicated herein below.

If number of Qualified Bidders are more than 3 (three), the bidder with highest price will be eliminated from the e-RA process. Only the remaining bidders shall be allowed to participate who shall be ranked as L-1,L-2, L-3 etc. . In case of number of Qualified Bidders are less than or equal to 3 (three), all such bidders shall be permitted to participate in reverse auction.

The Applicable Ceiling Price for e-RA for bidders shall be the Lowest Total Evaluated Bid Price of any Qualified Bidder. (refer Illustration of Price Bid Evaluation to fix the Ceiling Price for Reverse Auction as detailed above).The e-RA shall be conducted on e-bidding portal

36.2 The Qualified Bidders for e-RA shall be permitted to place their Final Offer on the electronic bidding platform, which is lower than zero point zero one (0.01) % of the prevailing L-1 bid price.

36.3 The initial period for conducting the e-reverse bidding will be 120 minutes.Further,it will be extended by 10 minutes from the last received bid time, if the bid is received during the last 10 minutes of the scheduled or extended bid time. Subsequently, it will be extended again by 10 minutes from the latest received bid time.

36.4 Notwithstanding above, the bidder(s) who either do not submit the requisite compliances for e-RA or do not participate in e-RA, their original price bid as opened, if valid, shall be considered for evaluation.

36.5 In the event of identical evaluated bid price from the Initial Offer having been arrived for one or more Bidders, all such Bidders shall be assigned the same rank for the purposes of determination of Qualified Bidders to participate in e-RA.

36.6 After completion of the reverse auction, the price reduced by the L-1 bidder from the originally Total Evaluated Price shall be uniformly applied to all items covered under Price Schedule 1,2 &3 The bidder shall be required to submit the revised offer complying this requirement.

Illustration of Discount Offered by L-1 Bidder (After Reverse Auction) and its applicability.

S.No.	Name of price Schedule	Value Quoted by Bidder (INR)			
		Bidder-1	Bidder-2	Bidder-3	Bidder-4
A	Price Schedule-1 (Labour for Complete scope of Work)	100	120	110	90
B	Price Schedule-2 (Supply of Material and Spares for Complete scope of Work)	70	110	90	110
C	Price Schedule-3 (Dismantled Material for	10	20	15	20

	Complete Scope of Work) (In compliance to requirement of Clause 9.14)				
D=A+B-C_	Total Evaluated Price (reflecting in Summary Sheet)	160	210	185	180
Ranking of Bidder		L-1 (Lowest)	L-4 (Highest)	L-3	L-2
Ceiling Price for Reverse Auction: 160 i.e. L-1 Price					
Qualified Bidders to Participate in reverse Auction: Bidder-1, Bidder-4 and Bidder 3.					
E =Final Price Offered after reverse auction		150		135*	155
Final Ranking of Bidder after reverse auction.		L-2		L-1	L-3
% discount uniformly applied to all BOQ items covered under Price Schedule 1,2 &3 by L-1 Bidder.				$=(D-E)/D$	

36.7 * Contract Price After completion of online Reverse Auction, the Bidder with lowest Total Evaluated Price shall be considered as successful bidder,

37 ACCEPTANCE OF BID AND AWARD OF CONTRACT

On final selection of the bid for the work, the i.e. KSEB Ltd. will issue LOA to notify the successful bidder at his address for communication given in the bid, that his bid has been selected and accepted for the work order from the agreement authority, the signed copy of which, in token of acceptance by the bidder will form part of the contract agreement. This letter will contain the sum which the Board will pay to the contractor as per the accepted bid, which is called the contract price and any other conditions, terms etc. on awarding the work. The amount of performance security, date of commencement and completion of works etc. will also be included.

38 PERFORMANCE SECURITY DEPOSIT (PSD) AND CONTRACT AGREEMENT

38.1 Within 15 calendar days of issue of work order from KSEBL, the successful bidder shall furnish to KSEBL, a Performance Security Deposit (PSD) as per the Sample form F of Section 4 in the form of a Bank Guarantee or DD for an amount equivalent to 5 **(five) percent of the contract price.** The performance Security shall be in the form of DD/BG from a Nationalized Bank or Scheduled Bank except Indus Ind Bank.

38.2 Failure of the successful bidder to comply with the requirements of clause 29 above shall constitute sufficient grounds for cancellation of the award and forfeiture of bid EMD and other appropriate penal action.

38.3 **The successful bidder shall enter in to contract agreements, within 15 days from the date of orders, as per the Sample Forms D and PSD BG as per sample form E of Section 4 for furnishing performance Guarantee as per clause 38.1**

Sd/-

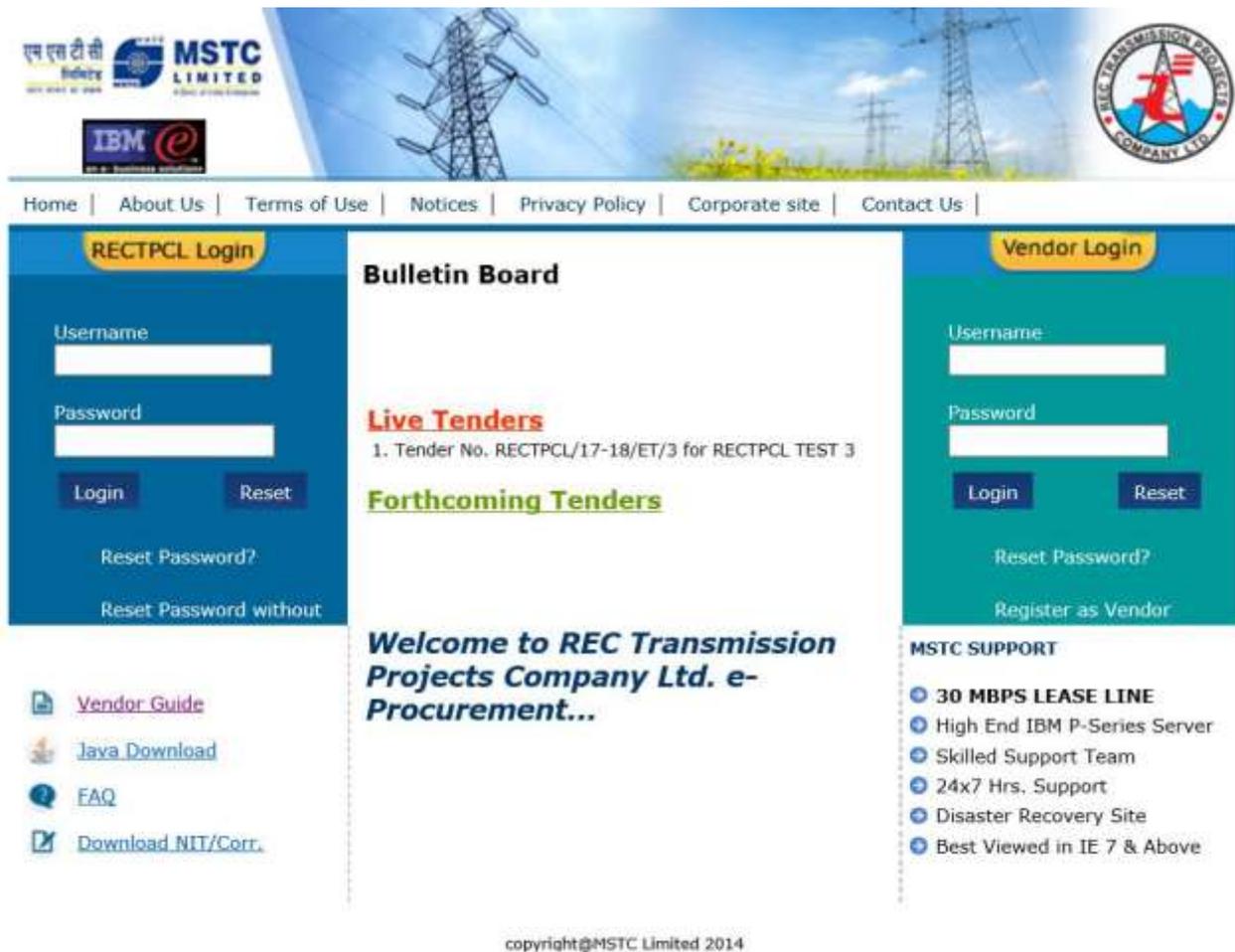
Addnl. CEO

REC Transmission Projects Company Limited

Annexure-2A to ITB

Bidder's guide for Bidding through excel based uploading in RECTPCL portal:

1. Use Internet Explorer to go to https://www.mstcecommerce.com/eprohome/rectpcl/buyer_login.jsp



2. On the right side of the page click on Register as a Vendor:

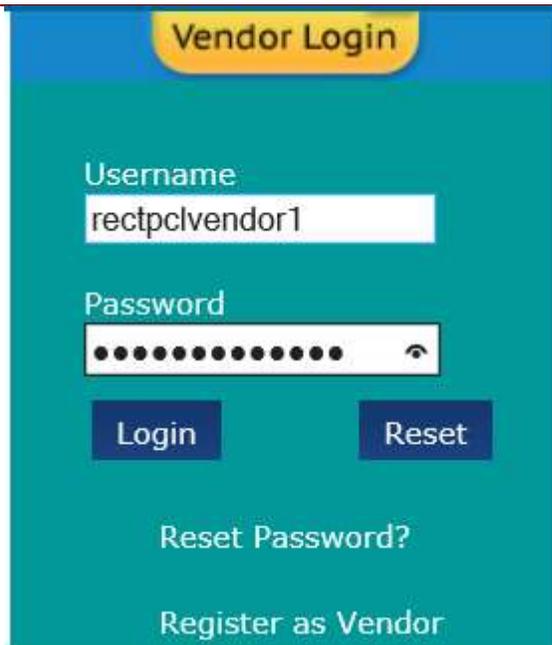


The image shows a screenshot of a web form titled "Vendor Login". The form has a teal background. At the top, there is a yellow rounded rectangle containing the text "Vendor Login". Below this, there are two white input fields: the first is labeled "Username" and the second is labeled "Password". Underneath the input fields are two dark blue buttons: "Login" on the left and "Reset" on the right. Below the buttons, there is a link that says "Reset Password?". At the bottom of the form, there is another link that says "Register as Vendor".

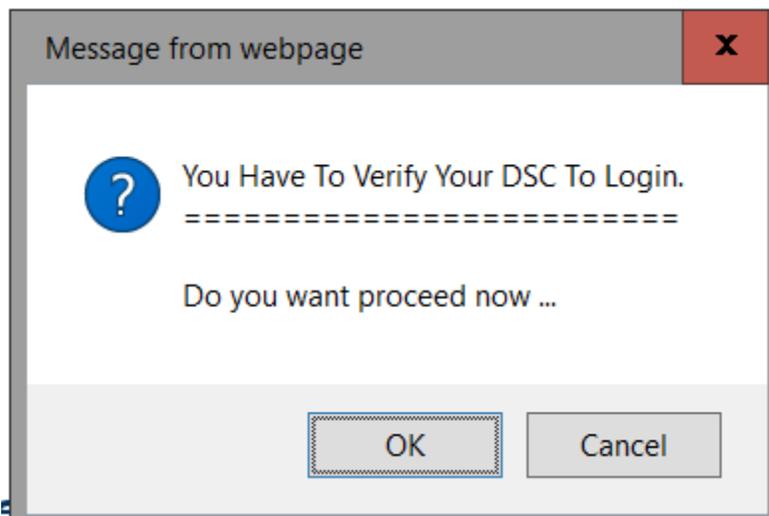
3. Fill the form that appears to create username and password.

MSTC Procurement		MSTC Limited	
e-Procurement > Vendor > New Registration			
Personal Information			** - mandatory fields
Company Name*	<input type="text"/>		
Contact Person*	<input type="text"/>		
Company Type*	---Select Company type--- v		
User Preferences			
Choose a Username *	<input type="text"/>	Click here to check availability of your User Id	
Choose a Password *	<input type="text"/>	(Your Password is Case Sensitive.)	
Retype Password *	<input type="text"/>		
Your Contact Details			
Email Id *	<input type="text"/>		
Mobile Phone No. *	<input type="text"/> (Please provide mobile no. to serve you better)		
Day Phone *	<input type="text"/>		
Fax No. *	<input type="text"/>		
Your Contact Address			
Street *	<input type="text"/>		
City *	<input type="text"/>		
Pin *	<input type="text"/>		
District *	<input type="text"/>		
Country *	India v	<input type="checkbox"/> Other	Field Disabled
State *	<input type="text"/>	Select State	v

4. Once the registration is done, login with your user name and password:

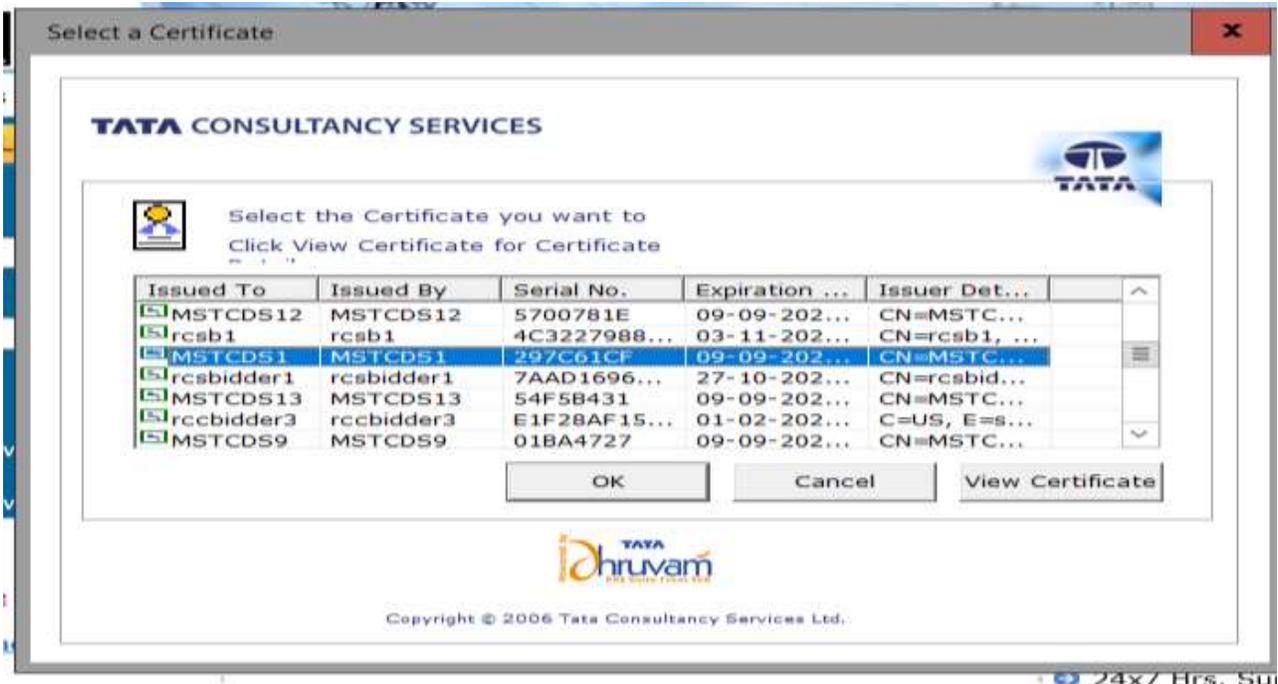


5. System will ask you to verify your digital signature

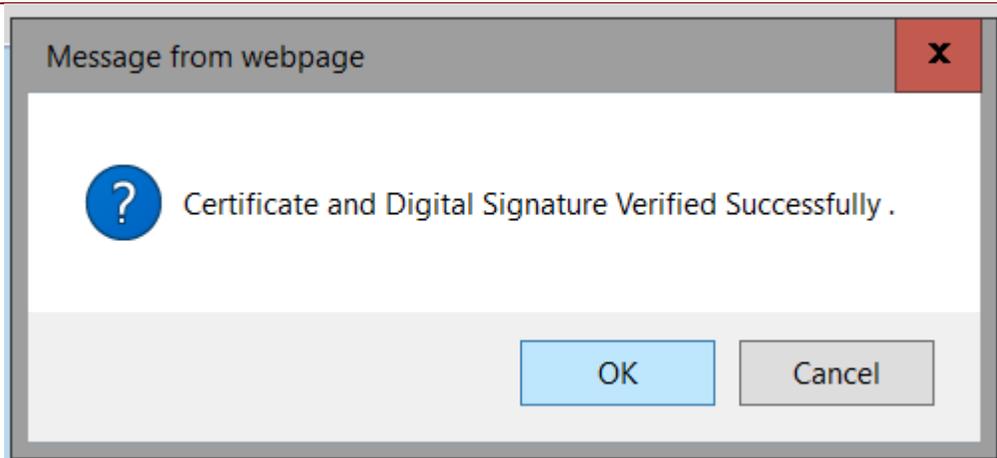


6. Press Ok and select your digital signature from the List. When you are logging into the system for the first time, system shall verify the name of the person to whom the DSC has been issued and the name of the contact person provided during registration for the user id being used for logging in. If the two names match, system will map the user id with the DSC without any prompt. If the two names don't match, system will give an alert stating that the two names are different and will ask you to confirm that the DSC being used is the correct DSC for the user id. If you proceed with the DSC, system will automatically change the contact person's name to match with the DSC Issued to name and will map the DSC

with the user id for future use. For all subsequent logins, system will check if the correct pair of user id and DSC are being used or not and will allow login only if the correct pair of DSC and user id are used. Else, system will prevent you from logging into the system.



7. Your digital signature will be verified



8. Once login is complete, a bidder can access My Menu through the left side of the page:



9. Here click on Download NIT/Corrigendum button to download the NIT/Corrigendums. Select Event number and click on download to download the files:

10. After going through NIT, a bidder will be required to submit the transaction fee before submitting the bid. To submit transaction fee click on transaction fee payment and select tender number. The transaction fee amount will be input by the system automatically. A bidder can deposit the transaction fee through Debit Card/Credit card/Net Banking by selecting the online payment option or through NETF/RTGS. Payment through online mode is authorized immediately while through NEft/RTGS is authorized by the system upon receipt of payment (this can take approx. 1 working day).

11. After the transaction fee is paid a bidder can proceed to Auc-Floor Manager through the left side My menu. In Auc floor manager click on live events to view a list of Live events. In live events select the tender number where you wish to submit a bid. (tenders have the denotation ET while e-Reverse Auctions have denotation RA).

e-Procurement Event No.	e-Procurement Event Start Date	e-Procurement Event Close Date
MSTC/17-18/RA/1	2017-05-16 10:12	2017-05-19 14:30
RECTPCL/17-18/ET/3	2017-05-16 10:05	2017-05-19 13:00

12. On clicking the tender number following screen will appear:

Hi MSTCDS1

EVENT INFO

Current Server Time: 7.11.2017 12:11:23 IST

Event No	Event Type	Event Start Time	Event Close Time
RECTPCL/17-18/ET/19	3Cover_Price_Bid_Upload_in_Excel	30.10.2017 16:30:00	10.11.2017 17:00:00

Part-I Cover Part-II Cover Upload Docs

ITEM NO	ITEM Name	Cover 3	Final Submission	Withdraw Bid	Delete Bid	Bid Status
1	1	Download Upload Price	Final Submission	Withdraw Bid Submit regret letter with	Delete Bid	Qualification part Bid Saved
2	2	Download Upload Price	Final Submission	Withdraw Bid Submit regret letter with	Delete Bid	Technical Saved

13. The first step towards submitting the bid is Cover 1 on the left side. Click on Cover 1 and fill the form given therein. Conditions with agree have to be necessarily agreed, while in the conditions with empty remarks field bidder can give their comments.

(PLEASE ENTER ALL VALUES AND CLICK ON SAVE BUTTON TO SAVE YOUR OPINIONS)

Purchaser's Specification		Agree
1 Technical Terms		
1.1	a	Agree Agree with remarks
1.2	a	Remarks
1.3	a	AGREE
1.4	a	Agree Agree
1.5	a	AGREE

14. After the common terms are saved, a bidder can proceed to saving the Cover 2. To fill Cover 2 form click on cover 2 and fill the form therein.

❗ (PLEASE ENTER ALL VALUES AND CLICK ON SAVE BUTTON TO SAVE YOUR QUOTE) ❗

ITEM INFO : Dismantling of both end terminations of existing oil filled cables as per scope of work mentioned in Technical Specification

Purchaser's Specification		Agree
1 Commercial Terms		
1.1	a	<input type="button" value="AGREE"/>
1.2	a	<input type="button" value="AGREE"/>
1.3	a	<input type="button" value="AGREE"/>
1.4	a	<input type="button" value="AGREE"/>
1.5	a	<input type="button" value="AGREE"/>

15. Once Cover 2 are saved, proceed with submitting the price bid. Click on Download button to download the Excel sheet for Price Bid.



16. Fill up the excel sheet as per the details given therein and tender document.

17. To upload the filled up excel click on Upload Price Button, click on browse to select the file and then click on Upload and Save encrypt file.

Upload Price Bid File :17-18-ET-19-5312-38840-Book2.xls

- Browse File : Browse...

Uploaded File Details

- File Name : File Size[bytes] : Encrypted File Size[bytes] :
- File Size % Increase After Encryption :

Uploaded And Encrypted Bid File:

18. Once all the covers are saved, click on upload documents on the top to upload documents for the said tender. Select the cover for which document are being uploaded. A list of previously uploaded files will be visible at the bottom of the screen:

UPLOAD DOCUMENTS

Select Cover :

Browse for File To Upload:

19. After the documents have been uploaded, click on final submit to finally submit the bid. In case of any amendments after final submit, click on delete bid button to delete the techno-commercial and price bids and resubmit the same. Please note that at the end the bid must be final submit, otherwise the same will not be considered.

E-Reverse Auction:

20. The Financial Bid will comprise of two rounds. In the first round, the total Initial Price Offer (submitted online along with the Cover 1 and 2) of the Technically Qualified bidders shall be opened and total Initial Price Offer shall be ranked on the basis of ascending order for determination of the L-1 bid. This L-1 Bid shall become the ceiling price for start of e-reverse auction. The qualified bidders shall be permitted to place their Final Price Offer on the electronic bidding platform which must be lower than 0.01% of prevailing L-1 Price. Prevailing L-1 price will be displayed to all the bidders up to the point no other bidder out bids that offer by quoting a lower price. All bidders may reduce their bids by any amount in the integral multiples of 0.01% of prevailing L-1 bid (rounded to the nearest whole number) by bidding any number of times for the duration of the auction. The initial period for conducting e-reverse auction shall be 120 minutes which will be extended by 10 minutes from the last received bid time if the bid is received during the last 10 minutes of the scheduled or extended bid time. Subsequently, it will be extended again by 10 minutes from the latest received bid time.
21. At the close of the e-Reverse auction the successful bidder will be notified by email that their bid amount _____ received in the system is the lowest amount in the system. They will be required to give a breakup of the bid quoted by them. The break up should be pro rata reduced (without disturbing rate of taxes) from their initial price offer at Tender stage as per the Illustration provided in the bid document i.e. for all items mentioned in Price Schedule 1, 2&3.

SECTION – 3

QUALIFICATION FORMATS AND OTHER SCHEDULES

TO BE FILLED IN BY THE BIDDER

TABLE OF FORMATS

Formats	Description
A	Qualification Information
B	Bidders Information
C	Form of Declaration -1
D	Form of Declaration-2
E	Authorization/Undertaking Format
F	Net Worth and Solvency Certificate
G	Bidders Experience
H	Details of Work
I	List of Material supplied by the manufacturer/technical collaborator
j	Schedule of Deviations from bid conditions
K	Schedule of Deviations from technical Specifications
L	Schedule of Deviations from General and Special Conditions
M	Local Representation
N	List of Proposed Vendor/Supplier for Equipment/Materials
O	Activity Time Schedule

FORMAT A

SECTION 1.1

Tender No. BPC/BD/KSEBL/2018-19 /01

Qualification Information

(The information to be filled in by the prospective Bidder in the following pages will be used for purposes of qualification as provided for in section 2 of the Instructions to Prospective Bidders)

FOR PROSPECTIVE BIDDER

Constitutional or legal status of Prospective Bidder (Attach copy)

Name of the Registered Company

Place of Registration of the Company

Date of Registration of the Company

Principal Place of Business

Power of attorney of signatory of bid (whether copy attached -Y/N)

FORMAT A**SECTION 1.2**

Tender No. BPC/BD/KSEBL/2018-19 /01

Total annual volume of work performed in last three years: If the bidder is providing detailed information's regarding their qualifications etc. through separate attachments, then please mention the reference number (Section/Page number) in its respective fields.

Years	Turnkey work of Transmission line projects		Manufacturing ACSR/HPC Conductor		Stringing of ACSR/HPC Conductor	
	Kms	Amount	Kms	Amount	Kms	Amount
2015-16						
2016-17						
2017-18						

FORMAT A

SECTION 1.3

Tender No. BPC/BD/KSEBL/2018-19 /01

Work performed as prime contractor on works of a similar nature and volume over the last three years. If the bidder is providing detailed information's regarding their qualifications etc. through separate attachments, then please mention the reference number (Section/Page number) in its respective fields.

Project Name	Name of Client	Type and Qty. of work performed and year of completion	Nature of Contract	Value of Contract or Construction

FORMAT A**SECTION 1.4**

Tender No. BPC/BD/KSEBL/2018-19 /01

The following items of the Contractors Equipment are essential for carrying out the Works. The Prospective Bidder should list all the information requested below:- If the bidder is providing detailed information's regarding their qualifications etc. through separate attachments, then please mention the reference number (Section/Page number)in its respective fields.

Item of equipment	Make and age (years)	Condition (new, good, poor) number available	Owned, Leased (from whom), to be purchased(from whom)
Civil Survey Equipment			
Construction Equipment			
Stringing and Tensioning, Equipments			
Measuring/Testing Equipment			
Any other Equipment (specify)			

FORMAT A**SECTION 1.5**

Tender No. BPC/BD/KSEBL/2018-19 /01

Qualifications and experience of key personnel proposed for administration and execution of Transgrid2.0 projects. Attach details. If the bidder is providing detailed information's regarding their qualifications etc through separate attachments, then please mention the reference number (Section/Page number) in its respective fields.

Position	Name	Years of Experience	Years of experience in proposed position
Project Manager			
Survey and Line Design Engineers			
Technical Supervisors			
Civil/Mechanical/ Electrical Engineer			
Skilled Line staff for line work using ACSR/HPC conductor			
Others (Specify)			

FORMAT A**SECTION 1.6****Tender No. BPC/BD/KSEBL/2018-19 /01**

Proposed Contractors and Technology partners for Transgrid2.0 project. If the bidder is providing detailed information regarding their qualifications etc through separate attachments, then please mention the reference number (Section/Page number) in its respective fields.

Item/Section of work*	Years of Association	Execution partners/Technology partner (Name and address)	Execution partners/Technology partner's experience in similar work

Note: It may be noted by the Prospective Bidder that the Execution partners intended to be deployed as listed above for specific tenders of works shall be as per qualifying conditions of bidding document conditions.

FORMAT A

SECTION 1.7

Tender No. BPC/BD/KSEBL/2018-19 /01

Financial reports for the last 3 years: Balance Sheet, Profit and Loss account, Auditor's reports, etc. List them below and attach copies. If the bidder is providing detailed information's regarding their qualifications etc through separate attachments, then please mention the reference number (Section/Page number) in its respective fields.

--

FORMAT A

SECTION 1.8

Tender No. BPC/BD/KSEBL/2018-19 /01

Evidence of access to financial resources to meet the qualification requirement: Cash in hand, networking capital, Lines of credit, etc. List them below and attach copies of support documents. If the bidder is providing detailed information's regarding their qualifications etc through separate attachments, then please mention the reference number (Section/Page number) in its respective fields.

FORMAT A

SECTION 1.9

Tender No. BPC/BD/KSEBL/2018-19 /01

Name, address and telephone, and fax number and e-mail of the Prospective Bidder's bankers who may provide references if contacted by the KSEBLTD. If the bidder is providing detailed information's regarding their qualifications etc through separate attachments, then please mention the reference number (Section/Page number) in its respective fields.

--

FORMAT A

SECTION 1.10

Tender No. BPC/BD/KSEBL/2018-19 /01

Party(ies)	Cause of dispute	Amount involved	Name of Court/Forum

Signature :

Name :

Place :

Name of Company :

Date :

Address :

FORMAT B

Bidders Information

(If the bidder is providing detailed information's regarding their qualifications etc through separate attachments, then please mention the reference number (Section/Page number) in its respective fields)

Sl. No.	Questions	Replies by the Bidder
1.	Name of Bidder	
2.	Nationality of Bidder	
3.	Head office Address Telephone Telex/Fax E-mail	
4.	Former Name of Company (If any)	
5.	Branch Offices and Addresses	
6.	Type of organization Individual Partnership Incorporated company	
7.	Year established and where	
8.	Whether the Bidder is	
a)	Member of a group of Companies (If yes, give name, address, connections and descriptions of the other companies)	
b)	Subsidiary of a large Organization	
c)	Are you a manufacturer of Transmission Towers/ACSR/HP Conductor? If Yes, give details.	
9.	The guarantee period offered.	
10.	Have you satisfactorily executed supply & installation of transmission towers/transmission lines using ACSR/HP Conductor for voltage greater than 110kV? If so, please furnish details and particulars of such works in the relevant format attached. Furnish certificates in respect of the important works executed by you(full details of previous experience shall be furnished)	

Sl. No.	Questions	Replies by the Bidder
11.	Are you registered with any Government Department/Public Sector Undertaking? (If yes, give details)	
12.	Have you ever failed to complete any work awarded to you? (If so, when, where and why)	
13.	In how many contracts were you imposed penalties for delay?(Furnish Details)	
14.	Have you ever been denied tendering facility by any	
a)	Government Department/Public-sector Undertakings?(Furnish Declaration)	
b)	Have you ever been debarred from undertaking in any Government Department/Undertaking? (Give details) (Furnish declaration)	
15.	How many years has your Organisation been in business under your present business name?	
16.	Name and address of affiliated Subcontractor/ Technical collaborator	
17.	Name of any International/National organisation for which your firm has already been registered/prequalified	
18.	What are your sources of finance?(Please give details, bank references, certificates from banks endorsing your financial stability and certificate to substantiate other sources)	
19.	Has your company ever been declared bankrupt? (If yes, please give details)	
20 a).	What is the maximum value of work that you can handle?	
20 b)	What is the maximum value of work that you have handled so far?	
21	Give complete details with certificates regarding the completed work orders from clients preferably State Electricity Boards regarding the last three year's orders received/ executed.	
22	How much is your turnover for the last	

Sl. No.	Questions	Replies by the Bidder
	three years? (year wise)	
	2015-16	
	2016-17	
	2017-18	
23	Do you intend to associate any other manufacturer/sub-contractor for the supply/work for which you are giving EOI for specified supply/ works as per PQ conditions If so, please give full particulars of that/those organization(s).	

Signature, Name and Address of
Prospective bidder

Place :

Date :

FORMAT-C

FORM OF DECLARATION-1

I/We

--

hereby declare that I am not in any way related to any KSEBL's servant who is in charge of or having control of this Project. I agree that if, at any stage, it is found that this declaration is untrue, the Earnest Money/Security deposit paid by me will be forfeited and the Contract entered will stand cancelled.

It is understood that the relationship with the KSEBL's servant referred to herein will be restricted to my Father, Mother, Son, Daughter, Brother, Sister, Direct Uncle, Nephew, Father-in-law, Mother-in-law, Brother-in-law, Sister-in-law and First Cousins of the Officer concerned.

		Name and Address of Bidder
Place:		
Date:		

FORMAT-D

FORM OF DECLARATION-2

I/We

--

hereby declare that I have not been debarred/blacklisted from undertaking similar work in any government/public undertaking. I agree that if, at any stage, it is found that this declaration is untrue, the Earnest Money/Security deposit paid by me will be forfeited and the Contract entered will stand cancelled.

		Name and Address of Bidder
Place:		
Date:		

FORMAT-E

AUTHORIZATION/UNDERTAKING FORMAT

(For each manufacturer/Contractor one sheet to be furnished in the letter head of respective agencies duly signed by both)

Declaration by Proposed Manufacturer/Manufacturer Dealer/Sub contractor/Technology Partner/Execution Partner

Sub: Bidding Doc. No.

I/We

hereby undertake that we are willing to work as authorised supplier/subcontractor/technical collaborator for related to the Transgrid 2.0 project tenders and agree to abide all conditions of KSEBL including that of warranty and BG requirement for the items of work/supply undertaken by us.

Signature

Name and Address of Bidder		
Place:	<input type="text"/>	<input type="text"/>
Date:	<input type="text"/>	

FORMAT-F

**NETWORTH and SOLVENCY CERTIFICATE
NETWORTH CERTIFICATE:**

Certificate date: _____

Submitted by: _____

CERTIFICATE

(To be given by a practicing Chartered Accountant within a period of 6 months prior to the date of submission of the bid)

This is to certify that the Net worth of M/s. _____ as on _____ as per the statement of computation of even date annexed to this report is Rs. (Rupees _____ only).

We further certify that: The computation of Net worth, based on my / our scrutiny of the books of accounts, records and documents, is true and correct to the best of my / our knowledge and as per information provided to my / our satisfaction.

This certificate is issued on the request of..... (Name and address of the bidder) to produce before the KERALA STATE ELECTRICITY BOARD LIMITED.

Place: _____ For (Name of Accounting Firm)

Date: _____ Name of Partner/Proprietor _____

Membership Number _____ Rubber Stamp

Note: Detailed computation to be attached to this certificate.

FORM OF SOLVENCY CERTIFICATE

(To be issued by Nationalized or approved Scheduled Bank, within a period of 6 months prior to the date of submission of the bid)

This is to certify that M/s..... has been banking with us for past.....years and certify that.....(Name and address of the prospective Bidder) are respectable and can be considered good for an amount up to Rs..... /- (Rupees.....)

This certificate is issued on the request of..... (Name and address of the prospective Bidder) to produce before the KERALA STATE ELECTRICITY BOARD LIMITED. Name and address of the Authorized Signatory

Seal of the Bank

Place & Date:

FORMAT-G

Bidder's Experience

The Prospective Bidder shall furnish here a list of similar jobs executed for last 10 Years by him to whom a reference may be made by KSEBL. (Testimonials/ documentary proof have to be attached separately). If the bidder is providing detailed information's regarding the same through separate attachments, then please mention the reference number (Section/Page number) in its respective fields.

Sl No.	Name and Description of work	Value of work	Period of construction and date of completion	Client	Persons to whom reference may be made

		Name and Address of Bidder
Place:		
Date:		

FORMAT-H

Details of works done by the contractor for KSEBL or similar utilities like PGCIL, other Transcos. (Proof to be attached) If the bidder is providing detailed information's regarding the same through separate attachments, then please mention the reference number (Section/Page number) in its respective fields.

Sl No.	Name of Work	Other Details		
		Name of Utility	Acting as main contractor/Subcontractor/Supplier	Value of work

		Name and Address of Bidder
Place:	<input type="text"/>	<input type="text"/>
Date:	<input type="text"/>	

FORMAT-I

(One form for one agency to be furnished)

List of materials supplied by the manufacturer/technical collaborator for last five years.

If the bidder is providing detailed information's regarding the same through separate attachments, then please mention the reference number (Section/Page number) in its respective fields.

Note: List of materials supplied by the manufacturer/technical collaborator for item 1d, 1e and 1f of Eligibility and Qualification of Intended Prospective Bidders also required

Sl No.	Details of materials supplied	Other Details		
		Client	Acting as Manufacturer/ Dealer	Value of Supply Signature, Name and Address of Prospective bidder Place :

		Name and Address of Bidder
Place:	<input type="text"/>	<input type="text"/>
	<input type="text"/>	
Date:	<input type="text"/>	

FORMAT J

E Tender No. BPC/BD/KSEBL/2018-19 /

To,
Addl. CEO,
REC Transmission Projects Company Limited
ECE House, 3rd Floor, Annexe – II,
28 A, K G MARG, NEW DELHI – 110 001
Tel: 011 – 47964705, Fax : 011-47964704
Email- bgupta@reclnic.in

Dear Sirs,

Sub: - Deviations from bid conditions

In respect of whatever has been stated to the contrary anywhere else in our offer, only the following (as in the Schedule of deviations) are the deviations and variations from and exception to the specifications in this bid. These deviations and variations are exhaustive. Except these deviations, the entire supply /work will be effected / carried out as per your bid specifications and documents. Further I/We agree that additional conditions if any, found in the offer other than those stated below, except those pertaining to any rebates offered/reductions in cost, the Board shall not be given effect to. I / We also certify that the financial implication of these deviations to be withdrawn has also been furnished.

		Name and Address of Bidder
Place:	<input type="text"/>	<input type="text"/>
Date:	<input type="text"/>	

FORMAT-K

SCHEDULE OF DEVIATIONS FROM TECHNICAL SPECIFICATIONS

All deviations from Technical specifications shall be filled in by the Bidder clause by clause in this schedule.

Section	Specification No.	Clause No.	Deviation	Monetary Implication

The Bidder hereby certifies that the above mentioned are the only deviation from KSEBL’s technical specifications for this Bid. The Bidder confirms that in the event of any other data and information being present in the Bidder’s proposal and accompanying documents including drawings, catalogues etc. and are at variance with the specific requirements laid out in the KSEBL’s technical specifications, then the later shall govern and will be binding on the Bidder for the quoted price.

		Name and Address of Bidder
Place:	<input type="text"/>	<input type="text"/>
Date:	<input type="text"/>	

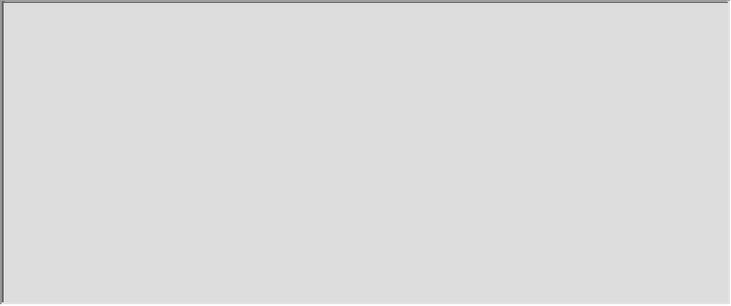
FORMAT-L

SCHEDULE OF DEVIATIONS FROM GENERAL & SPECIAL CONDITIONS

All deviations from general conditions shall be filled in by the Bidder clause by clause in this schedule.

Section	Specification No.	Clause No.	Deviation	Monetary Implication

The Bidder hereby certifies that the above mentioned are the only deviation from KSEBL's general conditions for this Bid. The Bidder confirms that in the event of any other data and information being present in the Bidder's proposal and accompanying documents including drawings, catalogues etc. and are at variance with the specific requirements laid out in the KSEBL's general & special conditions, then the later shall govern and will be binding on the Bidder for the quoted price.

		Name and Address of Bidder
Place:	<input type="text"/>	
Date:	<input type="text"/>	

FORMAT-M
LOCAL REPRESENTATION

The bidder shall furnish general information in the following format, related to the representing company / firm.

Name of the Firm:	
Head office address:	
Contact persons:	
Telephone No.	
Office:	Residence:
Fax No. Telex: 3672	E mail ID:
Place of incorporation/Regn.	
Year of incorporation/Regn.	

FORMAT-N

***LIST OF PROPOSED VENDOR/SUPPLIER
FOR EQUIPMENT/MATERIALS OTHER THAN THE APPROVED LIST AS PER
ANNEXURE III***

The bidder shall furnish SPECIFIC MANUFACTURERS/VENDORS ONLY

Item No	Material/Item name as per Tech specs of this project	OPTION 1: Name and address and contact of the Manufacturer/ Vendor	Expiry date of the Validity of Approval of the said vendor by PGCIL	OPTION 2: Name and address and contact of the Manufacturer/ Vendor	Expiry date of the Validity of Approval of the said vendor by PGCIL
1	ACSR Panther conductor				
2	Polymer long rod composite insulators				
3	Hardware and accessories for ACSR Panther conductor				
4	7/3.66 Galvanized Steel earth wire				
5	Fully Galvanized narrow based Transmission Tower				

6	Aviation warning system				
7	Earthing system				
8	48 Fibre OPGW				
9	48 fibre OPGW hardware				
10	Joint Box for OPGW				
11	FODP for OPGW				

Note: Add any other items, not specifically mentioned.

		Name and Address of Bidder
Place:		<div style="border: 1px solid black; height: 150px; width: 100%;"></div>
Date:		

FORMAT-O**ACTIVITY TIME SCHEDULE****Start date: 15 days from the date of detailed work order**

(Fill up in number of days)

Mile Stone	Item of Work	Completion Dates		Remarks
		From	To	
KLSP Project A: Construction of 9 kM 220kV Double circuit line from Kanhirod SS to Mundayad SS (1.5 kM 220kV Multi Circuit line from Kanhirod SS to Puravoor + 7.5 kM 220kV Double circuit line from Puravoor to Mundayad SS) which include Dismantling existing line, earthwire, towers, foundations etc & Stringing new line using narrow base towers				
1	Supply of materials			
2	Completion of stub setting and foundation of Towers			
3	Dismantling the existing Towers and line			
4	Tower assembly and erection and tightening of bolts punching			
5	Stringing Line conductors			
6	Stringing Ground wires/OPGW and earthing			
7	Final tensioning, Sag correction, testing and commissioning			
8	Name/Sign Boards, Aviation warning, Muffing the chimneys, etc			

<p>KLSP Project B : Construction of 81 kM 220kV /110kV Multi circuit Multi voltage (MCMV) line from Mundayad to Mylatty which include Dismantling existing line, earthwire, towers, foundations etc & Stringing new line using narrow based towers.</p>				
1	Supply of materials			
2	Completion of stub setting and foundation of Towers			
3	Dismantling the existing Towers and line			
4	Tower assembly and erection and tightening of bolts punching			
5	Stringing Line conductors			
6	Stringing Ground wires / OPGW and earthing			
7	Final tensioning, Sag correction, testing and commissioning			
8	Name/Sign Boards, Aviation warning, Muffing the chimneys, etc			

Mile Stone	Item of Work	Completion Dates		Remarks
		From	To	
3. NMLP Project A: Construction of 22.236 km 220/110 kV Multi Circuit Multi Voltage Line (MCMV) from Mundayad to Thalassery which include Dismantling existing line, earth-wire, towers, foundations etc., & Stringing new line using narrow base towers				
1	Supply of materials			
2	Completion of stub setting and foundation of Towers			
3	Dismantling the existing Towers and line			
4	Tower assembly and erection and tightening of bolts punching			
5	Stringing Line conductors			
6	Stringing Ground wires/OPGW and earthing			
7	Final tensioning, Sag correction, testing and commissioning			
8	Name/Sign Boards, Aviation warning, Muffing the chimneys, etc			
4.NMLP Project B: Conversion of 7.66 km of 110 kV DC line to 220kV /110kV Multi circuit from Areacode – Kaniyambetta feeder tap point to Kunnamangalam Substation through Existing Agasthimuzhi 110 kV line route which include Dismantling existing line, earthwire, towers,				

foundations etc & Stringing new line using narrow based towers.				
1	Supply of materials			
2	Completion of stub setting and foundation of Towers			
3	Dismantling the existing Towers and line			
4	Tower assembly and erection and tightening of bolts punching			
5	Stringing Line conductors			
6	Stringing Ground wires / OPGW and earthing			
7	Final tensioning, Sag correction, testing and commissioning			
8	Name/Sign Boards, Aviation warning, Muffing the chimneys, etc			

Note: Since the existing substations are to be fed back for taking shut down, phase wise execution only will be allowed sequentially.

		Name and Address of Bidder
Place:		

Date:	<input type="text"/>	
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SECTION - 4
SAMPLE FORMS

TABLE OF SAMPLE FORMS

Sample forms	Description
A	Tender Agreement (To be submitted by the bidder in Kerala Govt. Stamp paper worth 200/-)
B	Bid Form (To be submitted by the bidder in Bidder's Letter head)
C	Letter of Acceptance (Draft only)
D	Contract Agreement Format
E	Bank Guarantee in Lieu of Performance Security (Draft only)
F	Bank Guarantee in lieu of Earnest Money Deposit

SAMPLE FORM A
TENDER AGREEMENT

(In non-judicial Kerala Government stamp paper worth Rs.200/-)

“Articles of Agreement executed on this the.....day of Two Thousand and ... Between The KERALA STATE ELECTRICITY BOARD LIMITED acting through (the designation of the office who has invited this tender) hereinafter referred to as “the Board”) on one part and Sri..... (the name and address of the bidder) herein after referred to as “bounden”) on the other part.

WHEREAS in response to the invitation for tenders, contained in Notification No. Dated Inviting tenders the bounden has submitted to the Board a bid for the Specified therein subject to the terms and conditions contained in the said tender;

Whereas the bounden has also deposited with the Board a sum of Rs.....as earnest money for execution of an agreement undertaking the fulfilment of the contract in case his tender is accepted by the Board. NOW THESE PRESENTS WITNESSES and it is hereby mutually agreed as follows:

1. In case the bid submitted by the bounden is accepted by the Board and the contract for is awarded to the bounden, the bounden shall within days of acceptance of his bid, execute an agreement with the Board incorporating all the terms and conditions under which the Board accepts his bid.
2. In case the bounden fails to execute the agreement as aforesaid incorporating the terms and conditions governing the contract, the Board shall have power and authority to recover from the bounden, any loss or damages caused to the Board by such breach as may be determined by the Board, appropriating the earnest money if found to be inadequate, the deficit amount may be recovered from the bounden and his properties movable and immovable and also in the manner hereinafter contained.
3. All sums found due to the Board under or by virtue of this agreement shall be recoverable from the bounden and his properties movable and immovable, under the provisions of the Revenue

Recovery Act, for the time being in force as though such sums are arrears of land revenue and also in such other manner as the Board may deem fit.

In witnesses where of Sri.
..... (Name and Designation) for and on behalf of KSEBL and Sri.
..... The bounden have hereunto set their hands the day and year shown against their respective signatures.

Signed by Sri.....

In the presence of Witnesses:

- 1.
- 2.

Signed by Sri. (Contractor's signature with Date)

In the presence of Witnesses:

- 1.
- 2.

SAMPLE FORM B

Bid No. DCE/ TransGrid (N)/05/2017-18

Bid Form

(Sub-project wise on Bidder's Letter head)

Name of the Project and identification No.

To

The Deputy Chief Engineer with full powers of Chief Engineer,
TransGrid (North),
Kerala State Electricity Board Limited,
Vydyuthi Bhavanam , Kallippadam P.O
Shoranur - 679 122

GENTLEMEN

I / We the undersigned have carefully examined and understood the bid documents. I/We hereby agree for the works of **Execution of KOLATHUNADU LINE PACKAGE & NORTH MALABAR LINES PACKAGE on Turnkey Basis** as per the terms and conditions of the tender mentioned above.

This bid and your written acceptance shall be the basis for Contract Agreement. I/We understand that you are not bound to accept the lowest or any bid you receive or assign any reason therefore.

I / We further agree to sign an agreement to abide by the General Conditions of Contract and carry out all works according to specific clauses.

I / We, agree to keep this Bid open for acceptance for **180 days from the date of opening of Pre-qualification Bid or 120 days from the date of opening of price bid whichever is earlier** thereof and also agree not to make any modification in its terms and conditions of my/our own account.

Signed this dayof 2018

Yours faithfully,

Seal of the Company

Signature :

Name :

Address of

Date :

the Co.

1. Witness :

Signature :

2. Witness :

Signature :

SAMPLE FORM C

Letter of Acceptance

(On KSEBL' s Letterhead)

(Draft format only. Not to be filled by the bidder)

Bid No DCE/ TransGrid (N)/05/2017-18

(Date)

To

(Name and address of the Contractor)

Dear Sirs,

This is to notify you that your bid dated for the execution of the Works for Construction/Up gradation of 220/110kV transmission line using MCMV Towers which includes dismantling of existing conductor and towers, Supplying Towers / ACSR conductor/ OPGW with all accessories, polymeric suspension / tension insulator of approved type and capacity, stringing as per the specifications and other allied works as per the tower schedule and design provided by KSEBL, up to the full satisfaction of K.S.E.B Ltd on Turnkey Contract Basis and handing over to KSEBL for the Contract Price of Rupees(Amount in figures and words) as corrected and modified in accordance with the Instructions to Bidders is hereby accepted by us.

You are advised to submit performance security and sign contract agreements within 15 days from the issue of work order. The work order will be issued within seven days.

Yours faithfully,

Signature

Name:

Title:

KSEBL :

SEAL

..... (Signature, name and title of signatory authorised to sign on behalf of KSEBL)

SAMPLE FORM D

CONTRACT AGREEMENT FORMAT

(Agreement to be executed for the turn key work in Rs.200/- worth Kerala Govt. Stamp Paper)

Agreement No.....dt.....

This deed of Agreement made on the day of..... 2018 Between Sri., **Deputy Chief Engineer with full powers of Chief Engineer, Trans Grid South, Kerala State Electricity Board Limited, Vydyuthi Bhavanam , Kallippadam P.O. Shoranur - 679 122**

acting for and on behalf of the Kerala State Electricity Board Limited herein after called the “KSEBL” of the one part and Sri..... .. of.... incorporated under theand having its registered Office at..... (herein after called the Contractor) of the other part.

WHEREAS KSEBL has decided to take up the work of Constructing/Up-grading of 220/110kV transmission lines using MCMV / Double Circuit / Narrow base towers, wherever required, which includes dismantling of existing conductor and towers, Supplying Towers / ACSR/ACCC conductors / OPGW with all accessories, polymeric suspension / tension insulator of approved type and capacity, stringing as per the specifications and other allied works as per the tower schedule and design provided by KSEBL (including design, proto-fabrication & type-testing of 400 & 220KV Multi-circuit / Double Circuit towers), up to the full satisfaction of KSEB Ltd on Turnkey Contract Basis and handing over to KSEB Ltd and incur all other expenses required to perform the work and the Contractor shall perform every item of work as per specification with good workmanship, complete in every respect strictly in accordance with drawings, specifications, and conditions of contract as finally agreed to

AND WHEREAS KSEBL has tendered the work of Construction/Upgradation of 220/110kV transmission line using MCMV Towers which includes dismantling of existing conductors and towers and taking the scrap items in as is where is condition, Supplying Towers/ ACSR conductor/ OPGW with all accessories, polymeric suspension / tension insulators of approved type and capacity, stringing as per the specifications and other allied works as per the tower schedule and design provided by KSEBL, up to the

full satisfaction of KSEB Ltd on Turnkey Contract Basis and handing over to KSEB Ltd and incur all other expenses required to perform the work and the Contractor shall perform every item of work as per specification with good workmanship, complete in every respect strictly in accordance with drawings, specifications, and conditions of contract as finally agreed to as defined in the Bid documents as per Tender notification No. **dated**

AND WHERE AS the KSEBL is desirous of starting the actual work of Construction/Upgradation of 220/110kV transmission line using MCMV Towers which includes dismantling of existing conductors and towers and taking the scrap items in as is where is condition, Supplying Towers/ ACSR conductor/ OPGW with all accessories, polymeric suspension / tension insulators of approved type and capacity, stringing as per the specifications and other allied works as per the tower schedule and design provided by KSEBL, up to the full satisfaction of KSEB Ltd on Turnkey Contract Basis and handing over to KSEB Ltd and incur all other expenses required to perform the work and the Contractor shall perform every item of work as per specification with good workmanship, complete in every respect strictly in accordance with drawings, specifications, and conditions of contract as finally agreed to at an early date and of completing the work without time & cost overrun for the benefit of the State.

AND WHEREAS the above said "Contract" is tendered for the execution of the work of Construction/Upgradation of 220/110kV transmission line using MCMV Towers which includes dismantling of existing conductors and towers and taking the scrap items in as is where is condition, Supplying Towers/ ACSR conductor/ OPGW with all accessories, polymeric suspension / tension insulators of approved type and capacity, stringing as per the specifications and other allied works as per the tower schedule and design provided by KSEBL, up to the full satisfaction of KSEB Ltd on Turnkey Contract Basis and handing over to KSEB Ltd and incur all other expenses required to perform the work and the Contractor shall perform every item of work as per specification with good workmanship, complete in every respect strictly in accordance with drawings, specifications, and conditions mentioned herein after and as per the documents appended to this agreement.

AND WHEREAS on behalf of KSEBL, the Deputy Chief Engineer with full powers of Chief Engineer (TransGrid South), Kerala State Electricity Board Ltd, Vydyuthi Bhavanam , Kallippadam P.O Shoranur - 679 122 is responsible for the execution of the work.

AND WHEREAS the KSEBL is pleased to accept the bid submitted by the Contractor through **LOA No.** **issued vide No.** **dated** for the Manufacturing, Testing and Supply of materials, Spares, T&P; execution of the work and Sale of dismantled items at offered bid amount,

AND WHEREAS the KSEBL issued detailed work order vide **Work Order No.** **dated** for the execution of the works by the contractor for satisfactory completion of the project contracted for and the Contractor has furnished Performance Guarantee / Bank Guarantee No. for an amount of Rs (Rupees) of(Bank Name)... Branch, as being the performance Guarantee required for the proper performance of the contract.

AND WHEREAS the Contractor is responsible for the proper performance of the contract and the completion of the work in every aspect strictly as per the **Work Order No.....** **dated.....** issued to the contractor and as per the documents appended to this agreement. Now these presents witness and it is hereby mutually agreed as follows.

In this agreement, words and expressions shall have the same meaning as that are respectively assigned to them in the conditions of contract herein after referred to.

ARTICLE 1 - SCOPE OF WORK

Constructing/Up-grading of 220/110kV transmission lines using MCMV / Double Circuit / Narrow base towers, wherever required, which includes dismantling of existing conductor and towers, Supplying Towers / ACSR/ACCC conductors / OPGW with all accessories, polymeric suspension / tension insulator of approved type and capacity, stringing as per the specifications and other allied works as per the tower schedule and design provided by KSEBL (including design, proto-fabrication & type-testing of 400 & 220KV Multi-circuit / Double Circuit towers), up to the full satisfaction of KSEB Ltd on Turnkey Contract Basis and handing over to KSEB Ltd and incur all other expenses required to perform the work and the Contractor shall perform every item of work as per specification with good workmanship, complete in every respect strictly in accordance with drawings, specifications, and conditions of contract as finally agreed to.

The Contractor shall undertake to supply materials required for the work according to the standards and specifications in the tender documents. No representation for enhancement of rates once accepted will be considered. The approximate quantities to be supplied are shown in Schedule 2. Actual requirement shall be supplied during the execution of the work and excess if any, supplied shall be taken back. The supply should be made as and when required

for completing the work within the time stipulated in the Work Order No **dated**
.....

ARTICLE II – PAYMENT

In consideration of what the Contractor perform the work under the provisions of this contract and strictly in accordance with the terms thereof, the KSEBL agrees to pay the Contractor the amount in Indian currency as given in **Work Order No. dated** for items of supply and work contemplated under the agreement at the rates mentioned therein.

All payments to the Contractor will be made by the KSEBL. All costs, damages or expenses, which the KSEBL may have paid, for which, under the contract the contractor is liable, may be deducted by the KSEBL from any money due or becoming due by them to the contractor under the contract, or may be recovered by action at law or otherwise from the contractor.

ARTICLE III - COMMENCEMENT AND COMPLETION

The date of commencement of work under this contract shall be 15 days (fifteen days) after the date of issue of work order ie, from and shall be completed diligently in all respect within a period of months as per the schedules attached with Work order covered by this agreement. It shall be made ready in all respect for taken over by the agreement authority on or before

ARTICLE IV – COMPONENT PART OF THE AGREEMENT

The contract document consists of:

1. Work Order No. dated
2. Agreement executed on Kerala Government stamp paper of value Rs.200/- and;
3. Bid document submitted by the contractor including all the connected documents as specified below.

Volume I Pre-Qualification and General conditions of contract (As Annexure....)

Volume II Technical specifications and drawing (As Annexure....)

Volume III Price bid (BOQ) (As Annexure....)

Other Important bid documents furnished in addition to pre-qualification bid listed below.

Performance Bank Guarantee No _____ date _____ of Bank..... (As Annexure....)

Expression of Interest documents submitted during the Pre-qualification stage..... (As Annexure....)

Bid Clarification issued during the bidding stage..... (As Annexure....)

Rock bottom rate furnished by you (As Annexure....)

Activity schedule (As Annexure....)

..... (As Annexure....)

..... (As Annexure....)

ARTICLE V- RATES TO HOLD GOOD IN CASE THE PERIOD OF THE CONTRACT IS EXTENDED:

The rates agreed by the Contractor as per schedules Supply and Work orders respectively and accepted by the KSEBL shall hold good for all works done towards the completion of the contract whether within the period mentioned herein or during the mutually agreed extended period, if any. No revision of rates for the works shall be allowed on any ground or on any reason.

ARTICLE VI- SERVICE OF NOTICE:

Every notice to be given to the Contractor may be given to him by registered post to his office address or last known place of abode or business or handed over to his agent, personally which shall be deemed to have been served on the Contractor on the date on which in the ordinary course of post, a letter so addressed and posted would reach his place of abode of business.

ARTICLE VII- LIQUIDATED DAMAGES:

The Contractor is to pay liquidated damages to the KSEBL for delayed completion of the "Works" under the contract @ 1% of agreed contract price per month (percentage of contract price or part thereof) for delay, subject to a ceiling of 10% of total contract price. KSEBL shall deduct the liquidated damages from

any payments due to the Contractor. However the payment of liquidated damages does not affect the contractual liability of the contractor.

ARTICLE VIII – INSOLVENCY OR LIQUIDATION

In case the Contractor becomes insolvent or goes into liquidation or makes or proposes to make any assignment for the benefit of his creditors or proposes any composition with his creditors for the settlement of his debts or carries on his business or the contract under inspection on behalf of his creditors or in case any orders for the administration of his estate are made against him, or in case the Contractor shall commit any act of insolvency or in case in which, under any clause or clauses of this contract the Contractor shall have rendered himself liable to damages amounting to the whole of his security deposit, the contract will be terminated and the agreement authority may complete the contract in such time and manner by any such person as the KSEBL may think deem fit. But such termination of the contract shall be without any prejudice to any right of remedy of the KSEBL against the contractor or his sureties in respect of any breach of contract committed by the Contractor.

ARTICLE IX- BREACH OF CONTRACT:

If the Contractor commits breach of all or any of the terms and conditions of Contract the KSEBL shall be entitled to recover from the Contractor all damages it might suffer there by. The amount thus due could be recovered from the Contractor in any manner the KSEBL chooses including recovery by Revenue Recovery Proceedings.

In case the contractor after having partially executed the works, fails to fulfil the contract in full, all or any of the work not carried out may, at the discretion of the KSEBL, be arranged by means of another tender/quotation or by negotiation with the next higher tenderer who had offered to carry out the work already and the loss, if any, caused to the KSEBL shall there by together with such sums as may be fixed by the KSEBL towards damages, be recovered from the defaulting contractor.

All expenses and damages caused to the KSEBL by any breach of all or any of the terms of this contract by the Contractor shall be paid by the Contractor to the KSEBL and may be recovered from him.

ARTICLE X – PERFORMANCE GUARANTEE

The contractor has furnished performance security deposit against satisfactory performance of the contract as mentioned in this agreement and all the works, equipment, materials, offered as per this tender shall be guaranteed for the satisfactory performance for a period of **84 months from the date of commissioning and taking over by KSEBL**. The commissioning and taking over by KSEBL would be done as and when all the works as per the scope of this project is completed in all respects for energizing. Irrespective of the number of failure and repairs of failed materials/system, the works shall be guaranteed till the expiry of the warranty period.

Total guarantee period including the defect liability period shall be limited to 84 months. **Defect notice period may be taken as 3 months prior to warranty expiry and the defect rectification period will be 30 days from the defect intimation. During the warranty period, the bidder must provide technical support and training for KSEBL staff and officers for O&M of the line as per the conditions stipulated in tender documents.**

During the Performance Guarantee period, the Contractor shall repair / replace free of cost, any equipment / component supplied and installed by the Contractor which fails or proves to be unsatisfactory under normal operations due to faulty manufacture or design or engineering or poor workmanship.

However During the guarantee period, if the Contractor fails to rectify the defects if any, notified within reasonable time, KSEBL shall arrange for a third party to correct the defect, and the cost thereof plus 10% shall be recovered from the contractor from the amount payable to the contractor, by way of performance guarantee or any other means.

On the expiry of the guarantee period and defect liability period, the performance guarantee will be released after deducting the amount, if any to be deducted as above.

ARTICLE XI-RELEASE OF PERFORMANCE GUARANTEE AND RETENTION / BANK GUARANTEE

The Performance Guarantee and Retention amount required to be retained by the Contractor with KSEBL will be released only after the expiry of the guarantee period and defect liability period and KSEBL has certified that all defects notified have been corrected.

ARTICLE XII

The Contractor hereby agrees to extend the period of validity of Bank Guarantee furnished by him towards the Performance Guarantee under this contract for such time & for such amount as may be required as per rule for the satisfactory completion of performance guarantee till such an extension is not required by the agreement.

In witness where of the parties hereto have hereunto set their hands the day and year first above written.

Signed and sealed delivered by **Sri.**, **Deputy Chief Engineer with full powers of Chief Engineer (TransGrid South), Kerala State Electricity Board Ltd, Vydyuthi Bhavanam , Kallippadam P.O Shoranur - 679 122** acting for and on behalf of the Kerala State Electricity Board Ltd.

Agreement Authority

In the presence of:

1. Full name, address and Signature
2. Full name, address and Signature

Signed, sealed and delivered by Shri

.....

In the presence of

1. Full name, address and Signature.
2. Full name, address and Signature:

SAMPLE FORM E

(Draft format only)

Bank Guarantee in lieu of Performance Security

(On Stamp paper of appropriate value)

(To be furnished from State Bank of India and its subsidiaries/associates, nationalised Banks, Kerala State Co-operative Bank or from Scheduled Banks (Except Indus Ind bank) and District Co-operative Banks if approved by the Board)

Place:.....

Guarantee No.....Date:.....

This guarantee given this the day of 2018 at byhaving its principal office at office..... by its.....Branch (hereinafter referred as “the Guarantor”) which expression shall unless repugnant to the context and meaning thereof include its successors, administrators, executors and assigns.

To

The Deputy Chief Engineer with full powers of Chief Engineer,
Trans Grid (North),
Kerala State Electricity Board Limited,
Vydyuthi Bhavanam, Kallippadam P.O

Shoranur - 679 122

WHEREAS (name and address of Contractor) (hereinafter called “the Contractor) has to undertake an agreement, in pursuance of Order No.....Dated.....for the execution of the Works in connection with work of Construction/Upgradation of 220/110kV transmission line using MCMV Towers, which includes dismantling of existing conductor and towers, Supplying Towers/ ACSR conductor/ OPGW with all accessories, polymeric suspension / tension insulator of approved type and capacity, stringing as per the specifications and other allied works, up to the full satisfaction of K.S.E.B Ltd on Turnkey Contract Basis and handing over to KSEBL on Turnkey Contract Basis (hereinafter called “the Contract”).

AND WHEREAS as per the terms of the contract to be executed the contractor shall furnish KSEBL with an unconditional Bank Guarantee in lieu of performance security, from a recognized Bank for the sum specified AND WHEREAS the contractor has approached the Guarantor to issue an unconditional Bank guarantee for an amount of Rupees..... in favour of KSEBL

AND WHEREAS THE guarantor has agreed to give the Contractor such a Bank Guarantee;

NOW THEREFORE the Guarantor hereby guarantees as the obligator and not merely as surety, unconditional and absolutely to KSEBL of the payment of guarantee amount (amount of guarantee..... (in words) or such sum being payable, and guarantor undertake to pay KSEBL, immediately on its first written demand and without cavil or argument or demur, reservation, recourse, context or protest and/or without a reference to the contractor any sum or sums within the limits of(amount of guarantee) as aforesaid, without any need for the KSEBL to convey to us any reason for the invocation of the Guarantee or to prove or to show grounds or reason for the demand for the sum specified herein.

Any demand from KSEBL for payment under this guarantee shall be conclusive, final and binding on THE GUARANTOR (BANK) and GUARANTOR shall make payment to the KSEBL on receipt of such written demand without any demur.

Written demand by the KSEBL shall be sent by courier or by registered mail or by email to the Bank addressed as aforesaid.

The guarantor hereby waives the necessity of KSEBL demanding the said amount from the Contractor before presenting us with the demand.

The guarantor further agree that no change or addition to or other modification of the terms of the Contract or of the Works to be performed there under or of any of the Contract documents which may be made between KSEBL 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.

The obligation of the Guarantor under this guarantee shall not be affected by legal limitations, disability in capacity or other circumstances relating to the Contractor or by any change in the construction of or any amalgamation or reconstruction of the Contractor.

The guarantor understands that the onus of extending the validity of the Bank Guarantee in time till the

accounts in respect of the contract is finally settled with the Contractor.

The GUARANTOR further undertake not to revoke this guarantee during its term and such extended period AND THE GUARANTOR further agrees that any change in the constitution of the CONTRACTOR or THE GUARANTOR shall not discharge the liability of the GUARANTOR under this Bank guarantee.

That as to whether the occasion has arisen for the demand of the amount covered by the Bank guarantee the mere written demand made by the KSEBL, Vidyuthi Bhavanam, Pattom, Thiruvananthapuram-695 004, Kerala represented by The Deputy Chief Engineer with full powers of Chief Engineer, TransGrid (North), Kerala State Electricity Board Limited, Vidyuthi Bhavanam , Kallippadam P.O. Shoranur - 679 122 or any officer duly authorized by the KSEBL to the GUARANTOR is sufficient, shall be final and shall be accepted by the GUARANTOR without any reference to the contractor and also without any argument.

We unconditionally and irrevocably undertake to pay to the KSEBL, any amount so demanded not exceeding Rs.....(Rupees..... only) notwithstanding any dispute or disputes raised by contractor or anyone else in any suit or proceedings before any dispute review expert, arbitrator, court, tribunal or other authority, our liability under this guarantee being absolute, unconditional and unequivocal. The payment so made by us under this guarantee to the KSEBL, shall be a valid discharge of our liability for payment under this guarantee and the contractor shall be a valid discharge of our liability for payment under this guarantee and the contractor shall have no claim against us for making such payment.

That in case the validity of the Bank guarantee is not extended by the Contractor in time and in case the KSEBL has not requested the guarantor to release the Bank Guarantee to the Contractor before the expiry date specified or extension thereof, the guarantor hereby agrees to pay full amount as per this guarantee to the KSEBL, immediately on expiry of validity period, excluding grace period, the demand for which is here by waived.

That this Bank Guarantee shall be enforceable against the guarantor as a first charge and is not available to be appropriated by the Bank towards claims, if any, due to the Contractor.

This guarantee shall be valid for..... months from the date of commissioning and handing over of the works to KSEBL, and it will hold good for all demands made by The Deputy Chief Engineer with full powers of Chief Engineer, TransGrid (North), Kerala State Electricity Board Limited, **Vidyuthi**

Bhavanam , Kallippadam P.O. Shoranur - 679 122 in the meanwhile (i.e. validity period is up to)

In case the Bank Guarantee is issued from a branch outside Kalamassery (Name of KSEBL payment office), KSEBL can approach the(Bank Branch Address) of the same bank with a written demand for the encashment of the bank guarantee on or before the expiry date of the guarantee and the bank will be liable to pay the guaranteed amount or any part thereof under this guarantee.

Notwithstanding anything contained herein

- (1) Our liability under this guarantee shall not exceed Rs..... (Rupees..... only)
- (2) This Bank guarantee shall be valid up to and
- (3) We are liable to pay the guaranteed amount or any parts thereof under this guarantee only and only if you serve upon us (Name and address of Guarantor) a written demand on or before (date of expiry of guarantee) Dated theday of20....

SIGNATURE AND SEAL OF THE GUARANTOR:

Name of Bank: Address:

SAMPLE FORM F

Bank Guarantee In lieu of Earnest Money Deposit
(On Stamp paper of appropriate value)

TO:

The Deputy Chief Engineer with full powers of Chief Engineer
Trans grid (North)
Kerala State Electricity Board
Vydyuthi Bhavanam , Kallippadam P.O.
Shoranur - 679 122

IN CONSIDERATION OF KERALA STATE ELCTRICITY BOARD (hereinafter called "the Owner") issued a tender on Messrs. a partnership firm/sole proprietor business/a company having its office at (hereinafter called "the Tenderer" which expression shall include its executors, administrators and assigns) against Tender no..... dated (here in after called "the tender" which expression shall include any amendments/alterations to "the tender" issued by "Owner") for the supply of goods to/execution of services for "the Owner" and "the Owner" having agreed not to insist upon immediate payment of Earnest Money for the fulfillment of the said tender in terms thereof on production of an acceptable Bank Guarantee for an amount of `..... (Rupees only).

1. We, Bank having office at (hereinafter referred to as "the Bank" which expression shall include its successors and assigns) at the request and on behalf of "the Tenderer" hereby agree to pay to the Owner without any demur on first demand an amount not exceeding `..... (Rupees only) against any loss or damage, costs, charges and expenses caused to or suffered by "the Corporation" by

reason of nonperformance and fulfillment or for any breach on the part of "the Tenderer" of any of the terms and conditions of the said "tender".

2. We, Bank further agree that "the Owner" shall be sole Judge whether the said "Tenderer" has failed to perform or fulfill the said "tender" in terms thereof or committed breach of any of the terms and conditions of "the order" and the extent of loss, damage, cost, charges and expenses suffered or incurred or would be suffered or incurred by "the Owner" on account thereof and we waive in favour of "the Owner" all the rights and defences to which we as guarantors and/or "the Tenderer" may be entitled to.

3. We, Bank further agree that the amount demanded by "the Owner" as such shall be final and binding on "the Bank" as to "the Bank" 's liability to pay and the amount demanded and "the Bank" to undertake to pay "the Owner" the amount so demanded on first demand and without any demur notwithstanding any dispute raised by "the Tenderer" or any suit or other legal proceedings including arbitration pending before any court, tribunal or arbitrator relating thereto, our liability under this guarantee being absolute and unconditional.

4. We, Bank further agree with "the Owner" that "the Owner" shall have the fullest liberty without our consent and without affecting in any manner our obligations hereunder to vary any of the terms and conditions of the said "tender"/or to extend time of performance by "the Tenderer" from time to time or to postpone for any time to time any of the powers exercisable by "the Owner" against "the Tenderer" and to forbear to enforce any of the terms and conditions relating to "the tender" and we shall not be relieved from our liability by reason of any such variation or extension being granted to "the Tenderer" or for any forbearance, act or omission on the part of "the Owner" or any indulgence by "the Owner" to "the tenderer" or by any such matter or things whatsoever which under the law relating to sureties would but for this provision have the effect of relieving us.

-
5. NOTWITHSTANDING anything hereinbefore contained, our liability under this Guarantee is restricted to ` (Rupees..... only). Our liability under this guarantee shall remain in force until expiration of eight months from the due date of opening of the said "tender". Unless a demand or claim under this guarantee is made on us in writing within said period, that is, on or before all rights of "the Owner" under the said guarantee shall be forfeited and we shall be relieved and discharged from all liabilities thereunder.

 6. We, Bank further undertake not to revoke this guarantee during its currency except with the previous consent of "the Owner" in Writing.

 7. We, Bank lastly agree that "the Bank"'s liability under this guarantee shall not be affected by any change in the constitution of "the Tenderer".

 8. "The Bank" has power to issue this guarantee in favour of "the Owner" in terms of the documents and/or the Agreement/Contract or MOU entered into between "the Tenderer" and "the Bank" in this regard.

IN WITNESS WHEREOF the Bank has executed this document on this day of

For Bank
(by its constituted attorney)

(Signature of a person authorized to sign on behalf of "the Bank")

SECTION-5
GENERAL CONDITIONS OF CONTRACT

TABLE OF CLAUSES

Clause No.	Description
A. General	
1.	Definitions
2.	Interpretation
3.	Language and law
4.	Decision
5.	Delegation
6.	Communications
7.	Execution Partner
8.	Co-ordination with Other Contractors
9.	Personnel
10.	Contractor' s Risk
11.	Force Majeure
12.	Insurance
13.	Indemnities
14.	Site Investigation Data
15.	Queries about Contract Data
16.	Contractor to Construct the Works
17.	The Works to be Completed by the Completion date
18.	Approval of the Contractors Temporary Works
19.	Safety
20.	Discoveries
21.	Way leave clearance
22.	Access to the Site

23.	Instructions
24.	Disputes
25.	Import of Equipment if required for erection
B. Time Control	
26.	Programme
27.	Extension of the Completion Date
28.	Delays ordered by KSEBL
29.	Management meetings
30.	Early warning
C. Quality Control	
31.	Guarantee
32.	Identifying Defects
33.	Tests
34.	Correction of Defects
35.	Uncorrected Defects After Handing over
D. Cost Control	
36.	Activity Schedule
37.	Changes in the Activity Schedule
38.	Variations
39.	Payment for variations for Separately Identifiable Additional work
40.	Cash Flow Forecast
41.	Payment Terms
42.	Mode of Payment
43.	Price Adjustment
44.	Retention
45.	Liquidated Damages

46.	Incentive
47.	Securities
48.	Cost of Repairs
E. Finishing the Contract	
49.	Completion
50.	Taking Over
51.	Final Account
52.	Termination
53.	Payment upon Termination
54.	Property
55.	Operation and Maintenance Manuals
56.	Power
57.	Water, Fuels And Lubricants
F. Special conditions of contract	
58.	General
59.	Prices
60.	Regulation of local authorities and statutes
61.	KSEBL's lien on Equipment
62.	Inspection, Testing And Inspection Certificates
63.	Contractors site office Establishment
64.	Discipline of Workmen
65.	Contractors Field Operation
66.	Photographs and Progress Report
67.	Man-Power Report
68.	Protection of Work
69.	Employment of Labour

70.	Labour Welfare Measures and Workmen Compensation
71.	Display of Notice Regarding Wages etc.
72.	Facilities to be Provided by the Contractor.
73.	Integration with existing network
74.	Fire Protection
75.	Material Handling and Storage.
76.	Installation Management.
77.	Field Office Records.
78.	Work and Safety Regulations
79.	Drawings.
80.	Manufacturing Schedule
81.	Reference Standards.
82.	Quality Assurance
83.	Quality Assurance Documents
84.	Contractors Supervision
85.	Supervision by KSEBL
86.	Guaranteed Technical Particulars.
87.	Quantity Variation

SECTION- 5
GENERAL CONDITIONS OF CONTRACT

A. GENERAL**1. Definitions**

“**Acceptance date**” is the date when the Bid of the successful bidder is accepted by KSEBL by issuing a Letter of Acceptance.

“**Accepted Schedule**” is the schedule of items of work/supply containing the agreed rates on the basis of which the agreement is drawn for execution of the work.

The “**Activity Schedule**” is a schedule of the activities comprising the design, shop test, supply, transport, stringing, testing and commissioning and handing over of “the Work”. It includes a price for each activity which is used for valuations and for assessing the effects of Variations and Compensation Events.

“**Agreed rates**” shall mean the rate accepted and agreed both by the Board and the Contractor and which shall be given in the schedule forming part of the contract agreement and valid during the period of contract.

“**Agreement Authority**” shall mean the Officer authorized by the Board to execute the agreement with the Contractor for executing the work/project.

“**As-Built Drawing**” shall mean final drawings prepared and submitted by the Contractor after commissioning of the Work, duly incorporating modifications/corrections from the original approved construction drawings so as to take care of the actual installation/connection details. The Contractor shall prepare Marked-Up drawings incorporating modifications and corrections encountered from original drawings during the course of execution of work for preparing the As-Built Drawings.

“**Bank**” means State Bank of India and its subsidiaries/associates, Nationalised Banks, Kerala State Co-operative Bank and, also includes Scheduled Banks and District Co-operative Banks, if approved by the KSEBL (except Indus Ind Bank).

The words, ‘Bid’ and ‘Tender’ shall have the same meaning anywhere in these documents.

“Bid Amount/Bid Price” means the total bid amount indicated by the bidder in the schedule (Schedule of quantities or Bill of Quantities) of the bid documents.

Bid Security or ‘Earnest Money Deposit’ shall have the same meaning.

“Bidder” shall mean the person, company, corporate body, association, body of individuals, group of persons, limited Company, firm, organization for the works and his/its executors or administrators or successor or assignees.

The **‘Board** ‘shall mean The Kerala State Electricity Board Ltd’ or its successor’

“Chairman and Managing Director” shall mean the administrative head of Kerala State Electricity Board Limited or its successor appointed by the Government from time to time.’

Deputy Chief Engineer with full powers of Chief Engineer ‘ shall mean the Deputy Chief Engineer with full powers of Chief Engineer (TransGrid North), **Vydyuthi Bhavanam , Kallippadam P.O Shoranur - 679 122** of the Kerala State Electricity Board Limited or its successor in charge of the project or work concerned, who shall be the Agreement Authority. The Engineer-in-charge for each work shall be designated by the Board.

The **“Completion Date”** or **Commissioning and Handing Over Date (CHD)** is the date on which the Contractor shall complete the Works, duly notified by the Chief Engineer that the works can be taken over by KSEBL. The Completion Date is specified in the Tender documents. The Completion Date may be revised only by KSEBL by issuing in writing an extension of time.

The **“Contract”** is the contract between KSEBL and the Contractor, the terms and conditions of which have been incorporated in the agreement to be executed between the two parties.

“Contract Agreement” shall mean the agreement entered into between the contractor and the agreement authority.

The “**Contract Data**” defines the documents and other information which comprise the Contract.

The “**Contractor**” is the bidder whose bid to carry out the works has been accepted by KSEBL

The **Contractor’s Bid** is the completed bidding document submitted by the Contractor to KSEBL

The “**Contract Price**” is the price stated in the Letter of Acceptance and thereafter as adjusted in accordance with the provisions of the Contract.

“**Days**” are calendar days; “**Months**” are calendar months.

“**A Defect**” is any part of the Works not completed in accordance with the Contract.

The “**Engineer**” is the person or organisation named in the Contract Data or any other competent person appointed by KSEBL and notified to the Contractor, for effective implementation of the project(s).

“**Construction Equipment**” is the Contractor’s machinery and vehicle brought temporarily to the Site of construction of the Works.

“**Plant**” is any integral part of “**Brief of Works**” which is to have civil, mechanical, electrical, electronic or chemical function.

The “**Site(s)**” is/are the area(s) defined as such in the Contract Data.

The “**Start Date**” is given in the Contract Data. It is the date when the Contractor can commence work on the Contract. It does not necessarily coincide with any of the Site possession Dates.

“**Specifications**” mean collectively all the terms and stipulations contained in the bid document including the Conditions of Contract, Technical Provisions and Annexures thereto and list of correction and amendments.

A “**Sub-Contractor**” is a person or corporate body who has a Contract with the Contractor

to carry out a part of the work in the Contract which includes work on the Site.

“Temporary Works” are works designed, constructed, installed and removed by the Contractor at his own expenses which are needed for construction or installation of the Works.

A **Variation** is a modified instruction given by KSEBL which varies “Brief of Works”. The Works are what the Contract requires the execution of the Works in connection with work of Construction/Upgradation of 220/110kV transmission line using MCMV Towers/Monopoles, which includes dismantling of existing conductor and towers, Supplying Towers, ACSR conductor, OPGW, polymeric suspension / tension insulator of approved type and capacity, stringing as per the specifications and other allied works, up to the full satisfaction of K.S.E.B Ltd on Turnkey Contract as per the schedule , drawings and specification of KSEBL (hereinafter called “the Contract”).

2. INTERPRETATION

In Interpreting these Conditions of Contract, singular also means Plural, male also means female, and vice versa. Headings and cross-references between clauses have no significance. Words have their normal meaning under the language of the Contract unless specifically defined

3. LANGUAGE AND LAW

The Language of the Contract shall be English and the law governing the Contract shall be Indian and Kerala Laws and shall be subject to the jurisdiction of the courts in Thiruvananthapuram only.

4. DECISION

KSEBL is to decide contractual matters between the KSEBL and the Contractor fairly and impartially.

5. DELEGATION

KSEBL may delegate any of its duties and responsibilities to other people by notifying the Contractor and may even cancel/withdraw any such delegation by notifying to the

Contractor.

6. COMMUNICATIONS

Communications between parties which are referred to in the conditions are effective only when they are in writing.

7. EXECUTION PARTNER

The Contractor may utilize the execution partner for specific work having the stipulated experience as mentioned in the EOI and the tender documents. However such execution of work does not absolve the Contractor from the obligations under the Contract.

8. CO-ORDINATION WITH OTHER CONTRACTORS

The Contractor is to co-operate and share the Site with public authorities, utilities and the KSEBL

9. PERSONNEL

9.1. The Contractor is to employ either the key personnel named in the Schedule of Key personnel to carry out the functions stated in the Schedule or other personnel approved by the KSEBL. KSEBL will approve proposed replacement of key personnel only if their qualifications, abilities and relevant experience are equal or better than those of the personnel listed in the Schedule, without affecting the Contract Price.

9.2. If KSEBL asks the Contractor to remove a person who is a member of his staff or his work force and state its reasons, the Contractor is to ensure that the person leaves the Site within seven days and has no further connection with the work in the Contract. This should be completed by the Contractor without any financial implication to the KSEBL

10. CONTRACTOR'S RISK

10.1. All risks of loss or damage to physical property and of personal injury and death which arise during and in consequence of the performance of the Contract are the responsibility of the Contractor.

10.2. Safe custody of the materials supplied to the site is at contractor's risk till handing over of the same after testing and commissioning.

10.3. Damages caused if any to any public or private utility properties will be on contractors account.

11. FORCE MAJEURE

The term 'force majeure' as employed herein shall mean acts of God, strikes, lock-outs, or other industrial disturbances, acts of the public enemy, wars, blockades, insurrection, riots, epidemics, landslides, earthquakes, storms, lightning, floods, washouts, civil disturbances, explosion or any other similar events, not within the control of either party and which by the exercise of due diligence neither party is able to overcome.

12. INSURANCE

12.1. The following Erection, All Risk & Marine insurance cover are to be provided by the Contractor in the joint names of the KSEBL and the Contractor for the period from the Start Date to the date of handing over the 'Brief of Works'.

- a) All workmen engaged at site are to be covered under workmen compensation Act. The contractor shall provide a list of workmen engaged for the works. Necessary Labour License shall be obtained from concerned Authority.
- b) Full cover against damage to other people's property caused by the Contractor's acts or omissions;
- c) Cover against death or injury caused by the Contractor's acts or omissions to
 - i. any one authorized to be on the Site;
 - ii. third parties who are on the Site; as per laws.
- d) Full cover against injury or loss of life to contractor's workers including payment of compensation by way of Workmen Compensation Act as per rules. Any payment due to above to be made to subcontractor or workers also shall be paid by contractor and KSEBL will not be making any payment in this regard. If by any means the statutory body/Courts direct KSEBL to pay compensation, the same shall be deducted from contractor's bill, performance security or by RR action.

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- e) Full cover against theft and damage to the Works and materials during storage and construction.

Contractor shall pursue the matters related to insurance claims in association with KSEBL

- f) The contractor shall secure and maintain throughout the duration of this contract insurance of such type and in such amounts as may be necessary to protect himself and the interest of the board against all usual hazards or risk of loss. The form and limits of such insurance and the company together with the underwriting thereof in each case such as will be acceptable to the Board but regardless of such acceptance, it shall be the responsibility of the contractor to maintain adequate insurance coverage at all times. Failure of the contractor to maintain adequate coverage shall not relieve him of any contractual responsibility.

The contractor, without limiting Board's obligations and responsibilities shall insure:

- i. The works, together with materials and plant to the full replacement cost.
 - ii. An additional sum of 15% of such replacement cost to cover additional costs and incidental to the rectification of loss or damage including professional fees and cost of demolishing and removing debris of whatsoever nature, and
 - iii. the contractor's equipment and other things brought to the site, for a sum sufficient to provide for their replacement at the site.
- g) The insurance under item (i) and (ii) shall be in the joint names of contractor and Board and shall cover:
- a. The Board and the contractor against all losses or damage from whatsoever cause arising from the start of work at the site until the date of issue of the relevant taking over certificate in respect of the works or any section or part thereof as the case may be, and
 - b. the contractor for his liability:

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1. during the defects liability period for loss or damage arising from a cause occurring prior to the commencement of defect liability period and
 2. for loss or damage caused by the contractor in the course of any operations carried out by him under the terms of the contract. If the contractor shall fail to effect in force the insurances referred in the above clauses, or any other insurance which he may be required to effect under the terms of the contract then and in any such case ,the Board may effect and keep in force any such insurance and pay such premium or premiums as may be necessary for that purpose and from time to time deduct the amount so paid by the Board as aforesaid from any amounts due or which may become due to the contractor, or recover the same as a debt due from the contractor.

12.2. Policies and Certificates for insurance are to be produced by the Contractor to KSEBL for approval before the Start Date given in the Contract Data and subsequently as KSEBL may require.

12.3. Alterations to the terms of insurance either as a result of general changes imposed by the insurance company with which the insurance policy is effected or due to any other reasons may be made only with the approval of KSEBL. No work should be started unless Insurance cover Policies and Certificates as above are produced and approved by KSEBL

13. INDEMNITIES

13.1. The Contractor is liable for and shall indemnify the KSEBL and others against losses, expenses and claim for loss or damage to physical property, personal injury, and death caused by his own acts or omissions in stamp paper Rs. 200/-.

13.2. The Contractor shall indemnify KSEBL against claims for damage caused by the movement of his Equipment or Temporary Works.

14. SITE INVESTIGATION DATA

It is assumed that the Contractor has prepared the bid after site investigation and all other requisite details.

15. QUERIES ABOUT CONTRACT DATA

KSEBL is to give instructions clarifying queries about Contract Data.

16. CONTRACTOR TO CONSTRUCT THE WORKS

The Contractor is responsible for manufacture, shop test, and arranging for inspection of tests by representatives nominated by KSEBL, supply, transport, construct, install, test and commission and hand over the Work in accordance with the relevant Specifications and Drawing and to the full satisfaction of the KSEBL.

17. THE WORKS TO BE COMPLETED BY THE COMPLETION DATE

The Contractor shall begin the Works on the Start Date and is to carry out the Works in accordance with the programme submitted by him, as updated with the approval of KSEBL and complete them by the Completion Date.

18. APPROVAL OF THE CONTRACTOR'S TEMPORARY WORKS

- 18.1. The Contractor is to submit drawings and specifications showing his proposed Temporary Works to KSEBL who is to approve them if they comply with the Contract Data.
- 18.2. The Contractor is responsible for design of Temporary works.
- 18.3. KSEBL's approval does not alter the Contractor's responsibility for his design of the Temporary works.
- 18.4. The Contractor is to obtain approval of third parties to his design of the Temporary Works where required.

19. SAFETY

- 19.1. The Contractor is responsible for the safety of all activities on the Site.
- 19.2. The contractor shall ensure use of all safety implements like gloves, safety belts, safety slings, boots, eye glasses, helmets, safety dresses etc. as may be required to the personnel employed by him.
- 19.3. The contractor shall take all necessary precautions and follow other statutory safety codes while handling electric LINE and cables for welding and other and to pay any damages and cost of which may be awarded in consequence.
- 19.4. The contractor shall take all necessary precautions and follow other statutory safety codes while handling electric LINE and cables for welding and other

purposes, so that it shall not endanger the lives of personnel working in the site. The contractor shall be bound to bear the expense of defence of any action or law preceding that may be brought by any person or any injury sustained owing to neglect of precaution with the execution of the work and to pay any damages and cost which may be awarded in consequence.

- 19.5.** The Contractor shall ensure proper safety of all the workmen, materials plant and equipment belonging to it or to the others, working at the site. The Contractor shall also be responsible for provision of all safety notices and safety equipment required by the relevant legislations and deemed necessary by the Board.
- 19.6.** All equipment used in construction and erection by Contractor shall meet Indian/ International Standards and where such standards do not exist, the Contractor shall ensure these to be absolutely safe. All equipment shall be strictly operated and maintained by the Contractor in accordance with manufacturer's operation manual and safety instructions and as per Guideline/Rules in this regard.
- 19.7.** Periodical examinations and all tests for all lifting/hoisting equipment & tackle shall be carried-out in accordance with the Rules in force from time to time. A register of such examinations and tests shall be properly maintained by the Contractor and will be promptly produced as and when desired by Board.
- 19.8. No repair work shall be carried out on any live equipment.** The equipment must be declared safe by the Board's Engineer and a permit to work shall be issued by the Board before any repair work is carried out by the Contractor. While working on electric line/ equipment whether live or dead, suitable type and sufficient quantity of tools will have to be provided by Contractor to electricians/workmen/officers.
- 19.9.** The Contractor shall employ necessary number of qualified, full time electricians/electrical supervisors to maintain its temporary electrical installations.
- 19.10.** In case any accident occurs during the construction/ erection or other associated

activities undertaken by the Contractor, thereby causing any minor or major or fatal injury to its employees due to any reason whatsoever; it shall be the responsibility of the Contractor to promptly inform the same to the Board in prescribed form and also to all the authorities envisaged under the applicable laws.

- 19.11.** The Board shall have the right at its sole discretion to stop the work; if in its opinion the work is being carried out in such a way as may cause accidents and endanger the safety of the persons and/or property, and/or equipment. In such cases, the Contractor shall be informed in writing about the nature of hazards and possible injury/accident and he shall comply to remove short-comings promptly.

The Contractor, after stopping the specific work, can, if felt necessary, appeal against the order of stoppage of work to the Board within 3 days of such stoppage of work and the decision of the Board in this respect shall be conclusive and binding on the Contractor.

- 19.12.** The Contractor shall not be entitled for any damages/compensation for stoppage of work due to safety reasons as provided above and the period of such stoppage of work will not be taken as an extension of time for completion of work and will not be the ground for waiver of levy of liquidated damages

- 19.13.** The Contractor shall follow and comply with all Safety Rules, relevant provisions of applicable laws pertaining to the safety of workmen, employees plant and equipment as may be prescribed from time to time without any demur, protest or contest or reservation. In case of any unconformity between statutory requirement and Safety Rules referred above, the latter shall be binding on the Contractor unless the statutory provisions are more stringent.

- 19.14.** If the Contractor does not take all safety precautions and/or fails to comply with the Safety Rules as prescribed by the Board or as prescribed under the applicable law for the safety of the equipment, plant and personnel and the Contractor does not prevent hazardous conditions which may cause injury to its own employees or employees of other Contractors, or Board or any other person at Site or

adjacent thereto, the Contractor shall be responsible for payment of compensation.

The compensation mentioned above shall be in addition to the compensation payable to the workmen/employees under the relevant provisions of the Workmen's Compensation Act and rules framed there under or any other applicable law as applicable from time to time. In case the Board is made to pay such compensation, the Contractor will be liable to reimburse the Board such amount(s) in addition to the compensation indicated above.

19.15. Protection of other utility service

The contractor shall be responsible for any damages to other utilities caused by his workers and the damage shall be rectified at the cost of the contractor and no compensation shall be claimed from the Board on this. The overall rates quoted shall cover such contingencies and the contractor shall not be eligible for any extra payment on this account. However work at night and on holidays shall be arranged only with the approval of the Engineer in-charge of the work.

20. DISCOVERIES

Anything of historical or other interest or of significant value unexpectedly discovered on the site is the property of the State. The Contractor is to notify the KSEBL of such discoveries and carry out KSEBL's instructions for dealing with them.

21. WAY LEAVE CLEARANCE

The KSEB Ltd. will make necessary arrangements for the way leave clearance.

22. ACCESS TO THE SITE

The Contractor is to allow KSEBL and any person authorised by KSEBL access to the Site and to any place where work in connection with the Contract is being carried out or is intended to be carried out.

23. INSTRUCTIONS

The Contractor shall carry out all instructions of KSEBL which are in conformity with the law.

24. DISPUTES

24.1. The courts at Thiruvananthapuram alone will have jurisdiction to entertain suits pertaining to this Contract.

24.2. No arbitration of any dispute on Contract will be allowed under any circumstances. In case of dispute between Contractor and Board, the Board or agreement authority will give final decision.

25. IMPORT OF EQUIPMENT IF REQUIRED FOR ERECTION

The bidder shall make his own arrangement for import of erection equipment, procurement of equipment required for execution of work and any incidental imports duty as per Indian Customs Act shall be to his account. KSEBL will not render any assistance in this regard.

B. TIME CONTROL

26. PROGRAMME

26.1. Within 15 days from the date of issue of work order, as mentioned in the Contract Data, the Contractor shall submit to the KSEBL for approval a programme showing the general methods, arrangements, order, and timing for all activities in the Works in a systematic manner based on advanced planning technique like PERT/CPM/PC based Harvard Business Planner, Project Management Tool (TRANS PROJECT) of KSEBL etc. indicating the critical events/paths.

26.2 An update of the programme is a programme showing the actual progress achieved on each activity and the effect of the progress achieved on the timing of the remaining work including any change to the sequences of the activities.

26.3 The Contractor is to submit to KSEBL, for approval, an update programme at intervals not later than 30 days as stated in the Contract Data. If the Contractor does not submit an updated programme within this period, KSEBL may withhold the amount stated in the Contract Data from the next certified work bill and continue to withhold this amount until the next payment after the date on which the overdue programme has been submitted.

26.4 KSEBL's approval of the programme does not absolve the Contractor of his obligations. The Contractor may revise the programme and submit it to KSEBL

again at once. A revised programme is also to include the effect of Variations and Compensation Events.

27. EXTENSION OF THE COMPLETION DATE

27.1. KSEBL is to extend the Completion Date in the event of a Variation which makes it impossible for Completion to be achieved by the Completion Date without the Contractor taking steps to accelerate the remaining work and which would cause him to incur additional cost. **Extension of time will be without any additional financial commitment to the KSEBL**

27.2. KSEBL is to decide whether and by how much to extend the Completion Date within 21 days of the Contractor asking KSEBL to decide upon the effect of variation and submitting full supporting information. If the Contractor has failed to give early warning of a delay or has failed to co-operate in dealing with a delay, the delay by his failure is not considered in assessing the new Completion Date.

27.3. There may be some hindrances, other than covered under Force Majeure, while execution of work and in such cases the Contractor shall apply in writing to the Engineer-in-charge for extension of time (EOT) on account of which he desires such extension within 3 days of occurrence of hindrance. The Engineer-in-charge shall forward the request to the Competent Authority with his detailed report within 3 days of receipt of request from the Contractor. The Competent Authority is empowered to grant extension of time for completion of work.

27.4. The competent authority shall consider the request keeping all the facts and circumstances in view and shall grant extension and the reasons for delay is not ascribable to the Contractor.

27.5. The competent authority shall also grant extension of time for completion of work in case for reason for delay are ascribable to the Contractor, but such extension of time shall be with LD charges as per clause dealing with penalty for delays in execution of works. The extension of time with LD charges will be issued under the signature of

competent authority to grant extension of time.

27.6. If the competent authority is of the opinion that the grounds shown by the contractor are not reasonable and sufficient and decline to grant extension of time, the contractor cannot challenge the soundness of the opinion by reference to arbitration. The decision of the competent authority on period of extension of time or refusal for extension of time shall be final and binding for the contractor.

28. DELAYS ORDERED BY KSEBL

If the project is delayed due to stoppage of the work for the reasons beyond the control of the contractor, the contractor will be eligible for PAC revision based on the DSR rate at the point of resumption of the work, only if the period of delay is more than the period between two revisions of DSR, after the project completion date. But such revision amount will be worked out only after Commissioning and Handing over of the project and will be adjusted to the retention amount due for payment to the contractor.

If such stoppage mentioned above is ordered by KSEBL and is expected to have more than six months, KSEBL will be taking over the balance materials required for completion of the milestone of the project that is supposed to be completed within the end date of the stoppage period that is ordered by KSEBL and that materials stocked in the project stores of the Contractor at the time of stoppage order will only be taken. 75% of the rates mentioned in Tender Agreement for materials will be paid to the contractor and the Contractor will be using the same material when the resumption of the work is ordered by KSEBL. But the Guarantee and warranty of such materials taken over by KSEBL is with the contractor and if found functionally defective during the installation, then it will be made good by the contractor free of cost. The balance 25% material cost will be given at the time of satisfactory completion of the work using the materials issued to the contractor, along with the next milestone payment.

If the project is delayed due to the reasons attributed to the bidder, he will be charged with a penalty @1% of PAC for every month (Part month will be on Pro rate) subject to maximum

of 10%, which will be deducted from the final bill or retention with KSEB and/or encashing the PBG of the bidder.

If the contractor has violated the conditions of contract and lead to incompleteness of the work or short closing of the project (i.e. Reasons other than the Force-Majeure conditions) the contract will be terminated by forfeiting all the money to be paid and that spent by the contractor, including the security deposit and all other amount spent on the project. One month notice will be issued in this case to the contractor before termination of the work.

29. MANAGEMENT MEETING

29.1. KSEBL or the Contractor may call for a management meeting to review the plans for remaining works and to deal with matters raised in accordance with the early warning procedure.

29.2. KSEBL is to record the minutes of management meetings and is to provide copies of its record to those attending the meeting. The responsibility of the parties for actions to be taken is to be decided by the Deputy Chief Engineer with full powers of Chief Engineer (Transgrid - North) or his authorised representative either at the management meeting or after the management meeting and stated in writing to all who attended the meeting.

30. EARLY WARNING

30.1. The Contractor is to warn KSEBL at the earliest opportunity of specific likely future events or circumstances which may adversely affect the Project Implementation Schedule.

30.2. The Contractor shall co-operate with KSEBL in making and considering proposals for how the effect of such an event or circumstances can be avoided or reduced.

C. QUALITY CONTROL

31. GUARANTEE

The works, equipment, materials, offered as per this tender shall be guaranteed for the satisfactory performance for a period of **84 months from the date of commissioning and taking over by KSEBL**. The commissioning and taking over by KSEBL would be done as and when all the works as per the scope of this project is completed in all respects for energizing. Irrespective of the number of failure and repairs of failed materials/system, the works shall be guaranteed till the expiry of the warranty period.

Total guarantee period including the defect liability period shall be **limited to 84 months. Defect notice period may be taken as 3 months prior to warranty expiry and the defect rectification period will be 30 days from the defect intimation. During the warranty period the bidder must provide technical support and training for KSEBL staff and officers for O&M of the line as the conditions stipulated in tender documents.**

32. IDENTIFYING DEFECT

KSEBL is to check the Contractor's work and to notify the Contractor of any defect noted. Such checking does not absolve the Contractor's responsibilities. KSEBL may instruct the Contractor to search for a defect and to uncover and test any work which KSEBL consider may have a defect.

33. TESTS

If KSEBL instructs the Contractor to carry out a test not specified in the Specification to check whether any work has a Defect and the test shows that it does, the Contractor has to pay for the test and any samples. If there is no defect, the test is a Compensation Event.

34. CORRECTION OF DEFECTS

34.1. KSEBL is to give notice to the Contractor of any Defects of which he is aware before the end of the Defect Notice period, which begins at handing over of "Brief of Work" or its sub-items and extend up to 84 months thereafter.

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- 34.2.** Every time, notice of a Defect is given, a Defects Correction period for the notified defect begins. The Contractor is to correct the notified defect within the Defects Correction Period and the length of the Defect Correction Period is 30 days as stated in the Contract Data.
- 34.3.** The Contractor is to correct defect which he notices himself before the end of the Defects Notice Period.
- 34.4.** KSEBL is to certify that all Defects have been corrected when all known Defects have been corrected. If KSEBL considers that correction of a Defect is not essential it can request the Contractor to submit a quotation for the corresponding reduction in the Contract Price or an earlier Completion Date or both.

If KSEBL accepts the quotation, the corresponding change in the Contract Data is a Variation.

35. UNCORRECTED DEFECTS AFTER HANDING OVER

- 35.1.** After handing over KSEBL may arrange for a third party to correct a defect, if the Contractor has not corrected it within the Defects Correction Period.

KSEBL is to give the Contractor at least 15 days' notice of its intention to use a third party to correct a Defect. If the Contractor does not correct the Defect within this notice period, KSEBL may have the Defect corrected by the third party. The cost of the correction will be deducted from the Contract Price/ Performance security or any amount due to the contractor. Non-compliance of the defect notice and rectification of the defect for the second time will be treated as a violation of the contract and which can lead to encashment of the performance security of the contractor.

D. Cost Control

36. ACTIVITY SCHEDULE

The Contractor is to produce an updated Activity Schedule within 15 days of being instructed by KSEBL. The activities on the Activity Schedule are to be co-ordinated with the activities of the programme.

37. CHANGES IN THE ACTIVITY SCHEDULE

With the concurrence of KSEBL the Contractor may amend the schedule of activity to accommodate changes of programme or method of working. Prices in the Activity Schedule are not altered when the Contractor makes such changes to the Activity Schedule without affecting the completion date.

38. VARIATIONS

All Variations are to be included in updated programmes and Activity Schedule produced by the Contractor.

39. PAYMENT FOR VARIATION FOR SEPARATELY IDENTIFIABLE ADDITIONAL WORK

- 39.1.** During the course of execution of the Work, if it is found that any additional work other than those mentioned in the schedule becomes necessary for the successful completion of the Work, the Contractor shall carry out all such Works, for which a Variation will be ordered by KSEBL
- 39.2.** The Contractor is to forecast the cost effect of a proposed variation on the Contract Price and provide KSEBL with a quotation for carrying out the variation when requested to do so by KSEBL. KSEBL is to assess the quotation, which is to be given within seven days of the request or within the period stated by KSEBL and before the Variation is ordered by it.
- 39.3.** KERALA STATE ELECTRICITY BOARD LIMITED will estimate such additional works and variations, if necessary, will be ordered based on such estimation, PAC and contract amount and the contractor is bound to carry out such additional work accepting such variation.
- 39.4.** The Contractor is not entitled to additional payment for costs which could have been avoided by giving early warning

Note. The above clauses do not apply for the variation in quantities for the various items of works included in the Contract Data.

40. CASH FLOW FORECAST

When the programme or Activity Schedule is updated, the Contractor is to provide KSEBL with an updated cash flow forecast.

41. PAYMENT TERMS

Based on the item wise rate quoted by the bidder, the Probable amount of contract (PAC) will be worked out and KSEBL/KIIFB (Kerala Infrastructure Investment Funding Board) will release the payments in the following manner:

- a. The Contractor will raise invoice periodically for the portion of completed erection works and corresponding supply items based on rate mentioned in BOQ which shall be payable as per the provisions stipulated below:
 - 1) 1% as interest free mobilization advance against separate BG, which will be adjusted in future bills.
 - 2) 90% Materials installed/ used and the labour charges for the completed works up to the date of preferring the bill, will only be paid along with 100% taxes (on production of documentary evidences) after adjustment of value of dismantled material For the sake of clarity it is reiterated that the supplies are not payable until the supplied items are used in the construction. The following are the guidelines to ascertain if the supplied materials are used for construction:
 - i) the supplied tower structures are payable when they are erected
 - ii) the conductor is payable when the stringing of the conductors has been done
 - iii) the insulators, stringing hardware etc. are payable when the conductor stringing has been done
 - iv) supplied OPGW becomes payable on stringing of the same
 - v) the supplied spares shall be payable on commissioning and handing overThe work items shall be payable as and when it is done. However, payment towards excavation for foundation etc. shall be made only after the foundation is

complete upto the concreting of chimney of the foundation and backfilling done. Likewise, the supply of tower parts and erection of tower are payable only after tower is erected complete except for insulators and hardware for stringing.

75% of the Bill amount will be disbursed within 30 days of preferring the bill on preliminary verification and 100 % adjustment of corresponding value of dismantled items. The balance 15% will be paid only after auditing of the bill within 60 days.

- 2) On completion of the whole of the Works, half the total amount retained (5% of retention amount) will be released to the Contractor within 180 days of Commissioning and Handing over Date (CHD) and submission, auditing and settling of the final bill by the contractor, after adjusting the liabilities, deductions, quantity variations, price variations etc. if any.

The other half (balance 5% of retention amount) will be released on production of Fresh Bank Guarantee against the PBG or will be released along after the expiry of 84 months from date of commissioning and handing over the circuit.

If there is no reason to retain the Performance Security/securities, the Performance Security/securities is to be returned by KSEBL within 30 days after the expiry of 84 months from date of commissioning and handing over the circuit

- 3) **Price variation claims for transmission line towers** as per Annexure - I of this volume appended shall be claimed subsequently by the contractor along with all supporting documents. Price variation will be allowed strictly as per Annexure -I, section -7 of this volume and no other formula put forward by the supplier shall be accepted. Bank charges if any, incurred in connection with effecting payments will be to the Contractor's account.
- 4) **Price variation for ACSR conductor** as per Annexure II of this volume shall be claimed subsequently by the contractor with all supporting documents.

Any specific payment conditions mentioned there in will supersede all general conditions mentioned elsewhere with regard to the payment to be made to the contractor. The incentives and penalties mentioned in the tender document elsewhere, the values mentioned in Tender agreement and schedule of payment will prevail in this matter.

The Contractor shall submit to KSEBL monthly statement as indicating value of the work completed including materials used. The value work completed by the Contractor including materials used has to be checked by the Engineer in charge of works.

The value of work completed including materials used comprises the value of completed activities in the Activity Schedule.

The value of work completed includes the valuation of variations and deductions for retention.

The Engineer in charge of work may exclude any item certified in previous work bill or reduce the proportion of any item previously certified in any work bill in the light of later information.

42. MODE OF PAYMENT

42.1. KSEBL/KIIFB is to pay the Contractor 75% of the amount certified by the Engineer within 30 calendar days of the date of submitting the work bill and balance 15% within 60 days after having detailed verification, pre-audit etc. Banking charges in connection with this will be to the Contractor's account.

42.2. The 10% payment after CHD the payment will be made after adjusting all liabilities, variations in quantity, extra items etc.

43. PRICE ADJUSTMENT

43.1. The price quoted shall be FIRM throughout contract execution period. However the Price variation claims as per Annexure – I & II of this volume appended shall be claimed subsequently by the contractor along with all supporting documents. Price variation will be allowed strictly as per Annexure –I & II of this volume and

no other formula put forward by the contractor shall be accepted. Bank charges if any, incurred in connection with effecting payments will be to the supplier's account. All price variations will be adjusted in subsequent bills after installation of the materials and work using that material is claimed.

43.2. However the quantity variation on account of quantity of materials used, Tonnage of Towers, Volume of concrete etc will be considered for arriving final PAC at the time of final bill upon project completion.

44. RETENTION

44.1. KSEBL will retain 10% from each payment due to the Contractor as stated in the Contract Data.

44.2. On completion of the whole of the Works, half the total amount retained (5% of retention amount) will be released to the Contractor within 180 days of Commissioning and Handing over Date (CHD) and submission, auditing and settling of the final bill by the contractor, after adjusting the liabilities, deductions, quantity variations, price variations etc. if any.

The other half (balance 5% of retention amount) will be released on production of Fresh Bank Guarantee against the PBG or will be released after the expiry of 84 months from date of commissioning and handing over the circuit.

If there is no reason to retain the Performance Security/securities, the Performance Security/securities is to be returned by KSEBL within 30 days after the expiry of 84 months from date of commissioning and handing over the project.

45. LIQUIDATED DAMAGES

Delay penalty at the rate of 1% per month on all-inclusive rate minus taxes (i.e. Ex- works rate plus F & I) subject to a maximum of 10% for deviation in the schedule and delay in completion of the total work. Part month delay will be considered on Prorate for calculating the penalty. Any other damages caused by the contractor to KSEBL or Public will be made good from the contractor appropriately.

46. INCENTIVE

Incentive at the rate of 0.5% per month on the amount net excluding taxes, subject to a maximum of 5% for the early completion of the total work in all respects under this contract, will be paid. Only one full month will be considered for claiming the incentive. Advancement of intermittent mile stones will not be considered for incentives.

47. SECURITIES

The **Performance Security Deposit (PSD)** of 5% of the Contract Price is to be provided to the KSEBL as per Contract and is to be issued in the form of a bank guarantee in favour of the Deputy Chief Engineer, TransGrid North, **Vydyuthi Bhavanam , Kallippadam P.O Shoranur - 679 122**

- 47.1.** from any nationalised bank on non-judicial stamp paper. A letter from the local Branch of the bank to the effect that the amount on demand will be paid by them to KSE Board is to be furnished along with the Bank Guarantee.
- 47.2.** KSEBL is to notify the Contractor of any claim made against the Bank issuing the security.
 - 47.2.1.** KSEBL may adjust against the security, any claim, if any of the following events occurs for 42 days or more.
 - 47.2.2.** The Contractor is in breach of the Contract and KSEBL has notified him.
 - 47.2.3.** The Contractor has not paid an amount due to the KSEBL
 - 47.2.4.** Additional PBG will be liable to be en-cashed if the material/ work is found to be defective or inferior to that as agreed and not replaced/ repaired before the noticed time period.

48. COST OF REPAIRS

Loss or damage to the Works or materials to be incorporated in the Works between the Start Date and the end of the Defects Correction Period is to be met by the Contractor at his cost if the loss or damage arises from the Contractor's acts or omission.

E. FINISHING THE CONTRACT

49. COMPLETION

KSEBL is to issue a certificate certifying Completion to the Contract when it decides that the

work is completed and ready to take over with effect from Commission and Hand Over date.

50. TAKING OVER

KSEBL is to take over the Works within 14 days of issuing a certificate of completion and commissioning by the Deputy Chief Engineer with full powers of Chief Engineer or his authorised representative.

51. FINAL ACCOUNT

The Contractor shall submit to KSEBL a detailed account of the total amount which he consider is payable to him under the Contract before the end of the Defects Notice Period. KSEBL is to certify any final payment which is due to the Contractor within 60 days of receiving the Contractor's account if it is correct and complete. If it is not, KSEBL is to issue a schedule which state the scope of correction or additions which are necessary. If the final Account is still unsatisfactory after it has been resubmitted, KSEBL is to decide on the amount payable to the Contractor, and KSEBL's decision in this regard shall be final and binding.

52. TERMINATION

52.1. If the contractor has violated the conditions of contract and lead to incompleteness of the work or short closing of the project (i.e. Reasons other than the Force-Majeure conditions) the contract will be terminated by forfeiting all the money to be paid and that spent by the contractor, including the security deposit and all other amount spent on the project. **One month notice will be issued in this case to the contractor before termination of the work.**

52.2. KSEBL may terminate the Contract if the other party causes a fundamental breach of the Contract which substantially deprives him of the principal benefits of the Contracts.

52.3. Fundamental breaches of Contract will include, but will not be limited to the following:

- (a) The Contractor stops or abandons works for 28 days when no stoppage of work is shown on the current programme and the stoppage has not been

authorised by KSEBL

- (b) KSEBL instructs the Contractor to delay the progress of works and the instruction is not withdrawn within 28 days.
- (c) Contractor is made bankrupt or goes into liquidation other than for a reconstruction or amalgamation.
- (d) KSEBL gives notice to correct a particular defect and the Contractor fails to correct it within a reasonable period of time determined by KSEBL
- (e) The Contractor does not provide a security which is required
- (f) The Contractor fails to follow the agreed programme of Works or fails to employ competent or additional staff as required.

52.4. When the Contractor is given notice of breach of Contract in writing within 7 days from the date of occurrence of such breach, KSEBL is to decide whether the breach is fundamental or not.

52.5. Notwithstanding the above, KSEBL may terminate the Contract at its convenience by giving 30 days' notice to the Contractor. The Contractor will not be entitled for interest for delayed payments.

52.6. If the Contract is terminated the Contractor shall stop works immediately, make the Site safe and secure and leave the Site after handing over of the Site to KSEBL as soon as reasonably possible.

53. PAYMENT UPON TERMINATION

Termination of the work because of a breach of contract by the contractor is to be made at the risk and cost of the contractor. If the contract is terminated because of a breach of contract by the contractor, KSEBL is to issue a certificate for the value of the work done less the payment if any, made to the contractor up to the date of issue of certificate and less the penal percentage as per contract data of the value of the work not completed. Liquidated Damages will be applied for the delay of the works if termination is effected and KSEBL has a right to claim for loss and damages in respect of any delay incurred arising from the breach. If the total amount due to KSEBL exceeds payment due to the contractor as per the

contract, the difference shall be a debt payable to KSEBL and the amount will be recovered from security deposit/any amount payable to contractor from KSEBL. The contractor will not be eligible for any payments against the balance of payments or losses or compensation if KSEBL terminates the contract.

54. PROPERTY

All materials in the Site, Plant and Equipment owned by the Contractor, Temporary Works and Works are deemed to be the property of KSEBL and are at its disposal if the Contract is terminated because of a fundamental breach of Contract by the Contractor.

55. OPERATION AND MAINTENANCE MANUALS

55.1. Contractor shall supply detailed Operation and Maintenance manuals, as built drawings, recommended spare parts list etc. in 10 copies along with soft copies and special tools, prior to the completion date, as stated in the contract data.

55.2. If the contractor does not supply the manuals and the other requirements as listed in 56.1 above, the work will not be closed. If the same are not furnished within two months from the date of completion, penalty as per clause 45 under Section 4. Final payment will not be released until the manuals and other requirements as listed in 56.1 above are submitted.

56. POWER

56.1. Power required for execution of works will be supplied to the contractor by Board at the tariff applicable from time to time depending upon availability /feasibility. The contractor shall apply to the appropriate authority of Board at his requirement as per the prevailing rules in this regard in Board. Any extension of power line with required auxiliary equipment required shall be done by the contractor at his cost. The bidder shall take into account the limitation of the existing power supply and make due allowance as necessary in his methods and costs. He shall ensure availability of alternate power supply in case of failure in the Board's supply, as he considers necessary, the cost of such shall be included in his rates.

56.2. The Board will not be responsible for any failure or interruption of electric supply and for fluctuation in voltage and frequency and no claim for compensation by the contractor on this account will be entertained by the Board.

56.3. The Electricity duty fixed by the Government from time to time shall be paid by the contractor. The contractor's electrical installation shall be in accordance with the specifications stipulated by the Electrical Inspectorate of the Government of Kerala.

57. WATER, FUELS AND LUBRICANTS

The contractor shall make his own arrangements for providing fuel and lubricants and ample quantity of water at specified quality as per specifications for construction and camp at his own cost. The contractor shall not use trees available in the project site or adjacent forest land for the purpose of firewood.

F. SPECIAL CONDITIONS OF CONTRACT

58. GENERAL

58.1. The work covered by this tender document shall be carried out in accordance with the conditions of contract attached with this part of the tender and as per the tender documents issued along with this. Wherever any condition in the instructions to tenderers or general conditions of contract or technical specification embodied herein conflict with any part of the conditions of contract the later will prevail.

58.2. The following shall supplement the conditions already contained in the parts of these specifications and document shall govern the portion of the work of this contract to be performed at site.

58.3. All fitting accessories, apparatus or item of work which may not have been mentioned in these specifications, but which are essential for the completion and proper working of the network and fulfilment of the contract, shall also be provided/carried out by the contractor at no extra cost. He shall foresee, plan and quote covering all such items.

58.4. The Bidding Document and other specified conditions agreed during award of contract will be completely binding on the contractor vide **Vol I and Vol II of this document.**

59. PRICES

Prices shall be firm for a period of 180 days from the date of opening of the PQ bid (Envelope 1) or 120 days from the date of opening of the price bid, whichever is earlier The prices for the purpose of firmness include insurance, taxes and freight charges which are or become payable by the contractor under existing or future laws and rules. Price schedule shall be given in the Price bid (Part III) and shall be carefully filled to avoid any ambiguity. Fixed price offers shall only be accepted. Statutory levies shall be paid at actual. Any increase in statutory levy shall be paid by the contractor in case of delay in completion of supply / work after the scheduled period of completion.

60. REGULATION OF LOCAL AUTHORITIES AND STATUTES

- 60.1.** The Contractor shall comply with all the rules and regulations of local authorities during the performance of his field activities. He shall also comply with the Minimum Wages Act, 1948, the Payment of Wages Act, Contract Labour Regulation Abolition Act and the Workmen's Compensation Act (both of the State and Government of India) and the rules made hereunder in respect of any employee or workman employed or engaged by him or his Sub-Contractor.
- 60.2.** All registration and statutory inspection fees, if any, in respect of this work pursuant to this Contract shall be to the account of the Contractor. Should any such inspection or registration need to be rearranged due to the fault of the Contractor or his Subcontractor, the additional fees to such inspection and/or registration shall be borne by the Contractor.
- 60.3.** Necessary deduction will be made from the contractor's bill and deposited in the Construction Worker's Welfare Fund as per the statutory orders of the Kerala State Government

61. KSEBL'S LIEN ON EQUIPMENT

KSEBL shall have lien on all equipment including those of the Contractor brought to the

Site for the purpose of erection, testing and commissioning of the equipment to be supplied & erected under the Contract. The KSEBL shall continue to hold the lien on all such equipment throughout the period of Contract. No material brought to the Site shall be removed from the Site by the Contractor and/or his Sub-Contractors without the prior written approval of the Engineer.

62. INSPECTION, TESTING AND INSPECTION CERTIFICATES

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

63. CONTRACTORS SITE OFFICE ESTABLISHMENT

The Contractor shall establish a Site Office at the Site and keep posted authorised representative for the purpose of the Contract. Any written order or instruction of the Engineer or his duly authorised representative shall be communicated to the said authorised resident representative of the Contractor and the same shall be deemed to have been communicated to the Contractor at his legal address.

64. DISCIPLINE OF WORKMEN

The Contractor shall adhere to the disciplinary procedure set by the Engineer in respect of his employees and workmen at Site. The Engineer shall be at liberty to object to the presence of any representative or employee of the Contractor at the Site, if in the opinion of the Engineer such employee has misconducted himself or is incompetent or negligent or otherwise undesirable and then the Contractor shall remove such a person objected to and provide in his place a competent replacement.

65. CONTRACTORS FIELD OPERATION

- 65.1.** The Contractor shall keep the Engineer informed in advance regarding his field activity plans and schedules for carrying out each part of the works. Any review of such plan or schedule or method of work by the Engineer shall not relieve the Contractor of any of responsibilities towards the field activities. Such reviews shall also not be considered as an assumption of any risk or liability by the Engineer or the KSEBL or any of his representatives and no claim of the Contractor will be entertained because of the failure or inefficiency of any such plan or schedule or method of work reviewed. The Contractor shall be solely responsible for the safety, adequacy and efficiency of plant and equipment and his erection methods.
- 65.2.** The Contractor shall have the complete responsibility for the conditions of the work site including the safety of all persons employed by him or his subcontractor and all the properties under his custody during the performance of the work. This requirement shall apply continuously till the completion of the Contract and shall not be limited to normal working hours. The construction review by the Engineer is not intended to include review of Contractor's safety measures in, or of near the Work-Site, and their adequacy or otherwise.

66. PHOTOGRAPHS AND PROGRESS REPORT

- 66.1.** The Contractor shall furnish three (3) prints each to the Engineer of progress photographs of the work done at Site. Photographs shall be taken as and when indicated by the Engineer or his representative. Photographs shall be adequate in size and number to indicate various stages of erection. Each photograph shall contain the date, the name of the Contractor and the title of the photograph.
- 66.2.** The above photographs shall accompany the monthly progress report detailing out the progress achieved on all erection/installation activities as compared to the schedules. The report shall also indicate the reasons for the variance between the scheduled and actual progress and the action proposed for corrective measures, wherever necessary.

67. MAN-POWER REPORT

67.1. The Contractor shall submit to the Engineer, on the first day of every month, a man hour schedule for the month, detailing the man hours scheduled for the month, skill-wise and area-wise.

67.2. The Contractor shall also submit to the Engineer, on the first day of every month, a man power report of the previous month detailing the number of persons scheduled to have been employed and actually employed, skill-wise and the areas of employment of such labour.

68. PROTECTION OF WORK

The Contractor shall have total responsibility for protecting his works till it is finally taken over by the Engineer. No claim will be entertained by KSEBL or the Engineer for any damage or loss to the Contractor's works and the Contractor shall be responsible for complete restoration of the damaged works to original conditions to comply with the specification and drawings. Should any such damage to the Contractor's Works occur because of other party not being under his supervision or control, the Contractor shall make his claim directly with the party concerned.

69. EMPLOYMENT OF LABOUR

69.1. The Contractor will be expected to employ on the work only his regular skilled employees with experience of this particular work. No female labourer shall be employed after darkness. No person below the age of eighteen years shall be employed.

69.2. All travelling expenses including provisions of all necessary transport to and from Site, lodging allowances and other payments to the Contractor's employees shall be the sole responsibility of the Contractor.

69.3. The hours of work on the Site shall be decided by KSEBL and the Contractor shall adhere to it. Working hours will normally be eight (8) hours per day -Monday to Saturday (both days inclusive).

69.4. The Contractor's employees shall wear identification badges and safety equipments while on work at Site.

69.5. In case KSEBL becomes liable to pay any wages or dues to the labour or any Government agency under any of the provisions of the Minimum Wages Act, Workmen Compensation Act, Contract Labour Regulation Abolition Act or any other law due to act of omission of the Contractor, KSEBL may make such payments and shall recover the same from the Contractor's Bills.

70. LABOUR WELFARE MEASURES AND WORKMEN COMPENSATION

The contractor should obtain a valid labour license under the Contract Labour (R&A) Act 1970 and the Contract Labour (Regulation & Abolition) Central Rules 1971, before commencement of work, and continue to have a valid license until the compensation of work. The contractor shall also abide by the provision of the Child Labour (Prohibition and Regulation) Act 1986. Any failure to fulfill this requirement shall attract the penal provisions of this contract arising out of the resultant non-execution of work.

Contract Labour Regulations:

Working Hours:

- a) Normally working hours of an employee should not exceed 8 hours a day. The working hours shall be so arranged that inclusive of interval for rest, if any. It shall not spread over more than 12 hours on any day.
- b) When a worker is made to work more than 8 hours on any day or for more than 48 hours in any week he shall be paid over time for the extra hours put in by him.
- c) Every worker shall be given a weekly holiday normally on a Sunday, in accordance with the provisions of Minimum Wages (central) Rules 1960, as amended from time to time, irrespective of whether such worker is governed by the Minimum Wages Act or not.
- d) Where the minimum wages prescribed by the KSEB Ltd., under the Minimum Wages Act, are not inclusive of the wages for the weekly day of rest, the worker shall be entitled to rest day wages, at the rate applicable to the next preceding day, provided he has worked under the

same contractor for a continues period of not less than 6 years.

- e) Where a contractor is permitted by the Engineer-in-Charge to allow a worker to work on a normal weekly holiday, he shall grant a substituted holiday to him for the whole day, on one of the five days, immediately before or after the normal weekly holiday, and pay wages to such worker for the work performed on the normal weekly holiday at the overtime rate.

71. DISPLAY OF NOTICE REGARDING WAGES ETC.

71.1. The Contractor shall, before he commences his work on contract, display and correctly maintain and continue to display and correctly maintain, in clear and legible condition in conspicuous places on the work, notices in English and in local Indian language spoken by the majority of the workers, giving the minimum rates of the wages fixed under the Minimum wages Act, the actual wages being paid, the hours of work for which such wages are earned, wages periods, dates of payments of wages and other relevant information.

Payment of Wages:

- a) The contractor shall fix wage periods in respect of which wages shall be payable.
- b) No wage period shall exceed one month.
- c) The wages of every person employed as contract labour in an establishment or by a contractor, where less than 1000 such persons are employed, shall be paid before the expiry of the 7th day and in other cases before the expiry of 10th day after the last day of the wage period in respect of which the wages are payable.
- d) Where the employment of any worker is terminated by or on behalf of the contractor, the wages earned by him shall be paid before the expiry of the second working day from the date on which his employment is terminated.
- e) All payments of wages shall be made on a working day at the work premises and during the working time and on a date notified in advance and in case of the work is completed before the expiry of the wage period; final payment shall be made within 48 hours of the last working day.

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- f) Wages due to every worker shall be paid to him direct or to any other person authorized by him on his behalf.
 - g) All wages shall be paid in current coin or currency or in both.
 - h) Wages shall be paid without any deductions of any kind except those specified by the Central Government by general or special order on his behalf or permissible under the Payment of Wages Act 1956.
 - i) A notice showing the wages period and the place and time of disbursement of wages shall be displayed at the place of work and a copy sent by the contractor to the Engineer-in-Charge under acknowledgement.
 - j) It shall be the duty of the contractor to ensure the disbursement of the wages in presence of the site Engineer or any other authorized representative of the Engineer-in-Charge who will be required to be present at the place and time of the disbursement of wages by the contractor to the workman.
 - k) The contractor shall obtain from the site Engineer or any other authorized representative of the Engineer-in-Charge, as the case may be, a certificate under his signature at the end of the entries in the “Register of Wages” or the “Wage-cum-Muster Roll” as the case may be in the following form:-

“Certified that the amount shown in the column No... has been paid to the workman concerned in my presence on at

71.2 Fines And Deductions, Which May be Made from the Wages:

- 1) The wages of a worker shall be paid to him without any deduction of any kind except the following.
 - a) Fines.
 - b) Deductions of 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 for which he was absent.

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- c) Deductions for damage to or loss of goods expressly entrusted to the employed person for custody, or for loss of money or any other deductions which he is required to account, where such damage or loss is directly attributable to his neglect or default.
 - d) Deductions for recovery of advances or for adjustment for overpayment of wages, advances granted shall be entered in a register.
 - e) Any other deduction, which the State Government may from time to time, allow.
- 2) No fine should be imposed on any worker save in respect of such acts and omissions on his part as have been approved by the Labour Commissioner.
 - 3) No fines should be imposed on worker and no deduction for damage or loss shall be made from his wages until the worker has been given an opportunity for showing cause against such fines or deductions.
 - 4) Every fine shall be deemed to have been imposed on the day of the act or omission in respect of which it was imposed.

71.3 Labour Records:

71.3.1 The contractor shall maintain a **Register of Persons Employed** on work on contract in Form XIII of the contract labour (R&A) Central Rules 1971.

71.3.2 The contractor shall maintain a **Muster Roll** register in respect of all workmen employed by him on the work under in Form XVI of the contract labour (R&A) Central Rules 1971.

71.3.3 The contractor shall maintain a **Wages Register** in respect of all workmen employed by him on the work under in Form XVII of the contract labour (R&A) Central Rules 1971.

71.3.4 **Register of Accidents:** The contractor shall maintain a register of accidents in such a form as may be convenient at the work place but the same shall include the following particulars.

- a. Full particulars of the labourers who met with accident.
- b. Rate of wages.

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- c. Sex.
 - d. Age.
 - e. Nature of accident and cause of accident.
 - f. Time and date of accident.
 - g. Date and time when admitted in hospital.
 - h. Period of treatment and result of treatment.
 - i. Percentage of loss of earning capacity and disability as assessed by the Medical Officer.
 - j. Claim required to be paid under Workman's Compensation Act.
 - k. Date of payment of compensation.
 - l. Amount paid with details of the persons to whom the same was paid.
 - m. Authority by whom the compensation was assessed.
 - n. Remarks.
- 5) The contractor shall maintain a **Register of Fines** in the Form XII of the CL (R & A) Rules 1971. The contractor shall display in a good condition and in a conspicuous place of work the approved list of acts and omission for which fines can be imposed.
- 6) The contractor shall maintain a **Register of Deductions for damage or loss** in the Form XX of the CL (R & A) Rules 1971.
- 7) The contractor shall maintain a **Register of Advances** in the Form XXIII of the CL (R & A) Rules 1971.
- 8) The contractor shall maintain a **Register of Overtime** in the Form XXIII of the CL (R & A) Rules 1971.

71.4 Attendance Card Cum Wage Slip:

- 71.4.1.1** The contractor shall issue an Attendance card cum wage slip to each workman employed by him.

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- 71.4.1.2** The card shall be valid for each wage period.
- 71.4.1.3** The contractor shall mark the attendance of each workman on the card twice each day, once at the commencement of the day and again after the rest interval, before he actually starts work.
- 71.4.1.4** The card shall remain in possession of the worker during the wage period under reference.
- 71.4.1.5** The contractor shall complete the wage slip portion on reverse of the card at least a day prior to the disbursement of wages in respect of the wage period under reference.
- 71.4.1.6** The contractor shall obtain the signature or thumb impression of the workers on the wage slip at the time of disbursement of wages and retain the card with him.

71.5 Employment Card:

The contractor shall be issue an **Employment Card** in the Form XIV of CL(R&A) Central Rules 1971 to each worker within three days of the employment of the worker.

71.6 Service Certificate:

On termination of employment for any reason whatsoever the contractor shall issue to workman whose service has been terminated, a Service Certificate in the Form XV of CL(R&A) Central Rules 1971.

71.7 Reservation of labour records:

The labour records and records of fines and deductions shall be preserved in original for a period of 3 years from the date of last entries made in them and shall be made available for the inspection by the Engineer-in-Charge or Labour Officer.

71.8 Power of officer to make investigation on enquiry:

The labour officer or any person authorized by the State Government on their behalf shall have power to make enquiries with a view to ascertaining the enforcing due and proper observance of Fair Wage Clauses and provisions of these Regulations. He shall

investigate into any complaint regarding the default made by the contractor in regard to such provision.

71.9 Report of Investigating officer and action thereon:

The labour officer or any person authorized as aforesaid shall submit a report of result of his investigation or enquiry to the Engineer-in- Charge 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 paid to the labours concerned. The Engineer-in-Charge shall arrange the payments to the labour concerned within 45 days from the receipt of the report from the labour officer or any person authorized as the case may be.

71.10 Inspection of Books and Slips:

The contractor shall allow inspection of all the prescribed labour records to any of his workers or to his agent at a convenient time and place after due notice is received or to the labour officer or any person authorized.

71.11 Submission of Returns:

The contractor shall submit periodical returns as may be specified from time to time.

71.12 Amendments:

The State Government may from time to time add or amend the regulations and on any question as to application/interpretation or effect of those regulations.

71.13 Insurance:

Without limiting any of his other obligations or liabilities, the contractor shall, at his own expense, take and keep comprehensive insurance to cover workmen under Workmen Compensation Act for death or injuries including third party risk for the plant, machinery, men, materials etc. brought to the site and for all the work during the execution. The contractor shall also take out workmen's compensations insurance as required by the law under take to indemnity and keep indemnified the Government from and against all manner of claims and demands and losses and damages and cost (including between attorney and client) charges and expenses that may arise in regard

the same or that the Government may suffer of incur with respect to end / or incidental to the same. The contractor shall have furnished originals or attested copies as required by KSEBL of the policies of insurance taken, within 15 days of being called upon to do so together with all premium receipts and other papers related thereto which KSEBL may require.

72 FACILITIES TO BE PROVIDED BY THE CONTRACTOR.

72.1 First-Aid

The Contractor shall provide necessary first-aid facilities for all his employees, representatives and workmen working at the Site. Enough number of Contractor's personnel shall be trained in administering first-aid.

72.2 Cleanliness

The Contractor shall be responsible for keeping the entire area allotted to him clean and free from rubbish, debris etc. during the period of Contract. The Contractor shall employ enough number of special personnel to thoroughly clean his work-area. All such rubbish and scrap material shall be stacked or disposed in a place to be identified by the Engineer. Materials and stores shall be so arranged to permit easy cleaning of the area. In areas where equipment might drip oil and cause damage to the floor surface, a suitable protective cover of a flame resistant, oil proof sheet shall be provided to protect the floor from such damage.

72.3 Protection of Life and Property and Existing Facilities:

The Contractor is fully responsible for taking all possible safety precautions during preparation for and actual performance of the work and for keeping the construction site in a reasonable safe condition. The Contractor shall protect all life and property from damages or losses resulting from his construction operations and shall minimize the disturbance and inconvenience to the public.

The contractor shall take all precautions while excavating the trench to protect the public/private property and to avoid any accidental damage. An accidental damage should immediately be reported to the concerned utility.

72.4 The **contractor is liable to pay for all damages** caused by his workmen. KSEBL will not be responsible for any such acts/damages. Insurance coverage should be taken. **An undertaking in Kerala Stamp paper worth Rs.200/-should be executed before starting the work.**

72.5 The excavated material shall be properly stored to avoid obstruction. The bottom of the excavated trench should be carefully levelled and freed from pebbles stones. Any gradient encountered shall be gradual.

73 INTEGRATION WITH EXISTING NETWORK.

Wherever connections with the existing network/replacement of existing network/equipment are required, written permission from Engineer or his authorized field officer should be obtained.

74 FIRE PROTECTION

The work procedures that are to be used during the erection shall be those which minimize fire hazards to the extent practicable. Combustible materials, combustible waste and rubbish shall be collected and removed from the Site. Volatile or flammable materials shall be stored away from the construction equipment and materials storage areas in safe containers. Untreated canvas, paper, plastic or other flammable flexible materials shall not at all be used at Site for any other purpose unless otherwise specified. If any, such materials are received with the equipment at the Site, the same shall be removed and replaced with acceptable material before moving into the construction or storage area.

75 MATERIAL HANDLING AND STORAGE.

75.1 All the equipment/materials furnished under the Contract and arriving at Site shall be promptly received, unloaded, transported and stored in the storage spaces by the Contractor.

75.2 The Contractor shall maintain an accurate and exhaustive record, detailing out the List of all equipment/materials received by him for the purpose of erection and keep such record open for the inspection of the Engineer-in-Charge.

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- 75.3 All equipment/materials shall be handled very carefully to prevent any damage or loss. No bare wire ropes, slings, etc. shall be used for unloading and/or handling of the equipment without the specific written permission of the Engineer. The equipment /material stored shall be properly protected to prevent damage either to the equipment or to the floor where they are stored. The equipment from the store shall be moved to the actual location at the appropriate time so as to avoid damage of such equipment at Site.
- 75.4 The Contractor shall ensure that all the packing materials and protection devices used for the various equipment's during transit and storage are removed before the equipment's are erected. The **empty cable drums** and other packing materials shall be **removed and disposed** at the cost of the contractor. The site used to manufacture route marker, covering slab, U shaped ducts shall be cleared and cleaned by the contractor after the work is completed.
- 75.5 The consumables and other supplies likely to deteriorate due to storage must be thoroughly protected and stored in a suitable manner to prevent damage or deterioration in quality during storage.
- 75.6 The Contractor shall be responsible for making suitable indoor storage facilities to store all equipment which require indoor storage.

76 INSTALLATION MANAGEMENT.

- 76.1 The field activities of the various contractors executing different contracts for the project, will be coordinated by the Engineer and the Engineer's decision shall be final in resolving any disputes or conflicts between the Contractor and other Contractors and tradesmen of KSEBL regarding scheduling and coordination of work. Such decision by the Engineer shall not be a cause for extra compensation or extension of time for the Contractor.
- 76.2 The Engineer shall hold weekly meetings with the key personnel of the contractor of all the Contractors working at Site, at a time and place to be designated by the Engineer. The Contractor shall attend such meetings and take notes of discussions during the meeting and the decisions of the Engineer shall be strictly adhered to in performing his Works. In addition to the above weekly meeting, the Engineer may call for other meetings also if

warranted.

76.3 Time is the essence of the Contract and the Contractor shall be responsible for performance of his works in accordance with the specified construction schedule. If at any time, the Contract is falling behind the schedule, he shall take necessary action to make good for such delays by increasing his work force or by working overtime or otherwise accelerate the progress of the work to comply with the schedule in consultation with the Engineer . The Contractor shall not be allowed any extra compensation for such action. The Engineer shall however not be responsible for provision of additional labour and/or materials or supply or any other services to the Contractor.

77 FIELD OFFICE RECORDS.

The Contractor shall maintain at his Site Office up-to-date copies of all drawings, specifications and other Contract Documents and any other supplementary data complete with all the latest revisions thereto. The Contractor shall also maintain in addition, the continuous record of all changes to the above Contract Documents, drawings, specifications, supplementary data, etc. effected at the field and on completion of his total assignment under the Contract shall incorporate all such changes on the drawings and other Engineering data to indicate as erection conditions of the equipment furnished and erected under the Contract. Such drawings and engineering data shall be submitted to the Engineer in required number of copies.

78 WORK AND SAFETY REGULATIONS

As per the laws existing in the country a safety officer / safety engineers shall be suitably appointed at work site. Safety plan and EHS standards shall be furnished and strictly complied with. Necessary monthly safety audit reports shall be furnished.

79 DRAWINGS.

All rights of the design / drawing shall be strictly reserved with KSEBL only and any designs / drawings / data sheets submitted by the contractor from time to time shall become the property of KSEBL. Under no circumstances, the Contractor shall be allowed to use / offer above designs / drawings/ data sheets to any other authority without prior written permission of KSEBL. Any deviation to the above is not acceptable and may be a

cause of rejection of the bid or termination of the contract as the case may be.

80 MANUFACTURING SCHEDULE

The Contractor shall submit to KSEBL his manufacturing, testing and delivery schedules of various items within thirty (30) days from the date of the work order in accordance with the delivery requirements stipulated. Schedules shall also include the materials and items purchased from outside Contractors, if any.

81 REFERENCE STANDARDS.

81.1 The Codes and / or Standards referred to in Specifications shall govern, in all cases wherever such references are made. In case of a conflict between such Codes and / or Standards and the specifications, later shall govern. Such Codes and / or Standards, referred to shall mean the latest revisions, amendments /changes adopted and published by the relevant agencies.

81.2 Other internationally acceptable Standards, which ensure equivalent or better performance than those specified shall also be accepted.

82 QUALITY ASSURANCE

82.1 To ensure that the equipment/material under the scope of this Contract whether manufactured within the Contractor's or supplier's works or at his Sub-Contractor's premises is in accordance with the specifications, the Contractor/supplier shall adopt suitable Quality Assurance Programme to control such activities at all points necessary.

82.2 Such programme shall be outlined by the Contractor and shall be finally accepted by KSEBL after discussions before the award of Contract. A Quality Assurance Programme of the Contractor shall generally cover but not limited to the following.

82.2.1 His organization structure for the management and implementation of the proposed Quality Assurance Programme.

82.2.2 Documentation control system.

82.2.3 Qualification data for key personnel.

82.2.4 The procedure for purchases of materials. Parts/ components and selection of sub-Contractor's services including vendor analysis, source inspection, incoming raw

material inspection, verification of material purchases etc.

- 82.2.5 System for shop manufacturing including process controls.
- 82.2.6 Control of non-conforming items and system for corrective action.
- 82.2.7 Control of calibration and testing of measuring and testing equipments.
- 82.2.8 Inspection and test procedure for manufacture.
- 82.2.9 System for indication and appraisal of inspection status.
- 82.2.10 System for quality audits.
- 82.2.11 System for authorizing release of manufactured product to the Purchaser.
- 82.2.12 System for maintenance of records.
- 82.2.13 System for handling storage and delivery and
- 82.2.14 A Quality Plan detailing out the specific quality control procedure adopted for controlling the quality characteristics of the product.

The Quality Plan shall be mutually discussed and approved by the KSEBL after incorporating necessary corrections by the Contractor as may be required.

83 QUALITY ASSURANCE DOCUMENTS

- 83.1 The Contractor shall be required to submit all the Quality Assurance Documents as stipulated in the Quality Plan at the time of KSEBL's inspection of equipment / material.
- 83.2 KSEBL reserves the right to carry out Quality Audit and Quality surveillance of the systems and procedures of the Contractor's / his vendor's Quality Management and Control Activities.

84 CONTRACTORS SUPERVISION

- 84.1 The contractor shall appoint, sufficient number of competent and qualified Engineering personnel (graduate and diploma Engineers) as required and approved by the Engineer-in-charge for supervision and execution of the work. The contractor shall intimate the Engineer-in-charge in writing the names and identity of technical personnel proposed to be engaged on the work.

-
- 84.2 The contractor's representative receives instruction on behalf of the contractor from the Engineer-in-charge and such instruction shall be deemed to have been given to the contractor.
- 84.3 The contractor's representative shall be fluent in language for communication, competent for understanding drawing, executing and managing work.
- 84.4 If the contractor fails to appoint such personnel as directed by the Engineer-in-charge, the Engineer- in-charge shall have full powers to suspend the execution of the works until such date suitable personnel is appointed and the contractor shall be held responsible for the delay so caused to the works.
- 84.5 The contractor shall pay the required remuneration to technical personnel as per the relevant statutes and any claim of wage, compensation, labour disputes in this regard will not be admitted by KSEBL

85 SUPERVISION BY KSEBL

- 85.1 To eliminate delays and avoid disputes and litigation it is agreed between the parties to the Contract that all matters and questions shall be resolved in accordance with the provisions of this document.
- 85.2 The manufacturing of the product shall be carried out in accordance with the specifications. The scope of the duties of KSEBL's pursuant to the contract will include but not be limited to the following:
- 85.2.1 Interpretation of all the terms and conditions of these Documents and Specifications.
- 85.2.2 Review and interpretation of all the Contractor's drawings, engineering data etc.
- 85.2.3 Witness or authorize his representative to witness tests at the manufacturer's works or at site, or at any place where work is performed under the Contract.
- 85.2.4 Inspect, accept or reject any equipment, material and work under the Contract, in accordance with the Specifications.
- 85.2.5 Issue certificate of acceptance and / or progressive payment and final payment certificate.

85.2.6 Review and suggest modification and improvement in completion schedules from time to time; and

85.2.7 Supervise the Quality Assurance Programme implementation at all stages of the Works.

86 GUARANTEED TECHNICAL PARTICULARS.

86.1 The Guaranteed Technical Particulars of the various items shall be furnished by the Bidders. The Bidder shall also furnish any other schedule information as in their opinion is needed to give full description and details to judge the item(s) offered by them. Required drawings also should be furnished by the Contractor.

86.2 The data furnished in Guaranteed Technical Particulars should be the minimum or maximum value (as per the requirement of the specification) required. A Bidder may guarantee a value more stringent than the specification requirement. However, for testing purpose or from performance point of view, the material shall be considered performed successfully if it achieves the minimum/maximum value required as per the technical specification. No preference whatsoever shall be given to the bidder offering better / more stringent values than those required as per specification.

87 QUANTITY VARIATION

The materials/equipment such as conductor, tower structures, foundations, insulators, hardwares, OPGW, earthing materials etc may vary according to actual requirements at site and the Contractor is responsible to supply the additional quantity also at the agreed rates.

Sd/-

Addnl. CEO

REC Transmission Projects Company Limited

SECTION - 6

CONTRACT DATA

- 1) The following documents also form part of the contract.
 - a. The bid and Purchase/work order
 - b. Conditions of contract
 - c. Technical Specification
 - d. Drawings
 - e. Programme
 - f. Price Schedules of Activities
 - g. Schedule of O & M Manuals
 - h. Schedule of Key personnel
 - i. Site investigation data
 - j. Schedule of Taxes.
 - k. Clarifications issued during bidding stage, if any.
 - l. Bidding Document for Transmission line project.
- 2) **The Start Date is the date 15 days after the date of issue of work order.**
- 3) **The completion Date** for the Works is as per Brief Description of Work Clause 3.2 Section-1c reckoned from the official date of commencement **which is 15 days after the date of issue of work order.**
- 4) The contractor is to submit **the Programme for the work within 30 days** from the date of issue of work order.
- 5) The Site Possession Date is the start date itself.
- 6) The sites are under Kannur & Kasaragod Districts of Kerala State.

-
- 7) **Guarantee period is for 84 months from the date of commissioning and handing over date (CHD) of the works** and as per clause 31 of section 5 of this volume.
 - 8) The maximum liability of the contractor for damage to others property and personnel loss is to make good the full replacement/rectification value of all damaged/lost equipments plus an additional sum of 15% of such replacement and incidental to the rectification of the loss or damage including professional fees and the cost of demolishing and removing any debris of whatsoever nature and to ensure their availability as per project requirement, till the issue of defect correction certificate and within the guarantee period thereafter.
 - 9) The minimum insurance cover for physical property during storage and construction is as per clause 12 of section 5.
 - 10) The language of contract document is English.
 - 11) The laws, which apply to the contract, are the Indian Laws.
 - 12) **The liquidated damages** for works of each site are **1% of PAC for every month of delay from agreed date (CHD)**. (Percentage of contract price or part thereof).
 - 13) Incentive at the rate of 0.5% per month on the net amount excluding taxes, subject to a maximum of 5% for the early completion of the work in all respects under this contract, will be paid.
 - 14) The amount of **Performance Security Deposit (PSD) is 5% of contract price**.
 - 15) Performance Bank Guarantee of 10% of Contract Price shall be provided by the contractor, before release of the final payment, with validity till end of warrantee period,
 - 16) The date by which Operation and Maintenance manuals, as built drawings, recommended spare parts list etc. in 6 copies along with soft copies and special tools are required in one month prior to the completion date.
 - 17) The percentage of the value of the work not completed representing KSEBL's cost of completing the works is 150% of the contract data.

-
- 18) The DD/Bank Guarantee towards EMD is Rs. 5,00,000/- (Rs. five lakhs only).**
- 19) The contractor is prohibited from claiming price escalation in case the completion period is extended for any reason including litigation or force majeure.**
- 20) The length of the Defect Correction Period is 30 days. Defect notice period is 90 days before defect liability of 84 months.**

**Sd/-
Addnl. CEO**

REC Transmission Projects Company Limited

ANNEXURES

Annexure I	Price Variation Clause for GI Lattice Towers
Annexure II	Price Variation Clause for ACSR Conductors
Annexure III	List of Vendors Approved for Supply of Materials for Transmission Line Projects Under TransGrid 2.0

ANNEXURE- I
**PRICE VARIATION CLAUSE FOR TRANSMISSION LINE TOWERS - TOWER
EXTENSIONS OTHER SPECIAL STRUCTURES.**

The price quoted/confirmed is based on the input cost of raw materials/ components and labour cost as on the date of quotation and the same is deemed to be related to prices of raw materials and all India average consumer price index number for industrial workers as specified in the price variation clause given below. In case of any variation in these prices and index numbers, the price payable shall be subject to adjustment, up or down in accordance with the following formula:

A) Transmission Line Tower with both Heavy and Light angles:

$$P = \frac{P_0}{100} \left[11 + 32 \frac{\text{SBLR}}{\text{SBLR}_0} + 25 \frac{\text{SBIR}}{\text{SBIR}_0} + 09 \frac{Z_n}{Z_{n_0}} + 23 \frac{W}{W_0} \right]$$

B) Transmission Line Tower with only Heavy angles:

$$P = \frac{P_0}{100} \left[11 + 57 \frac{\text{SBLR}}{\text{SBLR}_0} + 09 \frac{Z_n}{Z_{n_0}} + 23 \frac{W}{W_0} \right]$$

C) Transmission Line Tower with only Light angles:

$$P = \frac{P_0}{100} \left[11 + 57 \frac{\text{SBLR}}{\text{SBLR}_0} + 09 \frac{Z_n}{Z_{n_0}} + 23 \frac{W}{W_0} \right]$$

Wherein,

P = Price payable as adjusted in accordance with the above formula.

P₀ = Price quoted/confirmed.

SBLR₀ = Price of Steel Blooms-Retail (refer notes)

This price is as applicable on the 1st working day of the month, **one** month prior to the date of tendering.

SBIR0 = Price of Steel Billets -Retail (refer notes)

This price is as applicable on the 1st working day of the month, **one** month prior to the date of tendering.

Zn0 = Price of Electrolytic high grade Zinc (refer notes)

This price is as applicable on the 1st working day of the month, **one** month prior to the date of tendering.

W0 = All India average consumer price index number for industrial workers, as published by the Labour Bureau, Ministry of Labour, Govt. of India (Base:2001 = 100) (Refer notes).

The index number is as applicable on the 1st working day of the month, **three** months prior to the date of tendering.

For example, if date of tendering falls in May 2014, the applicable prices of Steel Bloom-Retail (SBLR0), Steel Billets-Retail (SBIR0) and Zinc (Zn0) should be for the month April 2014 and all India average consumer price index number (W0) should be for the month of February 2014.

The above prices and indices are as published by IEEMA vide circular reference number IEEMA (PVC)/ TLT-2014/R1/_ one month prior to the date of tendering.

SBLR = Price of Steel Bloom-Retail (refer notes)

This price is as applicable on the 1st working day of the month, **two** months prior to the date of delivery.

SBIR = Price of Steel Billets-Retail (refer notes)

This price is as applicable on the 1st working day of the month, **two** months prior to the date of delivery.

Zn = Price of Electrolytic high grade Zinc (refer notes)

This price is as applicable on the 1st working day of the month, **two** months prior to the date of delivery.

W = All India average consumer price index number for industrial workers, as published by the Labour Bureau Ministry of Labour, Govt. of India (Base: 2001=100) (refer notes)

The index number is as applicable on the 1st working day of the month, **four** months prior to the date of delivery.

For example, if date of delivery falls in December 2014, the applicable prices of Steel Bloom-Retail (SBLR), Steel Billets-Retail (SBIR) and Zinc (Zn) should be for the month October 2014 and all India average consumer price index number (W) should be for the month of August 2014.

The date of delivery is the date on which Transmission line towers delivered at work site of the contractor based on the dispatch note and LR duly verified and signed by the engineer in charge of KSEBL Only the materials delivered before the scheduled date of completion as per the agreement will be eligible for claiming the price variation as above.

Notes:-

- a) All prices of raw materials are exclusive of excise/CV duty amount and exclusive of any other central, State or local taxes: octroi etc.
- b) All prices are as on first working day of the month.
- c) The details of prices are as under:
 - 1) The price of Steel Bloom-Retail are the average Retail price of Blooms of size 150x150mm of all cities in `/MT: as published by Joint Plant Committee (JPC), Kolkata. Heavy angles of size above 110mm x 110mm are deemed to be related to this price.
 - 2) The price of Steel Billets-Retail are the average Retail price of Billets of size 100mm of all cities in `/MT: as published by Joint Plant Committee (JPC), Kolkata.

Light angles of size below & including 110mm x 110mm are deemed to be related to this price.

- 3) The price of Electrolytic high grade zinc (in `/MT) is ex-works price as quoted by a primary producer.

Cost weightage of re-rolling/conversion charges is included in Labour cost weightage (W).

If the materials are not required within the scheduled delivery period in the Purchase Order or any mile stones are delayed, the Deputy Chief Engineer with full powers of Chief Engineer may re-arrange the schedule to a later date and the same will be intimated in writing or PVC for the material will be considered as good as delivered at the time of start of erection of that particular batch of materials. In this case, price variation applicable as per the revised scheduled date only will be paid.

**Sd/-
Addnl. CEO**

REC Transmission Projects Company Limited

ANNEXURE - II
PRICE VARIATION CLAUSE FOR ACSR CONDUCTORS**Price Variation Formula:-**

The actual increase/ decrease in the price of raw materials will be allowed as per IEEMA Price Variation formula and will be limited as per Government of India/IEEMA Circular. For the calculation Aluminium/ Steel content of conductor will be taken as follows:

Sl No	Description	Panther MT/kM	Kundah MT/kM
1.	Aluminium EC Grade/Alloy - WA	0.586	1.116
2.	HT GS Steel	0.388	0.165

The price variation will be calculated according to the following formula.

$$P = P_0 + WA (AL - AL_0) + WF (FE - FE_0)$$

$$P_0 = \text{Ex-works price of conductor in Rs/km as per order}$$

$$AL_0 = \text{Price of EC Grade Aluminium Ingot / Rod (as per contract) exclusive of excise duty in Rs./MT for AAC/ACSR conductor as on 30 days prior to the date of tender opening .}$$

$$AL = \text{Price of EC Grade Aluminium Ingot / Rod (as per contract) exclusive of excise duty in Rs./MT for AAC/ACSR conductor as on 30 days prior to the date of delivery. (Average value).}$$

$$FE = \text{Price (exclusive of excise duty) of High Tensile Galvanized Steel Wire of appropriate size in Rs / MT as on 30 days prior to the date of delivery.}$$

FEO	=	Price (exclusive of excise duty) of High Tensile Galvanized Steel Wire of appropriate size in Rs / MT as on 30 days prior to the date of tender opening.
WA	=	Weight of Aluminium in MT / km of Conductor
WF	=	Weight of Steel in MT / km of Conductor
P	=	Ex-works price of conductor in Rs / Km as adjusted in accordance with the Price Variation Clause

The revision in IEEMA formula will be applied to this purchase from the month of such revision.

For the purpose of price variation the basic cost of Aluminium or High Carbon Steel shall be arrived at the basis of the cost of raw material excluding taxes and freight charges etc. Clause for price variation / Price refixation, as detailed below.

- i. The price variation as per IEEMA formula will be applicable only to the materials supplied as per monthly schedule during the scheduled delivery period.
- ii. The date of delivery is the date on which the conductors delivered at work site of the contractor based on the dispatch note and LR duly verified and signed by the engineer in charge of KSEBL **Only the materials delivered before the scheduled date of completion as per the agreement will be eligible for claiming the price variation as above.**
- iii. If the materials are not required within the scheduled delivery period in the Purchase Order or any mile stones are delayed, the Deputy Chief Engineer with full powers of Chief Engineer may re-arrange the schedule to a later date and the same will be intimated in writing or PVC for the material will be considered as good as delivered at the time of start of erection of that particular batch of materials. In this case, price variation applicable as per the revised scheduled date only will be paid.

Sd/-

Addnl. CEO

REC Transmission Projects Company Limited

ANNEXURE- III

LIST OF VENDORS APPROVED FOR SUPPLY OF MATERIALS FOR TRANSMISSION LINE PROJECTS UNDER TRANSGRID 2.0

Sl. No.	Name of Company	Address of the Company
1	Lattice Type GI Transmission Towers	
	Bajaj Electricals Ltd	002,Rustomjee Aspitree Bhanu Shankar Yagnik Marg Off Eastern Express Highway, Sion(East), Mumbai 400022
	Larsen & Toubro Ltd	L&T Construction (Power Transmission & Distribution), Mount Poonammallie Road, Mnappakam, PB No.979, Chennai-600089
	Gammon India Ltd	G55, MIDC, Butigori, Nagpur-441108
	KEC International Ltd	B-190, M.I.D.C. Industrial Estate, Butibori, Nagpur - 441108.
	Jyoti Structures Ltd	6th Floor, Valecha Chambers, New Link Road, Andheri (W), Mumbai, Maharashtra, India – 400053.
	Amitasha Enterprises Pvt Ltd	101, Shivaji Nagar, Nagpur 440010, INDIA
	MPower Infratech (India) Pvt Ltd.	Plot No 28, Road No 4, Phase II, Cherlapally, Cherlapally, Hyderabad, Telangana 500051
2.	ACSR conductors	
	Apar Industries Ltd	301, Panorama Complex,, R. C. Dutt Road, Vadodara; Gujarat; Map -390007
	Sterlite Power Transmission Ltd	202, Pentagon Towers II, Magrpatta Township, Pune- 411028

Gammon India Ltd G55, MIDC, Butigori, Nagpur-441108

JSK Industries 9, A. K. Naik Marg, CST, Mumbai - 400 001. India.

3. High Temperature Low Sag (HTLS) Conductors

Apar Industries Ltd 301, Panorama Complex,, R. C. Dutt Road, Vadodara;
Gujarat; Pin -390007

**Sterlite Power
Transmission Ltd** 202, Pentagon TowersII, Magratta Township, Pune-
411028

4. OPGW

**Sterlite Power
Transmission Ltd** 202, Pentagon TowersII, Magratta Township, Pune-
411028

ZTT International Pvt Ltd 322, 3rd Floor, Tower B4, Spaze IT Tech Park, Sector 49,
Sohna Road, Gurgaon 122018

5. Monopole /Tubular Poles

Valmont Structures Unit 203, 2nd Floor, Pentagon IV, Magarappata City,
Hadapsar, Pune – 411028, Maharashtra, India

Bajaj Electricals Ltd 002,Rustomjee Aspitree Bhanu Shankar Yagnik Marg Off
Eastern Express Highway, Sion(East), Mumbai 400022

6. Hardware and accessories

TAG Corporation Pvt Ltd 91, Tiruneermalai Main Rd, Parvathipuram, Chromepet,
Chennai, Tamil Nadu 600044

ASBESCO India Pvt Ltd 1A K.B.R. Complex 4 Ho-Chi-Minh Sarani, Kolkata, West
Bengal – 700071, India

Rashtra Udhog Limited 004, Clyde Row, Hastings, Kolkata, West Bengal 700022

Karamtara Engineering Pvt. Ltd. 705, Morya Landmark II, New Link Road Andheri (West), Mumbai – 400 053

IAC Electricals Pvt Ltd 701, Central Plaza, 2/6, Sarat Bose Road, Kolkata, West Bengal 700020

EMI Transmission Pvt Ltd Center Point Unit – I, 1st floor, Dr. Babasaheb Ambedkar Road, Parel (E), Mumbai-12

7. Composite Polymeric Insulator

Gold Stone Teleservices Ltd 9-1-83 & 84 Ground Floor Amarchand Sharma Complex Secunderabad, Andhra Pradesh - 500 003, India

Deccan Enterprises Ltd B/58-60,APIE, Balanagar, Hyderabad, Pin 500037, India

Pfisterer Sefag AG Werkstrasse 7, 6102 Malters, Switzerland

MacLean Power York 7801 Park Place Rd PO Box 949 York, USA

**Sd/-
Addnl. CEO**

REC Transmission Projects Company Limited

REC TRANSMISSION PROJECTS COMPANY LIMITED



On Behalf of KERALA STATE ELECTRICITY BOARD LIMITED

Office of the Deputy Chief Engineer with full powers of Chief Engineer,

TransGrid (North)

**Vydyuthi Bhavanam , Kallippadam P.O
Shoranur - 679 122**

As Bid Process Coordinator

(Invites bid through e-tendering mode only)

FOR

TURNKEY CONTRACT PACKAGE

**KOLATHUNADU LINES STRENGTHENING PACKAGE & NORTH
MALABAR LINES PACKAGE**

**Construction / Upgradation of 220/110kV line using Narrow base
MCMV Towers**

- **KLSP Project A: Construction of 9 kM 220kV Double circuit line from Kanhirod to Mundayad**
- **KLSP Project B: Construction of 81 kM 220kV /110kV Multi circuit Multi voltage (MCMV) line from Mundayad to Mylatty**

- **NMLP Project A: Construction of 22.236 kM 220/110 kV Multi Circuit Multi Voltage Line (MCMV) from Mundayad to Thalassery**

- **NMLP Project B: Conversion of 7.66 kM of 110 kV DC line to 220kV /110kV Multi circuit from Areacode – Kaniyambetta tap point to Kunnamangalam Substation through Existing Agasthimuzhi 110 kV line route.**

REC Transmission Projects Company Limited
(A wholly owned subsidiary of REC, a 'Navratna CPSE'
Under the Ministry of Power, Govt of India)
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VOLUME II
(SPECIAL INSTRUCTIONS AND TECHNICAL SPECIFICATIONS)

TABLE OF CONTENTS

SL.NO.	DESCRIPTION	PAGE
Part A	TECHNICAL CONDITIONS OF CONTRACT	5
Section 1	General Information and Scope of the Work	6
Section 2	General Technical Conditions	19
Section 3	Site Access	30
Part B	TECHNICAL SPECIFICATIONS OF MATERIALS	34
Section 4	Technical Specifications of Tower & Accessories	35
Section 5	Technical Specifications of Conductors	51
Section 6	Technical Specifications of OPGW & Accessories	82
Section 7	Technical Specifications of Polymeric insulators	136
Section 8	Technical Specifications of Hardware & Accessories for Conductor, Insulator & Earth Wire	171
Part C	EXECUTION OF THE PACKAGE	197
Section 9	Tower Foundation, Erection, Stringing and Installation of Line Materials	198
Part D	DOCUMENTATION AND DELIVERABLE	230
Part E	DRAWINGS	238
Annexure A	Block diagram representation	283
Annexure B	Annexure B Bill of Quantities for Material, Spares , Labour and Dismantled item (Attached Separately)	
Annexure C	Annexure C Approximate Tower Quantity (Attached Separately)	

PART -A
TECHNICAL CONDITIONS OF CONTRACT

SECTION -1**GENERAL INFORMATION AND SCOPE OF THE WORK****1. PACKAGE SUMMARY**

Constructing / Up-grading 220/110 kV MCMV line using narrow base towers which includes dismantling of existing conductor and towers, Supplying Towers/ ACSR conductor/ OPGW with all accessories, polymeric suspension / tension insulator of approved type and capacity, stringing, supply of spares as per the specifications and other allied works as per the tower schedule and design provided by KSEBL and technical support and training for KSEBL staff and officers for O&M of the line, up to the full satisfaction of KSEBL on Turnkey Contract Basis as specified in the tender documents.

2. SCOPE OF THE WORK

2.1 The following works are included in the scope of the Contract:-

1. KLSP Project A: Construction of 9 km 220kV Double circuit line on 220/110 kV Multi Circuit towers from Kanhirode SS to Mundayad SS using the existing RoW of 66 kV and 110 kV Feeder. (1.5 km 220kV Multi Circuit line from Kanhirode SS to Puravoor + 7.5 km 220kV Double circuit line from Puravoor to Mundayad SS) which includes dismantling of existing conductor, earthwire, towers and all accessories, Supplying Towers and ACSR conductor with accessories, polymeric suspension / tension insulators of approved type and capacity, OPGW with all accessories etc., erection of towers, stringing the line and OPGW, supply of spares as per the specifications and other allied works as per the tower schedule and design provided by KSEBL and technical support and training for KSEBL staff and officers for O&M of the line, up to the full satisfaction of KSEBL on Turnkey Contract Basis.

2. KLSP Project B: Construction of 81 km of 220kV/110kV Multi Circuit Multi Voltage(MCMV) line using multi circuit narrow base towers from Mundayad Substation to Mylatty Substation using the existing RoW of 110 kV SC feeder which includes dismantling of existing conductor, earth-wire, towers and all

accessories, Supplying Towers and ACSR conductor with accessories, polymeric suspension / tension insulators of approved type and capacity, OPGW with all accessories etc., erection of towers, stringing the line and OPGW, supply of spares as per the specifications and other allied works as per the tower schedule and design provided by KSEBL and technical support and training for KSEBL staff and officers for O&M of the line, up to the full satisfaction of KSEBL on Turnkey Contract Basis.3. NMLP Project A: Construction of 22.236 km 220/110 kV Multi Circuit Multi Voltage Line (MCMV) from Mundayad to Thalassery using the existing 110kV DC and 66kV RoW.

3. NMLP Project A: Construction of 22.236 km 220/110 kV Multi Circuit Multi Voltage Line (MCMV) from Mundayad to Thalassery using the existing 110 kV DC and 66 kV RoW which includes dismantling of existing conductor, earth wire, towers and all accessories, Supplying Towers and ACSR conductor with accessories, polymeric suspension / tension insulators of approved type and capacity, OPGW with all accessories etc., erection of towers, stringing the line and OPGW, supply of spares as per the specifications and other allied works as per the tower schedule and design provided by KSEBL and technical support and training for KSEBL staff and officers for O&M of the line, up to the full satisfaction of KSEBL on Turnkey Contract Basis.

4. NMLP Project B: C Conversion of 7.66 km of 110 kV DC line to 220kV /110kV Multi circuit from Areacode – Kaniyambetta feeder tap point to Kunnamangalam Substation through existing Agasthimuzhi 110 kV DC line route which includes dismantling of existing conductor, earth-wire, towers and all accessories, Supplying Towers and ACSR conductor with accessories, polymeric suspension / tension insulators of approved type and capacity, OPGW with all accessories etc., erection of towers, stringing the line and OPGW, supply of spares as per the specifications and other allied works as per the tower schedule and design provided by KSEBL and technical support and training for KSEBL staff and officers for O&M of the line, up to the full satisfaction of KSEBL on Turnkey Contract Basis.

2.2 The general scope of work will include the following:

- a) Detailed Survey, Check survey, tower location marking, soil resistivity measurement and geotechnical investigation wherever necessary.
- b) Fabrication and supply of all types of 400/220/110kV transmission line towers / special poles (if required) fully hot dip galvanized, with all types of tower accessories like phase plate, circuit plate, number plate, danger plate, anti-climbing device, Bird guard, earth pipe and counterpoise type earthing as per KSEBL's design / drawings including fasteners, anti-theft fasteners, step bolt, hangers, D-shackles etc.
- c) Supply of Polymeric Insulators, Hardware Fittings, ACSR Conductor, OPGW and Accessories,
- d) De-stringing & dismantling of towers, earthwire / OPGW, Insulators, Hardware & Accessories including dismantling of tower accessories like phase, danger and number plates, bird guards, anti-climbing devices etc.
- e) Clearing grass & felling of trees, as required.
- f) Installation of Emergency Restoration System (ERS) Work in existing 220 KV Double circuit Line Route (ERS Equipment will be supplied by KSEB).
- g) Soil test, wherever found necessary for ascertaining type of foundation including taking pits/bore holes, collecting soil samples and testing at approved laboratories as per relevant IS codes
- h) Verification of the foundation schedule and casting of foundation for tower footings as per KSEBL foundations drawing.
- i) Erection of towers, punching of bolts and nuts, tower earthing including counter poise earthing if required and measurement of earth resistance (should be less than 10 ohm), fixing of insulator strings, stringing of conductors and OPGW along with all necessary line accessories.
- j) Painting of towers in bands of orange and white (above 45-meter height) and supply & erection of marker balls, obstruction lights (wherever applicable) for aviation requirements (as required) as per IS 5613.
- k) Erection of name boards, phase indicator, number plates, danger boards etc. as per standards on all towers.
- l) Erection, Testing and commissioning of Junction Box and FODP for both ends of substations.
- m) Testing & commissioning of the erected transmission lines, training to KSEBL staff and other items not specifically mentioned in this Specification but are required for the successful commissioning of the transmission line, unless specifically excluded in the Specification.
- n) Supply of necessary spares as per the details mentioned in Price Schedule-2 – List of Material and Spares.

The contractor shall supply the spares mentioned, only after commissioning of the project and before submission of final bill of the project. The payment for the spares will be paid up on satisfactory completion of supply of complete spares as per the list.

2.3 Scope for Supply of Towers

- a) KSEBL shall provide structural drawings, shop drawings & Bill of Materials of all type of transmission line towers and its extensions, to the Contractor after placement of award, in sequence, suiting the project requirement. Similarly the drawings for all type of foundations for the towers shall also be provided by KSEBL to the Contractor.
- b) The supply of required quantities of fabricated & galvanized steel parts as per specifications required for towers and should be strictly followed the same.
- c) Preparation of fabrication drawings for various types of towers required for project, including MCMV & narrow base special multi-circuit towers as per the design provided by KSEBL and proto fabrication.
- d) Supply of the required quantities of fabricated & galvanized steel parts as per specifications required for towers, concrete, reinforcement steel for foundation and other items as given in appropriate price schedule. However, the work shall be executed as per approved construction drawings.
- e) The various items of work are described very briefly in the appropriate price schedule. The various items of the price schedule shall be read in conjunction with the corresponding sections in the Technical Specifications including amendments and, additions, if any. The Bidder's quoted rates shall be based on the description of activities in the price schedule as well as other necessary operations required to complete the works detailed in these Technical Specifications.
- f) The Unit rates quoted shall include minor details which are obviously and fairly intended, and which may not have been included in these documents but are essential for the satisfactory completion of the various works.
- g) The unit rate quoted shall be inclusive of all plant equipment, men, material skilled and unskilled labour etc. essential for satisfactory completion of various works.
- h) All measurements for payment shall be in S.I. units, lengths shall be measured in meters corrected to two decimal places. Areas shall be computed in square meters & volume in cubic meters rounded off to two decimals.

- 2.4 The Bidder shall submit their offer taking into consideration that the tower and foundation **designs/drawings shall be developed/ provided by KSEBL and design rights will be strictly reserved with KSEBL.** Bidder shall quote the unit rates for various items of towers and foundations as per units mentioned in appropriate price schedule. **However, the mile stone payments to the contractor will be made as per the payment schedule mentioned in clause**

41, section 5 of volume I of this tender document. Please note that supply of materials alone will not be paid, except for the spares to be supplied towards the end of the project.

The payment to be made for towers/foundations shall be worked out based on the unit rates and approved Bill of Materials (BOM) for towers and quantities/volumes of concrete as per approved tower foundation drawings.

- 2.5** This specification also includes the supply of insulators & hardware fittings and all type of accessories for conductor and OPGW as detailed in the specification. Contractor shall clearly indicate in their offer, the sources from where they propose to procure these materials. The technical descriptions of these items are given in Technical specifications.
- 2.6** All the raw materials such as steel, zinc for galvanising, reinforcement steel, cement, coarse and fine aggregates for tower foundation, coke and salt for tower earthing etc. are included in the Contractor's scope of supply.
- 2.7** Bidder shall also indicate in the offer, the sources from where they propose to procure the fasteners, anti-theft fasteners, step bolts, hangers, D-shackles, tower accessories, Aerial marker balls, aviation signal etc.

2.8 Stringing

- a) The entire stringing work of conductor and earth wire shall be carried out by tension stringing technique. However, the Bidder having requisite experience has freedom to use helicopter for stringing. The Bidder intending to use helicopter shall furnish detailed description of the procedure, type & number of helicopter & accessories etc., to be deployed for stringing operation. Necessary clearance/ permissions shall be obtained by the contractor while using helicopter for stringing.
- b) In hilly terrain and thick forest or area with site constraints where deployment of tension stringing machine is not possible, manual stringing may be adopted after getting approval of supervising Engineer. The contractor shall deploy appropriate tools/ equipments/ machinery to ensure that the stringing operation is carried out without causing damage to conductor/OPGW and conductor/ OPGW is installed at the prescribed sag-tension as per the approved stringing charts.
- 2.9** In case of special type pile or well foundations, some suitable execution agency may be engaged by the contractor for casting of foundations, with the permission of KSEBL. However, the Bidder shall be responsible for all the necessary co-ordination with the special foundation Contractor including stub-setting/fixing of base plate with anchor bolt.

2.10 Details of Transmission Line Routes and Terrain

Bidders may visit the line route to acquaint themselves with terrain conditions and associated details of the proposed transmission lines.

2.11 Location Details and Terminal Points

The proposed Transmission lines shall emanate from existing Sub stations and end at respective Sub stations/ Terminal towers. The Contractor shall have to construct both 220/110kV and 220/220kV Transmission lines completely up to dead end towers/ termination gantry on either end. Stringing works shall also be carried out from dead end tower to terminal arrangements/terminal points in all projects. Detailed Block diagram representation for KOLATHUNAD AND NORTH MALABAR PACKAGE LINES is depicted as Annexure A in part E of this volume.

2.12 Access to the Line and Right of Way

KSEBL is utilizing the existing RoW as far as possible. Right of way and way leave clearance shall be arranged by the KSEBL in accordance with work schedule. KSEBL will secure way leave and Right of way in the Forest area. Access to the Line and the locations described in section 3, part A of this volume, and the directions may be strictly followed.

3 TRANSMISSION TOWERS AND LINE DATA

3.1 Tower Data

a) The towers for the above transmission lines are classified as given below:

Type of Tower	Deviation Limit	Typical Use
KLA/ MA/ D3	0 – 2 deg.	1. To be used as tangent tower.
KLB/ MB	0 - 15 deg.	1. Angle towers with tension Insulator string.
		2. Also to be used for uplift force resulting from an uplift span up to 1000m under broken wire conditions.
		3. Also to be used for Anti Cascading Condition (for usage as a section tower)
KLC/ MC/ D30	15 - 30 deg.	1. Angle towers with tension Insulator string.
		2. Also to be used for uplift force resulting from an uplift span up to 1000m under broken wire conditions.
		3. Also to be used for Anti Cascading Condition (for usage as a section tower)
KLD/ MD/ D60	30 - 60 deg.	1. Angle tower with tension insulator string.
		2. Also to be used for uplift forces resulting from an uplift span up to 1000m under broken wire condition

Note 1: KLA/KLB/KLC/KLD is for 220/110 kV MCMV Towers, MA/MB/MC/MD is for 220 kV Multi Circuit Towers and D3/D30/D60 is for 110kV Double circuit towers.

Note 2: The above towers can also be used for longer span with smaller angle of deviations without infringement of ground clearance. Similarly, D-type towers with lesser angles can be used as dead-end towers.

b) Extensions

The Multi Circuit Multi-voltage towers shall be designed so as to be suitable for adding +3m, +6m & +9m body extensions for maintaining adequate ground clearances without reducing the factor of safety (actual stress /allowable stress) available for the members of tested extensions in any manner.

c) Span and clearances

The minimum span and clearances are given in the design and will be provided with detailed tower schedule and should be strictly followed.

d) Electrical Clearances

The minimum electrical clearance between the lowest power conductors of crossing line over the crossed line should be as per the regulation 69 of CEA regulations on Safety and Electricity Supply 2010.

e) Ground Clearance

The minimum ground clearance should be followed as per regulation 58 (4) of CEA regulations on Safety and Electricity Supply – 2010. An allowance of 150mm shall be provided to account for errors in stringing.

4 Electrical System Data for 220/110 kV lines

Sl No.	Description	Unit	For 220kV	For 110 kV
1	System	kV	A.C.	A.C.
2	Nominal Voltage	kV	220	110
3	Maximum system voltage	kV	245	125
4	BIL (Impulse)/ Lightning Impulse Level	kV (Peak)	1050	650
5	Power frequency withstand voltage (Wet)	kV (rms)	460	275
6	Switching surge withstand voltage (Wet)	kV (rms)	NA	NA
Sl No.	Description	Unit	For 220kV	For 110 kV
Sl No.	Description	Unit	For 220kV	For 110 kV

7	Minimum Corona extinction voltage at 50 Hz AC system under dry condition	kV (rms) phase to earth	154 (min)	105 (min)
8	Radio interference voltage at one MHz for phase to earth voltage of 305 KV under dry condition.	Micro Volts	1000 (max)	500 (max)
9	Short circuit level	KA	40	31.5
10	Frequency i) Normal ii) Maximum iii) Minimum	Hz	50 51.5 47	

4.1 Details of line Materials:

a) Conductors

Sl No.	Description	Unit	Conductor types					
			ACSR Moose	ACSR Zebra	ACSR Wolf	Double ACSR Panther	Single ACSR Panther	ACSR Kundah
1	Construction/ Size		54/3.53mm AL + 7/3.53mm steel	54/3.18mm AL + 7/3.18mm steel	30/2.59mm AL + 7/2.59 mm steel	30/3mm Al + 7/3 mm steel	30/3mm Al + 7/3 mm steel	42/3.5mm Al + 7/1.96 mm steel
2	Number of Conductor per Phase	Nos.	4	1	1	2	1	1
3	Nominal Overall Diameter	mm	31.77	28.62	18.13	21	21	26.88
4	Cross Section Area Total	mm ²	597.0	484.5	194.9	261.5	261.5	425.2
5	Nominal Weight	Kg/Km	2004	1621	727	974	974	1282
6	Modulus of Elasticity	Kg/mm ²				8158	8158	
7	Co-efficient of Linear Expansion	/ °C				17.8*10 ⁻⁶	17.8*10 ⁻⁶	
8	Ultimate Tensile Strength	KN	159.6	130.32	67.34	89.67	89.67	88.79

Sl No.	Description	Unit	Conductor types					
			ACSR Moose	ACSR Zebra	ACSR Wolf	Double ACSR Panther	Single ACSR Panther	ACSR Kundah
9	DC resistance at 20°C	Ω/km	0.05595	0.06868	0.1871	0.139	0.14	0.7311
10	Current Carrying Capacity at max operating temp.	Amp				420	420	
11	Maximum Operating Temperature	°C		85		85	85	

b) OPGW

SI No	Description	Unit	Values Required
1	Name of Conductor		Optical Ground Wire (OPGW)
2	Identification		48 SMF

c) Insulator Strings

SL. No.	Particulars	Unit	400kV	220kV		110 kV	
			Tension	Suspension	Tension	Suspension	Tension
1	Type of String		T-String	V-String	I-String	I-String	I-String
2	No of individual Unit	No.	2	2	1	1	1
3	Core Diameter	mm	20	16	20	16	20
4	Size and designation of ball & socket	mm	20	16	20	16	20
5	Minimum Creepage Distance	mm	13,020	7595	7595	4495	4495
6	Nominal Length of Composite Insulator	mm	3150	2030	2175	1305	1450
7	Electro-Mechanical Strength of Insulator Unit	KN	160	90	120	70	90
8	Power frequency one-minute dry withstand voltage	kV (rms)		510	510	325	325
9	Power frequency one-minute	kV (rms)		460	460	275	275

SL. No.	Particulars	Unit	400kV	220kV		110 kV	
			Tension	Suspension	Tension	Suspension	Tension
	wet withstand voltage						
10	Visible discharge Test voltage	kV (rms)		154	154	NA	NA
11	Minimum dry impulse withstand voltage 1.2x50 micro second wave, positive and negative	kV (peak)		1050	1050	650	650

4.2 Climatic & Service Conditions

The materials offered shall be suitable for operation in tropical climate & shall be subject to the sun & inclement weather and shall be able to withstand wide range of temperature variations. The topography & climatic conditions in general are as under: -

Locations	Kannur & Kasaragod Districts under Kerala State
Voltage levels	220/110 kV
Frequency	50HZ
Maximum ambient temperature	50° C
Minimum ambient temperature	10° C
Every day temperature (average)	32° C
Solar Absorption coefficient	0.5
Solar Radiation	220.83Watt/sqm
Emissivity Constant	0.5
Limits of ambient temperature over period of 24 hours	15° peak
Wind zone (as per IS: 875)	2
Maximum wind velocity (m/sec.)	39 m/sec. (as per IS: 875)
Maximum wind pressure	584 N/sq. meter

Minimum factor of safety	2.5
Terrain Category	2
Reliability level	2
Maximum relative humidity	85%
Average rainfall per year	3107mm. Approx.
Average number of thunder storm days/annum	50
Average number dust storms days/annum	5
Isokeraunic level	100/year
Average number of rainy days per year	90 days
Altitude not exceeding (above MSL)	2000m
Ice load on conductor	N32
Seismic zone	Zone 2
Number of months of tropical monsoon per year	5

Note: Climate varies from moderately hot and humid tropical climate to cold climate.

SECTION-2
GENERAL TECHNICAL CONDITIONS

1.0 GENERAL TECHNICAL CONDITIONS**1.1 General**

The following provisions shall supplement all the detailed technical specifications and requirements brought out herein. The contractor's proposal shall be based on the use of materials complying fully with the requirements specified herein.

1.2 Engineering Data

1.2.1 The furnishing of engineering data by the Contractor shall be in accordance with the Schedule as specified in the Bidding Document. The review of these data by the KSEBL will cover only general conformance of the data to the specifications and not a thorough review of all dimensions, quantities and details of the materials, or items indicated, or the accuracy of the information submitted. This review by the KSEBL shall not be considered by the Contractor, as limiting any of his responsibilities and liabilities for mistakes and deviations from the requirements, specified under these specifications.

1.2.2 All engineering data submitted by the Contractor after review by the KSEBL shall form part of the contract document.

1.3 Drawings

In addition to those stipulated in clause regarding drawings in GCC/SCC, the following also shall apply in respect of Contractor Drawings.

1.3.1 All drawings submitted by the Contractor including those submitted at the time of Bid shall be with sufficient details to indicate the type, size, arrangement, dimensions, material description, Bill of Materials, weight of each component break-up for packing and shipment, fixing arrangement required, the dimensions required for installation and any other information specifically requested in these specifications.

1.3.2 Each drawing submitted by the Contractor shall be clearly marked with the name of the KSEBL, the specification title, the specification number and the name of the Project. All titles, noting, markings and writings on the drawing shall be in English. All the dimensions should be to the scale and in S.I. units.

1.3.3 The drawings submitted by the Contractor shall be reviewed by the KSEBL as far as practicable, within 15 days and shall be modified by the Contractor if any modifications and/or corrections are required by the KSEBL. The Contractor shall incorporate such modifications and/or corrections and submit the final drawings for approval. Any delay arising out of failure by the Contractor to rectify the drawings in time shall not alter the contract completion date.

1.3.4 The drawings submitted for approval to the KSEBL shall be in quadruplicate. One print of such drawings shall be returned to the Contractor by the KSEBL marked "approved/approved with corrections". The contractor shall there upon furnish

the KSEBL additional prints as may be required along with one reproducible in original of the drawings after incorporating all corrections.

- 1.3.5 The work shall be performed by the Contractor strictly in accordance with these drawings and no deviation shall be permitted without the written approval of the KSEBL, if so required.
- 1.3.6 All manufacturing, fabrication and erection work under the scope of Contractor, prior to the approval of the drawings shall be at the Contractor's risk. The contractor may incorporate any changes in the design, which are necessary to conform to the provisions and intent of the contract and such changes will again be subject to approval by the KSEBL.
- 1.3.7 The approval of the documents and drawings by the KSEBL shall mean that the KSEBL is satisfied that:
- (a) The Contractor has completed the part of the Works covered by the subject document (i.e. confirmation of progress of work).
 - (b) The Works appear to comply with requirements of Specifications.

In no case the approval by the KSEBL of any document does imply compliance with all technical requirements or the absence of errors in such documents.

If errors are discovered any time during the validity of the contract, then the Contractor shall be responsible for consequences.

- 1.3.8 All drawings shall be prepared using AutoCAD software version 2000 or later only. Drawings, which are not compatible to AutoCAD software version 2000 or later, shall not be accepted. After final approval, all the drawings (structural drawings, BOMs, shop sketches and tower accessories drawings) shall be submitted to the KSEBL in CDs.

A copy of each drawing reviewed will be returned to the Contractor as stipulated herein.

- 1.3.9 Copies of drawings returned to the Contractor will be in the form of a print with the KSEBL's marking, or a print made from a microfilm of the marked-up drawing.
- 1.3.10 The following is the general list of the documents and drawings that are to be approved by the KSEBL.
- a) Work Schedule (Master Network) Plan.
 - b) Detailed survey report and profile drawings showing ground clearance and tower locations (as applicable).
 - c) Tower schedule and foundation classification for individual tower locations.
 - d) Stringing procedure
 - e) Tower accessories drawings like danger plate, name plate, phase plate, circuit plate, pipe and counter poise type earthing etc.
 - f) Quality plans for fabrication and site activities including Quality System, Vendor's approval, etc.
 - g) Line material drawings.
 - h) Type test report for line materials.

- 1.3.11 All rights of the design/drawing for all types of towers and foundations shall be strictly reserved with the KSEBL only and any designs/drawings/data sheets submitted by the contractor from time to time shall become the property of the KSEBL. Under no circumstances, the Contractor shall be allowed to use/offer above designs/ drawings/data sheets to any other authority without prior written permission of the KSEBL. Any deviation to above is not acceptable and may be a cause for rejection of the bid.

1.4 Contractor Execution Plan

- 1.4.1 The time and the date of completion of the Contract as stipulated in the Contract by the Owner without or with modifications, if any, and so incorporated in the Letter of Award, shall be deemed to be the essence of the Contract. The Contractor shall so organize his resources and perform his work as to complete it not later than the date agreed to.
- 1.4.2 The Contractor shall submit a detailed PERT network/bar chart within the time frame agreed consisting of adequate number of activities covering various key phases of the work such as design, procurement, manufacturing, shipment and field erection activities within fifteen (15) days of the date of Notification of Award. This network shall also indicate the interface facilities to be provided by the Owner and the dates by which such facilities are needed. The Contractor shall discuss the network so submitted with the Owner and the agreed network shall form part of the Contract documents. During the performance of the Contract, if in the opinion of the Engineer, proper progress is not maintained, suitable changes shall be made in the Contractor's operations to ensure proper progress without any cost implication to the Owner. The interface facilities to be provided by the Owner in accordance with the agreed network shall also be reviewed while reviewing the progress of the Contractor.
- 1.4.3 Based on the above agreed network/bar chart fortnightly reports shall be submitted by the Contractor as directed by the Engineer.
- 1.4.4 Subsequent to the finalisation of the network, the Contractor shall make available to the Engineer a detailed manufacturing programme in line with the agreed Contract network. Such manufacturing programme shall be reviewed, updated and submitted to the Engineer once every two months thereafter.
- 1.4.5 The above bar charts/manufacturing programme shall be compatible with the Owner's computer environment and furnished to the Owner on such media as may be desired by the Owner.

1.5 Design Improvements

The KSEBL or the Contractor may propose changes in the specification and if the parties agree upon any such changes and the cost implication, the specification shall be modified accordingly.

1.6 Design Co-ordination

Wherever, the design is in the scope of Contractor, the Contractor shall be responsible for the selection and design of appropriate material/item to provide

the best coordinated performance of the entire system. The basic design requirements are detailed out in this Specification. The design of various components, sub-assemblies and assemblies shall be so done that it facilitates easy field assembly and maintenance.

1.7 Review Meeting

The contractor will be called upon to attend review meetings with the KSEBL, during the period of Contract. The contractor shall attend such meetings at his own cost at the Corporate Office of the KSEBL or at mutually agreed venue as and when required. Such review meeting will be held as and when required.

1.8 Quality Assurance, Inspection & Testing

1.8.1 Quality Assurance

To ensure that the supply 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 site or at any other place of work are in accordance with the specifications. The Contractor shall adopt suitable quality assurance programme to control such activities at all points necessary. Such programme shall be broadly outlined by the Contractor and shall be finalised after discussions before the award of Contract. The detailed programme shall be submitted by the contractor after the award of contract and finally accepted by the KSEBL after discussion. A quality assurance programme of the Contractor shall generally cover but not limited to 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 services including vendor analysis, source inspection, incoming raw material inspection, verification of material purchases etc.
- (e) System for shop manufacturing including process controls and fabrication and assembly controls.
- (f) Control of non-conforming items and system for corrective action.
- (g) Control of calibration and testing of measuring and testing equipments.
- (h) Inspection and test procedure for manufacture.
- (i) System for indication and appraisal of inspection status.
- (j) System for quality audits.
- (k) System for authorizing release of manufactured product to the KSEBL.
- (l) System for maintenance of records.
- (m) System for handling storage and delivery and
- (n) A quality plan detailing out the specific quality control procedure adopted for controlling the quality characteristics relevant to critical and important items of supply.
- (o) The Quality plan shall be mutually discussed and approved by the KSEBL after incorporating necessary corrections by the Contractor as may be required.

1.8.2 Quality Assurance Documents

The Contractor shall be required to submit all the Quality Assurance Documents as stipulated in the Quality Plan at the time of KSEBL's inspection of equipment/material.

1.8.3 The KSEBL or his duly authorized representatives reserves the right to carry out Quality Audit and quality surveillance of the systems and procedures of the Contractor's/his vendor's Quality Management and Control Activities.

1.8.4 KSEBL's Supervision

- a) To eliminate delays and avoid disputes and litigation to the Contract, all matters and questions shall be resolved in accordance with the provisions of this document.
- b) The manufacturing of the product shall be carried out in accordance with the specifications. The scope of the duties of the KSEBL, pursuant to the contract, will include but not be limited to the following.
 - i. Interpretation of all the terms and conditions of these Documents and Specifications.
 - ii. Review and interpretation of all the Contractor's drawings, engineering data etc.
 - iii. Witness or authorize his representative to witness tests at the manufacturer's works or at site, or at any place where work is performed under the contract.
 - iv. Inspect, accept or reject any equipment, material and work under the Contract, in accordance with the Specifications.
 - v. Issue certificate of acceptance and/or progressive payment and final payment certificate.
 - vi. Review and suggest modification and improvement in completion schedules from time to time, and
 - vii. Supervise the Quality Assurance Programme implementation at all stages of the works.

1.8.5 Contractors Supervision

The contractor shall appoint, sufficient number of competent and qualified Engineering personnel (graduate and diploma engineers) as required and approved by the Engineer in-charge for supervision and execution of the work. The necessary qualified supervisors for work execution/quality/safety/testing etc shall be employed by the contractor as per actual requirement of the work. The contractor shall intimate the Engineer-in-charge in writing the names and identity of technical personnel proposed to be engaged on the work.

1.9 Inspection and Tests

1.9.1 Inspection

- a) The KSEBL, its duly authorized representative and/or outside inspection agency acting on behalf of the KSEBL shall have, at all reasonable times,

access to the premises and /or works of the contractor and/or their sub-contractor(s) /sub-vendors and shall have the right, at all reasonable times, to inspect and examine the materials and workmanship of the product during its manufacture.

- b) The Contractor shall give the KSEBL's Inspector, fifteen (15) days (in case of domestic testing and thirty (30) days (in case of foreign testing), as the case may be, written notice of any material being ready for testing. In case of turnkey contract, the turnkey contractor shall give the notice for inspection and shall associate in the inspection with Employee's inspector. All such inspections shall be to the Contractor's account except for the expenses of the KSEBL's inspector. The KSEBL's inspector, unless witnessing of the tests is virtually waived, will attend such tests within fifteen (15) days (in case of domestic testing) and thirty (30) days in (in case of foreign testing) of the date of which the equipment is notified as being ready for test/ inspection or on a mutually agreed date, failing which the Contractor may proceed with the test in accordance with the technical specification after informing the KSEBL in writing and he shall forthwith forward to the inspector duly certified copies of test reports / certificates in triplicate.
- c) The KSEBL's Inspector shall, within fifteen (15) days from the date of inspection, give notice in writing to the Contractor, of any objection to any drawings and all or any equipment and workmanship which in his opinion is not in accordance with the Contract. The Contractor shall give due consideration to such objections and shall make the modifications that may be necessary to meet the said objections.
- d) When the factory tests have been completed at the Contractor's or Sub-Contractor's works, the KSEBL's inspector shall issue a certificate to this effect within fifteen (15) days after completion of tests but if the tests are not witnessed by the KSEBL's inspector, the certificate shall be issued within fifteen (15) days of receipt of the Contractor's Test Certificate by the KSEBL's Inspector. The completion of these tests or the issue of the certificate shall not bind the KSEBL to accept the equipment should it, on further tests after erection, be found not to comply with the Contract.
- e) In all cases where the Contract provides for test whether at the premises or works of the Contractor or of any Sub-Contractor, the Contractor except where otherwise specified, shall provide free of charge such item as labour, materials, electricity, fuel, water, stores, apparatus and instruments as may be reasonably demanded by the KSEBL's inspector or his authorised representative to carry out effectively such tests of the equipment in accordance with the Contract and shall give facilities to the KSEBL's Inspector or to his authorised representative to accomplish testing.
- f) The inspection by KSEBL and issue of Inspection Certificate thereon shall in no way limit the liabilities and responsibilities of the Contractor in respect of the agreed Quality Assurance Programme forming a part of the Contract.
- g) **i)** The Contractor shall keep the KSEBL informed in advance about the time of starting and of the progress of manufacture and fabrication of various

tower parts at various stages, so that arrangements could be made for inspection.

ii) The acceptance of any part of items shall in no way relieve the Contractor of any part of his responsibility for meeting all the requirements of the Specification.

- h) The KSEBL or his representative shall have free access at all reasonable times to those parts of the Contractor's works which are concerned with the fabrication of the KSEBL's material for satisfying himself that the fabrication is being done in accordance with the provisions of the Specification.
- i) Unless specified otherwise, inspection shall be made at the place of manufacture prior to dispatch and shall be concluded so as not to interfere unnecessarily with the operation of the work.
- j) Should any member of the structure be found not to comply with the supplied design, it shall be liable to rejection. No member once rejected shall be resubmitted for inspection, except in cases where the KSEBL or his authorized representative considers that the defects can be rectified.
- k) Defect which may appear during fabrication shall be made good with the consent of, and according to the procedure proposed by the Contractor and approved by the KSEBL.
- l) All gauges and templates necessary to satisfy the KSEBL shall be supplied by the contractor.
- m) The specified grade and quality of steel shall be used by the Contractor. To ascertain the quality of steel used, the inspector may at his discretion get the material tested at an approved laboratory.

1.9.2 Tests

- a) The type, acceptance and routine tests and tests during manufacture shall be carried-out on the material and shall mean as follows:
 - i. Type Tests shall mean those tests which are to be carried out to prove the process of manufacture and general conformity of the material to this Specification. These tests shall be carried out on samples prior to commencement of commercial production against the order.
 - ii. Acceptance Tests shall mean those tests which are to be carried out on samples taken from each lot offered for pre-dispatch inspection, for the purposes of acceptance of that lot.
 - iii. Routine Tests shall mean those tests, which are to be carried out on the material to check requirements which are likely to vary during production.
 - iv. 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.

- b) The norms and procedure of sampling for these tests will be as per the Quality Assurance Programme to be mutually agreed to by the Contractor and the KSEBL.
- c) 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 procedure of the test shall be as specified in respective Annexures or as mutually agreed to between the Contractor and the KSEBL in the Quality Assurance Programme.
- d) For all type and acceptance tests, the acceptance values shall be the values specified in this Specification or guaranteed by the Bidder, as applicable.

1.10 Guaranteed Technical Particulars (GTP)

The Guaranteed Technical Particulars (GTP) of the various items is given in the relevant schedule of the specification. **The bidder is required to comply with the same in line with technical requirements of the items/ materials as mentioned in part B of volume II.**

1.11 Packing

- a) All the materials shall be suitably protected, coated, covered or boxed and crated to prevent damage or deterioration during transit, handling and storage at Site till the time of erection. The Contractor shall be responsible for any loss or damage during transportation, handling and storage due to improper packing.
- b) The Contractor shall include and provide for securely protecting and packing the materials so as to avoid loss or damage during transport by air, sea, rail and road. All packing shall allow for easy removal and checking at site. Wherever necessary, proper arrangement for attaching slings for lifting shall be provided. All packages shall be clearly marked for with signs showing 'up' and 'down' on the sides of boxes, and handling and unpacking instructions as considered necessary. Special precaution shall be taken to prevent rusting of steel and iron parts during transit by sea.
- c) The cases containing easily damageable material shall be very carefully packed and marked with appropriate caution symbols, i.e. fragile, handle with care, use no hook etc. wherever applicable.
- d) Each package shall be legibly marked by the Contractor at his expenses showing the details such as description and quantity of contents, the name of the consignee and address, the gross and net weights of the package, the name of the Contractor etc.
- e) Angle section shall be wire bundled.
- f) Cleat angles, gusset plates, brackets, fillet plate, hanger and similar loose pieces shall be tested and bolted together in multiples or securely wired through holes.
- g) Bolts, nuts washers and other attachments shall be packed in double gunny

bags accurately tagged in accordance with the contents.

- h) The packing shall be properly done to avoid losses & damages during transit. Each bundle or package shall be appropriately marked.

2.0 KSEBL'S ENVIRONMENT AND SOCIAL POLICY AND ITS IMPLEMENTATION

2.1 Development and growth of mankind through Industrialization and unwarranted use of natural resources has inflicted considerable impact on Environment and Society. As a result, Environmental and Social issues have emerged as the focal point of global debate.

KSEBL's activities by their inherent nature and flexibility have negligible impacts on environmental and social attributes. In order to address these issues and to match the rising expectations of a cleaner, safer and healthier environment, KSEBL has evolved its Environmental and Social Policy and Procedures (ESPP). The key principles of KSEBL's Environmental and Social Policy are:

- i) Avoidance of environmentally and socially sensitive areas while planning project activities.
- ii) Minimisation of impacts when project activities occur in environmentally and socially sensitive areas.
- iii) Mitigation of any unavoidable adverse impacts arising out of its projects.

2.2 Basic issues to be kept in mind while carrying out construction activities are to:

- i) Avoid socially sensitive areas with regard to human habitations and areas of cultural significance.
- ii) Secure the interest of people affected by KSEBL's projects.
- iii) Involve local people affected by transmission line projects as per requirement and suitability.
- iv) Consult affected people in decisions having implication to them if considered necessary.
- v) Apply efficient and safe technology/practices.
- vi) Keep abreast of all potential dangers to people's health, occupational safety and safety of environment and the respective mitigation measures.
- vii) Establish preventive mechanisms to guarantee safety.
- viii) Mitigation measures in case of accidents.
- ix) Avoid unwarranted cutting of trees in forest area.

2.3 While constructing the lines through forest stretches the contractor will provide alternate arrangements to its employee e.g. working labours/supervisors etc. in order to avoid cutting of forest woods. Contractor will ensure safety to the wild life, during working/ camping near to the National park. Contractor during construction of lines in agricultural fields will ensure minimum damages to the crops, trees, bunds, irrigation etc. If the same is un-avoidable, the decision of Engineer- in-charge shall be final.

2.4 The waste/excess material/debris should be removed from the construction site including agricultural field, forest stretches, river etc. immediately after construction work. The Contractor will ensure least disturbance to the hill slope and natural drainage so as to avoid soil erosion. Natural drainage in plain area if

disturbed is to be restored to the satisfaction of Engineer-in-charge. As far as possible, existing path/kutchcha road/ approach shall be used for the construction. The Contractor will ensure supply of stone chips/sand from authorized/approved quarry areas, proper documentation of above, if any.

3.0 STANDARDS

The Indian Standard Specification (IS), British Standards (BS), IEC, ISO, ASTM, CBIP manual etc. relevant to transmission line design, testing and construction as amended up to date shall be applicable to the materials and works used in this project. Bidder shall ensure minimum compliance with the following Acts, Rules, Regulations, Codes, Standards and Specifications:

1	Indian Electricity Act - 2003
2	Indian Telegraph Act - 1885
3	Indian Electricity Rules - 1956
4	CEA (Technical Standards for construction of Electric Plants and Electric Lines) Regulations 2010
5	CEA (Safety requirements for Construction, Operation & Maintenance of Electrical Plants & Electric Lines) Regulation 2010
6	CEA (Measures relating to Safety & Electricity Supply) Regulation-2010
7	CEA (Technical Standards for connectivity to the Grid) Regulation-2007
8	Indian Electricity Grid Code (IEGC) 2006
9	CEA (Grid Standards) Regulations 2010
10	CBI&P Manual on Commissioning Procedure for Transmission Lines - Pub. No. 292
11	CBI&P Manual on Maintenance of EHV Substation Equipment
12	CBI&P Manual on Maintenance of Transmission Lines - Pub. No. 293
13	All relevant Indian Standards - up to date with amendments

Notes:

In the event of conflict between standards and specifications prescribed in two or more of the aforesaid codes, the Bidder shall be at liberty to rely on one of the aforesaid codes and on Good Industry Practice, provided however, that in the event of any such conflict, the following codes shall have overriding priority in the order listed:

- a) Specifications and Standards set out in this Document;*
- b) CEA (Technical Standards for construction of Electric Plants and Electric Lines Regulations 2010.*
- c) In the event of any conflict between the requirement of the international Standards or codes and the requirement of the BIS Standards or Codes, the latter shall prevail.*
- d) Where no standards exist, as in the case of patented or special materials; all such equipment's & materials shall be of reputed make. Full details of the material and any quality control tests to which they may be subject shall be submitted to the Independent Engineer for approval.*
- e) The latest version of the aforesaid codes, standards and specifications, which have been published at least 60 (sixty) days before the last date of bid submission shall be considered applicable.*

4.0 ALTERNATIVE STANDARDS AND SPECIFICATIONS

The requirements listed in this Document are the minimum. The Bidder may adopt alternative internationally recognized codes, standards and specifications if it can demonstrate to the Engineer of KSEBL that such alternative is superior or more pertinent to the Project than the standards specified in this document.

SECTION - 3
SITE ACCESS

1. WAY LEAVES

A preliminary line route shall be provided by the KSEBL to enable the Contractor to start with the Contract works. The line route plan does not include facilities for storing material.

The Contractor will satisfy himself that the necessary rights of entry and access have been obtained before entry is affected. The Contractor shall indicate to the Engineer such pipes or other obstructions, telephone, telegraph and power lines which infringe the clearances specified or otherwise fail to satisfy the requirements of the Specification.

The necessary permission for the removal of obstructions such as trees, houses, etc. and for the permanent removal or guarding of pipes, telegraph, telephone and power lines will be in the responsibility of the Contractor. The KSEBL shall assist the Contractor in getting that permission, if required for such works.

2. ACCESS TO SITE, NOTICE OF ENTRY

2.1 Access Routes – General

The KSEBL may indicate to the Contractor the general route for access to each or any position as agreed by the KSEBL, otherwise the Contractor shall make all necessary arrangements (other than questions of way leaves) with the occupier.

Subject to the provisions of the preceding paragraph the Contractor shall before commencing work, at his own expenses, do what is necessary to make the access suitable for his use and shall take all reasonable precautions to avoid damage, including, if required the erection of temporary fences or gates where permanent fences, hedges or gates have been removed. The Contractor shall not be entitled to any additional payment in the event of a particular access being difficult.

The Contractor shall be responsible for maintaining agreed access routes, without undue widening, in a usable condition for the duration of the Contract and the occupier shall not be put to any inconvenience in gaining access to his land or buildings. No unauthorised access route shall be taken by the Contractor.

2.2 Commencement of Work

The Contractor shall be responsible, before beginning work on any property for obtaining confirmation from the Engineer that way leaves are in order and any agreed accesses, have not been altered and for giving not less than 48 hours' notice to the occupiers that work is to begin. Work shall proceed on any land within the requisite period of such notice being given to the occupier.

2.3 Suspension of Work

Where work is to be suspended without the expectation of it being resumed within the specified period, the Contractor must notify the occupier of such intention and shall similarly give the occupier prior notification of the resumption

of work. The purpose of this Clause is to assist in maintaining good relations between the occupier, the Contractor and the KSEBL and to keep the occupier informed of what is going to happen on or across his land.

2.4 Compliance with Occupier's Requirements

The Contractor shall at all times during the execution of the Works ensure compliance with all such reasonable requirements of the occupier as are brought to the Contractor's notice by the Engineer.

2.5 Notice to Authorities

Before the Contractor carries out the stringing of conductors along, or across power or telecommunication circuits, public roads, etc., he shall give the requisite notice of the time and date when he proposes to perform the work to the Engineer and the Engineer will follow up the matter with appropriate Authorities.

3 ROUTE CLEARANCE

For details of the clearance requirements for survey, access routes, line route, tower locations and conductor stringing reference shall be given by KSEBL.

4 ACCESS ROADS

Access roads/ routes shall be identified by the Contractor themselves as and where necessary and shall be constructed by them at their own expense.

5 CROSSING OF OBSTACLES

5.1 General

The Contractor shall, at his own expense, make necessary arrangements and take the necessary precautions where the route crosses buildings, telecommunication, power or pipe lines, orchards, gardens, railways, antiquities or other obstructions or ground over or across which erection cannot be carried out in the normal manner or has to be avoided. These arrangements must be submitted to the Engineer.

Where a tower is set across a fence, hedge, bank or wall, the Contractor shall remove and reinstate the fence, hedge, bank or wall at his own expense and he shall be responsible at his own expense for making good to the satisfaction of the Engineer, owners and tenants concerned, all land, property, roads, drains, fences, walls, hedges, gates and the like which he has damaged or disturbed during the execution of the Contract Works and shall remove all surplus material after erection. The Contractor shall take proper precautions to prevent the straying of and damage to livestock until after the backfilling of excavations and permanent reinstatement of fences, walls, hedges, gates and the like is completed.

5.2 Public Utilities

The Contractor shall ensure that the erection of the Contract Works does not cause damage to or interference with existing telecommunication, power or pipe lines. Where appropriate Authorities affected deem it necessary for the

protection of their employees, property, or the public or for the assistance of traffic to provide flagmen and watchmen, the cost of such provision shall be borne by the Contractor. Where required by the appropriate Authorities, work shall be carried on outside normal hours and at the Contractor's own expense.

The Contractor shall also be liable to make good at least to the original condition or compensate the owners, operators and users or any public undertaking in respect of any damage however caused to their property, lands or roads arising, out of or in consequence of the execution of the Works.

5.3 Scaffolding

The Contractor shall provide all necessary scaffolding and the like for the crossing of telecommunications or power lines, roads, railways, buildings or other obstacles. The Contractor shall advise the KSEBL in each instance of the scaffolding he proposes to use. Drawings of the proposed scaffolding shall be submitted to the KSEBL, and the appropriate regulatory authorities for approval.

6 DAMAGE

6.1 General

The Contractor shall take all reasonable precautions to avoid damage to land, property, roads, crops, field drains, fences walls, hedges, gates, trees and the like and shall ensure that the work is adequately supervised so that any damage is reduced to the minimum. The Contractor shall pay compensation to the owners/tenants for damages of crops, trees and houses during the project implementation within the way leaves (right-of-way) which are unavoidable for construction of the transmission line. The KSEBL's representative shall assist the Contractor in his negotiations with the landowners about such compensation.

6.2 Contractor's Responsibility

The Contractor's liability for loss or damage shall extend to any such loss or damage resulting from the employment of a Subcontractor. This does not relieve the Contractor of his liability for all actions of his Subcontractor.

6.3 Livestock, Dogs

Adequate provision shall be made by the Contractor to prevent the straying of or injury to livestock during the execution of the Works and until the permanent reinstatement of fences, walls, hedges, gates and the like is completed.

The Contractor shall not bring any dog on or near the site or suffer or permit any of his employees, representatives or agents or any Subcontractor to bring any dog on or near the site and shall cause the immediate removal of any dog which may be on or near the Site in breach of this provision.

The Contractor shall be liable for any injury to or loss of livestock due in the opinion of the Engineer to failure to comply with the above requirements.

7 STANDARDS

The reference standards and other documents referred to in this Section of the specification are listed below:

BS 1139:	Metal scaffolding
BS 5950:	Structural use of steel work in building
BS EN 12811-1:	Code of practice for access and working scaffolds and special scaffold structures in steel
BS 6323:	Specification for seamless and welded steel tubes for automobile, mechanical and general engineering purposes.
BS EN 12810-1:	Facade Scaffolds
EN 10296/10297/10305:	Welded circular steel tubes/seamless circular tubes/steel tubes for precision application

Sd/-

Addnl. CEO

REC Transmission Projects Company Limited

PART B
TECHNICAL SPECIFICATIONS OF MATERIALS

SECTION - 4**TECHNICAL SPECIFICATIONS OF TOWER & ACCESSORIES****TABLE OF CONTENT**

Sl No.	Description
1	General Information and Scope
2	Transmission tower
3	Tower accessories
4	Tower fabrication
5	Drilling and punching
6	Erection mark
7	Quantities and weights
8	Galvanising
9	Earthing
10	Standard
11	Classification of towers
12	Extensions
13	Span and clearances
14	Electrical clearances
15	Service conditions

SECTION - 4**TECHNICAL SPECIFICATIONS OF TOWER & ACCESSORIES****A) GENERAL INFORMATION AND SCOPE****1. Scope**

The following 220/110 kV Towers & Materials are included in the scope of the Contractor:-

Sl No.	Item Description
1	220/110kV MCMV Galvanized Lattice towers, Stub & Cleat, Template, Bolt and Nut and all other accessories complete
2	ACSR Panther and Kundah Conductors
3	Dead End Fitting-single & twin
4	Suspension Clamp - single & twin
5	Mid Span Joint
6	Repair Sleeve
7	Pilot Suspension Clamp
8	Vibration Damper
9	70 KN / 90 kN /120 kN Long Rod Composite Insulator
10	Suspension Fitting-single & twin
11	Tension Fitting-single & twin
12	Pilot Suspension Fitting
13	Tee-Taps with Connectors
14	OPGW 48 Pair with accessories
15	Single Tension Dead End Fitting
16	Suspension Clamp
17	Double tension set for pass through location
18	Double tension set for Joint Box location
19	Vibration Damper
20	Down Lead clamp
21	Joint Box 48 Fiber
22	Reinforcing Rod for damper
23	FODP
24	Pipe Earthing Set 3M with all accessories
25	Counterpoise earthing set complete
26	Galvanized Earth Wire
27	
28	

Note: The items are tentative and actual may vary as per site conditions

2. Transmission Tower

The general description of towers applicable for the package and technical particulars thereof are indicated in Section-I of this Specification.

2.1 Design and Drawings

2.1.1 The basic drawings for all the towers and their extensions will be provided by KSEBL, which shall include structural drawings/erection drawings and / or shop fabrication drawings, Bill of Materials for all the towers and their extensions as well as construction drawings for foundations.

2.1.2 The tower members can be directly fabricated from the structural/erection drawings wherever the required fabrication details are provided on the same or shop fabrication drawings. Before taking up mass fabrication, the Contractor shall arrange for one number proto-assembly for each type of tower and extensions which shall be inspected by KSEBL. After assembly inspection, the Contractor shall incorporate revisions in the drawings. The revised drawing shall be submitted in 3 (three) copies for final approval by the KSEBL.

2.1.3 All the drawings shall have a proper name plate clearly displaying the name of KSEBL on right hand bottom corner. The exact format of the nameplate shall be handed over to the successful bidder for incorporation of the same on all the drawings.

2.1.4 While submitting the structural drawings, bill of materials, shop drawings and any other drawings pertaining to the subject transmission line, the Contractor shall clearly indicate on each drawing KSEBL Specification No., Name of the specific Transmission line and project, letter reference no. and date on which the submission are made. The same practice is also to be followed while submitting distribution copies.

2.1.5 The bidder shall submit the tower accessories drawings like number plate, phase plate, Danger plate, bird guard, circuit plate, step bolt, earthing, etc after endorsing the name of the project. Also drawing of anti-climbing device, D-shackle etc. shall be prepared by the Contractor and shall be submitted to the KSEBL, in three (3) copies for approval. This drawing shall be prepared in A4 size only.

2.1.6 The drawings prepared and submitted by the Contractor shall be approved / commented by the KSEBL as the case may be, within fifteen (15) days of receipt of drawings in his office. If the designs/drawings are commented by the KSEBL, the Contractor shall submit revised design/drawings duly incorporating all comments within fifteen (15) days of date of issue of comments. The Contractor shall submit 15 copies of all approved structural drawings and BOM for tower extensions as well as for tower accessories for further distribution by the KSEBL.

The mass fabrication shall be taken up from the approved shop drawings. The overall responsibility of fabricating tower members correctly lies with the Contractor only and the Contractor shall ensure that all the tower members can be assembled / fitted while erecting without any undue strain on them.

2.2 Materials

2.2.1 Tower Steel Sections

IS Steel Sections of tested quality of conformity with IS:2062:2006 grade E250 (Designated Yield Strength. 250 MPa) and/ or grade E350 (Designated Yield Strength 350 MPa) are to be used in towers, extensions, stubs and stub setting templates. The Contractor can use other equivalent grade of structural steel angle sections and plates conforming to latest International Standards. However, use of steel grade having designated yield strength more than that of EN 10025 grade S355 JR/JO (designated yield strength 355 MPa) is not permitted, unless otherwise indicated in this specification.

Steel plates below 6mm size exclusively used for packing plates/packing washers produced as per IS 1079 -1994 (Grade -0) are also acceptable. However, if below 6mm size plate are used as load bearing plates viz gusset plates, joint splices etc. the same shall conform to IS : 2062 / or equivalent standard meeting mechanical strength/ metallurgical properties corresponding to grade E250 or grade E350 (designated yield strength not more than 355MPa), depending upon the type of grade incorporated into design. Flats of equivalent grade meeting mechanical strength/ metallurgical properties may also be used in place of plates for packing plates/ packing washers. The chequered plates shall conform to IS: 3502. SAILMA 350HI grade plate can also be accepted in place of HT plates (EN 10025 grade S355 JR/JO / IS 2062:2006 – grade 350, as applicable) provided SAILMA 350HI grade plate meet all the mechanical properties of plate as per EN 10025 grade S355 JR/JO (designated yield strength 355 MPa) / IS 2062:2006 – grade 350.

For designing of towers, preferably rationalised steel sections have been used. During execution of the project, if any particular section is not available, the same shall be substituted by higher section. Any cost on account of the same shall be borne by the Contractor. However, design approval for such substitution shall be obtained from the Board before any substitution and records of such substitutions shall be maintained by the Contractor.

2.2.2 Fasteners: Bolts, Nuts and Washers including Anti-Theft Bolts & Nuts

All tower members shall be joined together with Bolts and nuts. The redundant members of first two panels from ground level shall be connected with Anti-theft bolts and nuts along with spring washers whereas the balance joints shall be connected with hexagonal bolts and nuts. All hexagonal bolts and nuts shall conform to IS-12427. They shall have hexagonal head and nuts, the heads being forged out of the solid, truly concentric, and square with the shank, which must be perfectly straight. Anti-theft bolts and nuts shall have round tapered heads with hexagonal shear nuts. They shall confirm to IS: 12427 and IS: 1367 for property class 5.6/5 except for dimensions. All bolts and nuts shall be galvanised as per IS: 1367 (Part-13)/IS: 2629.

- a) The bolt shall be of 16/24 mm diameter and of property class 5.6 as specified in IS: 1367 (Part-III) and matching nut of property class 5.0 as specified in IS: 1367 (Part-VI).
- b) Bolts up to M16 and having length up to 10 times the diameter of the bolt

should be manufactured by cold forging and thread rolling process to obtain good and reliable mechanical properties and effective dimensional control. The shear strength of bolts 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.

- c) Nuts for hexagonal bolts should be double chamfered as per the requirement of IS: 1363 Part-III. It should be ensured by the manufacturer that nuts should not be over tapped beyond 0.4mm oversize on effective diameter for size up to M 16.

Nuts for anti-theft bolts should be round tapered with hexagonal shear nuts. The hexagonal portion of shear nuts shall break away at specified torque recommended by the supplier to ensure proper tightening of members and the fasteners shall not be opened subsequently with tools. The tightening torque and shearing of anti-theft nuts shall be verified during proto-assembly.

- d) Fully threaded bolts shall not be used. The length of bolts shall be such that the threaded portion will not extend into the place of contact of the members.
- e) All bolts shall be threaded to take the full depth of the nuts 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 than 3mm and not more than 8mm when fully tightened. All nuts shall fit tight to the point where the shank of the bolt connects to the head.
- f) Flat and tapered washers shall be provided wherever necessary. Spring washers shall be provided for insertion under all nuts. These washers shall be steel electro galvanised, positive lock type and 3.5 mm in thickness for 16 mm dia bolt and 4.5 mm for 24 mm bolt.
- g) To avoid bending stress in bolts or to reduce it to minimum, no bolt shall connect aggregate thickness of members more than three times its diameter.
- h) The bolt positions in assembled towers shall be as per structural drawing.
- i) Bolts at the joints shall be so staggered that nuts shall be tightened with spanners without fouling.
- j) To ensure effective in-process Quality control it is desirable that the manufacturer should have in house testing facility for all tests like weight of zinc coating, shear strength and other tests etc. The manufacturer should also have proper Quality Assurance System which should be in line with the requirement of this specification and IS: 14000 series Quality System Standard.

3 Tower Accessories

Arrangement shall be provided for fixing of all tower accessories to the tower, at

a height between 2.5 meters and 3.5 meters above the ground level.

3.1 Step Bolts & Ladders

Each tower shall be provided with step bolts as per specification drawings. The contractor shall submit distribution copies of the same endorsing the package details (i.e. line name, LOI No. etc). The step bolts conforming to IS: 10238 of not less than 16mm diameter and 175mm long spaced not more than 450mm apart and extending from 2.5 meters above the ground level to the top of the tower. However, the head diameter shall be 50mm. For Double circuit tower the step bolt shall be fixed on two diagonally opposite legs up to top of the towers. Each step bolt 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. For special towers, where the height of the super structure exceeds 50 meters, ladders along with protection rings, as per KSEBL approved design shall be provided in continuation of the step bolts on one face of the tower from 30 meters above ground level to the top of the special structure. In this case the bidder shall supply the relevant drawings of the ladder to KSEBL for approval. From 2.5 m to 30m height of super structure step bolts shall be provided. Suitable platform using 6 mm thick perforated chequered plates along with suitable railing for access from step bolts to the ladder and from the ladder to each cross-arm tip and the ground wire support shall also to be provided. The platform shall be fixed on tower by using counter-sunk bolts.

3.1.1 Insulator Strings and Earth wire Clamps Attachments

3.1.2 For the attachment of suspension Insulator string, a suitable dimensioned swinging hanger on the tower shall be provided so as to obtain specified clearances under respective swinging condition of the strings. The hanger, extensions links, D-shackles etc. as required and considered in the design of the tower shall have minimum ultimate tensile strength of 90 kN /70 KN for single suspension string and 120 kN/90 KN for double suspension string for 220/110 KV suspension towers. The design and supply of hanger, D-shackles, strain plate, extension link etc. are also in the scope of Contractor.

3.1.3 At tension towers, strain plates of suitable dimensions under each cross-arm tip, shall be provided for taking the hooks or D-shackles of the tension insulator strings. Full details of the attachments shall be provided to the contractor. To achieve requisite clearances, if the design calls for providing extra D-shackles, link plate etc. before connecting the insulator string the same shall be supplied by the Contractor.

3.1.4 Earth wire Clamps Attachments

a) Suspension Clamp

Wherever required, the Contractor shall supply U – bolts, D – Shackles, copper bond etc. for attachment of Suspension clamp to the tower and take KSEBL's approval for details of the attachments before the mass fabrication.

b) Tension Clamps

- c) Earth wire peaks of tension towers shall be provided with suitable plates to accommodate the shackle of tension clamps. The contractor shall also supply the U-bolts wherever required and take KSEBL's approval for details of the attachments before the mass fabrication.

3.1.5 Anti-climbing Device & Bird Guard

Barbed wire type anti climbing device shall be provided and installed by the Contractor for all towers. The barbed wire shall conform to IS-278 (size designation A1). The barbed wires shall be given chromating dip as per procedure laid down in IS: 1340. The drawings of ACD shall be approved by KSEBL.

The bird guards for suspension towers shall be made of galvanized iron sheet and shall conform to IS: 5613 (Part-2/Section-1)-1985. Necessary holes shall be provided on the cross arm of the suspension towers for fixing the bird guards.

3.1.6 Danger, Number, Circuit and Phase plate

Danger Plates, Phase Plates and Number plates shall be provided and installed by the Contractor. Further Circuit plates also shall be provided and installed by the contractor for the Double circuit towers. These Danger/Number/Phase/ circuit Plate shall be as per the drawing enclosed in the section of drawing. The contractor shall submit distribution copies of the same endorsing the package details (i.e. line name, LOI No. etc) and installed by the Contractor.

- a) Each tower shall be fitted with a danger plate, number plate and a set of phase plates for each circuit. The transposition towers should have provision of fixing phase plates on both the transverse faces. Circuit plates shall be provided on all the Multi Circuit towers.
- b) The letters, figures and the conventional skull and bones of danger plates shall conform to IS-2551 and shall be in a signal red on the front of the plate.
- c) The corners of the danger, number and circuit plates shall be rounded off to remove sharp edges.
- d) The letters of number and circuit plates shall be red enamelled with white enamelled background.

4 Tower Fabrication

The tower members shall be fabricated in accordance with IS: 802(Part -II)-1978 with the latest revision thereof. Following important points relevant to work are described as below: -

- 4.1 All parts of towers shall be fabricated in accordance with the shop drawings prepared from approved detailed assembly drawings.
- 4.2 Towers shall have bolted connection. Welding shall not be permitted at any point unless otherwise previously approved by the KSEBL.
- 4.3 The tower members shall be accurately fabricated, so that these could be bolted together easily at site without undue strain on the bolts or members.
- 4.4 No angle member shall have the two leg flanges brought together by closing the angle.

- 4.5 The structure shall be such that all parts are accessible for inspection and cleaning. Drain holes shall be provided at all points where pockets of depression are likely to hold water. It will be ensured that the stressed members will not have any blank hole after final assembly, except for holes on account of step bolts or planned holes in stubs.
- 4.6 Fabrication of towers shall be carried out in conformity with the latest practice employed in the manufacture of transmission line towers by using power driven cropping, punching, shearing and drilling machines. The extent of various operations shall be governed by relevant Indian standards or any other approved standard specifications and standard practice followed by such operations.
- 4.7 All sections before any work is done on them, shall be carefully levelled, straightened and made true to detailed drawing by methods which will not injure the material so that when assembled, the adjacent matching surface are in clear contact throughout. The steel sections shall be straightened and trued by pressure and not by hammering. No rough edge shall be permitted anywhere in the entire structure. The flanges of the angle sections at the ends of members shall be properly chamfered, if there are even slight chances of its fouling with other members or if they cause difficulty in proper tightening of bolts. All clippings, back cuts, grindings, bends, holes etc. shall be as per the detailed drawings and free from burrs.
- 4.8 Full interchangeability shall be guaranteed.
- 4.9 No welding, filling or plugging shall be permitted unless previously approved. Welding of two or more pieces to obtain length of members specified will not be permitted.
- 4.10 All sections, plates and bars, before any work is done on them, shall be straightened, free from twists, carefully levelled and made true to detailed drawings by methods, which will not injure the materials so that when assembled, the adjacent surfaces are in close contact throughout. Hammering shall not be permitted for straightening or flattening of members.
- 4.11 Cuttings of members shall be affected by shearing, cropping, flame cutting or sawing. Members preferably over 10 mm thickness shall be sawn, or flame cut followed by grinding. The surface so cut shall be clean, smooth, reasonably square and free from any distortion.
- 4.12 Members shall be bent hot, but in case of small bends, the cold bending may be done with the prior approval of the Engineer, provided no fracture of materials occurs. All the bending operations shall be done by pressure. No bending of members shall be done for slope above 45°.
- 4.13 When members are spliced by a lap joint, heel of inside angles shall be rounded to the minimum possible radius consistent with proper fit with the fillet of the outside angle. The thickness of the ground heel shall not be less than that of leg. Flat heeling will not be allowed.
- 4.14 The fabrication tolerances shall be as per IS: 7215-1974.

5 Drilling and Punching

- 5.1 Before any cutting work is started, all steel sections shall be carefully straightened and trued by pressure and not by hammering. They shall again be trued after being punched and drilled.
- 5.2 Holes in the members shall be either punched or drilled with the help of jigs and fixtures. Drilled holes will be preferred. However, members up to 12 mm thickness may be punched. Members over 12 mm thickness shall be drilled. All burrs left after drilling or punching should be removed completely. Holes adjacent to the bend shall be drilled or punched after bending. Tolerances regarding punch holes are as follows: -
- 5.2.1 Holes must be perfectly circular and no tolerances in this respect are permissible.
- 5.2.2 The maximum allowable difference in diameter of the holes on the two sides of plates or angle is 0.8mm. i.e. the allowable taper in a punched hole should not exceed 0.8mm on diameter.
- 5.2.3 Holes must be square with the plates or angles and have their walls parallel.
- 5.3 Holes for bolts shall be circular. Oval or lobbed forms of holes shall not be permitted. The diameter of holes shall be 1.5 mm more than diameter of bolts.
- 5.4 The accuracy of location of holes shall be such that for any group when assembled, it shall admit the bolt at right angles to the plane of connection.
- 5.5 All burrs left by drills or punch shall be removed completely. When the tower members are in position the holes shall be truly concentric/matching to each other. Drilling or reaming to enlarge holes shall not be permitted.

6 Erection mark

- 6.1 Each individual member shall have erection mark conforming to the component number given to it in the fabrication drawings. The mark numbers shall be marked with marking dies of 16 mm size before galvanising and shall be legible after galvanising,
- 6.2 Erection Mark shall be A – BB – CC – DDD
- A = KSEBL code assigned to the Contractors – Alphabet
BB = Contractor's Mark-Numerical
CC = Tower Type Alphabet.
DDD = Number mark to be assigned by Contractor – Numerical. Erection mark for high tensile steel members shall be prefixed by the letter "H"

7 Quantities and weights

- 7.1.1 The quantities of the following items have been envisaged in Metric Tonne (MT) in the relevant price Schedules for various types of towers: -
- i) Basic Body.
 - ii) Body Extensions.
 - iii) Leg Extension.
 - iv) Stubs & Cleats
 - v) Bolts & Nuts including spring washers and step bolts etc.
- 7.1.2 During detail engineering, proto assembly of each of the above items shall be

inspected and approved by KSEBL and subsequently shall be released for fabrication and manufacturing as per the Technical Specification by the Contractor. The manufacturing of the above items shall be taken up in such a manner that the Equipment/Material offered for inspection to KSEBL are on completed tower basis for each type of tower, completed Stubs & Cleats set basis so as to facilitate availability of erectable tower of each type and erectable stubs & cleats set for casting of foundation. After inspection of the offered Equipment/Material by KSEBL representative(s), MDCC shall be issued only on completed tower basis for each type of tower, on completed tower extensions basis of each type tower and on completed Stubs & Cleats set basis for each type of tower foundations.

- 7.1.3 The provisional quantities required are mentioned in the respective Price Schedule. The final quantities of tower shall be confirmed by the KSEBL based on the requirement of quantities of various towers furnished by the Contractor after completion of check survey.

The KSEBL reserves the right to order the final quantities including reasonable quantities of spares for which the rates quoted in the Bid shall be valid.

- 7.1.4 The estimated total weight of tower/tower parts as well as bolts & nuts along with spring washers and step bolts to be supplied by the Contractor under various packages have been envisaged in the relevant Price Schedule. Though fully galvanised tower parts are to be supplied, the weight of tower shall mean the weight of tower calculated by using the black sectional (i.e. non-galvanised) weight of steel members of the size indicated in the approved fabrication drawings and bill of materials, without taking into consideration the reduction in weights due to holes, notches and level cuts etc. but taking into consideration the weight of the D shackles, hangers, strain plates, pack plates, gusset plates and pack washers etc.

The weight of stub and cleats also shall be calculated in similar manner. The weight of gusset plates shall mean the weight of its circumscribing rectangle, without taking into considerations the reductions in weight due to holes, notches etc. For bolts and nuts along with spring washers and step bolts, the weight per tower shall be calculated from the bolt schedule applicable to each type of towers and body extensions as per approved B.O.M.

- 7.1.5 The contractor is permitted to get inspected and supply up to 2.5% extra fasteners to take care of losses during erection. No payment shall be admissible for these extra supplies.

8 Galvanising

8.1 Fabricated Tower Parts & Stubs

- 8.1.1 The tower parts, stubs and pack washers shall be hot dip galvanized. The galvanization shall be done as per requirements of IS 4759 after all fabrication work is completed. The contractor shall also take guidelines from the recommended practices for hot dip galvanizing laid down in IS: 2629 while deciding and implementing galvanizing procedure. The mandatory requirements however, are specified herein.

- 8.1.2 Unless otherwise specified, the fabricated tower parts and stubs shall have a

minimum overall Zinc coating of 610 gms per sq. m of surface except for plates below 5mm which shall have Zinc coating of 460 gms per sq. m of surface. The average zinc coating for sections 5 mm & above shall be maintained as 87 microns and that for sections below 5mm shall be maintained as 65 microns.

- 8.1.3 The zinc coating shall be adherent, reasonably uniform, smooth, continuous and free from imperfections such as black/ bare spots, ash rust strains, bulky white deposits / wet storage strains and blisters.
- 8.1.4 The surface preparation for fabricated tower parts and stubs for hot dip galvanizing shall be carried out as indicated herein below:
- a) Degreasing & Cleaning of Surface: Degreasing and cleaning of surface, wherever required, shall be carried out in accordance with clause 4.1 of IS: 2629-1985. After degreasing the article shall be thoroughly rinsed. However, if acidic degreasers are used rinsing is not required.
 - b) Pickling: Pickling shall be done using either hydrochloric or sulphuric acid as recommended at clause 4.3 of IS 2629 -1985. The actual concentration of the acids and the time duration of immersion shall be determined by the Contractor depending on the nature of material to be pickled. Suitable inhibitors also shall be used with the acids to avoid over pickling. The acid concentration, inhibitors used, and maximum allowable iron content shall form part of plant standard to be formulated and submitted to employer along with Quality Assurance Program.
 - c) Rinsing: After pickling, the material shall be rinsed, preferably in running water to remove acid traces, iron particles or any other impurities from the surface. Two rinse tanks are preferable, with water cascading from the second tank to the first to ensure thorough cleaning. Wherever single tank is employed, the water shall be periodically changed to avoid acid contamination, and removal of another residue from the tank.
 - d) Fluxing: The rinsed article shall be dipped in a solution of Zinc ammonium chloride. The concentration and temperature of the flux solution shall be standardized by the contractor depending on the article to be galvanized and individual circumstances. These shall form part of plant standard to be formulated and submitted to employer along with Quality Assurance Program. The specific gravity of the flux solution shall be periodically monitored and controlled by adding required quantity of flux crystals to compensate for drag-out losses. Free acid content of the flux solution also shall be periodically checked and when it is more than two (2) grams of free acid per litre of the solution, it shall be neutralized. Alternatively, Ph value should be monitored periodically and maintained between 5.0 to 5.5.
 - e) Drying: When dry galvanizing is adopted the article shall be thoroughly dried after fluxing. For the purpose of drying, the contractor may use hot plate, air oven or any other proven method ensuring complete drying of the article after fluxing and prior to dipping in the molten zinc bath. The drying process shall be such that the article shall not attain a temperature at which the flux shall get decomposed. The article thus dried shall be galvanized before the flux coating picks up moisture from the atmosphere or the flux layer gets damaged or removed from the surface. The drying procedure, time duration,

temperature limits, time lag between fluxing, drying, galvanizing etc shall form part of plant standard to be formulated and submitted to employer along with Quality Assurance Program.

- f) Quality of Zinc: Any one or combination of the grades of zinc specified in IS 209 or IS 13229 or other comparable international standard shall be used for galvanizing. The contractor shall declare the grade(s) of zinc proposed to be used by them for galvanizing. The molten metal in the zinc bath shall contain minimum 98.5 % zinc by mass. It shall be periodically measured and recorded. Zinc aluminum alloy shall be added as per IS 2629.
- g) Dipping Process: The temperature of the galvanizing bath shall be continuously monitored and controlled. The working temperature of the galvanizing bath shall be maintained at 450 +/- 10-degree C. The article should be immersed in the bath as rapidly as possible without compromising on safety aspects. The galvanizing bath temperature, immersion angle & time, time duration of immersion, rate of withdrawal etc shall be monitored and controlled depending upon the size, shape, thickness and chemical composition of the article such that the mass of zinc coating and its uniformity meets the specified requirements and the galvanized surface is free from imperfections and galvanizing defects.
- h) Post Treatment: The article shall be quenched in water. The quench water is to be changed / drained periodically to prevent corrosive salts from accumulating in it. If water quenching is not done, then necessary cooling arrangements should be made. The galvanized articles shall be dipped in chromating solution containing sodium dichromate and sulphuric acid or chromic acid base additive at a predetermined concentration and kept at room temperature to retard white rust attack. The temperature of the chromate solution shall not exceed 65-degree C. The articles shall not be stacked immediately after quenching and dichromating. It shall be ensured that the articles are dry before any further handling operation.
- i) Storing, Packing and Handling: In order to prevent white rust formation sufficient care should be exercised while storing handling and transporting galvanized products. The articles shall be stored in an adequately ventilated area. The articles shall be stored with spacers in between them and kept at an inclination to facilitate easy drainage of any water collected on the articles. Similar care is to be taken while transporting and storing the articles at site.

The Contractor shall prepare a detailed galvanizing procedure including Flow Chart with control parameters and all plant standards as required above and submit to KSEBL for approval as part of Quality Assurance Plan.

8.2 Fasteners.

For fasteners, the galvanizing shall conform to IS-1367(Part-13). The galvanizing shall be done with centrifuging arrangement after all mechanical operations are completed. The nuts, may however be tapped (threaded) or rerun after galvanizing and the threads oiled. The threads of bolts & 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 bolts. Spring washers shall be electro galvanized as per Grade-IV of IS-1573.

9 Earthing

Each tower shall be earthed. The tower footing resistance shall not exceed 10 ohms. The Contractor shall measure the tower footing resistance (TFR) of each tower during dry weather after it has been erected and before the stringing of the earth wire. Pipe type earthing and counter poise type earthing shall be done as required in accordance with the following standards:

IS: 3043 Code of practice for Earthing.

IS: 5613 Code of practice for Design, Installation and maintenance (Part-II/Section-2) of overhead power lines.

9.1 The drawings and standards for pipe & counterpoise type earthing are as per CBIP manual.

9.2 Pipe Type Earthing

Each earthing arrangement will consist of 50 mm dia, not less than 3000 mm long heavy-duty G.I. pipe driven at least 3650mm away from the nearest leg of the tower so that the same is outside earthing zone of the tower itself. 50x6 mm G.S. strip 4650 mm long and placed 600 mm below the ground level shall be used to connect the tower with the pipe. Bolt holes of the leg members joining the bottom most bracing shall be used for connecting the G.S. strip. The quoted rates will include the supply of these earthing materials complete with necessary bolts and nuts required for connection of strip with pipe and of the strip with tower.

9.3 Counterpoise Type Earthing

Where necessary, because of difficulties in grounding pipes in rocks or to control excessively high footing resistance, counterpoise earth shall be provided by the contractor. The counterpoise earth will be of size not less than 7/9 SWG (3.67 mm) galvanized steel wire having suitable galvanised steel lugs forged at its one end. The length of each counterpoise earth will not be less than 30 meters.

The contractor shall furnish full details of counterpoise earth and the supply is also included under the scope of the contractor.

9.4 Earthing of River Crossing Tower

Galvanised earthing strip of flat 50 x 6 mm is to be provided in two legs of tower for each location with proper arrangement of connecting these strips by 16mm bolts shall be provided in the stubs. For well/pile foundation, the strip has to be taken up to scour level along the concrete of well/pile foundations. Only bolted connections are allowed for connecting this strip to achieve desired length. Contractor shall submit the detailed drawing for approval of KSEBL before installations.

10 Standards

10.1 The design, manufacturing, fabrication, galvanising, testing, erection procedure and materials used for manufacture and erection of towers, design and construction of foundations shall conform to the following Indian Standards (IS)/International Standards which shall mean latest revisions, with amendments/changes adopted and published, unless specifically stated otherwise in the Specification.

In the event of supply of material 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 Contractor to establish their equivalence.

The material and services covered under these specifications shall be performed as per requirements of the relevant standard code referred hereinafter against each set of equipment and services. Other internationally acceptable standards which ensure equal or higher performance than those specified shall also be accepted.

11 Classification of Towers

The towers for 220/110 kV MCMV, DC towers are classified as given below:

Type of Tower	Deviation Limit	Typical Use
KLA/MA/D3	0-2 deg	To be used as Suspension tower.
KLMB/MB	2 deg-15 deg	Small Angle towers with tension insulator string.
KLC/MC/D30	15 deg - 30 deg	Medium Angle towers with tension insulator string.
KLD/MD/D60	30 deg – 60 deg.	Large Angle towers with tension insulator string.

Note: The above towers can also be used for longer span with smaller angle of deviations without infringement of ground clearance.

12 Extensions

12.1 The towers are designed so as to be suitable for adding 3M, 6M and 9M body extensions/leg extensions for maintaining adequate ground clearances without reducing the specified factor of safety in any manner.

12.2 All above extension provisions to towers and foundations shall be treated as part of normal towers and foundations only.

13 Span and clearances

13.1 Normal Span

The normal ruling span of the line is 335m.

13.2 Wind Span

The wind span is the sum of the two half spans adjacent to the support under consideration. For normal horizontal spans this equals to normal ruling span.

13.3 Weight span

The weight span is the horizontal distance between the lowest points of the conductors on the two spans adjacent to the tower. For spotting of structures, the span limits given in following table shall prevail: -

Sl No.	Description	Type of tower (Suspension)	Type of tower (Small Angle)	Type of tower (Med Angle)	Type of tower (Large Angle)
1	Wind Span	335	335	335	335
2	Weight Span (Max. Effect of Both Span)	525/488	1000/1000	1000/1000	1000/1000
3	Weight Span (Min) Effect of Both Span	200/195	-1000/-1000	-1000/-1000	-1000/-1000
4	Weight Span (Max) Effect of Single Span	319/195	600/600	600/600	600/600
5	Weight Span (Min) Effect of Single Span	100/104	-600/-600	-600/-600	-600/-600
6	Permissible Sum of adjacent spans for various deviation angles		15° - 671 14° - 727 13° - 783 12° - 840 11° - 896 10° - 953 09° - 1009 08° - 1065 07° - 1122 06° - 1179 05° & Below-1235	30° -671 29° -725 28° -781 27° -836 26° -891 25° -946 24° -1001 23° -1057 22° -1112 21° -1168 20°-& Below-1224	60° -671 59° -720 58° -770 57° -820 56° -869 55° -920 54° -970 53° -1021 52° -1071 51° -1122 50°-& Below-1174

14 Electrical Clearances

14.1 Ground Clearance

The minimum ground clearance from the bottom conductor shall not be less than 6100 mm for 110KV lines at the maximum sag conditions i.e at 180° C and still air.

- An allowance of 150mm shall be provided to account for errors in stringing.
- Conductor creep shall be compensated by over tensioning the conductor at a temperature of 32°C lower than the stringing temperature for ACSR conductor.

15 Service Condition

Equipment/material to be supplied against this specification shall be suitable for satisfactory continuous operation under conditions as specified below:

Maximum ambient temperature (Degree Celsius)	40°C
Minimum ambient temperature (Degree Celsius)	10°C
Relative humidity (% range)	10-100

Maximum annual rainfall & snowfall (Cm)	as per published Meteorological/ climatological data
Wind zone (as per IS: 875)	2
Maximum wind velocity (m/sec.)	39 m/sec. (as per IS: 875)
Maximum altitude above mean sea level (Metre)	Below 1000 m
Isokeraunic level (days/years)	100/Year

Note: Climate varies from moderately hot and humid tropical climate to cold climate.

SECTION - 5**TECHNICAL SPECIFICATIONS OF CONDUCTORS****TABLE OF CONTENT**

SR. NO.	DESCRIPTION
1	SCOPE
2	STANDARD
3	SITE CLIMATIC CONDITIONS
4	TECHNICAL DETAILS OF CONDUCTOR
5	MATERIAL & WORKMANSHIP
6	JOINTS IN WIRES
7	TEST ON CONDUCTORS
8	PACKING
9	MARKING
10	VERIFICATION OF CONDUCTOR LENGTH
11	GUARANTEED TECHNICAL PARTICULARS
ANNEXURE - 5A	ANNEXURE - 5A - TESTS ON CONDUCTORS

SECTION - 5**TECHNICAL SPECIFICATIONS OF CONDUCTORS****1 SCOPE**

This section provides the technical details of Conductors for use on this transmission lines package. The material and services under this specification shall be performed as per the requirements of the latest revisions and amendments available at the time of placement of order of all the relevant Indian Standards/Codes listed in Clause-2 STANDARDS here under or equivalent International Standards, except as modified in this document.

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

2 STANDARDS

Sl. No.	Indian Standard	Title	International Standard
1.	IS: 209-1992	Specification for zinc	BS:3436-1986
2.	IS: 398-1982	Specification for Aluminium Conductors for Overhead Transmission Purposes	IEC:1089-1991 BS:215-1970
3.	IS:398-1990 Part-II	Aluminium Conductor Galvanised Steel Reinforced	BS;215-1970 IEC:1089-1991
4.	IS:398 (Part-IV)	Aluminium Alloy stranded conductor	IEC: 208-1966 BS-3242-1970
6.	IS: 1521-1991	Method of Tensile Testing of Steel Wire	ISO 6892-1984
7.	IS: 1778-1980	Reels and Drums for Bare Conductors	BS:1559-1949
8.	IS: 2633-1992	Method of Testing Uniformity of Coating on Zinc Coated Articles	
9.	IS: 4826-1992	Galvanised Coating on Round Steel Wires	IEC: 888-1987 BS:443-1969
10.	IS: 6745-1990	Methods of Determination of Weight of Zinc Coating of Zinc Coated Iron and Steel Articles	BS:433-1969 ISO 1460 - 1973
11.	IS: 8263-1990	Method of Radio Interference Tests on High Voltage Insulators	IEC:437-1973 NEMA:107-

			1964 CISPR
12.	IS: 9997-1988	Aluminium Alloy Redraw Rods	IEC 60104-1987
13.		Method of measurement of resistivity of metallic materials	IEC:468
14.		Calculating the Current Temperature of Bare Overhead Conductors	IEEE 738-2006
15.		Aluminium-Coated Steel Core Wire for Aluminium Conductors, Steel Reinforced	ASTM B341

The standards mentioned above are available from:

Reference Abbreviation	Name and Address
BS	British Standards, British Standards Institution 101, Pentonville Road, N - 19-ND, UK
IEC/CISPR	International Electro Technical Commission, Bureau Central de la Commission, electro Technique internationale, 1 Rue de verembe, Geneva, SWITZERLAND
BIS/IS	Bureau of Indian Standards. Manak Bhavan, 9, Bahadur Shah Zafar Marg, New Delhi - 110001, INDIA
ISO	International Organisation for Standardization. Danish Board of Standardization Danish Standardizing Sraat, Aurehoegvej-12 DK-2900, Heelestrup, DENMARK.
ASTM	ASTM Headquarters, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA 19428-2959, USA

Material meeting with the requirements of other authoritative standards, which ensure equal or better performance than the standards mentioned above, shall also be considered. When the material offered by the bidder conforms to other standards, salient points of difference between standards adopted & the standards specified in this specification shall be clearly brought out in the relevant schedules. Three copies of such standards with authentic translation in English shall be furnished along with the bid.

3 SITE CLIMATIC CONDITIONS

The materials offered shall be suitable for operation in tropical climate & shall be subject to the sun & inclement weather and shall be able to withstand wide range of temperature variations. The topography & climatic conditions are furnished in clause 4.2, section 1, part A of volume II.

4 TECHNICAL DETAILS OF CONDUCTOR

Technical details of conductors are mentioned in clause 4.1, Section 1, Part A of this volume.

5 MATERIAL & WORKMANSHIP

- 5.1 The material offered shall be of best quality and workmanship. The Aluminium conductor strands will consist outer stranding of fully annealed aluminium wire of 1350-O & inner core shall be of aluminium conductor steel reinforced for 220 & 110kV.
- 5.2 The steel wires for conductor shall be evenly and uniformly coated with Zn complying with ASTM B498/957.
- 5.3 The Aluminium and steel strands shall be smooth, uniform and free from all imperfections, such as spills and splits, die marks, scratches, abrasions, etc., after drawing and also after stranding.
- 5.4 The finished conductor shall be smooth, compact, uniform and free from all imperfections including kinks (protrusion of wires), wire cross over, over riding, looseness (wire being dislocated by finger/hand pressure and/or unusual bangle noise on tapping), material inclusions, white rust, powder formation or black spot (on account of reaction with trapped rain water etc.), dirt, grit etc.
- 5.5 The steel strands shall be pre-formed and post formed in order to prevent spreading of strands in the event of cutting of core wire. Care shall be taken to avoid, damages to galvanization during pre-forming and post-forming operation.

6 JOINTS IN WIRES

6.1 Aluminium Wires

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

No joints shall be permitted in the individual wires in the outer most layer of the finished conductor. However, Joints in the inner layers are permitted in addition to those made in the base rod or wire before final drawing, but no two such joints shall be less than 15 meters apart in the complete stranded conductor. Joints shall be made by cold pressure butt welding and shall withstand a stress of not less than the breaking strength of individual strand guaranteed.

6.2 Steel Wires

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

6.3 STRANDING

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

6.4 STANDARD LENGTH

6.4.1 The standard length of the conductor shall be 2000 meters . A tolerance of +/-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.

6.4.2 Random lengths will be accepted provided no length is less than 70% of the standard length and the total quantity of such random lengths shall not be more than 10% of the total quantity ordered.

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

6.5 TOLERANCES

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

7 TEST ON CONDUCTORS

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

In the event of any discrepancy in the test report (i.e., any test report not applicable due to any design/ material/manufacturing process change including substitution of components or due to noncompliance with the requirement stipulated in the Technical Specification) the tests shall be conducted by the Contractor at no extra cost to the KSEBL.

7.1 Type Tests

I) On Complete Conductor

- | | |
|--|----------------------|
| a) DC resistance test on stranded conductor | : As per Annexure-5A |
| b) UTS test on stranded conductor | : As per Annexure-5A |
| c) Stress- Strain test on stranded conductor and core at room temperature | : IEC 1089 |
| d) Stress-strain test on stranded conductor and core at elevated temperature | : As per Annexure-5A |
| e) Crush Strength Test | : As per Annexure-5A |
| f) Torsional Ductility & Wrapping Test | : As per Annexure-5A |
| g) Corona Extinction Voltage Test | : As per Annexure-5A |

h) Radio Interference Voltage Test : As per Annexure-5A

II) On Conductor Strand/ Core

- a) Heat resistance test on Aluminium Alloy strands : As per Annexure-5A
- b) Bending test on core : As per Annexure-5A
- c) Compression test on core : As per Annexure-5A
- d) Coefficient of linear expansion on core/ core strand : As per Annexure-5A

7.2 Acceptance Tests

- a) Visual and dimensional check on drum : As per Annexure-5A
- b) Visual check for joints scratches etc. and length measurement of conductor by rewinding : As per Annexure-5A
- c) Dimensional check on steel and aluminium strands : As per Annexure-5A
- d) Check for lay-ratios of various layers : As per Annexure-5A
- e) Galvanizing test : As per Annexure-5A
- f) Aluminium thickness on aluminium clad wires (if applicable) : As per Annexure-5A
- g) Torsion and Elongation tests on core strand/composite core : As per Annexure-5A
- h) Breaking load test on core and Aluminium strands : As per Annexure-5A
- i) Wrap test on core & Aluminium strands : IEC: 888 & 889
- j) Minimum conductivity test on conductor strands. : IEC: 889
- k) Minimum conductivity test on core Strands (if applicable) : As per Annexure-5A
- l) Procedure qualification test on welded joint of Aluminium strands : As per Annexure-5A

Note: All the above tests except (j) shall be carried out on aluminium and steel strands after stranding only.

7.3 Routine Test

- a) Check to ensure that the joints are as per Specification
- b) Check that there are no cuts, fins etc., on the strands.
- c) Check that drums are as per Specification

- d) All acceptance test as mentioned above to be carried out on 10% of drums

7.4 Tests During Manufacture

- a) Chemical analysis of zinc used for galvanizing (if applicable) : As per Annexure-5A
- b) Chemical analysis of Aluminium used for making Aluminium strands : As per Annexure-5A
- c) Chemical analysis of core strand : As per Annexure-5A

7.5 Test Reports

- 7.5.1 Copies of type test reports shall be furnished in at least six copies along with one original. One copy will be returned duly certified by the Owner only after which the commercial production of the material shall start.
- 7.5.2 Record of routine test reports shall be maintained by the Supplier at his works for periodic inspection by the Owner's representative.
- 7.5.3 Test Certificates of tests during manufacture shall be maintained by the Supplier. These shall be produced for verification as and when desired by the Owner.

7.6 Inspection

- 7.6.1 The Owner's representative shall at all times be entitled to have access to the works and all places of manufacture, where conductor shall be manufactured, and representative shall have full facilities for unrestricted inspection of the Supplier's works, raw materials and process of manufacture for conducting necessary tests as detailed herein.
- 7.6.2 The Supplier shall keep the Owner informed in advance of the time of starting and of the progress of manufacture of conductor in its various stages so that arrangements can be made for inspection.
- 7.6.3 No material shall be dispatched from its point of manufacture before it has been satisfactorily inspected and tested, unless the inspection is waived off by the Owner in writing. In the latter case also, the conductor shall be dispatched only after satisfactory testing for all tests specified herein have been completed.
- 7.6.4 The acceptance of any quantity of material shall in no way relieve the Supplier of any of his responsibilities for meeting all requirements of the Specification and shall not prevent subsequent rejection if such material is later found to be defective.

7.7 Test Facilities

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

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

Standard resistance for calibration of resistance bridges.

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

8 PACKING

- 8.1 The conductor shall be supplied in non-returnable, strong, wooden drums provided with lagging of adequate strength, constructed to protect the conductor against all damage and displacement during transit, storage and subsequent handling and stringing operations in the field. The Supplier shall be responsible for any loss or damage during transportation handling and storage due to improper packing. The drums shall generally conform to IS:1778, except as otherwise specified hereinafter.
- 8.2 The drums shall be suitable for wheel mounting and for letting off the conductor under a minimum controlled tension of the order of 5 KN.
- 8.3 The Bidder should submit their proposed drum drawings along with the bid.
- 8.4 For conductor, one standard length shall be wound on each drum.
- 8.5 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 shall be applied to the entire drum with preservatives of a quality which is not harmful to the conductor.
- 8.6 The flanges shall be of two ply construction 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 that indicated in the figure. There shall be at least 3 nails per plank of ply with maximum nail spacing of 75mm. Where a slot is cut in the flange to receive the inner end of the conductor the entrance shall be in line with the periphery of the barrel.
- 8.7 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.
- 8.8 Barrel studs shall be used for the 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.
- 8.9 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 counter sunk. The ends of barrel shall generally be flushed with the top of the nuts.
- 8.10 The inner cheek of the flanges and drum barrel surface shall be painted with a bitumen-based paint.

- 8.11 Before reeling, card board or double corrugated or thick bituminized water-proof bamboo paper shall be secured to the drum barrel and inside of flanges of the drum by means of a suitable commercial adhesive material. After reeling the conductor, the exposed surface of the outer layer of conductor shall be wrapped with water proof thick bituminized bamboo paper to preserve the conductor from dirt, grit and damage during transport and handling.
- 8.12 A minimum space of 75 mm for conductor shall be provided between the inner surface of the external protective tagging and outer layer of the conductor.
- 8.13 Each batten shall be securely nailed across grains as far as possible to the flange, edges with at least 2 nails per end. The length of the nails shall not be less than twice the thickness of the battens. The nails shall not protrude above the general surface and shall not have exposed sharp, edges or allow the battens to be released due to corrosion.
- 8.14 The nuts on the barrel studs shall be tack welded on the one side in order to fully secure them. On the second end, a spring washer shall be used.
- 8.15 A steel collar shall be used to secure all barrel studs. This collar shall be located between the washers and the steel drum and secured to the central steel plate by welding.
- 8.16 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.
- 8.17 The conductor ends shall be properly sealed and secured on the side of one of the flanges to avoid loosening of the conductor layers during transit and handling.
- 8.18 As an alternative to wooden drum Bidder may also supply the conductors in non-returnable painted steel drums. After preparation of steel surface according to IS:9954, synthetic enamel paint shall be applied after application of one coat of primer. Wooden/Steel drum will be treated at par for evaluation purpose and accordingly the Bidder should quote in the package.

9 MARKING

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

- (a) Contract/Award letter number.
- (b) Name and address of consignee.
- (c) Manufacturer's name and address.
- (d) Drum number
- (e) Size of conductor
- (f) Length of conductor in meters
- (g) Arrow marking for unwinding

- (h) Position of the conductor ends
- (i) Distance between outer-most Layer of conductor and the inner surface of lagging.
- (k) Barrel diameter at three locations & an arrows marking at the location of the measurement.
- (l) Number of turns in the outer most layer.
- (m) Gross weight of drum after putting lagging.
- (n) Tear weight of the drum without lagging.
- (o) Net weight of the conductor in the drum.
- (p) CIP/MICC No.

The above should be indicated in the packing list also.

10 VERIFICATION OF CONDUCTOR LENGTH

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

TABLE OF CONTENTS

Sl No.	Sample Form
GTP- 1	GTP of ACSR /ACCC Conductor (separate sheet to be submitted for each type of conductor appearing in Price Schedule -2 Material and Spares)
GTP- 2	GTP of Suspension Hardware Fittings - Separate sheet for all items appearing in Price Schedule -2 Material and Spares, including but not limited to the following: a) 220KV Single V-string for Twin ACSR Panther / Single ACCC (Drake equivalent) Conductor b) 220KV Single I-string for Single ACSR Zebra / Panther / Kundah / ACCC (Drake equivalent) Conductor c) 220KV Double I-string for Single ACSR Zebra / Kundah / ACCC (Drake) Conductor d) 110KV Single I-string for Single ACSR Panther / Wolf Conductor e) 110KV Double I-string for Single ACSR Panther / Wolf Conductor
GTP- 3	GTP of Tension Hardware Fittings (separate sheet for Single & Double Tension for each type of conductor appearing in Price Schedule -2 Material and Spares)
GTP- 4	GTP of Mid Span Compression Joint for ACSR / ACCC Conductor (separate sheet for each type of conductor appearing in Price Schedule -2 Material and Spares)
GTP- 5	GTP of Repair Sleeve for ACSR / ACCC Conductor (separate sheet for each type of conductor appearing in Price Schedule -2 Material and Spares)
GTP- 6	GTP of Vibration Damper for ACSR / ACCC Conductor (separate sheet for each type of conductor appearing in Price Schedule -2 Material and Spares)

SCHEDULE -1			
GUARANTEED TECHNICAL PARTICULARS OF ACSR / ACCC CONDUCTOR (Separate sheet to be submitted for each type of conductor i.e. Moose/Zebra, Panther, Wolf, Kundah etc. appearing in Price Schedule -2 Material and Spares)			
Sl	Description	Unit	Value guaranteed by the Bidder
3.4	Aluminium used for Aluminium Cladding (if applicable) a) Minimum purity of aluminum b) Maximum Copper content c) Other-----elements----- i) ii).....	% % % %	
4.	STRANDS OF OUTER CONDUCTING PART (AFTER STRANDING)		
4.1	Number of outer layers	Nos.	
4.2a	Number of strands		
	a) 1st Layer from core	Nos.	
	b) 2nd Layer from core	Nos.	
	c) 3rd Layer from core	Nos.	
4.2b	Diameter of strands		
	a) Nominal	mm	
	b) Maximum	mm	
	c) Minimum	mm	
4.3	Minimum Breaking load of strand		
	a) Before stranding	kN	
	b) After stranding	kN	
4.4	Resistance of 1m length of strand at 20 deg C	Ohm	
4.5	Final Modulus of elasticity	Kg/sq. mm	
4.6	Final Coefficient of linear expansion	Per C	
5	INNER CORE STRANDS/ INNER CORE (AFTER STRANDING)		

SCHEDULE -1			
GUARANTEED TECHNICAL PARTICULARS OF ACSR / ACCC CONDUCTOR (Separate sheet to be submitted for each type of conductor i.e. Moose/Zebra, Panther, Wolf, Kundah etc. appearing in Price Schedule -2 Material and Spares)			
Sl	Description	Unit	Value guaranteed by the Bidder
5.1	Number of layers in inner core (excluding central wire)		
5.2	Number of strands		
	a) 1st Layer from centre (excluding central wire)	Nos.	
	b) 2nd Layer from centre	Nos.	
	c) 3rd Layer from centre	Nos.	
5.3a	Diameter		
	a) Nominal	mm	
	b) Maximum	mm	
	c) Minimum	mm	
5.3b	Minimum Breaking load of strand / Core		
	a) Before stranding	kN	
	b) After stranding	kN	
5.4	Resistance of 1m length of strand at 20 deg.C	Ohm	
5.5	Final Modulus of elasticity	Kg/sq. mm	
5.6	Final coefficient of linear expansion	Per 0 C	
5.7	Aluminum cladding of core (if applicable)		
	a) Thickness of cladding		
	i) Maximum	mm	
	ii) Minimum	mm	
	b) Minimum no. of twists in a guage length equal to 100 times diameter of wire which the strands can withstand in the torsion test		
	a) Before stranding	Nos.	
	b) After stranding Nos.	Nos.	
	c) Minimum elongation of strand for a gauge length of 250 mm	%	
	d) Resistance of 1m length of strand at 20 deg. C	Ohm	
6	Galvanising coating		
	a) Minimum mass of zinc coating per sqm. Of uncoated wire surface.	gm	
	b) Min. no. of twists which a single strand shall withstand during torsion test for a length equal to 100times dia of wire after stranding	Nos.	

SCHEDULE -1			
GUARANTEED TECHNICAL PARTICULARS OF ACSR / ACCC CONDUCTOR (Separate sheet to be submitted for each type of conductor i.e. Moose/Zebra, Panther, Wolf, Kundah etc. appearing in Price Schedule -2 Material and Spares)			
Sl	Description	Unit	Value guaranteed by the Bidder
	c) Minimum elongation of strand for a gauge length of 250 mm	%	
7	COMPLETE ACSR PANTHER CONDUCTOR		
7.1	Cross section drawing of the offered conductor enclosed	Yes / no	
7.2	Diameter of conductor		
	a) Nominal	mm	
	b) Maximum	mm	
	c) Minimum	mm	
7.3	UTS (minimum) of Conductor	kN	
7.4	Lay ratio of conductor		Max.
	a) 1st layer from centre (excluding central wire)		
	b) 2nd Layer		
	c) 3rd Layer		
	d) 4th Layer		
7.5	DC resistance of conductor at 20°C		
7.6	Final Modulus of elasticity		
	f) Up to transition temperature	Per deg C	
	g) Above transition temperature	Per deg C	
7.7	Coefficient of linear expansion		
	Upto transition temperature	Per deg C	
	Above transition temperature	Per deg C	
7.8	Calculation for transition temperature Enclosed	Yes/no	
7.12	Maximum permissible conductor temperature for continuous operation	Deg. C	
7.13	Maximum permissible conductor temperature for short term operation	Deg. C	
7.14	Permissible duration of above short-term	Minutes	

SCHEDULE -1			
GUARANTEED TECHNICAL PARTICULARS OF ACSR / ACCC CONDUCTOR (Separate sheet to be submitted for each type of conductor i.e. Moose/Zebra, Panther, Wolf, Kundah etc. appearing in Price Schedule -2 Material and Spares)			
Sl	Description	Unit	Value guaranteed by the Bidder
	operation		
7.15	Steady state conductor temperature at specified conductor current of A and under Ambient conditions.		
7.16	AC resistance at maximum continuous operating temperature corresponding to specified maximum operating current	Ohm/ km	
7.17	AC resistance at continuous operating temperature corresponding to specified operating current ofA	Ohm/ km	
7.18	Details of Creep characteristic for ACSR PANTHER conductor enclosed	Yes/No	
7.19	Sag Tension Calculation		
7.19.1	Sag Tension Calculation enclosed	Yes/No	
7.19.2	Tension at 32 deg. C & no wind	Kg	
7.19.3	Sag & tension at maximum continuous operating temperature	Meters & Kgs	
	i. Tension for following conditions:		
	32 deg. C & full wind condition	kg	
	32 deg. C & Nil wind condition	kg	
	Minimum tempt. & 36% of full wind condition		
	32 deg. C & 75% of full wind condition		
7.20	Direction of lay for outside layer		
7.21	Linear mass of the Conductor		
	a) Standard	Kg/km	
	b) Minimum	Kg/km	
	c) Maximum	Kg/km	
7.22	Standard length of conductor	M	
7.23	Maximum length of conductor that can be offered as single length	M	
7.24	Tolerance on standard length of conductor	%	
7.25	Drum is as per specification	Yes/No	
7.26	No. of cold pressure butt welding equipment	Nos.	

SCHEDULE -1			
GUARANTEED TECHNICAL PARTICULARS OF ACSR / ACCC CONDUCTOR (Separate sheet to be submitted for each type of conductor i.e. Moose/Zebra, Panther, Wolf, Kundah etc. appearing in Price Schedule -2 Material and Spares)			
Sl	Description	Unit	Value guaranteed by the Bidder
	available at works		

GTP-2			
GUARANTEED TECHNICAL PARTICULARS OF SUSPENSION HARDWARE FITTINGS (Bidder to submit information for all type of Conductors appearing in Price Schedule -2 Material and Spares)			
Sl. No.	Description	Unit	Value guaranteed by the Bidder
1	Name & address of Manufacturer		
2	Address of Manufacturer		
3	Drawing enclosed	Yes/No	
4	Maximum magnetic power loss of suspension clamp at conductor / sub conductor current of ---- amperes (at steady state conductor temperature)	Watt	
5	Slipping strength of suspension assembly (clamp torque Vs slip curve shall be enclosed)	kN	
6	Particulars of standard/AGS Standard / AGS preformed armour rod set for suspension assembly a) No. of rods per set b) Direction of lay c) Overall length after fitting on conductor d) Actual length of each rod along its helix e) Diameter of each rod f) Tolerance in i.Length of each rod ii.Diameter of each rod iii.Difference of length between the longest and shortest rod in a set g) Type of Aluminium alloy used for manufacture of PA rod set h) UTS of each rod	No Mm Mm Mm ±mm ±mm ±mm Kg/mm ²	
7	Particulars of Elastomer (For AGS Clamp only)		
	a) Supplier of elastomer		
	b) Type of elastomer		

GTP-2			
GUARANTEED TECHNICAL PARTICULARS OF SUSPENSION HARDWARE FITTINGS (Bidder to submit information for all type of Conductors appearing in Price Schedule -2 Material and Spares)			
	c) Shore hardness of elastomer		
	d) Temperature range for which elastomer is Designed		
	e) Moulded on insert	Yes/No	
8	UTS of suspension clamp	Yes/No	
9	Purity of Zinc used for galvanising	%	
12	Maximum permissible continuous operating temperature of		
	i) Clamp body ii) Standard/AGS preformed rods		

GTP-3			
GUARANTEED TECHNICAL PARTICULARS OF TENSION HARDWARE FITTINGS (separate sheet for Single & Double Tension for each type of conductor appearing in Price Schedule -2 Material and Spares)			
Sl	Description	Unit	Value guaranteed by the Bidder
1	Name of Manufacturer		
2	Address of Manufacturer		
3	Drawing enclosed		Yes / No
4	Purity of aluminium used for aluminium sleeve	%	
5	Material for steel sleeve		
	(i) Type of material with chemical composition		
	(ii) Range of Hardness of material (Brinell Hardness)	BHN	Fromto
	(iii) Weight of zinc coating	gm/m ²	
			Aluminium/ Alloy Steel
6	Outside diameter of sleeve before compression	mm	
7	Inside diameter of sleeve before compression	mm	
8	Length of sleeve before compression		
9	Dimensions of sleeve after compression		
	(a) Corner to Corner		
	(b) Surface to Surface		
10	Length of sleeve after compression		
11	Weight of sleeve		
	(a) Aluminium / Aluminium Alloy	kg	
	(b) Steel	kg	
	(c) Total	kg	
12	Electrical resistance of dead end assembly as a percentage of equivalent length of Conductor	%	
13	Slip strength of dead end assembly	kN	
14	UTS of dead end assembly	kN	

15	Purity of Zinc used for galvanising	%	
16	Design calculation of yoke plates and sag adjustment plate enclosed.		Yes / No
19	Maximum permissible continuous operating temperature of dead end assembly		

SCHEDULE -4			
GUARANTEED TECHNICAL PARTICULARS OF MID SPAN COMPRESSION JOINT FOR ACSR / ACCC CONDUCTOR (separate sheet for each type of conductor appearing in Price Schedule -2 Material and Spares)			
Sl	Description	Unit	Value guaranteed by the Bidder
1.	Name of Manufacturer		
2	Address of Manufacturer		
3	Drawing enclosed	Yes / No	
4	Suitable for conductor size	mm	
5	Purity of aluminium used for aluminium sleeve	%	
6	Material for steel sleeve		
	(i) Type of material with chemical composition		
	(ii) Range of Hardness of material (Brinnel Hardness)	BHN	Fromto
	(iii) Weight of zinc coating	gm/m ²	
			Aluminium/alloy
7	Outside diameter of sleeve before compression	mm	
8	Inside diameter of sleeve before compression	mm	
9	Length of sleeve before compression		
10	Dimensions of sleeve after compression		
	(a) Corner to Corner		
	(b) Surface to Surface		
11	Length of sleeve after compression		
12	Weight of sleeve		
	(a) Aluminium	kg	
	(b) Steel	kg	
	(c) Total	kg	
13	Slip strength	kN	

SCHEDULE -4			
GUARANTEED TECHNICAL PARTICULARS OF MID SPAN COMPRESSION JOINT FOR ACSR / ACCC CONDUCTOR (separate sheet for each type of conductor appearing in Price Schedule -2 Material and Spares)			
14	Resistance of the compressed unit expressed, as percentage of the resistivity of equivalent length of bare conductor.	%	
15	Maximum permissible continuous operating temperature of mid span compression joint	Deg. C	

SCHEDULE -5			
GUARANTEED TECHNICAL PARTICULARS OF REPAIR SLEEVE FOR ACSR / ACCC CONDUCTOR (separate sheet for each type of conductor appearing in Price Schedule -2 Material and Spares)			
Sl.	Description	Unit	Particulars/ Value
1.	Material		
2.	<u>Dimension of Aluminum sleeve Before compression</u>		
i)	Inside diameter	mm	
ii)	Outside diameter	mm	
iii)	Length	mm	
3.	<u>Dimensions of Aluminum Sleeve After compression</u>		
i)	Outside dimension (Corner to corner)	mm	
ii)	Outside dimension (face to face)	mm	
4.	Minimum corona Extinction voltage kV (rms) under dry condition	kV	
5.	Maximum Radio Interference Voltage at 1 MHz for phase to earth voltage of 510 kV (rms) under dry condition	Micro Volts (μ V)	

SCHEDULE - 6			
GUARANTEED TECHNICAL PARTICULARS OF VIBRATION DAMPER FOR ACSR / ACCC CONDUCTOR (separate sheet for each type of conductor appearing in Price Schedule -2 Material and Spares)			
Sl	Description	Unit	Value guaranteed by the Bidder
1	Name of Manufacturer		
2	Address of Manufacturer		
3	Drawing enclosed		
	(a) Design Drawing	YES / NO	
	(b) Placement Chart	YES / NO	
4	Suitable for conductor size		
5	Total weight of one damper		
			Right
6	Diameter of each damper mass	mm	
7	Length of each damper mass	mm	
8	Weight of each damper mass	kg	
9	Material of damper masses		
10	Material of clamp		
11	Material of the stranded messenger cable		
12	Number of strands in stranded messenger cable		
13	Lay ratio of stranded messenger cable		
14	Minimum ultimate tensile strength of stranded messenger cable	Kg/mm ²	
15	Slip strength of stranded messenger cable (mass pull off)	kN	
16	Resonance frequencies		
	(a) First frequency	Hz	
	(b) Second frequency	Hz	
17	Designed clamping torque	Kg-m	

SCHEDULE - 6			
GUARANTEED TECHNICAL PARTICULARS OF VIBRATION DAMPER FOR ACSR / ACCC CONDUCTOR (separate sheet for each type of conductor appearing in Price Schedule -2 Material and Spares)			
18	Slipping strength of damper clamp		
	(a) Before fatigue test	kN	
	(b) After fatigue test	kN	
19	Magnetic power loss per vibration damper watts for ---Amps, 50 Hz Alternating Current [average continuous operating current]	watts	
20	Maximum permissible continuous operating temperature of Vibration Damper	Deg. C	
22	Percentage variation in reactance after fatigue test in comparison with that. before fatigue test	%	
23	Percentage variation in power dissipation after fatigue test in comparison with that before fatigue test	%	

ANNEXURE-5A**TESTS ON CONDUCTORS****1.1 UTS Test on Stranded Conductor**

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

1.2 Corona Extinction Voltage Test

One sample of conductor of 5m length shall be strung. In case of twin conductor, two samples shall be arranged with the actual sub-conductor spacing between them. This sample assembly when subjected to power frequency voltage shall have a corona extinction voltage of not less than 154 KV (rms) for 220 KV system line to ground under dry condition. There shall be no evidence of corona on any part of sample when all possible sources of corona are photographed in a darkened room. The test shall be conducted without corona control rings. The voltage shall be corrected for standard atmospheric conditions. However, small corona rings shall be used to prevent corona in the end fittings.

1.3 Radio Interference Voltage Test

Under the conditions as specified under (1.2) above, the insulator string along with complete hardware fittings shall have a radio interference voltage level below 1000 micro volts at one MHz when subjected to 50 Hz AC voltage of 154kV line to ground under dry condition for 220kV AC line. The test procedure shall be in accordance with IS: 8263/ IEC: 60437. The Test may be carried out with corona control rings and arcing horns.

1.4 D.C. Resistance Test on Stranded Conductor

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

1.5 Coefficient of linear expansion for core/core strands

The temperature and elongation on a sample shall be continuously measured and recorded at interval of approximately 15degree C from 15degree C to maximum designed continuous operating temperature corresponding to rated current as of

specification by changing the temperature by suitable means. Coefficient of linear expansion shall be determined from the measured results.

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

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

1.7 Wrap test on Steel Core strand

The wrap test on steel strands shall be meet the requirements of IEC: 888.0. In case of aluminium clad core wire, the same shall be wrapped around a mandrel of diameter of five times that of the strand to form a helix of eight turns. The strand shall be unwrapped. No breakage of strand shall occur.

1.8 Heat Resistance test on Aluminium Alloy wire (If Applicable)

Breaking load test as per clause 1.5 above shall be carried out before and after heating the sample in uniform heat furnace at 280 degC (+5/-3 degC) temperature for one hour. The breaking strength of the wire after heating shall not be less than the 90% of the breaking strength before heating.

1.9 Chemical Analysis of Aluminium Alloy and Core

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

1.10 Visual and Dimensional Check on Drums

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

1.11 Visual Check for Joints, Scratches etc.

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

1.12 Dimensional Check on Core Strands and Aluminium Alloy Strands

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

1.13 Check for Lay-ratios of Various Layers

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

1.14 Procedure Qualification test on welded Aluminium Alloy strands.

Two Aluminium Alloy wire 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.

1.15 Chemical Analysis of Zinc

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

1.16 Galvanizing Test

The test procedure shall be as specified in IEC: 888.0. The material shall conform to the requirements of this Specification. The adherence of zinc shall be checked by wrapping around a mandrel four times the diameter of steel wire.

1.17 Torsion and Elongation Tests on Core Strands

The test procedures shall be as per clause No. 10.3 of IEC: 888.0. In torsion test, the number of complete twists before fracture shall not be less than 18 on a length equal to 100 times the standard diameter of the strand. In case test sample length is less or more than 100 times the stranded diameter of the strand, the minimum number of twists will be proportioned to the length and if number comes in the fraction then it will be rounded off to next higher whole number. In elongation test, the elongation of the strand shall not be less than 1.5% for a gauge length of 250 mm.

1.18 Bending test on conductor core strand

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

1.19 Compression test on steel strand

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

1.20 Aluminium conductivity test on aluminium clad strand (If Applicable)

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

1.21 Minimum conductivity test on thermal resistant aluminium alloy strands (If Applicable)

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

1.22 Stress-strain test at elevated temperature

Stress-strain test as per IEC-1089 shall be conducted keeping conductor temperature at designed maximum temperature. The guaranteed Core UTS shall be considered for performing the test.

1.23 High Temperature endurance & creep test

A conductor sample of length equal to at least $100 \times d + 2 \times a$ (where, d is the conductor diameter and a is the distance between the end fitting and the gauge length) shall be strung at tension equal to 25 % of conductor UTS. The distance, a , shall be at least 25 % of the gauge length or 2 m whichever is the smaller. The conductor sample shall be subjected to two tests as indicated below:

- (i) The conductor temperature shall be maintained at 20 deg C for 1000 hours. The elongation/creep strain of the conductor during this period shall be measured and recorded at end of 1 hour, 10 hour, 100 hour and subsequently every 100 hour up to 1000 hours' time period.
- (ii) The conductor temperature shall be increased to design maximum temperature in steps of 20 deg. C and thermal elongation of the conductor sample shall be measured & recorded at each step. The temperature shall be held at each step for sufficient duration for stabilization of temperature. Further, the temperature of the conductor shall be maintained at maximum designed continuous operating temperature (+10 Deg. C) for 1000 hours. The elongation/creep strain of the conductor during this period shall be measured and recorded at end of 1 hour, 10 hour, 100 hour and subsequently every 100 hour up to 1000 hours' time period. After completion of the above, the core of the conductor sample shall be subjected to UTS test where the conductor core should achieve 95% of the guaranteed core UTS. The supplier shall plot the thermal elongation with temperature. In case of polymer composite core conductor, the flexural strength & glass transition temperature of the core shall also be evaluated and the same shall not be degraded by more than 10 % over the initial value. The supplier shall plot the thermal elongation with temperature.

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

1.24 Axial Impact Test

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

1.25 Crush Strength Test

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

1.26 Torsional Ductility Test

The conductor sample of 10-15m shall be loaded to 20% of UTS and then loaded in increasing steps of +/-180 deg, the core shall withstand at least 16 such rotation for steel core and there shall be no damage to steel core wires and in case of trapezoidal shaped conductor or composite conductor, after 4 rotations and after separation of aluminum strands, the aluminum wires shall be cut and removed from the conductor and the exposed core shall be twisted and shall withstand up to 16 rotations.

1.27 Sheaves Test (if required)

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

SECTION -6
TECHNICAL SPECIFICATION OF OPGW

TABLE OF CONTENT

SR. NO.	DESCRIPTION
1	SPECIFICATION FOR OPGW CABLING & ASSOCIATED HARDWARE & FITTINGS
2	INSPECTION & TESTING REQUIREMENT
3	INSTALLATION FOR OPGW CABLING
4	GUARANTEED TECHNICAL PARTICULARS FOR OPTICAL GROUND WIRE (OPGW) & ACCESSORIES

SECTION -6**TECHNICAL SPECIFICATION OF OPGW****1 SPECIFICATION FOR OPGW CABLING AND ASSOCIATED HARDWARE & FITTINGS**

The broad scope of this specification includes the design, engineering, manufacturing, supply, transportation, insurance, delivery at site, unloading, handling, storage, supervision of erection/ installation, installation, splicing, termination, testing, demonstration for acceptance and commissioning and documentation for:

- a) OPGW fibre optic cable including all associated hardware, accessories & fittings
- b) Fibre Optic Distribution Panels (FODP) & Joint Box
- c) Supply of spares
- d) Splicing of fibres
- e) Supply of all test equipment
- f) All other associated work/items described in the technical specifications.

This section of the technical specification describes the functional and technical specifications of OPGW cabling and associated hardware and fittings.

1.1 Fibre Optic Cabling

In this section of the technical specification, the functional & technical specifications of OPGW cable, associated hardware & fittings for the requirements for G.652D Dual-Window Single Mode (DWSM) telecommunications grade fibre optic cable is mentioned.

All optical fibre cabling including fibre itself and all associated installation hardware shall have a minimum guaranteed design life span of 25 years. Documentary evidence in support of guaranteed life span of cable & fibre shall be submitted by the Contractor during detailed engineering.

1.2 Required Optical Fibre Characteristics

The optical fibre to be provided should have following characteristic.

1.3 Physical Characteristic

Dual-Window Single mode (DWSM), G.652D optical fibres shall be provided in the fibre optic cables. DWSM optical fibres shall meet the requirements defined in Table 6a.

1.4 Attenuation

The attenuation coefficient for wavelengths between 1525 nm and 1575 nm shall not exceed the attenuation coefficient at 1550 nm by more than 0.05 dB/km. The

attenuation coefficient between 1285 nm and 1330 nm shall not exceed the attenuation coefficient at 1310 nm by more than 0.05 dB/km. The attenuation of the fibre shall be distributed uniformly throughout its length such that there are no point discontinuities in excess of 0.10 dB. The fibre attenuation characteristics specified in table 6a shall be “guaranteed” fibre attenuation of any & every fibre reel. The overall optical fibre path attenuation shall not be more than calculated below:

Maximum attenuation @ 1550nm: 0.21 dB/km x total km + 0.05 dB/splice x no. of splices + 0.5 dB/connector x no. of connectors

Maximum attenuation @ 1310nm: 0.35dB/km x total km + 0.05 dB/splice x no. of splices + 0.5 dB/connector x no. of connectors

TABLE 6a: DWSM OPTICAL FIBRE CHARACTERISTICS

Fibre Description:	Dual-Window Single-Mode
Mode Field Diameter:	8.6 to 9.5 μm ($\pm 0.6\mu\text{m}$)
Cladding Diameter:	125.0 μm $\pm 1 \mu\text{m}$
Mode field concentricity error	$\leq 0.6\mu\text{m}$
Cladding non-circularity	$\leq 1\%$
Cable Cut-off Wavelength λ_{cc}	$\leq 1260 \text{ nm}$
1550 nm loss performance	As per ITU-T G.652 D
Proof Test Level	$\geq 0.69 \text{ GPa}$
Attenuation Coefficient:	@ 1310 nm $\leq 0.35 \text{ dB/km}$ & @ 1550 nm $\leq 0.21 \text{ dB/km}$
Chromatic Dispersion; Maximum: Zero Dispersion Wavelength: Zero Dispersion Slope:	18 ps/ (nm x km) @ 1550 nm, 3.5 ps/ (nm x km) 1288-1339nm 5.3 ps/ (nm x km) 1271-1360nm, 1300 to 1324nm 0.092 ps/ (nm ² x km) maximum
Polarization mode dispersion coefficient	$\leq 0.2 \text{ ps/km}^{1/2}$
Temperature Dependence:	Induced attenuation $\leq 0.05 \text{ dB}$ (-60°C - +85°C)
Bend Performance:	@ 1310 nm (75 \pm 2 mm dia Mandrel), 100 turns; Attenuation Rise $\leq 0.05 \text{ dB}$ @ 1550 nm (30 \pm 1 mm radius Mandrel), 100 turns; Attenuation Rise $\leq 0.05 \text{ dB}$ @ 1550 nm (32 \pm 0.5 mm dia Mandrel, 1 turn; Attenuation Rise $\leq 0.50 \text{ dB}$

1.5 Fibre Optic Cable Construction

The OPGW (Optical Ground Wire) cable is proposed to be installed on the 220/110KV MCMV transmission lines. The design of cable shall account for the varying operating and environmental conditions that the cable shall experience while in service. The OPGW cable to be supplied shall be designed to meet the overall requirements of all the transmission lines. Normally the tower span of the lines shall not exceed 600m, however, some of the spans may be up to around 1000m or more.

1.6 Optical Fibre Cable Link Lengths

The estimated optical fibre link lengths shall be provided by Contractor for transmission line route length. However, the Contractor shall supply & install the optical fibre cable as required based on detailed site survey already carried out by KSEBL. The Contractor shall verify the transmission line route length and the Contract price shall be adjusted accordingly.

For the purpose of payment, the optical fibre link lengths are defined as transmission line route lengths from Gantry at one terminating station to the Gantry in the other terminating station. The actual cable lengths to be delivered shall take into account various factors such as sag, service loops, splicing, working lengths & wastage etc. The unit rate for FO cable quoted in the Bid price Schedules shall take into account all such factors.

1.7 Optical Fibre Identification

Individual optical fibres within a fibre unit and fibre units shall be identifiable in accordance with EIA/TIA 598 or IEC 60304 or Bellcore GR-20 colour-coding scheme.

Colouring utilized for colour coding optical fibres shall be integrated into the fibre coating and shall be homogeneous. The colour shall not bleed from one fibre to another and shall not fade during fibre preparation for termination or splicing.

Each cable shall have traceability of each fibre back to the original fibre manufacturer's fibre number and parameters of the fibre. If more than the specified number of fibres is included in any cable, the spare fibres shall be tested by the cable manufacturer and any defective fibres shall be suitably bundled, tagged and identified at the factory by the vendor.

1.8 Buffer Tube

Loose tube construction shall be implemented. The individually coated optical fibre(s) shall be surrounded by a buffer for protection from physical damage during fabrication, installation and operation of the cable. The fibre coating and buffer shall be strippable for splicing and termination. Each fibre unit shall be individually identifiable utilizing colour coding. Buffer tubes shall be filled with a water-blocking gel.

1.9 Optical Fibre Strain & Sag-Tension chart

The OPGW cable shall be designed and installed such that the optical fibres experience no strain under all loading conditions defined in IS 802. Zero fibre strain condition shall apply even after a 25 year cable creep.

For the purpose of this specification, the following definitions shall apply:

- Maximum Working Tension (MWT) is defined as the maximum cable tension at which there is no fibre strain.
- The no fibre strain condition is defined as fibre strain of less than or equal to 0.05%, as determined by direct measurements through IEC/ ETSI (FOTP) specified optical reflectometry.
- The Cable strain margin is defined as the maximum cable strain at which there is no fibre strain.
- The cable Maximum Allowable Tension (MAT) is defined as the maximum tension experienced by the Cable under the worst case loading condition.
- The cable max strain is defined as the maximum strain experienced by the Cable under the worst case loading condition.
- The cable Every Day Tension (EDT) is defined as the maximum cable tension on any span under normal conditions.
- The Ultimate /Rated Tensile Strength (UTS/ RTS/ breaking strength) is defined as the maximum tensile load applied and held constant for one minute at which the specimen shall not break.
- While preparing the Sag-tension charts for the OPGW cable the following conditions shall be met:
 - The Max Allowable Tension (MAT) / max strain shall be less than or equal to the MWT/ Strain margin of the cable.
 - The sag shall not exceed the earth wire sag in all conditions.
 - The Max Allowable Tension shall also be less than or equal to 0.4 times the UTS of OPGW. However, Maximum Allowable Tension up to 0.5 times the UTS of OPGW may be accepted, subject to no fibre strain.
 - The 25 year creep at 25% of UTS (creep test as per IEEE 1138) shall be such that the 25 year creep plus the cable strain at Max Allowable Tension (MAT) is less than or equal to the cable strain margin.
 - The everyday tension (EDT) shall not exceed 20% of the UTS for the OPGW cable.

The Sag-tension chart of OPGW cable indicating the maximum tension, cable strain and sag shall be calculated and submitted along with the bid under various conditions mentioned below:

1. 53° C, no wind and no ice

2. 32° C, no wind and no ice
3. 0°C, no wind and no ice
4. 32° C, full wind and no ice
5. 32° C, 75% full wind and no ice
6. 0° C, 2/3rd / 36% of full wind (IS 802)

The above cases shall be considered for the spans from 100 m to 600 m or higher span length in the range of 50 m spans. Max. Vertical sag, max. tension and max sag at 0°C & no wind shall be considered in line with the design parameter of transmission line. The full wind load shall be considered as the design wind load for all the specified transmission lines as per relevant IS 802 version and the sag-tension chart shall be submitted considering the transmission lines. In case of any span higher than 600m, suitable OPGW cable meeting sag-tension requirement of transmission line shall also be provided by the Contractor. The Contractor shall submit the stringing chart for review of KSEBL.

1.10 Cable Materials

The materials used for optical fibre cable construction, shall meet the following requirements:

1.11 Filling Materials

The interstices of the fibre optic unit and cable shall be filled with a suitable compound to prohibit any moisture ingress or any water longitudinal migration within the fibre optic unit or along the fibre optic cable. The water tightness of the cable shall meet or exceed the test performance criteria as per IEC 60794-1-F-5.

The filling compound used shall be a non-toxic homogeneous waterproofing compound that is free of dirt and foreign matter, non-hygroscopic, electrically non-conductive and non-nutritive to fungus. The compound shall also be fully compatible with all cable components it may come in contact with and shall inhibit the generation of hydrogen within the cable.

The waterproofing filling materials shall not affect fibre coating, colour coding, or encapsulant commonly used in splice enclosures, shall be dermatologically safe, non-staining and easily removable with a non-toxic cleaning solvent.

1.12 Metallic Members

When the fibre optic cable design incorporates metallic elements in its construction, all metallic elements shall be electrically continuous.

1.13 Marking, Packaging and Shipping

This section describes the requirements for marking, packaging and shipping the overhead fibre optic cable.

- (a) Drum Markings: Each side of every reel of cable shall be permanently marked in white lettering with the vendors' address, the Purchaser's destination

address, cable part number and specification as to the type of cable, length, number of fibres, a unique drum number including the name of the transmission line & segment no., factory inspection stamp and date.

- (b) **Cable Drums:** All optical fibre cabling shall be supplied on sturdy, corrosion resistant, steel drums suitable for long periods of storage and re-transport & handling. All drums provided with lagging or PP sheets of adequate strength, constructed to protect the cabling against all damage and displacement during transit, storage and subsequent handling during installation. Both ends of the cable shall be sealed as to prevent the escape of filling compounds and dust & moisture ingress during shipment and handling. Spare cable caps shall be provided with each drum as required.

The spare cable shall be supplied on sturdy, corrosion resistant, steel drums suitable for long periods of storage and re-transport & handling.

There shall be no factory splices allowed within a continuous length of cable. Only one continuous cable length shall be provided on each drum. The lengths of cable to be supplied on each drum shall be determined by a "schedule" prepared by the Contractor and approved by the owner.

1.14 Optical Ground Wire (OPGW)

OPGW cable construction shall comply with IEEE-1138, 2009. The cable provided shall meet both the construction and performance requirements such that the ground wire function, the optical fibre integrity and optical transmission characteristics are suitable for the intended purpose. The cable shall consist of optical fibre units as defined in this specification. There shall be no factory splices within the cable structure of a continuous cable length.

The composite fibre optic overhead ground wire shall be made up of multiple buffer tubes embedded in a water tight aluminium/ aluminium alloy/stainless steel with aluminium coating protective central fibre optic unit surrounded by concentric-lay stranded metallic wires in single or multiple layers. In case of central Aluminum tube type OPGW, each buffer tube shall have maximum 12 no. of fibers and all fibers in single buffer tube is not acceptable. The dual purpose of the composite cable is to provide the electrical and physical characteristics of conventional overhead ground wire while providing the optical transmission properties of optical fibre.

1.15 Central Fibre Optic Unit

The central fibre optic unit shall be designed to house and protect multiple buffered optical fibre units from damage due to forces such as crushing, bending, twisting, tensile stress and moisture. The central fibre optic unit and the outer stranded metallic conductors shall serve together as an integral unit to protect the optical fibres from degradation due to vibration and galloping, wind and ice loadings, wide temperature variations, lightning and fault current, as well as environmental effects which may produce hydrogen.

The OPGW design of dissimilar materials such as stainless steel tube with aluminium or aluminium-clad-steel wire strands are not allowed. Central fibre

optic unit may be of aluminium or stainless steel tube with aluminium protective coating. In case of aluminium protective coating, the coating must completely cover the tubes leaving no exposed areas of tubing that can make electrical contact either directly or indirectly through moisture, contamination, protrusions, etc with the surrounding stranded wires. The tube may be fabricated as a seamless tube, seam welded, or a tube without a welded seam.

1.16 Basic Construction

The OPGW cable construction shall conform to the applicable requirements of this specification, applicable clauses of IEC 61089 related to stranded conductors. In addition, the basic construction shall include bare concentric-lay stranded metallic wires with the outer layer having left hand lay. The wires may be of multiple layers with a combination of various metallic wires within each layer. The direction of lay for each successive layer shall be reversed. The finished wires shall contain no joints or splices unless otherwise agreed to by the KSEBL and shall conform to all applicable clauses of IEC 61089 as they pertain to stranded conductors.

The wires shall be so stranded that when the complete OPGW is cut, the individual wires can be readily regrouped and then held in place by one hand.

1.17 Breaking Strength

The rated breaking strength of the completed OPGW shall be taken as not more than 90 percent of the sum of the rated breaking strengths of the individual wires, calculated from their nominal diameter and the specified minimum tensile strength.

The rated breaking strength shall not include the strength of the optical unit. The fibre optic unit shall not be considered a load bearing tension member when determining the total rated breaking strength of the composite conductor.

1.18 Electrical and Mechanical Requirements

“Table 6b” provides OPGW Electrical and Mechanical Requirements for the minimum performance characteristics. Additionally, the OPGW mechanical & electrical characteristics shall be similar to that of the earthwire being replaced such that there is no or minimal consequential increase in stresses on towers. For the purposes of determining the appropriate Max Working Tension limit for the OPGW cable, IS 802 shall be applied. However, the OPGW installation sag & tension charts shall be based on IS 802 version to which the line is originally designed. For the OPGW cable design selection and preparation of sag tension charts, the limits specified in this section shall also be satisfied.

TABLE 6b: OPGW ELECTRICAL AND MECHANICAL REQUIREMENTS

1)	Everyday Tension	$\leq 20\%$ of UTS of OPGW
2)	D.C. Resistance at 20°C:	< 1.0 ohm/Km
3)	Short Circuit Current	≥ 6.32 kA for 1.0 second (for 220 KV & above lines) ≥ 5.6 kA for 1.0 second (for 132 KV & 66 KV lines) Short Circuit shall be applicable as per the voltage level of the line
4)	Ultimate tensile Strength(UTS)	The following parameter of the existing earth wire also shall be considered for UTS design
4a)	Outer diameter(220/100kV)	10.98/9.75 mm
4b)	UTS (220/110kV)	68.4/56.02 KN
4c)	Weight per Km (220/110kV)	583/428 Kgs

1.19 Operating conditions

Since OPGW shall be located at the top of the transmission line support structure, it will be subjected to Aeolian vibration, Galloping and Lightning strikes. It will also carry ground fault currents. Therefore, its electrical and mechanical properties shall be same or similar as those required of conventional ground conductors.

1.20 Installation Hardware

The scope of supply includes all required fittings and hardware such as Tension assembly, Suspension assembly, Vibration dampers, reinforcing rods, Earthing clamps, Down-lead clamps, splice enclosure etc. The Bidder shall provide documentation justifying the adequacy and suitability of the hardware supplied. The quantity of hardware & fittings to meet any eventuality during site installation minimum @ 1% shall also be provided as part of set/ km for each transmission line without any additional cost to KSEBL.

The OPGW hardware fittings and accessories shall follow the general requirements regarding design, materials, dimensions & tolerances, protection against corrosion and markings as specified in clause 4.0 of EN 61284: 1997 (IEC 61284). The shear strength of all bolts shall be at least 1.5 times the maximum installation torque. The OPGW hardware & accessories drawing & GTP (DRS) document shall consist of three parts:

- (1) A technical particular sheet

- (2) An assembly drawing i.e. level 1 drawing and
- (3) Component level drawings i.e. level 2 & lower drawings. All component reference numbers, dimensions and tolerances, bolt tightening torques & shear strength and ratings such as UTS, slip strength etc shall be marked on the drawings.

The fittings and accessories described herein are indicative of installation hardware typically used for OPGW installations and shall not necessarily be limited to the following:

- (a) Suspension Assemblies: Preformed armour grip suspension clamps and aluminium alloy armour rods/ reinforcing rods shall be used. The suspension clamps shall be designed to carry a vertical load of not less than 25 kN. The suspension clamps slippage shall occur between 12kN and 17 kN as measured.

The Contractor shall supply all the components of the suspension assembly including shackles, bolts, nuts, washers, split pins, etc. The total drop of the suspension assembly shall not exceed 150 mm (measured from the centre point of attachment to the centre point of the OPGW). The design of the assembly shall be such that the direction of run of the OPGW shall be the same as that of the conductor.

- (b) Dead End Clamp Assemblies: All dead-end clamp assemblies shall preferably be of preformed armoured grip type and shall include all necessary hardware for attaching the assembly to the tower strain plates. Dead end clamps shall allow the OPGW to pass through continuously without cable cutting. The slip strength shall be rated not less than 95% of the rated tensile strength of the OPGW.

- (c) Clamp Assembly Earthing Wire: Earthing wire consisting of a 1500 mm length of aluminium or aluminium alloy conductor equivalent in size to the OPGW shall be used to earth suspension and dead-end clamp assemblies to the tower structure. The earthing wire shall be permanently fitted with lugs at each end. The lugs shall be attached to the clamp assembly at one end and the tower structure at the other.

- (d) Structure Attachment Clamp Assemblies: Clamp assemblies used to attach the OPGW to the structures, shall have two parallel grooves for the OPGW, one on either side of the connecting bolt. The clamps shall be such that clamping characteristics do not alter adversely when only one OPGW is installed. The tower attachment plates shall locate the OPGW on the inside of the tower and shall be attached directly to the tower legs/cross-members without drilling or any other structural modifications.

- (e) Vibration Dampers: Vibration dampers type 4R Stockbridge or equivalent, having four (4) different frequencies spread within the Aeolian frequency bandwidth corresponding to wind speed of 1m/s to 7 m/s, shall be used for suspension and tension points in each span. The Contractor shall determine the exact numbers and placement(s) of vibration dampers

through a detailed vibration analysis as specified in technical specifications.

One damper minimum on each side per OPGW cable for suspension points and two dampers minimum on each side per OPGW cable for tension points shall be used for nominal design span of 400 meters. For all other ruling spans, the number of vibration damper shall be based on vibration analysis.

The clamp of the vibration damper shall be made of high strength aluminum alloy of type LM-6. It shall be capable of supporting the damper and prevent damage or chaffing of the conductor during erection or continued operation. The clamp shall have smooth and permanent grip to keep the damper in position on the OPGW cable without damaging the strands or causing premature fatigue failure of the OPGW cable under the clamp. The clamp groove shall be in uniform contact with the OPGW cable 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 OPGW cable 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.

The messenger cable shall be made of high strength galvanised steel/stainless steel. It shall be of preformed and post formed quality in order to prevent subsequent drop of weight and to maintain consistent flexural stiffness of the cable in service. The messenger cable other than stainless steel shall be hot dip galvanised in accordance with the recommendations of IS:4826 for heavily coated wires.

The damper mass shall be made of hot dip galvanised mild steel/cast iron or a permanent mould cast zinc alloy. All castings shall be free from defects such as cracks, shrinkage, inclusions and blow holes etc. The surface of the damper masses shall be smooth.

The damper clamp shall be casted over the messenger cable and offer sufficient and permanent grip on it. The messenger cable shall not slip out of the grip at a load less than the mass pull-off value of the damper. The damper masses made of material other-than zinc alloy shall be fixed to the messenger cable in a suitable manner in order to avoid excessive stress concentration on the messenger cables which shall cause premature fatigue failure of the same. The messenger cable ends shall be suitably and effectively sealed to prevent corrosion. The damper mass made of zinc alloy shall be casted over the messenger cable and have sufficient and permanent grip on the messenger cable under all service conditions.

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

The vibration analysis of the system, with and without damper and dynamic characteristics of the damper as detailed in Technical Specification, shall have to be submitted. The technical particulars for vibration analysis and damping design of the system are as follows:

Sl No.	Description	Technical Particulars
1	Span Length in meters (i) Ruling design span: (ii) Maximum span: (iii) Minimum Span:	400 meters 1100 meters 100 meters
2	Configuration:	As per Specifications
3	Tensile load in each:	As per sag tension calculations
4	Armour rods used:	Standard preformed armour rods/AGS
5	Maximum permissible dynamic strain:	5 +/- 150 micro strains

The damper placement chart for spans ranging from 100m to 1100m shall be submitted by the Contractor. Placement charts should be duly supported with relevant technical documents and sample calculations.

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 OPGW cable 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 center 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.

1.21 Fibre Optic Splice Enclosures (Joint Box)

All splices shall be encased in Fibre Optic Splice Enclosures. Suitable splice enclosures shall be provided to encase the optical cable splices in protective, moisture and dust free environment. Splice enclosures shall comply with ingress protection class IP 66 or better. The splice enclosures shall be designed for the storage and protection of required number of optical fibre splices and equipped with sufficient number of splice trays for splicing all fibres in the cable. Not more than 12 fibres shall be terminated in a single splice tray. They shall be filled with suitable encapsulate that is easily removable should re-entry be required into the enclosures.

Splice enclosures shall be suitable for outdoor use with each of the cable types provided under this contract. Splice enclosures shall be appropriate for mounting on transmission line towers above anti-climb guard levels at about 10 metres from top of the tower and shall accommodate pass-through splicing. Contractor shall be responsible for splicing of fibres and installation of splice enclosures.

1.22 Optical Fibre Splices

Splicing of the optical fibre cabling shall be minimized through careful Contractor planning. There shall be no mid-span splices allowed. All required splices shall be planned to occur on tower structures. All optical fibre splicing shall comply with the following:

- (a) All fibre splices shall be accomplished through fusion splicing.
- (b) Each fibre splice shall be fitted with a splice protection sheath fitted over the final splice.
- (c) All splices and bare fibre shall be neatly installed in covered splice trays.
- (d) For each link, bi-directional attenuation of single mode fusion splices, shall not average more than 0.05 dB and no single splice loss shall exceed 0.1 dB when measured at 1550 nm.
- (e) For splicing, fibre optic cable service loops of adequate length shall be provided so that all splices occurring at tower structures can be performed at ground level.

1.23 Service Loops

For purposes of this specification, cable and fibre service loops are defined as slack (extra) cable and fibre provided for facilitating the installation, maintenance and repair of the optical fibre cable plant.

- (a) **Outdoor Cable Service Loops:** In-line splice enclosures installed outdoors and mounted on the utility towers shall be installed with sufficient fibre optic cable service loops such that the recommended minimum bend radius is maintained while allowing for installation or maintenance of the cable to be performed in a controlled environment at ground level.
- (b) **Fibre Units Service Loops:** For all fibre optic cable splicing, the cable shall be stripped back a sufficient length such that the fan-out of fibre units shall provide for at least one (1) metre of fibre unit service loop between the stripped cable and the bare fibre fan-out.
- (c) **Pigtail Service Loops:** Connectorised pigtails spliced to bare fibres shall provide at least 1 metre of service loop installed in the FODP fibre organizer and at least one (1) metre of service loop to the couplings neatly stored behind the FODP coupling panels.
- (d) **Fibre Service Loops:** At least 0.5 metre of bare fibre service loop shall be provided on each side of all fibre splices. The bare fibre service loops shall be neatly and safely installed inside covered splice trays.

2 INSPECTION & TESTING REQUIREMENT

All materials furnished, and all work performed under this Contract shall be inspected and tested. Deliverables shall not be shipped until all required inspections and tests have been completed, and all deficiencies have been corrected to comply with this Specification and approved for shipment by the KSEBL.

Except where otherwise specified, the Contractor shall provide all manpower and materials for tests, including testing facilities, logistics, power and instrumentation, and replacement of damaged parts. The costs shall be borne by the Contractor and shall be deemed to be included in the contract price.

The entire cost of testing for factory, production tests and other test during manufacture specified herein shall be treated as included in the quoted unit price of materials, except for the expenses of Inspector/KSEBL's representative.

Acceptance or waiver of tests shall not relieve the Contractor from the responsibility to furnish material in accordance with the specifications.

All tests shall be witnessed by the KSEBL and/or its authorized representative (hereinafter referred to as the KSEBL) unless the KSEBL authorizes testing to proceed without witness. The KSEBL representative shall sign the test form indicating approval of successful tests.

Should any inspections or tests indicate that specific item does not meet Specification requirements; the appropriate items shall be replaced, upgraded, or added by the Contractor as necessary to correct the noted deficiencies at no cost to the KSEBL. After correction of a deficiency, all necessary retests shall be performed to verify the effectiveness of the corrective action.

The KSEBL reserves the right to require the Contractor to perform, at the KSEBL's expense, any other reasonable test(s) at the Contractor's premises, on site, or elsewhere in addition to the specified Type, Acceptance, Routine, or Manufacturing tests to assure the KSEBL of specification compliance.

2.1 Test Plans and Procedures

Test plans and test procedures for both factory and site acceptance tests shall be provided by the Contractor. Test plans and test procedures shall ensure that each factory and site test is comprehensive and verify all the features of the equipment to be tested. Test plans and test procedures shall be modular to allow individual test segments to be repeated upon request.

The Contractor shall give the KSEBL twenty-one (21) days written notice of any material being ready for testing. Fifteen days prior to the scheduled testing, the KSEBL shall provide written notice to the Contractor of any drawings, equipment, material, or workmanship in which the KSEBL's opinion, are not compliant to the specification. The contractor shall give due consideration to such objections, if valid, effecting the corrections as necessary or shall prove, in writing, that said modifications are unnecessary for contract compliance.

2.2 Factory and Site Test Plans

A test plan for factory and site acceptance tests shall be submitted for the KSEBL approval, at least four (4) weeks before the start of testing. The test plan shall be a single overview document that defines the overall schedule and individual responsibilities associated with conducting the tests, documenting the test results, and successfully completing the test criteria.

2.3 Test Procedures

Test procedures for factory and site testing shall be submitted for the KSEBL approval at least four (4) weeks before each individual test. Testing shall not commence without approved test procedures.

All test equipment and/or instruments shall bear calibration stickers indicating valid calibration on and beyond the testing date. The time lapsed since last calibration shall not exceed the test equipment/ jig manufacturer recommended calibration interval or the interval recommended in the test lab's internal quality procedures.

The Contractor shall ensure that all testing will be performed by qualified testing personnel well experienced in performing such tests.

2.4 Test Records

Complete and indexed records of all factory and site acceptance tests results shall be maintained and provided to the KSEBL by the Contractor in hard & soft copy. The records shall be keyed to the steps enumerated in the test procedures.

All principle test records, test certificates and performance curves shall be supplied for all tests carried out as proof of compliance with the specifications and/or each and every specified test. These test certificates, records and performance curves shall be supplied for all tests, whether or not they have been witnessed by the KSEBL within the specified duration after the completion of test. Information given on such test certificates and curves shall be sufficient to identify the material or equipment to which the certificates refer and shall also bear the Contractor's reference and heading.

2.5 Rejection of Elements

Any item or component which fails to comply with the requirements of this Specification in any respect, at any stage of manufacture, test, erection or on completion at site may be rejected by the KSEBL either in whole or part as considered necessary. Material or components with defects of such a nature that do not meet the requirements of the Specification by adjustment or modification shall be replaced by the Contractor at his own expense. After adjustment or modification, the Contractor shall submit the items to the KSEBL for further inspection and/or tests.

2.6 Testing Requirements: Following are the requirements of testing:

1. Type Testing
2. Factory Acceptance Testing
3. Site Acceptance Testing

2.7 Type Testing

"Type Tests" shall be defined as those tests which are to be carried out to prove the design, process of manufacture and general conformity of the materials to this Specification. Type Testing shall comply with the following:

- (a) All cable & equipment being supplied shall conform to type tests as per technical specification.
- (b) The test reports submitted shall be of the tests conducted within last seven (7) years for OPGW cable prior to the date of proposal/offer submitted. In case the test reports are older than seven (7) years for OPGW cable on the date of proposal/offer, the Contractor shall repeat these tests at no extra cost to the KSEBL.
- (c) The Contractor shall submit, within 30 days of Contract Award, copies of test reports for all of the Type Tests that are specified in the specifications and that have previously (before Contract award) been performed.

These reports may be accepted by the KSEBL only if they apply to materials and equipment that are essentially identical to those due to be delivered under the Contract and only if test procedures and parameter values are identical to those specified in this specification carried out at accredited labs and witnessed by third party / customer's representatives.

In the event of any discrepancy in the test reports or any type tests not carried out, same shall be carried out by Contractor without any additional cost implication to the KSEBL.

In case the Type Test is required to be carried out, then following shall be applicable: -

- (a) Type Tests shall be certified or performed by reputed laboratories using material and equipment data sheets and test procedures that have been approved by the KSEBL. The test procedures shall be formatted as defined in the technical specifications and shall include a complete list of the applicable reference standards and submitted for KSEBL approval at least four (4) weeks before commencement of test(s). The Contractor shall provide the KSEBL at least 30 days written notice of the planned commencement of each type test.
- (b) The Contractor shall provide a detailed schedule for performing all specified type tests. These tests shall be performed in the presence of a representative of the KSEBL.
- (c) The Contractor shall ensure that all type tests can be completed within the time schedule offered in his Technical Proposal.

In case of failure during any type test, the Supplier is either required to manufacture a fresh sample lot and repeat all type tests successfully or repeat that particular type test(s) at least three times successfully on the samples 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.

2.8 Type Test Samples

The Contractor shall supply equipment/material for sample selection only after the Quality Assurance Plan has been approved by the KSEBL. The sample material shall be manufactured strictly in accordance with the approved Quality Assurance

Plan. The Contractor shall submit for KSEBL approval, the type test sample selection procedure. The selection process for conducting the type tests shall ensure that samples are selected at random. For optical fibres/ Fibre Optic cables, at least three reels/ drums of each type of fibre/cable proposed shall be offered for selection. For FO cable installation hardware & fittings at least ten (10) samples shall be offered for selection. For Splice enclosures at least three samples shall be offered for selection.

2.9 List of Type Tests

The type testing shall be conducted on the following items

- (a) Optical fibres
- (b) OPGW Cable
- (c) OPGW Cable fittings
- (d) Vibration Damper
- (e) Splice Enclosure (Joint Box)

2.10 Type Tests for Optical Fibres

The type tests listed below in Table 6d shall be conducted on DWDM fibres to be supplied as part of overhead cables. The tests specific to the cable type are listed in subsequent sections.

Table 6d: TYPE TESTS FOR OPTICAL FIBRES

SI NO.	TEST NAME	ACCEPTANCE CRITERIA	TEST PROCEDURE
1	Attenuation	As per Clause-1 of TS	IEC 60793-1-40 Or EIA/TIA 455-78A
2	Attenuation Variation with Wavelength	As per Clause-1 of TS	IEC 60793-1-40 Or EIA/TIA 455-78A
3	Attenuation at Water Peak	As per Clause-1 of TS	IEC 60793-1-40 Or EIA/TIA 455-78A
4	Temp. Cycling (Temp dependence of Attenuation)	As per Clause-1 of TS	IEC 60793-1-52 Or EIA/TIA 455-3A, 2 cycles
5	Attenuation with Bending (Bend Performance)	As per Clause-1 of TS	IEC 60793-1-47 Or EIA/TIA 455-62A
6	Mode Field dia.	As per Clause-1 of TS	IEC 60793-1-45 Or EIA/TIA 455-164A/167A/174
7	Chromatic Dispersion	As per Clause-1 of TS	IEC 60793-1-42 Or EIA/TIA 455-168A/169A/175A
8	Cladding Diameter	As per Clause-1 of TS	IEC 60793-1-20 Or EIA/TIA 455-176
9	Point Discontinuities of Attenuation	As per Clause-1 of TS	IEC 60793-1-40 Or EIA/TIA 455-59
10	Core –Clad concentricity error	As per Clause-1 of TS	IEC 60793-1-20 Or EIA/TIA 455-176
11	Fibre Tensile Proof Testing	As per Clause-1 of TS	IEC 60793-1-30 Or EIA/TIA 455-31B

2.11 Type Tests for OPGW Cables

The type tests to be conducted on the OPGW cable are listed in Table 6e Type Tests for OPGW Cables. Unless specified otherwise in the technical specifications or the referenced standards, the optical attenuation of the specimen, measured during or after the test as applicable, shall not increase by more than 0.05 dB/Km.

Table 6e: TYPE TESTS FOR OPGW CABLE

SR. NO.	TEST NAME	TEST DESCRIPTION	TEST PROCEDURE	
1	Water Ingress Test	IEEE 1138-2009	IEEE 1138-2009(IEC 6074-1-2 Method F5 or EIA/TIA 455-82B)	Test duration: 24 hours
2	Seepage of filling compound	IEEE 1138-2009	IEEE 1138-2009 (EIA/TIA 455-81B)	Preconditioning period: 72 hours. Test duration: 24 hours.
3	Short Circuit Test	IEEE 1138-2009	IEEE 1138-2009	<p>Fibre attenuation shall be continuously monitored and recorded through a digital data logging system or equivalent means.</p> <p>A suitable temperature sensor such as thermocouple shall be used to monitor and record the temperature inside the OPGW tube in addition to monitoring & recording the temperatures between the strands and between optical tube and the strand as required by IEEE 1138.</p> <p>Test shall be conducted with the tension clamps proposed to be supplied. The cable and the clamps shall be visually inspected for mechanical damage and photographed after the test.</p>
		Or IEC60794-4-10/IEC 60794-1-2 (2003) Method H1		Initial temperature during the test shall be greater than or equal to ambient field temperature.
4	Aeolian Vibration Test	IEEE 1138-2009 Or IEC60794-4-10 / IEC 60794-1-2,	IEEE 1138-2009	<p>Fibre attenuation shall be continuously monitored and recorded through a digital data logging system or equivalent means.</p> <p>The vibration frequency and amplitude shall be monitored and recorded continuously.</p> <p>All fibres of the test cable</p>

		Method E19		sample shall be spliced together in serial for attenuation monitoring. Test shall be conducted with the tension/suspension clamps proposed to be supplied. The cable and the clamps shall be visually inspected for mechanical damage and photographed after the test.
5	Galloping test	IEEE 1138-2009	IEEE 1138-2009	Test shall be conducted with the tension/suspension clamps proposed to be supplied. The cable and clamps shall be visually inspected for mechanical damage and photographed after the test. All fibres of the test cable sample shall be spliced together in serial for attenuation monitoring.
6	Cable Bend Test	Procedure 2 in IEC 60794-1-2 Method E11		The short-term and long-term bend tests shall be conducted in accordance with Procedure 2 in IEC60794-1-2 E11 to determine the minimum acceptable radius of bending without any increase in attenuation or any other damage to the fibre optic cable core such as bird caging, deformation, kinking and crimping.
7	Sheave Test	IEEE 1138-2009 OR IEC 60794-1-2 (2003) Method E1B	IEEE 1138-2009	Fibre attenuation shall be continuously monitored and recorded through a digital data logging system or equivalent means. The Sheave dia. shall be based on the pulling angle and the minimum pulley dia employed during installation. All fibres of the test cable sample shall be spliced together in serial for attenuation monitoring.
8	Crush Test	IEEE 1138-2009	IEEE 1138-2009	The crush test shall be carried out on a sample of approximately one (1) metre

			(IEC 60794-1-2, Method E3/ EIA/TIA 455-41B)	long in accordance with IEC 60794-1-2 E3. A load equal to 1.3 times the weight of a 400-metre length of fibre optic cable shall be applied for a period of 10 minutes. A permanent or temporarily increase in optical attenuation value greater than 0.1 dB change in sample shall constitute failure. The load shall be further increased in small increments until the measured attenuation of the optical waveguide fibres increases and the failure load recorded along with results.
9	Impact Test	IEEE 1138-2009	IEEE 1138-2009, (IEC 60794-1-2 E4/ EIA/TIA 455- 25B)	The impact test shall be carried out in accordance with IEC 60794-1-2 E4. Five separate impacts of 0.1-0.3kgm shall be applied. The radius of the intermediate piece shall be the reel drum radius \pm 10%. A permanent or temporary increase in optical attenuation value greater than 0.1 dB/km change in sample shall constitute failure.
10	Creep Test	IEEE 1138-2009	IEEE 1138-2009	As per Aluminium Association Method, the best-fit straight line shall be fitted to the recorded creep data and shall be extrapolated to 25 years. The strain margin of the cable at the end of 25 years shall be calculated. The time when the creep shall achieve the strain margin limits shall also be calculated.
11	Fibre Strain Test	IEEE 1138-1994	IEEE 1138-1994	
12	Stress strain Test	IEEE 1138-2009	IEEE 1138-2009	
13	Cable Cut-off Wavelength test	IEEE 1138-1994	IEEE 1138-1994	
14	Temperature Cycling Test	IEEE 1138-2009	IEEE 1138-2009 Or IEC 60794-1-2, Method F1	

15	Corrosion (Salt Spray) Test	EIA/TIA 455-16A/IEEE 1138: 2009	
16	Tensile Performance Test	IEC 60794-1-2 E1 / EIA/TIA 455-33B	The test shall be conducted on a sample of sufficient length in accordance with IEC 60794-1-2 E1. The attenuation variation shall not exceed 0.05 dB/Km up to 90% of RTS of fibre optic cable. The load shall be increased at a steady rate up to rated tensile strength and held for one (1) minute. The fibre optic cable sample shall not fail during the period. The applied load shall then be increased until the failing load is reached, and the value recorded.
17	Lightning Test	IEC 60794-4-10 / IEC 60794-1-2 (2003)	The OPGW cable construction shall be tested in accordance with IEC 60794-1-2, Method H2 for Class 1.
18	DC Resistance Test (IEC 60228)	On a fibre optic cable sample of minimum 1 metre length, two contact clamps shall be fixed with a predetermined bolt torque. The resistance shall be measured by a Kelvin double bridge by placing the clamps initially zero metre and subsequently one metre apart. The tests shall be repeated at least five times and the average value recorded after correcting at 20°C.	

2.12 Type Test on OPGW Cable Fittings

The type tests to be conducted on the OPGW Cable fittings and accessories are listed below:

(i) Mechanical Strength Test for Suspension/Tension Assembly

Applicable Standards: IEC 61284, 1997.

SUSPENSION ASSEMBLY

The armour rods /reinforcement rods are assembled on to the approved OPGW using the Installation Instructions to check that the assembly is correctly fitted and is the same that will be carried out during installations.

Part 1:

The suspension assembly shall be increased at a constant rate up to a load equal to 50% of the specified minimum Failure Load increased and held for one minute for the test rig to stabilize. The load shall then be increased at a steady rate to

67% of the minimum Failure Load and held for five minutes. The angle between the cable, the Suspension Assembly and the horizontal shall not exceed 16°. This load shall then be removed in a controlled manner and the Protection Splice disassembled. Examination of all the components shall be made and any evidence of visual deformation shall be documented.

Part 2:

The Suspension clamp shall then be placed in the testing machine. The tensile load shall gradually be increased up to 50% of the specified Minimum Failure Load of the Suspension Assembly and held for one minute for the Test Rig to stabilize and the load shall be further increased at a steady rate until the specified minimum Failure Load 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 shall be documented.

TENSION ASSEMBLY

The Tension Assembly is correctly fitted and is the same that will be carried out during installations.

Part 1:

The tension assembly (excluding tension clamp) shall be increased at a constant rate up to a load equal to 50% of the specified minimum Failure Load increased at a constant rate and held for one minute for the test rig to stabilize. The load shall then be increased at a steady rate to 67% of the minimum Failure Load and held for five minutes. This load shall then remove in a controlled manner and the Tension Assembly disassembled. Examination of the Tension Dead-End and associated components shall be made, and any evidence of visual deformation shall be documented.

Part 2:

The Tension Dead-End and associated components shall then be reassembled, and bolts tightened as before. The tensile load shall gradually be increased up shall gradually be increased up to 50% of the specified Minimum Failure Load of the Tension Assembly and held for one minute for the Test Rig to stabilize and the load shall be further increased at a steady rate until the specified minimum Failure Load 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 shall be documented.

Acceptance Criteria for Tension/Suspension Assembly:

- No evidence of binding of the Nuts or Deformation of components at end of Part 1 of Test.
- No evidence of Fracture at the end of one minute at the minimum failure load during Part 2 of the Test.

Any result outside these parameters shall constitute a failure

(ii) Clamp Slip Strength Test for Suspension Assembly

The suspension assembly shall be vertically suspended by means of a flexible attachment. A suitable length fibre optical cable shall be fixed in the clamps.

Once the Suspension Clamp has been assembled, the test rig is tensioned to 1 kN and the position scale on the recorder 'zeroed'. The test rig is then tensioned to 2.5 kN and the relative positions of the Reinforcing Rods, Armour Rods and Suspension Clamp shall be marked by a suitable means to confirm any slippage after the test has been completed. The relative positions of the helical Armour Rods and associated Reinforcing Rods at each end shall be marked and also 2 mm relative position between clamp body and Armour Rods shall be marked on one side. The load shall be increased to 12 kN at a loading rate of 3 kN/min and held for one minute. At the end of this one minute period, the relative displacement between clamp body and the armour rods shall be observed. If the slippage is 2 mm or above, the test shall be terminated. Otherwise, at the end of one minute the position of the clamp body and 2 mm. relative positions between clamp body and armour rods shall be marked on the other side. After the one minute pause, the load shall be further increased at a loading rate of 3 kN/min, and recording of load and displacement shall continue until either the relative Position displacement between clamp body and armour rods reaches more than 2 mm or the load reaches the maximum slip load of 17 kN. On reaching either of the above values the test is terminated. Visual examination of all paint marks shall be recorded, and a measurement of any displacement recorded in the Table of Results.

Acceptance Criteria:

The Suspension Clamp has passed the Slip Test if the following conditions are met:

No slippage* shall occur at or below the specified minimum slip load.

Definition of no slippage in accordance with IEC 61284, 1997: - Any relative movement less than 2 mm is accepted. The possible couplings or elongations produced by the cable as a result of the test itself are not regarded as slippage.

Slippage shall occur between the specified maximum and minimum slip load of 12 - 17 kN.

There shall be no slippage of the Reinforcing Rods over the cable, and no slippage of the Armour Rods over the Reinforcing Rods.

The relative movement (i.e. more than 2 mm between Armour Rods & Clamp body) between minimum 12 kN and maximum slip 17 kN, shall be considered as slip.

The Armour Rods shall not be displaced from their original lay or damaged**.

** Definition of no damage in accordance with convention expressed in IEC 61284:1997 no damage, other than surface flattening of the strands shall occur.

Any result outside these parameters is a failure.

(iii) Slip Strength Test of Tension Clamp

Tension clamps shall be fitted on an 8 m length of fibre optic cable 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 shall gradually be applied up to 20% of the RTS of OPGW. Displacement transducers shall be installed to measure the relative movement between the OPGW relative to the Reinforcing Rods and Tension Dead –End relative to Reinforcing Rods. In addition, suitable marking shall be made on the OPGW and Dead-End to confirm grip. The load shall be gradually increased at a constant rate up to 50 % of the UTS and the position scale of the recorder is zeroed. The load shall then gradually have increased up to 95 % of the UTS and maintained for one minute. After one minute pause, the load shall be slowly released to zero and the marking examined and measured for any relative movement.

Acceptance Criteria:

- No movement* shall occur between the OPGW and the Reinforcing Rods, or between the Reinforcing Rods and the Dead-End assembly.
- No failure or damage or disturbance to the lay of the Tension Dead-End, Reinforcing Rods or OPGW.
- Definition of no movement as defined in IEC 61284: Any relative movement less than 2 mm is accepted. The possible couplings or elongations produced by the conductor as a result of the test itself are not regarded as slippage.

Any result outside these parameters shall constitute a failure

(iv) Grounding Clamp and Structure Mounting Clamp Fit Test

For structure mounting clamp, one series of tests shall be conducted with two fibre optic cables installed, one series of tests with one fibre optic cable installed in one groove, and one series of tests with one fibre optic cable in the other groove. Each clamp shall be installed including clamping compound as required on the fibre optic cable. The nut shall be tightened on to the bolt by using torque wrench with a torque of 5.5 kgm or supplier's recommended torque and the tightened clamp shall be held for 10 minutes. After the test remove the fibre optic cable and examine all its components for distortion, crushing or breaking. Also, the fibre optic cable shall be checked to ensure free movement within the core using dial callipers to measure the diameter of the core tube. The material shall be defined as failed if any visible distortion, crushing, cracking or breaking of the core tube is observed or the fibre optic cable within the core tube is not free to move, or when the diameter of the core tube as measured at any location in the clamped area is more than 0.5 mm larger or smaller of the core diameter as measured outside the clamped area.

(v) Structure Mounting Clamp Strength Test

The clamp and mounting assembly shall be assembled on a vertical 200 mm x 200 mm angle and a short length of fibre optic cable installed. A vertical load of 200 kg shall be applied at the end of the mounting clamp and held for 5 minutes. Subsequently, the load shall be increased to 400 kg and held for 30 seconds. Any visible distortion, slipping or breaking of any component of the mounting clamp or assembly shall constitute failure.

2.13 Type Test on Vibration Damper

(a) Dynamic Characteristic Test

The damper shall be mounted with its clamp tightened with torque recommended by the manufacturer on shaker table capable of simulating sinusoidal vibrations for Critical Aeolian Vibration frequency band ranging from $0.18/d$ to $1.4/d$ – where d is the OPGW cable diameter in meters. The damper assembly shall be vibrated vertically with a ± 1 mm amplitude from 5 to 15 Hz frequency and beyond 15 Hz at 0.5 mm to determine 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 peaks 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 fibre optic cable without dampers.

Acceptance criteria for vibration damper:

- (i) The above dynamic characteristics test on five dampers shall be conducted.
- (ii) The mean reactance and phase angle Vs frequency curves shall be drawn with the criteria of best fit method.
- (iii) The above mean reactance response curve should lie within following limits:
V.D. for OPGW - $0.060 f$ to $0.357 f$ kgf/mm*
Where f is frequency in Hz.
- (iv) The above mean phase angle response curve shall be between 25° to 130° within the frequency range of interest.
- (v) If the above curve lies within the envelope, the damper design shall be considered to have successfully met the requirement.
- (vi) 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 fibre optic cable 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 fibre optic cable without armour rods. The tension shall be taken as 25% of RTS of fibre optic cable for a span ranging from 100 m to 1100 m.

- (ii) The self-damping factor and flexural stiffness (EI) for fibre optic cable shall be calculated on the basis of experimental results. The details to experimental analysis with these data shall be furnished.
- (iii) The power dissipation curve obtained from Damper Characteristics Test shall be used for analysis with damper.
- (iv) Examine the Aeolian Vibration level of the fibre optic cable 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 fibre optic cable 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 Aeolian vibration levels exceed the specified limits shall be determined.
- (vi) From vibration analysis of fibre optic cable with damper(s) installed at the recommended location, the dynamic strain level at the clamped span extremities, damper attachment points and the antinodes on the fibre optic cable shall be determined. In addition to above damper clamp vibration amplitude and antinodes vibration amplitudes shall also be examined.

The dynamic strain levels at damper attachment point, 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) Fatigue Tests

(i) Test Set Up

The fatigue tests shall be conducted on a laboratory set up with a minimum effective span length of 30m. The fibre optic cable shall be tensioned at 25% of RTS of fibre optic cable 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 fibre optic cable has been tensioned, clamps shall be installed to support the fibre optic cable 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 fibre optic cable. 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 step less speed control as well as step less 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) 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 $\pm 25/f$ 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 herein shall be repeated after fatigue tests 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 fibre optic cable and subjected to dynamic characteristics test. There shall not be any major deterioration in the characteristics 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 fibre optic cable under clamp shall also be free from any damage.

For purposes of acceptance, the following criteria shall be applied:

- (1) There shall not be any resonant frequency shift before and after the test by more than $\pm 20\%$
- (2) The power dissipation of the damper before and after test at the individual resonant frequencies do not differ by more than $\pm 20\%$

Beside above tests, the type tests listed below in the table shall also be conducted on Vibration Damper

Sl No.	Test Name	Test Procedure
1	Visual examination & Dimensional and material verification	IEC 61897 Clause 7.1 & 7.2
2	Clamp Slip test	IEC 61897 Clause 7.5
3	Clamp bolt tightening test	IEC 61897 Clause 7.7
4	Attachments of weights to messenger cable	IEC 61897 Clause 7.8
5	Attachment of clamps to messenger cable	IEC 61897 Clause 7.8

6	Damper effectiveness evaluation	IEC 61897 Clause 7.11.3.2
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2.14 Type Tests for Splice Enclosures (Joint Box)

Following Type tests shall be demonstrated on the Splice Enclosure(s) (Splice Enclosure/Box). For certain tests, lengths of the fibre optic cable shall be installed in the splice box, and the fibres must be spliced and looped in order to simulate conditions of use. The attenuation of the fibres shall be measured, during certain tests, by relevant Fibre Optic Test Procedures (EIA/TIA 455 or IEC 60794-1 procedures).

(i) Temperature Cycling Test

FO cable is installed in the splice enclosure and optical fibres spliced and looped. The box must be subjected to 5 cycles of temperature variations of -40°C to +65°C with a dwell time of at least 2 hours on each extreme.

Fibre loop attenuation shall be measured in accordance with EIA 455-20 / IEC 60794-1-C10. The variation in attenuation shall be less than ± 0.05 dB. The final humidity level, inside the box, shall not exceed the initial level, at the closing of the box.

(ii) Humid Heat test

The sealed splice enclosure, with fibres spliced and looped inside, must be subjected to a temperature of $+55^{\circ}\text{C} \pm 2^{\circ}\text{C}$ with a relative humidity rate of between 90% and 95% for 5 days. The attenuation variation of the fibres during the duration of the test shall be less than ± 0.05 dB, and the internal humidity rate measured, less than 2%.

(iii) Rain Withstand Test / Water Immersion test

The splice enclosure with optical fibres cable installed and fibres spliced fixed, shall be subjected to 24 hours of simulated rain in accordance with IEC 60060 testing requirements.

No water seepage or moisture shall be detected in the splice enclosure. The attenuation variation of the fibres after the test shall be less than ± 0.05 dB.

(iv) Vibration Test

The splice enclosure, with fibres united inside, shall be subjected to vibrations on two axes with a frequency scanning of 5 to 50 Hz. The amplitude of the vibrations shall be constant at 0.450mm, peak to peak, for 2 hours, for each of the vibrations' axes. The variation in attenuation, of the fibres, shall be less than ± 0.05 dB. The splice enclosure shall be examined for any defects or deformation. There shall be no loosening or visible damage of the FO cable at the entry point.

(v) Bending and Torsion test

The splice enclosure, with fibres spliced inside, shall be firmly held in place and be subjected to the following sequence of mechanical stresses on the cable:

- a) 3 torsion cycles of $\pm 180^\circ$ shall be exercised on the cable. Each cycle shall be less than one minute.
- b) 3 flexure cycles of the cable, of $\pm 180^\circ$ with one cycle less than one minute.

The variation in the attenuation, of the fibres, shall be less than ± 0.05 dB. The cables connection ring shall remain securely fixed to the box with the connection maintained firmly.

No defects/fissures shall be noted on the joint ring or on the splice enclosure

(vi) Tensile test

The splice enclosure with cable fixed to the boxes shall be subjected to a minimum tension of 448 N for a period of two minutes. No fissure shall be noted in the connections or on the box.

(vii) Drop Test

With 2 lengths of 11 meters of cable fixed to the box, it shall be dropped five times from a height of 10 meters. There shall be no fissure, at all, of the box, and the connections shall remain tight. The test surface shall be carried out in accordance with IEC 60068-2-32.

2.15 Factory Acceptance Tests

Factory acceptance tests shall be conducted on randomly selected final assemblies of all equipment to be supplied. Factory acceptance testing shall be carried out on OPGW Cable and associated hardware & fittings, Approach Cable, Joint Box, FODP etc. and all other items for which price has been identified separately in the Bid Price Schedules.

Material shall not be shipped to the KSEBL until required factory tests are completed satisfactorily, all variances are resolved, full test documentation has been delivered to the KSEBL, and the KSEBL has issued Material Inspection & Clearance Certificate (MICC).

Successful completion of the factory tests and the KSEBL approval to ship, shall in no way constitute final acceptance of the system or any portion thereof. These tests shall be carried out in the presence of the KSEBL's authorised representatives unless waiver for witnessing by KSEBL's representatives is intimated to the contractor.

Factory acceptance tests shall not proceed without the prior delivery to and approval of all test documentation by the KSEBL.

The factory acceptance tests for the supplied items shall be proposed by the Contractor in accordance with technical specifications and Contractor's (including Sub-Contractor's / supplier's) standard FAT testing program. In general, the FAT for other items shall include at least: Physical verification, demonstration of technical characteristics, various operational modes, functional interfaces etc.

For Test equipment FAT shall include supply of proper calibration certificates, demonstration of satisfactory performance, evidence of correct equipment configuration and manufacturer's final inspection certificate/ report.

2.16 Sampling for FAT

From each batch of equipment presented by the Contractor for Factory acceptance testing, the KSEBL shall select random sample(s) to be tested for acceptance. Unless otherwise agreed, all required FAT tests in the approved FAT procedures, shall be performed on all samples.

The Sampling rate for the Factory acceptance tests shall be minimum 10% of the batch size (minimum 1) for all items. The physical verification shall be carried out on 100% of the offered quantities as per the approved FAT procedure. In case any of the selected samples fail, the failed sample is rejected, and additional 20% samples shall be selected randomly and tested. In case any sample from the additional 20% also fails the entire batch may be rejected.

For the OPGW cable hardware fittings & accessories, the minimum sampling rate, and batch acceptance criteria shall be as defined in IS 2486.

The Sampling rate for the Factory acceptance tests shall be 10% of the batch size (minimum 2) for FO cable drums, FODPs, Joint box and other similar items.

Since FAT testing provides a measure of assurance that the Quality Control objectives are being met during all phases of production, the KSEBL reserves the right to require the Contractor to investigate and report on the cause of FAT failures and to suspend further testing/ approvals until such a report is made and remedial actions taken, as applicable.

2.17 Production Testing

Production testing shall mean those tests which are to be carried out during the process of production by the Contractor to ensure the desired quality of end product to be supplied by him. The production tests to be carried out at each stage of production shall be based on the Contractor's standard quality assurance procedures. The production tests to be carried out shall be listed in the Manufacturing Quality Plan (MQP), along with information such as sampling frequency, applicable standards, acceptance criteria etc.

The production tests would normally not be witnessed by the KSEBL. However, the KSEBL reserves the right to do so or inspect the production testing records in accordance with Inspection rights specified for this contract.

2.18 Factory Acceptance Tests on Optical Fibre to be supplied with OPGW

The factory acceptance tests listed in table below are applicable for the Optical fibres to be supplied. The listed tests follow testing requirements set forth in IEEE standard 1138/IEC 60794. The referenced sections specify the detailed test description. The acceptance norm shall be as specified in the above-mentioned IEEE standards unless specified otherwise in the technical specifications.

Table 6g: Factory Acceptance Tests for Optical Fibres: Optical Tests

Sr. No.	Test Name	Acceptance Criteria	Test procedure
1	Attenuation Coefficient	As per T S	EIA/TIA 455- 78A
2	Point Discontinuities of attenuation	As per T S	EIA/TIA 455-59

3	Attenuation at Water Peak	As per T S	EIA/TIA 455- 78A
4	Chromatic Dispersion		EIA/TIA 455-168A/169A/175A
5	Core – Clad Concentricity Error		EIA/TIA 455-/176
6	Cladding diameter		EIA/TIA 455-176
7	Fibre Tensile Proof Testing		EIA/TIA 455-31B

The test report for the above tests for the fibers carried out by the Fiber Manufacturer and used in the OPGW cables shall be shown to the inspector during OPGW cable FAT and shall be submitted along with the OPGW cable FAT report.

2.19 Factory Acceptance Test on OPGW Cable

The factory acceptance tests for OPGW cable specified below in Table follow the requirements set forth in IEEE standard 1138 / IEC 60794. The FAT shall be carried out on 10% of offered drums in each lot as specified in technical specifications and the optical tests shall be carried out in all fibres of the selected sample drums. The Rated Tensile Strength test shall be carried out on one sample in each lot.

Table 6h: Factory Acceptance Tests on OPGW**Applicable standard: IEEE 1138 / IEC 60794**

Sr. No.	Factory Acceptance Test on Manufactured OPGW
1	Attenuation Co-efficient at 1310 nm and 1550 nm
2	Point discontinuities of attenuation
3	Visual Material verification and dimensional checks as per approved DRS/Drawings
4	Rated Tensile Strength
5	Lay Length Measurements

2.20 Factory Acceptance Test on OPGW Fittings

The factory acceptance tests for OPGW Fittings as specified below. The sampling plan shall be as per relevant standard:

Factory Acceptance Tests on OPGW Fittings

S. No.	Factory Acceptance Test
Suspension Assembly	
1	UTS/ Mechanical Strength of the assembly
2	Clamp Slip Test
3	Visual Material verification and dimensional checks as per approved DRS/ Drawings
4	Mechanical strength of each component
5	Galvanizing test
Tension Assembly	
6	Clamp Slip Strength test
7	Visual Material verification and dimensional checks as per approved DRS/Drawings
8	Mechanical strength of each component
9	Galvanizing Test
Vibration Damper	
10	Galvanizing test on damper, masses and messenger wires
11	Damper response (resonant frequencies)
12	Clamp Slip test
13	Strength of messenger wires

14	Attachments of weights to messenger cable
15	Attachments of clamps to messenger cable
16	Clamp bolt tightening test
17	Clamp bolt torque test
18	Dynamic characteristic test.
19	Visual Material verification and dimensional checks as per approved DRS/Drawings
Structure Mounting Clamp	
20	Clamp fit test
21	Clamp Strength test
22	Visual Material verification and dimensional checks as per approved DRS/Drawings

2.21 Factory Acceptance Test on Splice Enclosure (Joint Box) /FODP

The factory acceptance tests for Splice Enclosures/FODP as specified below.

Factory Acceptance Tests on Splice Enclosures (Joint Box)/FODP

Sr. No.	Factory Acceptance Test
1	Visual check of Quantities and Specific Component Number for each component of Splice Enclosure/FODP and dimensional checks against the approved drawings.

2.22 Factory Acceptance Test on Test Equipment & other items

As per technical specification and approved DRS/Documents

2.23 Site Acceptance Tests

The Contractor shall be responsible for the submission of all material & test equipment supplied in this contract for site tests and inspection as required by the KSEBL. All equipment shall be tested on site under the conditions in which it will normally operate.

The tests shall be exhaustive and shall demonstrate that the overall performance of the contract works satisfies every requirement specified. At a minimum Site Acceptance Testing requirement for FO cable etc. is outlined in following section. This testing shall be supplemented by the Contractor's standard installation testing program, which shall be in accordance with his quality plan(s) for FO installation.

During the course of installation, the KSEBL shall have full access for inspection and verification of the progress of the work and for checking workmanship and

accuracy, as may be required. On completion of the work prior to commissioning, all equipment shall be tested to the satisfaction of the KSEBL to demonstrate that it is entirely suitable for commercial operation.

2.24 Minimum Site Acceptance Testing Requirement for FO Cabling

Prior to installation, every spooled fibre optic cable segment shall be tested for compliance with the Pre-shipment data previously received from the manufacturer. This requirement will preclude the installation of out of specification cable segments that may have been damaged during shipment.

2.25 Phases of Site Acceptance Testing

SAT shall be carried out link by link from Tap tower joint enclosure to Gantry side joint enclosure. SAT may be performed in parts in case of long links.

The tests, checks, adjustments etc conducted by the Contractor prior to offering the equipment for SAT shall be called Pre-SAT activities. The Pre-SAT activities shall be described in the installation manuals and Field Quality Plan documents.

Sag and tension of OPGW shall generally be as per approved sag-tension chart and during installation, sag and tension of OPGW shall be documented. Upon completion of a continuous cable path, all fibres within the cable path shall be demonstrated for acceptance of the cable path. Fibre Optic cable site testing minimum requirements are provided in Tables below:

Fibre Optic Cable Pre-Installation Testing

Item	Description
1	Physical Inspection of the cable assembly for damage
2	Optical fibre continuity and fibre attenuation with OTDR at 1550 nm
3	Fibre Optic Cable length measurement using OTDR
Fiber Optic Cable Post-Installation Testing (Each section)	
4	Physical Inspection of the installed OPGW and hardware fittings
5	Optical fiber continuity, fiber attenuation and cable length with OTDR

Fibre Optic Cable Splicing Testing

Item	Description
1	Per splice bi-directional average attenuation with OTDR
2	Physical inspection of splice box/enclosure for proper fibre / cable routing techniques
3	Physical inspection of sealing techniques, weatherproofing, etc.

Fibre Optic Cable Commissioning Testing

Item	Description
1	End to End (FODP to FODP) bi-directional average attenuation of

	each fibre at 1310 nm and 1550 nm by OTDR.
2	End to End bi-directional average attenuation of each fibre at 1310 nm and 1550 nm by Power meter.
3	Bi-directional average splice loss by OTDR of each splice as well as for all splices in the link.
4	Proper termination and labelling of fibres & fibre optic cables at as per approved labeling plan.

3 INSTALLATION OF OPGW CABLING

3.1 OPGW cable installation

The OPGW cable shall be installed at the top of the tower. The OPGW shall be installed generally in accordance with the IEEE Guide to the Installation of Overhead Transmission Line Conductors (IEEE STD. 524 with latest revisions), with additional instructions and precautions for fibre optic cable handling. The stringing procedure shall be submitted by the Contractor prior to stringing for KSEBL's approval.

The OPGW cable sections shall normally be terminated & spliced only on tension towers. In exceptional circumstances and on KSEBL specific approval, cable may be terminated on Suspension towers, but in this case tower strength shall be examined to ensure that tower loads are within safe limits and if required, necessary tower strengthening shall be carried out by the Contractor.

The stringing shall be carried by the Transmission Line Contractor as per the stringing chart/ procedure submitted by them and approved by KSEBL. The following shall be under the scope of OPGW Cabling Package Contractor:

- Supply of OPGW Cable & Hardware Fittings needed to tie the OPGW cable to the towers/gantries.
- Supervision of stringing of OPGW Cable at sites as per instruction by KSEBL. The supervision shall include the inspection as per stringing procedure, proper location of drum site, installation of stringing blocks/pulleys, proper sagging, proper installation of hardware, proper tension as per Sag-Tension chart, provision of service loops of OPGW in jointing locations
- The Splicing work of OPGW Cable and after that testing of link.

While handing over the OPGW drums, the testing (fibre loss and length measurement using OTDR) of OPGW in each drum shall be carried out by Fibre Optic Cabling Package Contractor in presence of Tower package contractor(s) and KSEBL representative. After installation of OPGW cable, the testing of each section shall be carried out again by the Fibre Optic Cabling Package Contractor in presence of Transmission Line Package contractor(s) and KSEBL representative. In case of any damage/ high loss in the fibre, the total length of that particular section of OPGW cable shall be replaced by Transmission Line Package Contractor(s). Fibre Optic Cabling Package Contractor shall supply new OPGW cable in place of damaged cable. The Contract price shall be adjusted accordingly.

3.2 Installation Hardware

All required hardware's shall be installed along with OPGW Cable.

3.3 Methodology for Installation and Termination

All optical fibre cable termination, installation, stringing and handling plans, guides and procedures, and engineering analysis (e.g. tension, sag, vibration etc.) shall be submitted to the KSEBL for review and approval in the engineering/design phase of the project. All installation practices shall be field proven, and ISO accredited.

All cable segments shall include service loops as specified in this specification. The maximum allowable stringing tension, maximum allowable torsional shear stress, crush strength and other physical parameters of the cable shall not be exceeded. The preventative measures to be taken shall be documented in detail and submitted to KSEBL in advance of installation.

Optical fibre attenuation shall be measured after installation and before splicing. Any increase in attenuation or step discontinuity in attenuation shall not be acceptable and shall constitute a cable segment failure. In the event of cable damage or any fibre damage, the complete section (tension location to tension location) shall be replaced as mid-span joints are not acceptable.

Any or all additional steel work or modifications required to attach the fibre cabling to the overhead transmission/ distribution line towers shall also be carried out by the Contractor. It shall be the Contractors responsibility to provide adequate communications among all crew members and support staff to ensure safe and successful installations.

3.4 Cable Raceways

To the extent possible, existing cable raceways shall be utilized. The Contractor is required to provide and install any additional indoor cable raceways which may be required for proper implementation of the fibre optic cabling system. This requirement shall be finalized during survey.

The cable raceways shall conform to the following:

- (a) All cable raceways shall be sized to support full loading requirements plus at least a 200% safety loading factor.
- (b) Indoor cable raceways shall be fabricated from construction grade aluminium, galvanized iron or anodized sheet metal or any other suitable material approved by the KSEBL. Suitable anticorrosion measures shall be provided. Steel fabricated raceways shall be finished inside and out, treated to resist rust and to form a metal-to- paint bond.
- (c) Mechanical construction drawings of the cable raceways shall be submitted for KSEBL's information & review.

Expected Contents & Structure of FO Cable Installation Manual for Overhead FO cable		
Sl no.	Chapters	Description
1	Installation procedure	Description of activities of installation gangs: Preparation & Setting up, Stringing, sagging, attaching hardware, attaching down lead clamps & cable routing on the tower, securing cable ends (for protection before work by jointing gang). Precautions for preventing cable damage shall be highlighted.
2	Safety Instructions	Instructions & procedures related to ensuring installation crew safety: personnel grounding & safety, installation equipment safety, Safety for power system & environment (viz preventing accidental tripping, precaution for railway crossings etc)
3	Description of Installation Equipment	Sketches, drawings, photographs, safe working ratings of installation equipment, tools & tackles etc., handling instructions & precautions.
4	Cable routing	Illustrations of the positions of tower attachment clamps (down lead clamps), routing of FO cable on the tower, service loop(s), joint box position. References to other related documents covering the test
5	References	installation, jointing & testing, such as SAT administrative & functional test plans & procedures
		Jointing Procedures
		Field Quality Plan & Field Quality Audit Storage & Handling Instructions
		FO cable & hardware drawings, technical parameters, DRS etc.
		KSEBL & Statutory safety rules, safety manuals, standards, codes of practices etc.

DRS Form 1

DATA REQUIREMENTS SHEETS FOR OVERHEAD FIBRE OPTIC CABLE**OPTICAL GROUND WIRE (OPGW) – 48 Fibre**

Manufacturer:

Part:

Configuration:

CABLE CONSTRUCTION			
Sr. No.	Parameter	As per Technical Specification	As per Bidder Offering
1	No. of Fibres Dual Window Single-Mode:	48	
2	Buffer Type:	Loose Tube	
3	Buffer Tube material	As applicable	
4	No. of Buffer Tubes:	As applicable	
5	No. of Fibers per Buffer Tube:	As applicable	
6	Expected Cable Life	25 Year	

DATA REQUIREMENTS SHEETS FOR OPTICAL FIBRE**DUAL-WINDOW SINGLE MODE (DW-SM)**

OPTICAL PARAMETERS			
Sr. No.	Parameter	As per Technical Specification	As per Bidder Offering
1	Fibre manufacturer(s)/Type:		
2	Attenuation Coefficient @ 1310 nm: @ 1550 nm:	≤ 0.35 dB/km ≤ 0.21 dB/km	
3	Point discontinuity @ 1310nm: @ 1550nm:	≤ 0.05 dB ≤ 0.05 dB	
4	Nominal Mode Field Diameter @ 1310 nm: @ 1550 nm:	8.6 to 9.5 μm ($\pm 0.6\mu\text{m}$)	
5	Chromatic Dispersion Coefficient @ 1310 (1288-1339) nm: @ 1310 (1271-1360) nm: @ 1550 nm:	3.5 ps/ (nm x km) 5.3 ps/ (nm x km) 18 ps/ (nm x km)	
6	Zero dispersion wavelength:	1300 to 1324 nm	
7	Cutoff wavelength:	≤ 1260 nm	
PHYSICAL AND MECHANICAL PROPERTIES			
8	Bend Performance: (37.5 mm radius, 100 turns) @1310 nm (30 mm radius, 100 turns) @1550 nm (16mm radius, 1 turn) @1550nm	≤ 0.05 dB ≤ 0.05 dB ≤ 0.50 dB	
9	Cladding Diameter (nominal \pm deviation):	125.0 μm ± 1 μm	
10	Polarization mode dispersion coefficient	≤ 0.2 ps/km ^{1/2}	
11	Proof test level	≥ 0.69 GPa	

PART – III GUARANTEED TECHNICAL PARTICULARS FOR OPTICAL GROUND WIRE (OPGW) & ACCESSORIES

The following sets of GTP are required to be filled up by the bidders to aid in the evaluation process. The response shall be brief and to the point and shall be supported by the printed product description and other literature. The same GTP format duly filled and the relevant drawings shall also be submitted during the detailed engineering along with the relevant technical brochures.

The bidder shall fill in the guaranteed technical particulars in the Proforma given in this section and submit the same with his tender, without which bid will not be considered.)

TABLE OF CONTENTS

Sl No.	Sample Form
GTP- 1	GTP of Optical Ground Wire (OPGW)
GTP- 2	GTP of Dual-Window Single Mode (DWSM)
GTP- 3	GTP of Hardware and Accessories
GTP- 4	GTP of Splice Enclosures (Joint Box) for Overhead FO cable
GTP- 5	GTP of Fibre Optic Distribution Panels (FODPs)

GTP-1 GUARANTEED TECHNICAL PARTICULARS OF OPTICAL GROUND WIRE (OPGW)			
Manufacturer:			
Model Name:			
GENERAL PARAMETERS			
Sl No	Parameter	Units	Particulars
1	Fibre Manufacturer Dual Window Single-Mode		
2	No. of Fibres Dual Window Single-Mode:	each	
3	Buffer Type		
4	Buffer Tube Diameter	mm	
5	Buffer Tube material		
6	No. of Buffer Tubes	each	
7	No. of Fibers per Tube	each	
8	Identification/numbering of individual tubes		
9	No. of empty tubes (If any)		
10	Filling material		
11	Filling material compliant with technical specifications?		
12	Strength member(s)		
13	Binding yarn/ tape		
14	Describe Central Core Design		
15	Aluminum Clad steel wire Diameter Number	mm each	
16	Aluminum alloy wires Diameter Number	mm each	
17	Aluminum tube inner diameter	mm	
18	Aluminum tube outside diameter	mm	
19	Cable Diameter (nominal \pm deviation)	mm	
20	Cable cross-section area (Nominal)	mm ²	
21	Cable cross-section area (Effective)	mm ²	
22	Fully Compliant with IEEE 1138	Yes/No	
Mechanical Properties of Cable			
23	Max. breaking load/ Ultimate Tensile Strength (UTS)	kN	
24	Fibre strain margin	%	
25	Zero fibre strain up to load	kN	
26	Weight	kg/km	

27	Crush strength	kg/mm	
28	Equivalent Modulus of elasticity	KN/mm ²	
29	Minimum Bending Radius without microbending	mm	
30	Maximum Bending Radius:ShortTerm:Long Term (Continuous)	mm	
31	Tensile proof test (Screening) level	KN/mm ²	
32	Maximum permissible tensile stress	KN/mm ²	
33	Permissible CTS. tensile stress	KN/mm ²	
34	Maximum sag at maximum temperature and design span with no wind	mm	
35	Everyday tension at 32°C, no wind	% of UTS	
36	Maximum tension at Every day condition with full wind pressure	Kg	
Thermal Properties of Cable			
37	Coefficient of linear expansion	per °C	
38	Coefficient of expansion Cladding : Core :	per °C per °C	
39	Nominal operating temperature range	°C	
40	SC current transient peak temperature	°C	
41	Maximum allowable temperature for lightning strike	°C	
CABLE SPOOL and DRUM			
42	Available length per spool Maximum : Nominal :	m	
43	Size of drum :	m	
44	Weight of empty drum :	kg	
45	Weight of drum with cable spooled :	kg	
46	Will drum length scheduling be practiced to match transmission line span lengths?	Yes/No	
47	Describe Drum materials :		
48	Describe cable end capping and protection against abrasion etc. :		

INSTALLATION			
49	Splice Loss Maximum : Average :	dB dB	
50	Operating Temperature Range :	°C	
51	Rated Isokeraunic No.		
52	Expected Cable Life :	Years	
53	Installation rate per team :	km/day	
54	No. of persons per team :	no.	
55	Max. possible span for specified operating conditions :	M	
56	Midspan sag at 0°C with no wind loading :	Mm	
57	Midspan sag at max temp. with no wind loading :	Mm	
58	Midspan sag at max temp. and wind loading	Mm	
59	Cable swing angles Worst Case : Everyday :		
60	Describe Installation method(s) :		
Sag tension chart parameters like sag and tension at various spans and applicable wind and ice load conditions shall be submitted along with the DRS. The cable parameters like coefficient of liner expansion, modulus of elasticity shall also be indicated.			

GTP- 2			
GUARANTEED TECHNICAL PARTICULARS OF DUAL-WINDOW SINGLE MODE (DWSM)			
OPTICAL PARAMETERS			
Sl No.	Parameter	Unit	Particulars
1	Fiber manufacturer(s)/Type :		
2	Fiber production method :		
3	Attenuation Coefficient @ 1310 nm : @ 1550 nm :	dB/km dB/km	
4	Attenuation Variation with Wavelength (± 25 nm) :	dB/km	
5	Attenuation at water peak :	dB/km	
6	Point discontinuity @ 1310nm : @ 1550nm :	dB dB	
7	Temperature dependence (induced attenuation) :	dB	
8	Nominal Mode Field Diameter @ 1310 nm : @ 1550 nm :	μm	
9	Mode Field Diameter Deviation @ 1310 nm : @ 1550 nm :	μm	
10	Mode field non-circularity :	%	
11	Chromatic Dispersion Coefficient @ 1310 (1288-1339) nm : @ 1310 (1271-1360) nm : @ 1550 nm :	Ps/nm.km	
12	Zero dispersion wavelength :	nm	
13	Zero dispersion Slope :	ps/nm ² .km m	
14	Cut-off wavelength :	nm	
15	Refractive Index :		
16	Refractive Index profile :		
17	Cladding Design :		
18	Numerical aperture :		

PHYSICAL and MECHANICAL PROPERTIES			
Sl No.	Parameter	Unit	Particulars
19	Bend Performance : (37.5 mm radius, 100 turns) @1310 nm (30 mm radius, 100 turn) @1550 nm (16mm radius, 1 turn) @ 1550nm	dB dB	
20	Core Diameter (nominal± deviation) :	µm	
21	Core non-circularity :	%	
22	Cladding Diameter (nominal ± deviation) :	µm	
23	Core- Clad concentricity Error :	µm	
24	Cladding non-circularity :	%	
25	Fibre cut-off wavelength	µm	
26	Protective Coating type & material Primary : Secondary :		
27	Protective Coating Diameter (nominal ± deviation) :	µm	
28	Protective Coating removal method :		
29	Coating Concentricity	µm	
30	Polarisation mode dispersion coefficient	ps/km ^{1/2}	
31	Proof test level	kpsi	
32	Colour coding scheme compliant with EIA/TIA 598 or IEC 60304 or Bellcore GR-20.	Yes/No	
33	Colouring material compliant with technical specs?	Yes/No	

GTP- 3			
GUARANTEED TECHNICAL PARTICULARS FOR HARDWARE AND ACCESSORIES			
Suspension Clamp Assembly			
Manufacturer:			
Type:			
Drawing No.			
Sl No.	Parameter	Unit	Particulars
1	Minimum vertical Strength	kN	
2	Maximum Slip Strength	kN	
3	Minimum Slip Strength	kN	
4	Length (nominal)	mm	
5	Weight (nominal)	kg	
6	Total Drop (maximum) including shackles	mm	
7	Tightening torque (nominal)	Nm	
8	Details of Armour Rod Set		
	No. of rods per clamp		
	Direction of Lay		
	Overall length	mm	
	Diameter of each Rod	mm	
	e) Tolerances		
	(i) Diameter of each rod	±%	
	(ii) Length of each rod	±%	
	Material of manufacture		
	UTS of each Rod	kN	
	Weight	kg	
9	Details of Protection Splice Set (Reinforcing Rods)		
	i) No. of rods per clamp		
	j) Direction of Lay		

	k) Overall length	mm	
	l) Diameter of each Rod	mm	
	m) Tolerances		
	(i) Diameter of each rod	±%	
	(ii) Length of each	±%	
	n) Material of manufacture		
	o) UTS of each Rod	kN	
	p) Weight	kg	
Dead End Clamp Assembly			
Manufacturer:			
Type:			
Drawing No.:			
1	Minimum Slip Load	kN	
2	Length (nominal)		
	a) Reinforcing Rods	mm	
	b) Dead end	mm	
3	Weight (nominal)		
	a) Reinforcing Rods	kg	
	b) Dead end	kg	
4	Breaking strength (minimum)	kN	
5	Wire Size		
	a) Reinforcing Rods	mm	
	b) Dead end	mm	
Vibration Damper			
Manufacturer:			
Type:			
Drawing No.:			

1	Total Weight	Kg	
2	Weight of each Damper		
3	Material of Damper Weight		
4	Clamp Material		
5	Clamp bolt tightening torque	Nm	
6	Clamp bolt material		
7	Messenger Cable Material		
8	No. of Strands in Messenger Cable		
9	Breaking Strength of Messenger Cable	kN	
10	Resonance Frequencies		
	First Frequency	Hz	
	Second Frequency	Hz	
	Third Frequency	Hz	
11	Minimum Slip Strength of Damper Clamp		
	a) Before Fatigue Test	kN	
	b) After fatigue Test	kN	
Down Lead Clamp /Fastening Clamp			
Manufacturer:			
Type:			
Drawing No.:			
1	Material:		
2	Suitable for OPGW (range) :	mm	
3	Tightening torques	Nm	
4	Vertical load	kN	
5	Filler details :		
	Material		
	diameter	mm	

6	Tower attachment arrangement		
Earth lead assembly			
Manufacturer:			
Type:			
Drawing No.:			
1	Weight	kg	
2	Material		
3	length	mm	
4	Short circuit current	KA	

GTP- 4 GUARANTEED TECHNICAL PARTICULARS FOR SPLICE ENCLOSURES (JOINT BOX) FOR OVERHEAD FO CABLE			
Splice Enclosures (Joint Box)			
Manufacturer:			
Type:			
Drawing No.:			
1	Dimensions H * W * D :	cm	
2	Weight :	Kg	
3	Colour and Finish :		
4	Cable Glanding& Fixing		
5	Construction materials & Gauge		
6	Locking arrangements :		
7	Installation Clearances :		
	Front Access :		
	Rear Access :		
	Top * Bottom * Sides :	cm	
8	IP Protection	Class	
9	Total number of optical couplings	ea	
10	Provision of pass through splicing	Yes/No	
11	Whether filled with suitable encapsulant	Yes/No	
12	Method(s) for mounting with the tower :		
Optical Fibre Cable Accommodations			
13	Cable Glanding :		
14	Maximum number of cables that can be accommodated :		
15	Diameter(s) of cables that can be accommodated :	each	
16	Describe Cable entries :		
Cable Termination Splice Accommodations			
17	Details of Splice Trays :		
	Dimension :		
	Material/Gauge :		
	Weight :	kg	

	Colour & Finish		
	Method of mounting		
18	Maximum number of splice trays	ea	
19	Number of splices per tray	ea	
20	Provision of Splice organisers		
	Do splice trays require a separate enclosure? If so	Yes/No	
	Manufacturer		
21	Dimensions H * W * D	cm	
	Weight:	Kg	
	Colour and Finish:		
	Method(s) of Mounting:		
	Construction materials & Gauge:		
	Locking arrangements:		
22	Installation Clearances Front Access : Rear Access : Top * Bottom * Sides : Excess length of fibre service loops	m	

GTP- 5 GUARANTEED TECHNICAL PARTICULARS FOR FIBRE OPTIC DISTRIBUTION PANELS (FODPs)			
Manufacturer :			
Model :			
Sl No.	Parameter	Unit	Particulars
1	Dimensions H * W * D :	cm	
2	Weight :	kg	
3	Colour and Finish :		
4	Cable Glanding& Fixing :		
5	Construction materials & Gauge		
6	Locking arrangements :		
7	Installation Clearances: Front Access : Rear Access : Top * Bottom * Sides :	cm	
8	IP Protection	Class	
9	Total number of optical couplings	ea	
10	Provision of pass through splicing	Yes/No	
11	Whether filled with suitable encapsulant	Yes/No	
12	Method(s) for mounting		
Optical Fibre Cable Accommodations			
13	Cable Glanding :		
14	Maximum number of cables that can be accommodated :		
15	Diameter(s) of cables that can be accommodated :	each	
16	Describe Cable entries :		
Cable Termination Splice Accommodations			
17	Details of Splice Trays :		
	Dimension :		

	Material/Gauge :		
	Weight :	kg	
	Colour & Finish		
	Method of mounting		
18	Maximum number of splice trays	ea	
19	Number of splices per tray	ea	
20	Provision of Splice organizers		
	Do splice trays require a separate enclosure? If so	Yes/No	
	Manufacturer		
	Dimensions H * W * D	cm	
21	Weight	Kg	
	Colour and Finish		
	Method(s) of Mounting		
	Construction materials & Gauge		
	Locking arrangements		
22	Installation Clearances Front Access : Rear Access : Top * Bottom * Sides : Excess length of fibre service bops	m	

SECTION 7
TECHNICAL SPECIFICATIONS OF POLYMERIC INSULATORS
TABLE OF CONTENT

SR. NO.	DESCRIPTION
1	SCOPE
2	STANDARDS
3	ELECTRIC SYSTEM DATA & SITE CLIMATIC CONDITIONS
4	DETAILS OF CONDUCTOR
5	DETAILS OF COMPOSITE POLYMER INSULATORS
6	GENERAL TECHNICAL REQUIREMENTS
7	MATERIAL DESIGN AND WORKMANSHIP
8	TEST ON INSULATORS
9	PACKING & FORWARDING
10	GUARANTEED TECHNICAL SPECIFICATIONS OF POLYMERIC INSULATORS & ACCESSORIES
	ANNEXURE - 7A

SECTION 7
TECHNICAL SPECIFICATIONS OF POLYMERIC INSULATORS

1 SCOPE

This specification covers design, manufacturing, testing, inspection, packing and supply of Silicon Rubber housed composite Insulators for satisfactory operation on various transmission lines and Substations situated in any part of Kerala State.

These insulators are to be used as insulating part of Multi circuit Multi voltage tower structures single/double suspension & tension (dead end) for 220kV/110kV MCMV transmission lines. The configuration on structure may be single or double insulators per phase at required locations.

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

2 STANDARDS

2.1 Unless otherwise specified elsewhere in this specification, the rating as well as performance & testing of the Polymer Insulators shall conform but not limited to the latest revision & amendments available at the time of placement of order of all the relevant standards as listed hereunder, except as modified in this document.

Sl No.	Indian Standard	Title	International Standard
1	IS:209	Specification for Zinc	BS:3436
2	IS:406	Method for Chemical Analysis of Slab Zinc	BS:3436
3	IS:731	Porcelain insulators for overhead power lines with a nominal voltage greater than 1000V	IEC:61109-1992
4	IS:2071 Part I, II, III	Method of High Voltage Testing	IEC:60060-1
5	IS:2486 Part-I Part-II Part-III	Specification for insulator fittings for overhead power lines with a nominal voltage greater than 1000V- General Requirements, Tests, Dimensional Requirements, Locking Devices	IEC-60575 IEC-60120 IEC:60372
6	IS:2629	Recommended practice for Hot Dip Galvanization for iron & steel	ISO:1461(E)

7	IS:2633	Testing for Uniformity of Coating of Zinc coated articles	
8	IS: 3203	Methods of testing of local thickness of electroplated coatings	ISO: 2178
9	IS: 4699	Specification for refined secondary zinc	
10	IS: 4759	Hot dip zinc coatings on structural steel & other allied products	ISO: 1459, ISO: 1461
11	IS:6745	Determination of Weight of Zinc coating on Zinc coated iron and steel articles	BS:443-1969 ISO 1460-1973
12	IS: 8263	Methods of RIV Test of HV Insulators	IEC:60487
13	IS:8269	Methods for Switching impulse test on HV insulators	IEC:60506
14	IS:13134	Guide for the selection of insulators in respect of polluted conditions	IEC: 60815
15		Standard for insulators- Composite - Distribution Dead end type	ANSI C29 13-2000
16		Standard specification for glass fiber strands	ASTM D 578-05
17		Standard test method for compositional analysis by Thermo gravimetry	ASTM E 1131-03
18		Characteristics of string insulator units of the long rod type	IEC: 60433
19		Verification of Dimensions of Polymer Insulators	IEC:61109
20		Hydrophobicity classification guide	STRI guide 1.92/1
21		Tests on insulators of Ceramic material or glass or glass for overhead lines with a nominal voltage greater than 1000V	IEC:60383
22		Salt Fog Pollution Voltage Withstand Test	IEC:60507
23		Thermal Mechanical Performance test and mechanical performance test on string insulator units	IEC: 60575
24		Electrical Insulating materials used under severe ambient conditions -Test methods for evaluating resistance to tracking and erosion	IEC 60587
25		Selection and dimensioning of high voltage insulators intended for use in	IEC:60815-3

		polluted conditions: Polymer Insulators for AC systems	
26		Composite insulators for A.C. Overhead lines with nominal voltage greater than 1000V – Definitions, test methods and acceptance criteria	IEC 61109
27		Composite string insulator units for overhead lines with a nominal voltage above 1000V : i) Standard strength classes and end fittings ii) Dimensional and electrical characteristics	IEC 61466-1 IEC 61466-1
29		Polymeric insulators for indoor and outdoor use with nominal voltage greater than 1000V- General definitions, tests, methods and acceptance criteria.	IEC 62217

The standards mentioned above are available from:

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

- 2.2 Material meeting with the requirements of other authoritative standards, which ensure equal or better performance than the standards mentioned above, shall also be considered. When the material offered by the bidder conforms to other standards, salient points of difference between standards adopted & the standards specified in this specification shall be clearly brought out in the relevant schedules. Three copies of such standards with authentic translation in English shall be furnished along with the bid.

3 ELECTRIC SYSTEM DATA & SITE CLIMATIC CONDITIONS

Electrical system data and site climatic conditions are furnished in clause 4, section 1, part A of volume II.

4 DETAILS OF CONDUCTOR

Details of conductors are furnished in clause 4.1, section 1, part A of volume II.

5 DETAILS OF COMPOSITE POLYMER INSULATORS

5.1 The technical specifications of composite polymer insulators are furnished in clause 4.1, section 1, part A of this volume

5.2 The Composite Polymer insulator shall be suitable for a three phase 50 Hz, effectively earthed 220/110kV transmission systems in a moderately polluted atmosphere.

5.3 The specified values and dimensions, impulse and power frequency voltages, electromechanical strength [EMS] of Polymer insulators are as under. The values given are minimum which apply to all cases. Specified withstand and flashover voltages are referred to standard atmospheric condition.

5.4 Composite Polymer Insulators shall have sheds with good self-cleaning properties. Insulator shed profile, spacing, projection etc., and selection in respect of polluted conditions shall be generally in accordance with the recommendation of IEC-60815/IS: 13134

5.5 Dimensional Tolerance of Composite Insulators

The tolerances on all dimensions e.g. diameter, length and creepage distance shall be allowed as follows in line with IEC 61109:

$\pm (0.04d + 1.5)$ mm when $d \leq 300$ mm

$\pm (0.025d + 6)$ mm when $d > 300$ mm

Where, "d" being the dimensions in millimeters for diameter, length or creepage distance as the case may be.

However, no negative tolerance shall be applicable to creepage distance

6 GENERAL TECHNICAL REQUIREMENTS

6.1 CORE

The core shall be glass-fiber reinforced epoxy resin rod (FRP) of high strength. Both, glass fiber and resin shall be optimized in the FRP rod. Glass fibers with low content in alkalis shall be boron free E glass or Boron free electrically corrosion resistance (ECR) glass. Use of resin with hydrolysis trend due to water penetration should be prevented i. e. matrix of the FRP rod shall be Hydrolysis resistant. Suitability of Epoxy matrix as well as interface between matrix and fibers is to be

considered as design parameter to prevent brittle fracture. The FRP rod should be void free and shall be manufactured through Pultrusion process.

6.2 HOUSING (SHEATH)

The core of the Polymer insulator shall be completely covered by a continuous housing consisting of a sheath-weathershed. For moulding of entire weathershed structure on to the rod in a one shot moulding process to be employed to avoid multiple interfaces.

Hardware i.e. metal fittings may be installed on the rod prior to moulding of the shed controlling moulding lines. The base polymer shall be 100% Silicon Rubber prior to the addition of reinforcing fillers. The thickness of compounding material on core should be minimum 3 mm.

Manufacturer should furnish a description of its Quality Assurance Programme including fabrication, testing and inspection for any material (i.e. rubber), components (i.e. rod) or hardware (i.e. end fittings). The manufacturer has had fabricated by others should also be included. Manufacturing methods and material composition documentation will be a part of Technical Bid to be submitted along with offer. Insulator should have hermetically sealed structure in which the housing material is moulded to cover the interface between the end fittings and the FRP Prod. This seal should never be broken during testing or otherwise.

6.3 END FITTINGS

The Polymer insulators shall be socket and ball type with the necessary coupling arrangement such that pin shall move freely in the socket but do not get disengaged while in service under various operating and atmospheric conditions.

The socket & ball type metal end fittings shall be designed to transmit the mechanical load to the core & the end fittings shall maintain uniform and consistent mechanical strength. Material and methods used in the fabrication of metal parts shall be selected to provide good toughness and ductility. Metal end fittings shall be made from a quality malleable cast iron or forged steel or Spheroidal Graphite Iron (SGI) and shall be hot dipped galvanized in accordance with IS 2629. Metal end fittings shall be uniform and without sharp edges or corners and shall be free of cracks, flakes, slivers, slag, blow-holes shrinkage defects and localized porosity.

The attachment to the FRP rod shall be performed with a symmetrically controlled crimping method control by acoustic method that compresses the metal radially onto the rod without damage to the rod fibers or resin matrix while providing a strength equal to or greater than the defined and specified ultimate strength to the insulator. The material used in fittings shall be corrosion resistant.

Nominal dimensions of the pin, ball and socket interior shall be in accordance with the standard. No joints in ball & socket or pin will be allowed. Outer portion of ball or socket should be Zinc sleeved with minimum 99.95% purity of

electrolytic high-grade Zinc. The finished surface shall be smooth and shall have a good performance. The surface shall not crack or get chipped due to ageing effect under normal and abnormal service conditions or while handling during transit or erection. The design of the fittings and the insulators shall be such that there is no local corona formation or discharges likely to cause the interference to either sound or vision transmission.

6.4 GRADING RINGS

Grading rings shall be provided when system voltages are equal to or greater than 220kV. For 220kV transmissions, grading ring is to be provided at the energized end only.

All grading rings and brackets shall be designed as an integral part of the insulator assembly with a positive mounting system that allows mounting in one position. The design of the grading ring shall be such that ring can only be mounted with its orientation towards the weather sheds for maximum RIV and Corona control. Grading rings shall be designed in such a manner that the rings can be readily installed and removed with hot line tools without disassembling any other part of the insulator assembly.

Grading ring height (is the distance from the end of the end fitting to the top of corona ring) should be so selected that maximum field minimizes and uniformly distributed along the insulator. Manufacturer should provide reports of successful electric field modeling testing for the specific insulator design. The EFM should be three dimensional with result containing drawing depicting the electric field in various colours, each of a different voltage level. The result of this study should show that the voltage field surrounding the polymer insulators is optimum along the entire length of the insulator, with the effected hot end of the insulator being a critical location. The threshold at which corona may or may not be present should be defined as a figure in KV/mm for the designed insulator.

6.5 VERIFICATION OF HOUSING MATERIAL

The manufacturer should provide written verification about housing material, for which base polymer shall be 100% Silicon Rubber prior to the addition of reinforcing fillers considered will provide satisfactory performance in the particular environment It shall meet following requirements Be homogenous, impermeable, with no fissures, bubbles and strange materials inclusions. Be designed in order to avoid formation of localized discharges and to prevent interfaces humid penetration. Be resistant to corona, UV radiation, ozone, atmospheric contamination, water penetration and power arcs.

6.6 BALL AND SOCKET DESIGNATION

The dimensions of the Ball and Socket shall be 16mm designation for 70KN and 90KN Polymer insulators and 20 mm & 24MM designation for 120 KN and 160 KN Polymer insulators in accordance with the standard dimensions stated in IEC:60120/IS:2486(Part-II)

6.7 MARKINGS:

6.7.1 Each insulator shall be legibly and indelibly marked with the following details as per IEC – 61109.

a. Name or trademark of the manufacturer.

b. Voltage and Type.

c. Month and year of manufacturing.

d. Minimum failing load / guaranteed mechanical strength in kilo Newton followed by the word 'KN' to facilitate easy identification.

e. Country of manufacture

6.7.2 One 10 mm thick ring of suitable quality of paint shall be marked on the end fitting of particular strength for easy identification of Polymer insulators. The paint shall not have any deteriorating effect on the insulator performance.

Following codes shall be used as identification mark:

For 90KN Polymer insulator : Blue

For 120KN Polymer insulator : Yellow

6.8 BID DRAWINGS

6.8.1 The Bidder shall furnish full description and illustration of the material offered.

6.8.2 The Bidder shall furnish along with the bid the outline drawing of each insulator unit along with grading rings including a cross sectional view of the long rod insulator unit. The drawing shall include but not limited to the following information:

(a) Major Dimensions with manufacturing tolerances

(b) Minimum Creepage distance with positive tolerance

(c) Protected creepage distance

(d) Unit mechanical and electrical characteristics

(e) Size and weight of ball and socket parts

(f) Weight of composite long rod units

(g) Materials

6.8.3 After placement of award, the Manufacturer/contractor shall submit full dimensioned insulator drawings containing all the details as given in Clause No. 6.8.2 above, in four (4) copies to KSEBL for approval. After getting approval from

KSEBL and successful completion of all the type tests, the Manufacturer/contractor shall submit 10 more copies of the same drawing along with a soft copy to the KSEBL for further distribution and field use at KSEBL's end.

6.8.4 After placement of award the Manufacturer/contractor shall also submit fully dimensioned insulator crate drawing for different type of insulators.

7 MATERIAL DESIGN AND WORKMANSHIP

7.1 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 high voltage transmission. Bidders shall therefore offer insulators as are guaranteed by them for satisfactory performance on 110kV and 220kV Transmission lines.

(ii) The design, manufacturing, process and material control at various stages 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.

7.2 GALVANISING

All ferrous parts shall be hot dip galvanized in accordance with the latest edition of IS: 2629. The zinc to be used for galvanizing 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 fittings are galvanized, all die flashing on the shank and on the bearing surface of the ball shall be carefully removed without reducing the designed dimensional requirements.

7.3 INTERCHANGEABILITY

The Polymer insulators inclusive of the ball and socket fittings shall be of standard design suitable for use with hardware fittings of any make conforming to relevant Indian Standards.

7.4 CORONA AND RADIO INTERFERENCE VOLTAGE (RIV) PERFORMANCE

All surfaces shall be even, smooth, without cuts, abrasions or projections. No part shall be subjected to excessive localized pressure. The metal parts shall not produce any noise generating corona under all operating conditions.

7.5 SUITABILITY FOR LIVE LINE MAINTENANCE

7.5.1 The Polymer 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.

7.5.2 Suppliers shall indicate the methods generally adopted in routine hot and cold line maintenance of EHV lines for similar Polymer insulators supplied by them. Suppliers shall also indicate the recommended periodicity of such maintenance.

8 TEST ON INSULATORS

The following tests shall be carried out on the Composite Polymer insulator:

8.1 TYPE TESTS

This 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 intents of this specification. These tests shall be conducted on a representative number of samples prior to commencement of commercial production.

8.2 ACCEPTANCE TESTS

This 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.

8.3 ROUTINE TESTS

This shall mean those tests, which are to be carried out on each Polymer insulator to check the requirements, which are likely to vary during production.

8.4 STAGE TESTS DURING MANUFACTURE

Stage tests during manufacture shall mean those tests, which are to be carried out during the process of manufacture to ensure quality control such that the end product is of the designed quality conforming to the intent of this specification.

8.5 TEST VALUES

For all type and acceptance tests, the acceptance values shall be the value guaranteed by the Supplier in the guaranteed technical particulars or the acceptance value specified in this specification or the relevant standard whichever is more stringent for that particular test.

8.6 TEST PROCEDURES AND SAMPLING NORMS

The norms and procedure 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 successful Supplier and 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 procedure for the same shall be as mutually agreed to between the successful supplier and purchaser in the quality assurance programme. The supplier shall offer at least three times the quantity of material required for conducting all the type tests for sample selection.

Before sample selection, the supplier shall be required to conduct the entire acceptance test successfully in presence of purchaser's representative.

8.6.1 TYPE TESTS

(A) The following type tests shall be conducted on all types of the Polymer insulator with hardware fittings:

Power frequency voltage withstand test with corona control rings and arcing horn under (dry/wet) conditions

a) Power frequency voltage flash over test with corona control rings and arcing horn under (dry/wet) conditions

b) Power frequency voltage flash over test without corona control rings and arcing horn under (dry/wet) conditions

c) Switching surge voltage withstand test under wet condition.

d) Impulse voltage withstand test under dry condition.

e) Voltage Distribution test

f) Impulse voltage flash over test under dry condition

g) Corona and RIV Test under dry condition.

h) Mechanical strength test

i) Vibration test.

j) Power Arc Test

k) Salt fog pollution withstand Test

(B) On composite Insulator Unit: -

1. Tests on interface and connection of metal fittings

(a) Dry Power Frequency Voltage Test

(b) Sudden Load Release Test

(c) Thermal Mechanical Test

(d) Steep Front Impulse Voltage Test

(e) Dry Power Frequency Voltage Test

2. Assembled Core Load Time Test

(a) Determination of the Average failing load of the core of the assembled unit

(b) Control of slope of the strength time curve of the insulator

3. Accelerated Ageing Test of 5000 hours

4. Flammability Test

5. Recovery of Hydrophobic Test

6. Mechanical Load Time Test

7. Brittle Fracture resistance test

8. Test of Housing, Tracking and Erosion Test

9. Test for the Core Material

- Dye Penetration Test

- Water Diffusion Test

8.6.2 ACCEPTANCE AND ROUTINE TESTS

On Polymer Insulators following Acceptance & Routine tests shall be conducted:

(A) Acceptance tests:

a) Verification of dimensions	IEC: 61109-1992
b) Verification of Locking System	-
c) Galvanizing test	IS-731
d) Verification of specified Mechanical Load	IEC: 575
e) Recovery of Hydrophobicity	As per annex-A

(B) Routine tests:

a) Visual Inspection	IS-731
b) Mechanical routine test	IS-731
c) Electrical routine test	IEC: 383

8.6.3 TESTS DURING MANUFACTURE (STAGE TESTS)

On all components as applicable

- Chemical analysis of Zinc used for galvanizing
- Chemical analysis, mechanical and metallographic test and magnetic particle inspection for malleable castings

- c) Chemical analysis, hardness test and magnetic particle inspection for forgings
- d) Crack detection test for metal parts

8.6.4 ADDITIONAL TESTS

The purchaser reserves the right for carrying out any other tests of a reasonable nature at the works of the Supplier/laboratory or at any other recognized 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.

8.6.5 COORDINATION FOR TESTING:

For polymer insulator strings, the Supplier is required to produce type test reports to the satisfaction of the Purchaser. However, in case the Purchaser desires, the Supplier shall conduct all the type tests on the complete string with relevant hardware fittings. Responsibility of arranging required hardwares for the purpose of type testing will remain with the insulator Supplier.

8.7 TEST SCHEDULE

8.7.1 TYPE TESTS

The material offered shall be fully type tested as per this specification and the Supplier shall furnish four sets of type test reports along with the offer. These tests must not have been conducted earlier than five years.

For any change in the design/type, already type tested and the design/type offered against this bid, the purchaser reserves the right to demand repetition of some or all type tests without any extra cost.

8.7.2 ACCEPTANCE AND ROUTINE TESTS

All Acceptance and Routine tests as stipulated herein shall be carried out by the Supplier in the presence of Purchaser's (Board's) representative.

8.7.3 Immediately after finalization of the programme of acceptance/ routine testing, the Supplier shall give sufficient advance intimation to the Purchaser, to enable him to depute his representative for witnessing the test.

8.8 INSPECTION

- i) Purchaser and its representatives shall at all times be entitled to have access to the works and to all places of manufactures where insulators are manufactured, and the successful Supplier shall afford all facilities to them for unrestricted inspection of the works, inspection of material, inspection of manufacturing process of insulators and for conducting necessary tests as specified herein.

- ii) The successful Supplier shall keep the Purchaser informed in advance of the time of starting and progress of manufacture of insulators in its various stages so that arrangements could be made for inspection.
- iii) No material shall be dispatched 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 successful Supplier of his responsibility for meeting all the requirement of this specification and shall not prevent subsequent rejection, if such insulators are later found to be defective.

8.9 QUALITY ASSURANCE PLAN

8.9.1 The Supplier hereunder shall invariably furnish following information alongwith his offer, failing which the offer shall be liable for rejection. Information shall be separately given for individual type of material 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 Supplier's representative, 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 in quality control and details of such test and inspections.
- vi) Special features provided in Polymer insulators to make it maintenance free.
- vii) List of testing equipment available with the Supplier for final testing of Polymer insulators specified and test plant limitation, if any, vis-a-vis the type, special, acceptance and routine tests specified in the relevant standards.

8.9.2 The successful 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 material as well as bought out accessories and the names of sub-suppliers selected from those furnished along with the offer.
- ii) Type test certificates of the raw material and bought out accessories.

- iii) Quality assurance plan (QAP) withhold 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 finalized.

The successful Supplier shall submit the routine test certificates of bought out items and raw material at the time of routine testing of the insulator.

8.10 DOCUMENTATION

The Supplier shall furnish full description and illustrated catalogues of insulators offered, along with the bid. The supplier shall also furnish along with the bid the outline drawing of Polymer insulator unit including cross-sectional view. The drawing shall include the following information:

- i) Shed diameter and unit spacing with manufacturing tolerance.
- ii) Creepage distance.
- iii) Unit mechanical and electrical characteristics for the complete string-suspension and tension. Unit
- iv) Size and weight of ball and socket part.
- v) Weight of Polymer unit.
- vi) Materials for the cap and pin.
- vii) Identification mark.
- viii) Manufacturer's catalogue number.
- ix) Brief installation instructions.
- x) Relevant technical details of significance.

8.11 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 thereafter and on receipt of the same Supplier shall commence with the commercial production of the Polymer insulators.
- 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 dispatched.
- 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.

8.12 GUARANTEED PARTICULARS AND PERFORMANCE GUARANTEE:

- (i) The bidder shall furnish all relevant technical guaranteed particulars of the long rod Polymer Insulators offered. Offers without such details may not be considered.
- (ii) The Polymer Insulators shall be guaranteed for satisfactory performance for a period of 24 months from the date of commissioning of line. Any defect due to faulty material or workmanship found during guarantee period shall be rectified free of cost to the KSEBL. The replacement will have to be organized expeditiously and within one month from the date of intimation.
- (iii) The contractor must ensure that the material supplied from specific vendor also guaranteed for the period specified in the bid against the manufacturing defect.

9 PACKING & FORWARDING

- i) All Polymer insulators shall be packed in suitable PVC/Plastic tubes/any other suitable packing. The packing shall provide protection against rodents. The supplier shall furnish detailed design of the packing. For marine transportation crates shall be palletted.
- 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 spacers shall be provided to prevent damage or deformation during transit and handling.
- iv) All packing cases shall be marked legibly and correctly so as to ensure safe arrival at their destination and avoid the possibility of goods being lost or wrongly dispatched on account of faulty packing and faulty or illegible markings.

Each case/crate shall have all the markings stenciled on it in indelible ink.

The supplier shall guarantee the adequacy of the packing and shall be responsible for any loss or damage during transportation handling, storage and installation due to improper packing indelible ink.

10 GUARANTEED TECHNICAL SPECIFICATIONS OF POLYMERIC INSULATORS & ACCESSORIES

(The following sets of GTP are required to be filled up by the bidders to aid in the evaluation process. The response shall be brief and to the point and shall be supported by the printed product description and other literature. The same GTP format duly filled and the relevant drawings shall also be submitted

during the detailed engineering along with the relevant technical brochures. The bidder shall fill in the guaranteed technical particulars in the Proforma given in this section and submit the same with his tender, without which bid will not be considered.)

TABLE OF CONTENTS

Sl No.	Sample Form
GTP- 1	110 kV 90KN Tension Type Silicone Rubber Housed long rod composite polymer insulator
GTP- 2	110 kV 70KN Suspension Type Silicone Rubber Housed long rod composite polymer insulator
GTP- 3	220 kV 120KN Tension Type Silicone Rubber Housed long rod composite polymer insulator
GTP- 4	220 kV 90KN Suspension Type Silicone Rubber Housed long rod composite polymer insulator

GTP- 1				
110kV 90KN Tension Type Silicone Rubber Housed long rod composite polymer insulator				
Sl No.	Description	Unit	110kV:90KN Tension type	To be filled by the bidder
1.	Manufacturer			
2.	Country of Origin		India	
3.	Insulator type Origin		110kV:90KN Tension type composite long rod insulators	
4.	Standard according to which the insulators will be manufactured and tested		IEC - 61109	
5.	Name of material used in manufacture of insulator with class/ grade		Silicone Rubber	
6a.	Material of core (FRP rod)		ECR boron free	
	i) E-glass of ECR glass			
	ii) Boron content			
6b	Material of Housing & weather - sheds (Silicon content by weight)		Silicon Rubber (40%)	
6c	Material End Fitting		MCI/SGI/Forged steel	
6d	Sealing compound for end fittingsq		Silicon Sealant	
6e	Colour		Blue	
7	Electrical Characteristic			

GTP- 1				
110kV 90KN Tension Type Silicone Rubber Housed long rod composite polymer insulator				
Sl No.	Description	Unit	110kV:90KN Tension type	To be filled by the bidder
7a	Nominal system voltage	KV	110	
7b	Highest system voltage	KV	125	
7c	Dry power frequency withstand voltage	kV (rms)	325	
7d	Wet power frequency withstand voltage	kV (rms)	275	
7e	Dry Flashover Voltage	kV (rms)	350	
7f	Wet Flashover voltage	kV (rms)	300	
7g	Dry lighting impuse withstand voltage	kV (rms)		
	i) Positive		650	
	ii) Negative		650	
7h	RIV at 1 MHz when energised at 10kV/30kV/110kV (rms under dry condition)	kV (rms)	<500 micro volts	
7i	Creepage Distance (Minimum)	Mm	4495	
8	Mechanical Characteristics			
8a	Minimum failing load	KN	90	
9	Dimensions of insulators			
9a	Weight	Kgs		
9b	Diameter of FRP rod	mm		

GTP- 1				
110kV 90KN Tension Type Silicone Rubber Housed long rod composite polymer insulator				
Sl No.	Description	Unit	110kV:90KN Tension type	To be filled by the bidder
9c	Length of FRP rod	mm		
9d	Dia Weather – Shed	mm		
9e	Thickness of Housing	Mm		
9f	Dry arc distance	Mm		
10	Method of fixing of sheds to housing			
	i) Single mould			
	ii) Modular construction			
	(injection moulding/compression moulding)			
11	No of weather sheds	Nos		
12	Type of sheds			
12a	Aerodynamic			
12b	With under-rubs			
13	Packing details			
13a	Type of packing			
13b	No of insulator in each pack			
13c	Gross weight of package	Kgs		

GTP- 1				
110kV 90KN Tension Type Silicone Rubber Housed long rod composite polymer insulator				
Sl No.	Description	Unit	110kV:90KN Tension type	To be filled by the bidder
14	Dimensioned drawings of the insulator (including weight with tolerance in weight)			

GTP- 2				
110kV 70 KN Suspension Type Silicone Rubber Housed long rod composite polymer insulator				
Sl No.	Description	Unit	110kV:70 KN	To be filled by the bidder
1.	Manufacturer			
2	Country of Origin		India	
3.	Insulator type Origin		110kV:70KN type composite long rod insulators	
4.	Standard according to which the insulators will be manufactured and tested		IEC - 61109	
5.	Name of material used in manufacture of insulator with class/ grade		Silicone Rubber	
6a.	Material of core (FRP rod)		ECR Boron free	
	i) E-glass of ECR glass			
	ii) Boron content			
6b	Material of Housing & weather – sheds (Silicon content by weight)		Silicon Rubber (40%)	
6c	Material End Fitting		MCI / SGI /Forged steel	
6d	Sealing compound for end fittingsq		Silicon Sealant	
6e	Colour		Yellow	
7	Electrical Characteristic			
7a	Nominal system voltage	KV	110	
7b	Highest system voltage	KV	125	

GTP- 2				
110kV 70 KN Suspension Type Silicone Rubber Housed long rod composite polymer insulator				
Sl No.	Description	Unit	110kV:70 KN	To be filled by the bidder
7c	Dry power frequency withstand voltage	kV (rms)	325	
7d	Wet power frequency withstand voltage	kV (rms)	275	
7e	Dry Flashover Voltage	kV (rms)	350	
7f	Wet Flashover voltage	kV (rms)	300	
7g	Dry lighting impuse withstand voltage	kV (rms)		
	i) Positive		650	
	ii) Negative		650	
7h	RIV at 1 MHz when energised at 10kV/30kV/110kV (rms under dry condition	kV (rms)	<500 micro volts	
7i	Creepage Distance (Minimum)	Mm	4495	
8	Mechanical Characteristics			
8a	Minimum failing load	KN	70	
9	Dimensions of insulators			
9a	Weight	Kgs		
9b	Diameter of FRP rod	mm		
9c	Length of FRP rod	mm		
9d	Dia Weather – Shed	mm		
9e	Thickness of Housing	Mm		
9f	Dry arc distance	Mm		

GTP- 2				
110kV 70 KN Suspension Type Silicone Rubber Housed long rod composite polymer insulator				
Sl No.	Description	Unit	110kV:70 KN	To be filled by the bidder
10	Method of fixing of sheds to housing			
	i) Single mould			
	ii) Modular construction			
	(injection moulding/compression moulding)			
11	No of weather sheds	Nos		
12	Type of sheds			
12a	Aerodynamic			
12b	With under-rubs			
13	Packing details			
13a	Type of packing			
13b	No of insulator in each pack			
13c	Gross weight of package	Kgs		
14	Dimensioned drawings of the insulator (including weight with tolerance in weight)			

GTP- 3				
220 kV 120KN Tension Type Silicone Rubber Housed long rod composite polymer insulator				
Sl. No.	Description	Unit	220kV:120KN Tension type	To be filled by the bidder
1.	Manufacturer			
2.	Country of Origin		India	
3.	Insulator type Origin		220kV:120KN Tension type composite long rod insulators	
4.	Standard according to which the insulators will be manufactured and tested		IEC - 61109	
5.	Name of material used in manufacture of insulator with class/ grade		Silicone Rubber	
6a.	Material of core (FRP rod)		ECR boron free	
	i) E-glass of ECR glass			
	ii) Boron content			
6b	Material of Housing & weather - sheds (Silicon content by weight)		Silicon Rubber (40%)	
6c	Material End Fitting		MCI/SGI/Forged steel	
6d	Sealing compound for end fittings		Silicon Sealant	
6e	Colour		Yellow	
7	Electrical Characteristic			

GTP- 3				
220 kV 120KN Tension Type Silicone Rubber Housed long rod composite polymer insulator				
Sl. No.	Description	Unit	220kV:120KN Tension type	To be filled by the bidder
7a	Nominal system voltage	KV	220	
7b	Highest system voltage	KV	245	
7c	Dry power frequency withstand voltage	kV (rms)	510	
7d	Wet power frequency withstand voltage	kV (rms)	460	
7e	Dry Flashover Voltage	kV (rms)		
7f	Wet Flashover voltage	kV (rms)		
7g	Dry lighting impuse withstand voltage	kV (rms)		
	i) Positive		1050	
	ii) Negative		1050	
7h	RIV at 1 MHz when energised at 10kV/30kV/110kV (rms under dry condition)	kV (rms)	<500 micro volts	
7i	Creepage Distance (Minimum)	Mm	7595	
8	Mechanical Characteristics			
8a	Minimum failing load	KN		
9	Dimensions of insulators			
9a	Weight	Kgs		

GTP- 3				
220 kV 120KN Tension Type Silicone Rubber Housed long rod composite polymer insulator				
Sl. No.	Description	Unit	220kV:120KN Tension type	To be filled by the bidder
9b	Diameter of FRP rod	mm		
9c	Length of FRP rod	mm		
9d	Dia Weather – Shed	mm		
9e	Thickness of Housing	Mm		
9f	Dry arc distance	Mm		
10	Method of fixing of sheds to housing			
	i) Single mould			
	ii) Modular construction			
	(injection moulding/compression moulding)			
11	No of weather sheds	Nos		
12	Type of sheds			
12a	Aerodynamic			
12b	With under-rubs			
13	Packing details			
13a	Type of packing			
13b	No of insulator in each pack			
13c	Gross weight of package	Kgs		

GTP- 3				
220 kV 120KN Tension Type Silicone Rubber Housed long rod composite polymer insulator				
Sl. No.	Description	Unit	220kV:120KN Tension type	To be filled by the bidder
14	Dimensioned drawings of the insulator (including weight with tolerance in weight)			

GTP- 4				
220kV 90 KN Suspension Type Silicone Rubber Housed long rod composite polymer insulator				
Sl No.	Description	Unit	220kV:90 KN	To be filled by the bidder
1.	Manufacturer			
2	Country of Origin		India	
3.	Insulator type Origin		220kV:90KN type composite long rod insulators	
4.	Standard according to which the insulators will be manufactured and tested		IEC - 61109	
5.	Name of material used in manufacture of insulator with class/ grade		Silicone Rubber	
6a.	Material of core (FRP rod)		ECR Boron free	
	i) E-glass of ECR glass			
	ii) Boron content			
6b	Material of Housing & weather – sheds (Silicon content by weight)		Silicon Rubber (40%)	
6c	Material End Fitting		MCI / SGI /Forged steel	
6d	Sealing compound for end fittingsq		Silicon Sealant	
6e	Colour		Blue	
7	Electrical Characteristic			
7a	Nominal system voltage	KV	220	
7b	Highest system voltage	KV	245	

GTP- 4				
220kV 90 KN Suspension Type Silicone Rubber Housed long rod composite polymer insulator				
Sl. No.	Description	Unit	220kV:90 KN	To be filled by the bidder
7c	Dry power frequency withstand voltage	kV (rms)	510	
7d	Wet power frequency withstand voltage	kV (rms)	460	
7e	Dry Flashover Voltage	kV (rms)		
7f	Wet Flashover voltage	kV (rms)		
7g	Dry lighting impuse withstand voltage	kV (rms)		
	i) Positive		1050	
	ii) Negative		1050	
7h	RIV at 1 MHz when energised at 10kV/30kV/110kV/220kV (rms under dry condition	kV (rms)	<1000 micro volts	
7i	Creepage Distance (Minimum)	Mm	7595	
8	Mechanical Characteristics			
8a	Minimum failing load	KN		
9	Dimensions of insulators			
9a	Weight	Kgs		
9b	Diameter of FRP rod	mm		
9c	Length of FRP rod	mm		
9d	Dia Weather – Shed	mm		
9e	Thickness of Housing	Mm		
9f	Dry arc distance	Mm		

GTP- 4				
220kV 90 KN Suspension Type Silicone Rubber Housed long rod composite polymer insulator				
Sl. No.	Description	Unit	220kV:90 KN	To be filled by the bidder
10	Method of fixing of sheds to housing			
	i) Single mould			
	ii) Modular construction			
	(injection moulding/compression moulding)			
11	No of weather sheds	Nos		
12	Type of sheds			
12a	Aerodynamic			
12b	With under-rubs			
13	Packing details			
13a	Type of packing			
13b	No of insulator in each pack			
13c	Gross weight of package	Kgs		
14	Dimensioned drawings of the insulator (including weight with tolerance in weight)			

ANNEXURE-7A**TESTS ON COMPLETE COMPOSITE INSULATOR WITH HARDWARE FITTINGS****1 CORONA EXTINCTION VOLTAGE TEST (DRY)**

The sample assembly when subjected to power frequency voltage shall have a corona extinction voltage of not less than 154kV (rms) line to ground under dry condition for 220kV line. There shall be no evidence of corona on any part of the sample. The atmospheric condition during testing shall be recorded and the test results shall be accordingly corrected with suitable correction factor as stipulated in IEC: 60383.

2 RIV TEST (DRY)

Under the conditions as specified under (1.2) above, the insulator string along with complete hardware fittings shall have a radio interference voltage level below 1000 micro volts at one MHz when subjected to 50 Hz AC voltage of 305kV line to ground under dry condition for 220kV AC line. The test procedure shall be in accordance with IS: 8263/ IEC: 60437.

3 MECHANICAL STRENGTH TEST

The complete insulator string along with its hardware fitting excluding arcing horn, corona control ring, grading ring 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 till 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.

4 VIBRATION TEST

The suspension string shall be tested in suspension mode, and tension string in tension mode itself in laboratory span of minimum 30 meters. 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 the each sub-conductor (each tensioned at 35KN for 220kV) shall be secured with clamps. The system shall be suitable to maintain constant tension on each sub-conductor throughout the duration of the test. Vibration dampers shall not be used on the test span. All the sub-conductors shall be vertically vibrated simultaneously 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 insulators shall be examined for looseness of pins and cap or any crack. The hardware shall be examined for looseness, fatigue failure and mechanical strength test. There shall be no deterioration of properties of hardware components and insulators after the vibration test. The insulators shall be subjected to the Mechanical performance test followed by mechanical strength test as per relevant standards.

5 SALT - FOG POLLUTION WITHSTAND TEST

This test shall be carried out in accordance with IEC-60507. The salinity level for composite long rod insulators shall be 80 Kg/m³ NaCl.

6 COMPOSITE LONG ROD INSULATOR UNITS

6.1 BRITTLE FRACTURE RESISTANCE TEST

Assembled core load time test with container that contains in HNO₃ concentric acid this is applied at the naked FRP rod. The rod should be held at 80% of SML for the duration of the test. The rod should not fail within the 96-hour test duration.

6.2 RECOVERY OF HYDROPHOBICITY TEST

- (i) The surface of selected samples shall be cleaned with isopropyl alcohol. Allow the surface to dry and spray with water. Record the HC classification. Dry the sample surface
- (ii) Treat the surface with corona discharges to destroy the hydrophobicity. This can be done utilizing a high frequency corona tester. Holding the electrode approximately 3 mm from the sample surface slowly move the electrode over an area approximately 1" x 1". Continue treating this area for 2-3 minutes, operating the tester at maximum output.
- (iii) Immediately after the corona treatment, spray the surface with water and record the HC classification. The surface should be hydrophilic with an HC value of 6 to 7. If not, dry the surface and repeat the corona treatment for a longer time until an HC of 6 or 7 is obtained. Dry the sample surface.
- (iv) Allow the sample to recover and repeat the Hydrophobicity measurement at several time intervals. Silicone rubber should recover to HC 1 – HC 2 within 24 to 48 hours, depending on the material and the intensity of the corona treatment

6.3 SILICONE CONTENT TEST

Minimum content of silicone as guaranteed by supplier shall be verified through FT-IR spectroscopy & TGA analysis or any other suitable method mutually agreed between Owner & Supplier in Quality Assurance Programme.

7 HIGH PRESSURE WASHING TEST

The washing of a complete insulator of each E&M rating is to be carried out at 3800 KPa with nozzles of 6mm diameter at a distance of 3m from nozzles to the insulator. The washing shall be carried out for 10minutes. There shall be no damage to the sheath or metal fitting to housing interface. The verification shall be 1 minute wet power frequency withstand test at 460 kV r.m.s for 220KV.

8 TORSION TEST

Three complete insulators of each E&M rating shall be subjected to a torsional load of 55Nm. The torsional strength test shall be made with test specimen adequately secured to the testing machine. The torsional load shall be applied to the test specimen through a torque member so constructed that the test specimen is not subjected to any cantilever stress. The insulator after torsion test must pass the Dye Penetration Test as per IEC 61109.

9 TESTS ON ALL COMPONENTS (AS APPLICABLE)

9.1 CHEMICAL ANALYSIS OF ZINC USED FOR GALVANIZING

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

9.2 TESTS FOR FORGINGS

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

9.3 TESTS ON CASTINGS

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

10 POWER ARC TEST:

Three insulators having any one design of end fittings shall be tested for power arc endurance while tensioned horizontally at 3000lb. An arc shall be initiated across the insulator by means of a Copper shorting fuse wire. The arc shall burn 15 to 30 cycles and its current magnitude is determined by ampere- time product (IxT) equal to a minimum of 150kA cycles. Each insulator is only acceptable if there is no exposure of the core, no mechanical separation of the insulator, and no cracks in the housing.

SECTION - 8**TECHNICAL SPECIFICATION OF HARDWARE & ACCESSORIES FOR CONDUCTOR,
INSULATOR & EARTH WIRE****TABLE OF CONTENT**

SR. NO.	DESCRIPTION
1	SCOPE
2	STANDARD
3	LINE REQUIREMENT
4	TECHNICAL DESCRIPTION OF HARDWARE FITTINGS
5	PARTICULARS OF HARDWARE FITTINGS
6	GENERAL SPECIFICATIONS
7	BID DRAWINGS
8	DIMENSIONS & TOLERANCES
9	IMPORTANT CONDITIONS
10	GALVANISING
11	TESTS
12	TESTING EXPENSES
13	TEST REPORTS
14	INSPECTION
15	PACKING AND MARKING

SR. NO.	DESCRIPTION
16	QUALITY ASSURANCE PROGRAM
	ANNEXURE-8A - TESTS ON HARDWARE FITTINGS
	ANNEXURE-8B - ACCEPTANCE TESTS

SECTION - 8**TECHNICAL SPECIFICATION OF HARDWARE & ACCESSORIES FOR CONDUCTOR,
INSULATOR & EARTH WIRE****1 SCOPE**

This section provides the technical details of Hardware fittings & Accessories suitable for Insulator string, Conductor and Earth wire for use on 220kV/110kV MCMV transmission lines. The material and services under this specification shall be performed as per the requirements of the latest revisions and amendments available at the time of placement of order of all the relevant Indian Standards/Codes listed in Clause-2 STANDARDS here under or equivalent International Standards, except as modified in this document.

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

2 STANDARDS

Sl No.	Indian Standard	Title
1	IS:206	Tee and Strap Hinges
2	IS:209	Specification for Zinc
3	IS:1367	Technical supply conditions for threaded fasteners
4	IS:1385	Phosphor Bronze Rods & Bar Sheet and Strips and Wire
5	IS:1570 (part-I)	Schedules for wrought steels for general engineering purposes steel specified by tensile and/or yield properties
6	IS:1573	Electroplated coatings of zinc on iron and steel
7	IS:2002	Steel plates for pressure vessels for intermediate and high temperature
8	IS:2004	Specification for carbon steel forgings the general engineering purposes
9	IS 2062-2011	Specification for steel for general purpose
10	IS:2071	Method of high voltage testing
11	IS:2121	Specification of conductors and earthwire accessories for over-head power lines

	(all parts)	
Sl No.	Indian Standard	Title
12	IS:2486 (all parts)	Specification for insulator fittings for overhead power lines with nominal voltage greater than 1000V
13	IS:2629	Recommended practice for Hot Dip galvanizing of iron & steel
14	IS:2633	Methods of testing uniformity of coating on zinc coated articles
15	IS:3138	Hexagon Bolts and Nuts
16	IS:3188	Characteristic of String Insulators Units
17	IS:4759	Hot Dip Zinc Coatings on Structural Steel and other Allied Products
18	IS: 4826-1979	Hot Dip Galvanised Coating on Round Steel Wires
19	IS 6639	Specification for Hexagonal bolts for steel structures
20	IS:6745	Methods of Determination of Weight of Zinc Coating of Zinc Coated Iron and Steel Articles
21	IS:7814-1985	Phosphor Bronze Sheet and Strip
22	IS: 8263	Method of Radio Interference Tests on High Voltage Insulators
23	IS: 9708	Stockbridge Vibration Dampers for Overhead Power lines.
24	IS:10162	Spacers and Spacer Dampers for twin horizontal bundle Conductors.
25	BS:970 (Part-I)	General Instructions and Testing Procedures Specific Requirements for Carbon and Carbon Manganese Alloy and Stainless Steels.
26		Ozone test on Elastomer
27		Composite string insulator units for overhead lines with a nominal voltage above 1000V: i) Standard strength classes and end fittings ii) Dimensional and electrical characteristics

The standards mentioned above are available from:

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

3 LINE REQUIREMENT

3.1 INSULATOR STRING CHARACTERISTICS

Insulator string characteristics are furnished in clause 4.1, section 1, part A of volume II.

3.2 CONDUCTORS CHARACTERISTICS

Conductor characteristics are furnished in clause 4.1, section 1, part A of volume II.

3.3 OPGW CHARACTERISTICS

OPGW characteristics are furnished in clause 4.1, section 1, part A of volume II.

4 TECHNICAL DESCRIPTION OF HARDWARE FITTINGS

4.1 General

The Hardware fittings & Accessories shall meet the technical requirement as per standards. Hardware fittings & Accessories shall be suitable for single/double suspension V-string Insulator and single/double tension Insulator strings.

Each Hardware fitting shall be supplied complete in all respect and shall include all components, which are required for making complete set.

The hardware fittings shall be suitable for use with Composite Long Rod insulators having ball and socket fittings.

Corona control rings/grading ring with fittings for attachment to line side yoke plate.

Sag adjustment plate for Double tension hardware fittings and turn buckle for single tension hardware fittings.

Suspension and dead-end assembly to suit conductor size as detailed in clause 4.6 & 4.7 hereinafter.

Other necessary fittings viz D-shackles, eye links, extension links, ball clevis, socket clevis, clevis eye, U clevis and chain link etc. to make the hardware fittings complete.

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

4.2 Interchangeability

The hardware for insulator strings with Composite long rod insulators together with ball and socket fittings shall be of standard design, so that these hardware are inter- changeable with each other and suitable for use with insulators of any make conforming to relevant Indian/International Standard.

4.3 Corona and RI Performance

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

4.4 Maintenance

The hardware fittings offered shall be suitable for employment of hot line maintenance technique so that usual hot line operations can be carried out with ease, speed and safety. The technique adopted for hot line maintenance shall be generally bare hand method & hot stick method. The Bidder should clearly establish in the bid, the suitability of his fittings for hot line maintenance.

The line side yoke plate shall have a notch & a working hole of suitable size. The design of corona control rings/grading ring shall be such that it can be easily replaced by employing hot line maintenance technique.

4.5 Split Pins

Split pins shall be used with bolts & nuts.

4.6 SUSPENSION ASSEMBLY

4.6.1 The suspension assembly shall be suitable for the ACSR Panther conductor

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

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

- 4.6.4** The suspension clamp suitable for various type of Conductor along with standard preformed armour rods/armour grip suspension clamp set shall have a slip strength between 8% to 15% of ultimate strength of conductor.
- 4.6.5** The suspension clamp shall be designed for continuous operation at the temperature according to the temp of required conductor.
- 4.6.6** The suspension assembly shall be designed, manufactured and finished to give it a suitable shape, so as to avoid any possibility of hammering between suspension assembly and conductor due to vibration. The suspension assembly shall be smooth without any cuts, grooves, abrasions, projections, ridges or excrescence which might damage the conductor.
- 4.6.7** The suspension assembly/clamp shall be designed so that it shall minimise the static & dynamic stress developed in the conductor under various loading conditions as well as during wind induced conductor vibrations. It shall also withstand power arcs & have required level of Corona/RIV performance.

4.6.8 Free Centre Type Suspension Clamp

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

4.6.9 Standard Preformed Armour Rod Set

- 4.6.9.1** The Preformed Armour Rods Set shall be used to minimize the stress developed in the sub-conductor due to different static and dynamic loads because of vibration due to wind, slipping of conductor from the suspension clamp as a result of unbalanced conductor tension in adjacent spans and broken wire condition. It shall also withstand power arcs, chafing and abrasion from suspension clamp and localized heating effect due to magnetic power losses from suspension clamps as well as resistance losses of the conductor.
- 4.6.9.2** The preformed armour rods set shall have right hand lay and the inside diameter of the helics shall be less than the outside diameter of the conductor to have gentle but permanent grip on the conductor. The surface of the armour rod when fitted on the conductor shall be smooth and free from projections, cuts and abrasions etc.
- 4.6.9.3** The pitch length of the rods shall be determined by the Bidder but shall be less than that of the outer layer of conductor and the same shall be accurately controlled to maintain uniformity and consistently reproducible characteristic wholly independent of the skill of linemen.
- 4.6.9.4** The tolerance in length of the rods in complete set should be within 13 mm between the longest and shortest rod. The ends of armour rod shall be parrot billed.
- 4.6.9.5** The number of armour rods in each set shall be eleven. Each rod shall be marked in the middle with paint for easy application on the line.
- 4.6.9.6** The armour rod shall not lose their resilience even after five applications. The conductivity of each rod of the set shall not be less than 40% of the conductivity of the International Annealed Copper Standard (IACS).

4.6.10 Armour Grip Suspension Clamp

- 4.6.10.1** The armour grip suspension clamp shall comprise of retaining strap, support housing, elastomer inserts with aluminium reinforcements and AGS preformed rod set.
- 4.6.10.2** Elastomer insert shall be resistant to the effects of temperature up to maximum conductor temperature guaranteed by the bidder corresponding to peak current, Ozone, ultraviolet radiations and other atmospheric contaminants likely to be encountered in service. The physical properties of the elastomer shall be of approved standard. It shall be electrically shielded by a cage of AGS performed rod set. The elastomer insert shall be so designed that the curvature of the AGS rod shall follow the contour of the neoprene insert.
- 4.6.10.3** The length of the AGS preformed rods shall be such that it shall ensure sufficient slipping strength and shall not introduce unfavorable stress on the conductor under all operating conditions.

4.7 DEAD END ASSEMBLY

- 4.7.1** The dead-end assembly shall be suitable for the ACSR Panther Conductor.
- 4.7.2** The dead-end assembly shall be of compression type with provision for compressing jumper terminal at one end. The angle of jumper terminal to be mounted should be 30° with respect to the vertical line. The area of bearing surface on all the connections shall be sufficient to ensure positive electrical and mechanical contact and avoid local heating due to I²R losses.

The resistance of the clamp when compressed on Conductor shall not be more than 75% of the resistance of equivalent length of Conductor.

- 4.7.3** Die compression areas 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. If the dead-end assembly is designed for intermittent die compressions it shall bear identification marks 'COMPRESSION ZONE' and 'NON-COMPRESSION ZONE' distinctly with arrow marks showing the direction of compressions and knurling marks showing the end of the zones. Tapered aluminium filler plugs shall also be provided at the line of demarcation between compression & non-compression zone. The letters, number and other markings on the finished clamp shall be distinct and legible. The dimensions of dead end assembly before & after compression along with tolerances shall be shall be guaranteed in the relevant schedules of the bid and shall be decided by the manufacturer so as to suit the conductor size & conform to electrical & mechanical requirement stipulated in the specification.
- 4.7.4** 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 ultimate tensile strength of the conductor.

4.8 OTHER HARDWARE FITTINGS

4.8.1 BALL AND SOCKET

The Ball and Socket for Hardware fittings shall necessarily conform to the dimensions as stipulated in the Indian Standards. The Ball and Socket dimensions of the Hardware sets to be used with 90KN Electro Mechanical strength of

Polymeric Insulators shall be of 16mm. The Ball and Socket dimensions of the Hardware sets to be used with 120KN Electro Mechanical strength of Polymeric Insulators shall be of 20mm. The Bidder shall offer full detail of locking device in accordance with IS 2486:(Part-III) or equivalent International Standard along with test reports, gauges and adherence to Standards for Tests on Locking Devices in line with IS:2486 (Part-IV) or equivalent International Standard.

4.8.1.1 Ball fittings

Ball fittings shall be made of class IV steel as per IS:2004 or steel of equivalent grade and shall be forged in one piece. They shall be normalized to achieve the minimum breaking strength specified on the respective drawings. Before galvanization 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.

4.8.1.2 Socket fittings

Socket fittings shall be made of class IV steel as per IS:2004 or steel of equivalent grade and shall be forged in one piece. They shall be normalized to achieve the minimum breaking strength specified on the respective drawings.

4.8.1.3 Security clips for socket fittings

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 template withdrawal from the socket. The clip end shall not project outside the recess of socket when the clip in locked position.

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 energized conditions.

The security clip shall be made of stainless steel of type AISI 302 or 304 or phosphor bronze as per IS:7814.

4.8.2 YOKE PLATE/LINK PLATE

The strength of yoke plates shall be adequate to withstand the minimum ultimate tensile strength suits to Insulators mentioned in Section 7 of Volume II.

The plates shall be either triangular or rectangular in shape as may be necessary. The design of yoke plate shall take into account the most unfavorable loading conditions likely to be experienced as a result of dimensional tolerances for Composite insulators as well as components of hardware fittings within the specified range. The plates shall have suitable holes for fixing corona control rings/grading ring/arcing horn. All the corners and edges should be rounded off with a radius of atleast 3 mm. Design calculations i.e. for bearing & tensile strength, for deciding the dimensions of yoke plate shall be furnished by the bidder.

The yoke plate/link plate shall be made of steel plate as per IS: 226 or equivalent standards. Shearing/cutting of the plate shall be clean without drawn or ragged

edges. If the plates are flame cut, mechanical guides shall be used. It shall be ensured that the grain flow of the yoke plate shall be in the direction of the tensile load.

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

4.8.3 ANCHOR SHACKLE

Anchor shackle shall be made of forged steel complete with G.I. rivets and stainless-steel split pin, minimum breaking strength shall be 240KN for double tension string.

4.8.4 BALL CLEVIS, SOCKET CLEVIS

The Ball clevis shall be made of forged steel and socket clevis from malleable cast iron complete with G.I. rivet and stainless-steel split pins. Ball and socket clevis shall be suitable for insulator string for appropriate fitting to which they are connected. All ball and clevis shall be a minimum breaking strength of 120KN.

4.8.5 CLEVIS - CLEVIS

Clevis fittings shall be made of malleable cast iron, complete with G.I. rivet and stainless-steel split pins. Clevis shall be suitable for connecting to yoke plate on sub-station structure side. Minimum breaking strength of the clevis shall be 120KN

4.8.6 TURN BUCKLE

The turn buckle is to be provided with single tension hardware fitting. The threads shall be of sufficient strength to remain unaffected under the specified tensile load.

It shall be made of forged steel. The minimum adjustment in the movement facilitated by the turn buckle shall be 175mm. The minimum breaking strength of the turn buckle shall be 160KN and requisite locking arrangement shall be provided for safe guarding shearing of threads under working conditions. The same shall be specifically indicated in the drawings.

4.8.7 SAG ADJUSTMENT PLATE

The Sag adjustment plate shall be made of steel plate as per IS:226 or equivalent standards. Shearing/cutting of the plate shall be clean without drawn or ragged edges. If the plates are flame cut, mechanical guides shall be used.

Sag adjustment plate for Dead End Assembly having adjustment of upto 150mm minimum at the interval of 6 mm.

The sag-adjustment plate to be provided with the Double tension hardware fitting shall be of three plate type. The sag adjustment plate shall be provided with a safety locking arrangement. The device shall be of such design that the adjustment is done with ease, speed and safety.

Design calculations for deciding the dimensions of sag adjustment plate shall be furnished by bidder

4.8.8 ARCING HORN

220/110kV Insulator strings for transmission line shall be provided with Arcing Horns of different type at suitable position for each insulator. In case of 220kV Insulator strings, the Arcing Horn shall be provided on both line side & tower side. The dimension of the Arcing Horn shall be as per standard. However, the height of the Arcing Horn may be changed depending upon the length of Socket Eye, Yoke Plate etc. The arrangement for fixing of Arcing Horn shall be such that they do not get loose while in service. To achieve this, they should have proper seat for the Arcing Horn and heat-treated Belleville washers should be provided with the bolts.

5 PARTICULARS OF HARDWARE FITTINGS

Each Hardware fitting for the transmission line shall be complete in all respect and Bidder should furnish complete drawings and technical particulars of the items of hardware fittings. The Hardware fittings should normally comprise items mentioned below:

5.1 SINGLE SUSPENSION V-STRING HARDWARE FITTING

Single suspension Hardware string shall comprise of one Ball Hook, one Socket Eye Horn holder, one-line side Arcing Horn and one Suspension Clamp of AGS type with armour rod suitable for respective sizes of Conductors. The Complete string shall have ultimate breaking strength of not less than 90KN for 220kV.

5.2 SINGLE TENSION STRING HARDWARE FITTINGS

Single tension string Hardware shall comprise of one 'D' Shackle, one Ball Link, one Forged Steel Socket, Socket Clevis Horn holder, Arcing Horn and one Tension Clamp of compression type. The Complete string shall have ultimate breaking strength of not less than 120KN for 220kV.

5.3 DOUBLE TENSION STRING HARDWARE FITTINGS

The double tension string Hardware shall comprise of two 'D' shackle, one chain link one top yoke plate, two ball clevis, two socket clevis, one bottom yoke plate, Arcing horn, one clevis and a compression type dead-end Clamp. The Complete string shall have ultimate breaking strength of not less than 240KN for 220kV.

6 GENERAL SPECIFICATIONS

- 6.1** All the materials shall be of the latest design and conform to the best modern practice adopted in the extra high voltage field. The manufacturer shall supply only such material as guaranteed by him to be satisfactory and suitable for 220/110kV Transmission lines.
- 6.2** The design, manufacturing process and quality control of all the materials shall be such as to give maximum factor of safety, maximum possible working load, highest mobility, elimination of sharp edges and corners, best resistance to corrosion and a good finish.
- 6.3** All ferrous parts shall be hot dip galvanised, after all machining has been completed. Nuts may, however, be tapped (threaded) after galvanizing and the threads oiled. Spring washers shall be electro galvanised. The bolts threads shall be undercut to take care of increase in diameter due to galvanizing. Galvanizing shall be done in accordance with IS:2629-1990 or equivalent International Standard and satisfy the tests mentioned in IS:2633- 1992 or equivalent International Standard. Fasteners shall withstand four dips while spring washers shall be

guaranteed to withstand at least six dips each lasting one minute under the standard preece test for galvanizing.

- 6.4 The Zinc coating shall be perfectly adhere, of uniform thickness, smooth, reasonably bright, continuous and free from imperfections such as flux, ash, rust stains, bulky while deposits and blisters. The Zinc used for galvanizing shall be grade Zn. 99.95 as per IS: 209-1992 or equivalent International Standard.
- 6.5 In case of castings, the same shall be free from all internal defects like shrinkage, inclusion, blowholes, cracks etc.
- 6.6 All current carrying parts shall be so designed and manufactured that contact resistance is reduced to minimum.
- 6.7 No item which would produce high electrical and mechanical stresses in normal working shall have sharp ends or edges, abrasions or projections and shall not cause any damage to the Conductor in any way during erection or during continuous operation. The design of adjacent metal parts and mating surfaces shall be such as to prevent corrosion of the contact surface and no maintain good electrical contact under service conditions.
- 6.8 Particular care shall be taken during manufacturing and subsequent handling to ensure smooth surface free from abrasion or dents.
- 6.9 The fasteners shall conform to the requirement of IS: 6639-1972 or equivalent International Standard. All fasteners and clamps shall have locking arrangements to guard against vibration loosening.

7 BID DRAWINGS

- 7.1 The Bidder shall furnish full description and illustrations of materials offered.
- 7.2 Fully dimensioned drawings of the complete insulator string hard wares and their component parts showing clearly the following arrangements shall be furnished along with the bid. Weight, material and fabrication details of all the components should be included in the drawings.
 - (i) Attachment of the hanger or strain plate.
 - (ii) Suspension or dead-end assembly.
 - (iii) Arcing horn attachment to the string as specified in clause 4.8.8 of this technical Specification.
 - (iv) Yoke plates
 - (v) Hardware fittings of ball and socket type for inter connecting units to the top and bottom Yoke plates.
 - (vi) Corona control rings/grading ring attachment to conductor and other small accessories.
 - (vii) Links with suitable fittings.
 - (viii) Details of balancing weights and arrangements for their attachment in the single suspension pilot insulator string.
- 7.3 All drawings shall be identified by a drawing number and contract number. All drawings shall be neatly arranged. All drafting & lettering shall be legible. The

minimum size of lettering shall be 3 mm. All dimensions & dimensional tolerances shall be mentioned in mm.

The drawings shall include:

- (i) Dimensions and dimensional tolerance.
- (ii) Material, fabrication details including any weld details & any specified finishes & coatings. Regarding material designation & reference of standards are to be indicated.
- (iii) Catalogue No.
- (iv) Marking
- (v) Weight of assembly
- (vi) Installation instructions
- (vii) Design installation torque for the bolt or cap screw.
- (viii) Withstand torque that may be applied to the bolt or cap screw without failure of component parts.
- (ix) The compression die number with recommended compression pressure.
- (x) All other relevant terminal details.

7.4 After placement of award, the Contractor/Manufacturer shall submit fully dimensioned drawing including all the components in four (4) copies to the KSEBL for approval. After getting approval from the KSEBL and successful completion of all the type tests, the Contractor/Manufacturer shall submit thirty (30) more copies of the same drawings to the KSEBL for further distribution and field use at KSEBL's end.

8 DIMENSIONS & TOLERANCES:

- 8.1** The dimensions and tolerances of pin balls and socket ends shall conform to IS 2486 Part-II/IEC-120 and shall be checked by the gauge therein after galvanizing.
- 8.2** 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.
- 8.3** The bearing surfaces of balls and machined sockets, before galvanizing shall not have surface roughness more than 250 micro inches.
- 8.4** 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.

9 IMPORTANT CONDITIONS:

- 9.1** All Hardware items shall be complete with minor items such as security clip, bolts, nuts, washer, split pins and inners etc.
- 9.2** The Contractor shall be responsible for satisfying him that the Insulator fittings offered are entirely suitable for the proposed attachments and for the sizes of the Conductor specified.

- 9.3** All ferrous fittings (except those specified otherwise) shall be hot dip galvanized, after all machining and fitting has been completed, in accordance with relevant Indian Standard. All Hardware items (other than clamps) and those specified otherwise should be made of Drop Forged Steel. Socket items in forged steel must be forged. All forgings supplied should be stress relieved and this treatment should be done at the Contractor works. Forgings, which are not stress relieved, will not be acceptable. The items like Yoke Plate, Arcing Horn, Bolts and Nuts shall be of mild steel and rest of the items shall be of forged steel.
- 9.4** All Bolts, Nuts and Screw heads shall have only wide worth standard thread and of sizes indicated in the enclosed drawing. Bolts head and Nuts shall be hexagonal. Where required, nuts shall be locked in approved manner. The thread in Nuts shall be over tapped after galvanizing and shall be cut before galvanizing. The threads shall not be undercut. The Nuts should be tapped such that they are fit on the bolt threads i.e. these should not have loose fitting.

9.5 Compression Markings

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

10 GALVANISING:

- 10.1** Hot dip galvanizing shall conform to Indian Standard specification IS-2633 or equivalent International Standard.
- 10.2** Galvanizing shall be uniform, free from blisters, and shall not peel off due to abrasion, Zinc coating shall be thick enough to withstand 6 one minute dips in Copper Sulphate solution (preece test) for all ferrous parts except for threaded portions which shall withstand at least 4 one minute dips.
- 10.3** The Contractor must emboss/engrave their name in each forged steel item and Aluminium castings such as Ball Hook, Yoke Plate, Socket Clevis, Clevis Eye, Clevis-Clevis, Anchor Shackle/D-Shackle, Chain Link, Suspension Clamps of AGS type, Tension Clamps and Arcing Horns.

11 TESTS

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

type tested as per the relevant standards. Further the acceptance, routine tests and tests during manufacture shall be carried out on the conductor.

- 11.3** Acceptance tests shall mean those tests, which are to be carried out on samples taken from each lot offered for pre-dispatch inspection, for the purpose of acceptance of that lot.
- 11.4** Routine tests shall mean those tests which are to be carried out on each and every product so as to check with requirements which are likely to vary during production.
- 11.5** 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.
- 11.6** The norms and procedure of sampling for these tests will be as per the Quality Assurance Programme to be mutually agreed to by the Contractor and the KSEBL.
- 11.7** For all type and acceptance tests, the acceptance values shall be the values guaranteed by the Contractor in the “Technical Questionnaire” or the acceptance value specified in this specification, whichever is more stringent for that particular test.

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

11.8.1 On Suspension Clamp

- | | | |
|---------------------------------------|---|--------------------|
| a) Magnetic power loss test | : | As per Annexure-8A |
| b) Clamp slip strength Vs torque test | : | As per Annexure-8A |
| c) Ozone Test on elastomer | : | As per Annexure-8A |

11.8.2 On Dead End Tension Assembly

- | | | |
|--|---|--------------------------|
| a) Electrical resistance test for dead end Assembly: | | As per IS:2486- (Part-I) |
| b) Heating cycle test for dead end Assembly | : | As per IS:2486-(Part-I) |
| c) Slip strength test for dead end assembly | : | As per IS:2486-(Part-I) |
| d) Ageing test on filler (if applicable) | : | As per Annexure-8A |

11.8.3 Mid Span Compression Joint for Conductor

- | | | |
|--|---|--------------------------|
| a) Chemical analysis of materials | : | As per Annexure-8A |
| b) Electrical resistance test | : | As per IS: 2121(Part-II) |
| c) Heating cycle test | : | As per IS: 2121(Part-II) |
| d) Slip strength test | : | As per Annexure-8A |
| e) Corona extinction voltage test (dry) | : | As per Annexure-8A |
| f) Radio interference voltage test (dry) | : | As per Annexure-8A |

Note: Tests mentioned at (c), (e) & (f) are not applicable to mid span compression joints for earth wire

11.8.4 Repair Sleeve for Conductor

- | | | |
|-----------------------------------|---|--------------------|
| a) Chemical analysis of materials | : | As per Annexure-8A |
|-----------------------------------|---|--------------------|

- | | | |
|--|---|--------------------|
| b) Corona extinction voltage test (dry) | : | As per Annexure-8A |
| c) Radio interference voltage test (dry) | : | As per Annexure-8A |

11.8.5 Connector for Conductor

- | | | |
|--|---|--|
| a) Chemical analysis of materials | : | As per Annexure-8A |
| b) Electrical resistance test | : | As per IS: 2121(Part-II)
Clause 6.5 & 6.6 |
| c) Heating cycle test | : | As per IS: 2121 (Part-II) |
| d) Axial tensile load test on welded portion | : | As per Annexure-8A |
| e) Corona extinction voltage test (dry) | : | As per Annexure-8A |
| f) Radio interference voltage test (dry) | : | As per Annexure-8A |

11.8.6 Vibration Damper for Conductor

- | | | |
|--|---|--------------------|
| a) Chemical analysis of materials | : | As per Annexure-8A |
| b) Dynamic characteristics test* | : | As per Annexure-8A |
| c) Vibration analysis | : | As per Annexure-8A |
| d) Clamp slip test | : | As per Annexure-8A |
| e) Fatigue tests | : | As per Annexure-8A |
| f) Magnetic power loss test | : | As per Annexure-8A |
| g) Corona extinction voltage test (dry) | : | As per Annexure-8A |
| h) Radio interference voltage test (dry) | : | As per Annexure-8A |
| i) Damper efficiency test | : | As per IS: 9708 |

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

11.8.7 Acceptance Tests**On Both Suspension Clamp and Tension Assembly**

- | | | |
|---|---|--------------------------|
| a) Visual Examination | : | As per IS: 2486-(Part-I) |
| b) Verification of dimensions | : | As per IS: 2486-(Part-I) |
| c) Galvanising/Electroplating test | : | As per IS: 2486-(Part-I) |
| d) Mechanical strength test of each component | : | As per Annexure-8A |
| e) Mechanical Strength test of welded joint | : | As per Annexure-8A |
| f) Mechanical strength test for corona control ring/ grading ring and arcing horn | : | BS:3288 - (Part-I) |
| g) Test on locking device for ball and socket coupling | : | As per IEC:372 (2) |
| h) Chemical analysis, hardness tests, | | |

grain size, inclusion rating & magnetic
particle inspection for forgings/castings : As per Annexure-8A

On Suspension Clamp only

- a) Clamp Slip Strength Vs Torque test for suspension clamp : As per Annexure-8A
- b) Shore hardness test of elastomer cushion for AG suspension clamp : As per Annexure-8A
- c) Bend test for armour rod set : As per IS: 2121(Part-I), Clause 7.5,7,10 &7.11
- d) Resilience test for armour rod set : As per IS: 2121(Part-I), Clause 7.5,7,10 & 7.11
- e) Conductivity test for armour rods set : As per IS: 2121(Part-I), Clause 7.5,7,10 & 7.11

On Tension Hardware Fittings only

- a) Slip strength test for dead end assembly : As per IS: 2486 (Part-I) Clause 5.4
- d) Ageing test on filler (if applicable) : As per Annexure-8A

On Mid Span Compression Joint for Conductor & Earth wire

- a) Visual examination and dimensional verification: As per IS: 2121 (Part-II), Clause 6.2, 6.3 7 6.7
- b) Galvanizing test : As per Annexure-8A
- c) Hardness test : As per Annexure-8A
- d) Ageing test on filler (if applicable) : As per Annexure-8A

Connector for Conductor

- a) Visual examination and dimensional verification: As per IS:2121 (Part-II)
- b) Axial tensile load test for welded portion : As per Annexure-8A

Repair Sleeve for Conductor

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

Vibration Damper for Conductor

- a) Visual examination and dimensional verification: As per IS: 2121(Part-II) Clause 6.2, 6.3 7 6.7
- b) Galvanizing test : As per Annexure-8A
- i) On damper masses : As per Annexure-8A

ii) On messenger cable	:	As per Annexure-8A
c) Verification of resonance frequencies	:	As per Annexure-8A
d) Clamp slip test	:	As per Annexure-8A
e) Clamp bolt torque test	:	As per Annexure-8A
f) Strength of the messenger cable	:	As per Annexure-8A
g) Mass pull off test	:	As per Annexure-8A
h) Dynamic characteristics test*	:	As per Annexure-8A

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

Routine Tests

For Hardware Fittings

a) Visual examination	:	IS:2486-(Part-I)
b) Proof Load Test	:	As per Annexure-8A

For Conductor

a) Visual examination and dimensional verification	:	As per IS: 2121(Part-II) Clause 6.2, 6.3 7 6.7
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Tests During Manufacture on all components as applicable

a) Chemical analysis of Zinc used for galvanizing:	IS:2486-(Part-I)
b) Chemical analysis mechanical metallographic test and magnetic particle inspection for malleable castings	: As per Annexure-8A
c) Chemical analysis, hardness tests and magnetic particle inspection for forging	: As per Annexure-8A

12 TESTING EXPENSES

12.1 In case of failure in any type test, the Bidder whose material has failed is either required to modify the design of the material & successfully carryout all the type tests as has been detailed out in Clause 11 of this specification or to repeat that particular type test at least three times successfully at his own expenses.

12.2 In case of type test on the complete insulator string, the Contractor/Manufacturer has to arrange similar insulators at his own cost.

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

12.4 The entire cost of testing for acceptance and routine tests and tests during manufacture specified herein shall be treated as included in the quoted Ex-works/CIF Price.

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

12.6 The Contractor/Manufacturer shall intimate the KSEBL about carrying out of the type tests along with detailed testing programme at least 3 weeks in advance (in case of Domestic Contractor/Manufacturer and at least 6 weeks advance in case of Foreign Contractor/Manufacturer) of the scheduled date of testing during which the KSEBL will arrange to depute his representative to be present at the time of carrying out the tests.

12.7 Sample Batch For Type Testing

12.7.1 The Contractor/Manufacturer shall offer material for sample selection for type testing only after getting Quality Assurance Programme approved by the KSEBL. The Contractor/Manufacturer 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 KSEBL.

12.7.2 Before sample selection for type testing the Contractor/Manufacturer shall be required to conduct all the acceptance tests successfully in presence of KSEBL's representative.

12.8 Schedule of Testing and Additional Tests

12.8.1 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 tests.
- (d) Type testing.

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

12.8.3 The KSEBL 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 Manufacturer's premises or at any other test center. In case of evidence of noncompliance, it shall be binding on the part of Contractor/Manufacturer to prove the compliance of the items to the technical specifications by repeat tests, or correction of deficiencies, or replacement of defective items, all without any extra cost to the KSEBL.

13 TEST REPORTS

- 13.1** Copies of type test reports shall be furnished in at least six copies along with one original. One copy shall be returned duly certified by the KSEBL, only after which the commercial production of the concerned material shall start.
- 13.2** Copies of acceptance test report shall be furnished in at least six copies. One copy shall be returned, duly certified by the KSEBL, only after which the materials will be dispatched.
- 13.3** Record of routine test report shall be maintained by the Manufacturer at his works for periodic inspection by the KSEBL 's representative.
- 13.4** Test certificates of tests during manufacture shall be maintained by the Manufacturer. These shall be produced for verification as and when desired by the KSEBL.

14 INSPECTION

- 14.1** The Owner's representative shall at all times be entitled to have access to the works and all places of manufacture, where the material and/or its component parts shall be manufactured, and the representatives shall have full facilities for unrestricted inspection of the Contractor's, sub- Contractor's works raw materials. Manufacturers of all the material and for conducting necessary tests as detailed herein.
- 14.2** The material for final inspection shall be offered by the Contractor only under packed condition. The engineer shall select samples at random from the packed lot for carrying out acceptance tests.
- 14.3** The Contractor shall keep the Owner informed in advance of the time of starting and of the progress of manufacture of material in its various stages so that arrangements could be made for inspection.
- 14.4** Material shall not be dispatched from its point of manufacture before it has been satisfactorily inspected and tested unless the inspection is waived off by the Owner in writing. In the latter case also, the material shall be dispatched only after all tests specified herein have been satisfactorily completed.
- 14.5** The acceptance of any quantity of material shall in no way relieve the Contractor of his responsibility for meeting all the requirements of the Specification, and shall not prevent subsequent rejection, if such material is later found to be defective.

15 PACKING AND MARKING

- 15.1** All material shall be packed in strong and weather resistant wooden cases/crates. The gross weight of the packing shall not normally exceed 200 Kg to avoid handling problems.
- 15.2** The packing shall be of sufficient strength to withstand rough handling during transit, storage at site and subsequent handling in the field.
- 15.3** Suitable cushioning, protective padding, dunnage or spacers shall be provided to prevent damage or deformation during transit and handling.
- 15.4** 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.

- 15.5** Each component part shall be legibly and indelibly marked with trade mark of the manufacturer and year of manufacture.
- 15.6** 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 dispatched on account of faulty packing and faulty or illegible markings. Each wooden case/crate shall have all the markings stenciled on it in indelible ink.
- 15.7** Each consignment shall be accompanied by a detailed packing list showing following details: -
- (i) The name of the consignees
 - (ii) Details of consignment.
 - (iii) Destination.
 - (iv) Total weight of consignment.
 - (v) Handling and unpacking instrumentation.
 - (vi) Bill of material indicating content of each package.

16 QUALITY ASSURANCE PROGRAM

The contractor shall submit the Quality Assurance Programme. A copy of the accepted Quality Assurance Plan must be available at the manufacturer's works of the Plant for reviewing by inspecting officer of the KSEBL.

ANNEXURE - 8A**TESTS ON HARDWARE FITTINGS****1.1 Magnetic Power Loss Test for Suspension Assembly**

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

1.2 Galvanizing/Electroplating Test

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

1.3 Mechanical Strength Test of Each Component

Each component shall be subjected to a load equal to the specified minimum ultimate tensile strength (UTS) which shall be increased at a steady rate to 67% of the minimum UTS specified. The load shall be held for five minutes and then removed. The component shall then again be loaded to 50% of UTS and the load shall be further increased at a steady rate till the specified UTS and held for one minute. No fracture should occur. The applied load shall then be increased until the failing load is reached, and the value recorded.

1.4 Mechanical Strength Test of Welded Joint

The welded portion of the 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.

1.5 Mechanical Strength Test for Suspension/Tension Hardware Fittings

The complete string without insulators excluding arcing horn, corona control rings/grading ring 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. 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 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 the 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.

1.6 Clamp Slip Strength Vs Torque Test for Suspension Clamp

The suspension assembly shall be vertically suspended by means of a flexible attachment. A suitable length of conductor shall be fixed in the clamp. The clamp

slip strength at various tightening torques shall be obtained by gradually applying the load at one end of the conductor. The Clamp slip strength vs torque curve shall be drawn. The above procedure is applicable only for free centre type suspension clamp. For AG suspension clamp only, clamp slip strength after assembly shall be found out. The clamp slip strength at the recommended tightening torque shall be more than 20 KN but less than 29 KN.

1.7 Heating Cycle Test

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

- i) Temperature of conductor during each cycle: 40 deg. C above designed maximum operating temperature of the conductor.
- ii) Number of cycle: 100 Slip strength tests shall also be carried out after heating cycle test.

1.8 Shore Hardness Test for Elastomer Cushion for AG Suspension Assembly

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

1.9 Proof Load Test

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

1.10 Tests for Forging Casting and Fabricated Hardware

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

1.11 Ozone Test for 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.

2. TESTS ON ACCESSORIES FOR CONDUCTOR

2.1 Mid Span Compression Joint for Conductor

(a) Slip Strength Test: The fitting compressed on conductor shall not be less than one meter 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/earth wire and retained for one minute at this load. There shall be no movement of the conductor/ earth wire relative to the fittings and no failure of the fittings during this one minute period.

2.2 Connector for Conductor

Axial Tensile Load Test for Welded Portion: - The sleeve portion of the T-Connector shall be compressed on conductor. The compressed portion shall be held rigidly on some fixtures and axial load shall be applied along with the jumper terminal the load shall be increased gradually till breaking of welded joint occurs. The breaking load should be above 30 KN.

2.3 Vibration damper for conductor

Clamp Slip and Fatigue Tests

- (i) Test Set Up: The clamp slip and fatigue tests shall be conducted on a laboratory set up with a minimum effective span length of 30 m. The conductor shall be tensioned at tension corresponding to 0 deg & no wind condition and ruling span 400 from sag –tension calculation and shall not be equipped with protective armour rods at any point. Constant tension shall be maintained within the span by means of lever arm arrangement. After the conductor has been tensioned, clamps shall be installed to support the conductor at both ends and thus influence of connecting hardware fittings are eliminated from the free span. The clamps shall not be used for holding the tension on the conductor. There shall be no loose parts, such as suspension clamps, U bolts on the test span supported between clamps mentioned above. The span shall be equipped with vibration inducing equipment suitable for producing steady standing vibration. The inducing equipment shall have facilities for step less speed control as well as step less amplitude arrangement. Equipment shall be available for measuring the frequency, cumulative number of cycles and amplitude of vibration at any point along the span.
- (ii) Clamp Slip test: The vibration damper shall be installed on the test span. The damper clamp, after lightning with the manufacturer's specified tightening torque, when subjected to a longitudinal pull of 2.5 KN parallel to the axis of conductor for a minimum duration of one minute shall not slip i.e. the permanent displacement between conductor and clamp measured after removal of the load shall not exceed 1.0 mm. The load shall be further increased till the clamp starts slipping. The load at which the clamp slips shall not be more than 5 KN.

2.4 Mechanical Strength Test for Earth wire Suspension/Tension Clamp

- (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.
- (b) 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 Earth wire shall be fixed in the clamps. The clamp slip

strength at various tightening torques shall be obtained by gradually applying the load at one end of the earth wire. The clamp slip strength Vs torque curve shall be drawn. The clamp slip strength at the recommended tightening torque shall be as per the values stipulated in the Standard Technical Particulars.

- (c) Slip Strength Test of Tension Clamp: Tension clamps shall be compressed on a 5 m length of earth wire 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 earth wire 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 earth wire 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 earth wire. The electrical resistance shall be measured between points on earth wire 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 earth wire. The test shall be conducted with direct current. The current connections shall be at a distance not less than 50 times the diameter of earth wire from the fitting and shall be made so that effective contact is ensured with all those strands of the earth wire 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.

2.5 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.

3. TESTS ON ALL COMPONENTS (AS APPLICABLE)

3.1 Chemical Analysis of Zinc used for Galvanizing

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

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

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

ANNEXURE-8B**ACCEPTANCE TESTS****1 Mid Span Compression Joint for Conductor**

(a) Hardness Test: - The Brinnel hardness at various points on the steel sleeve of conductor core and tension clamp shall be measured.

2 Connector for Conductor

(a) Axial Tensile Load Test for Welded Portion: - Same as clause 2.2 of Annexure – 8A

3 Vibration Damper for Conductor

- a) Verification of Resonance Frequencies: - The damper shall be mounted on a shaker table and vibrate at damper clamp displacement of +/-0.5 mm to determine the resonance frequencies. The resonance shall be visually identified as the frequency at which damper mass vibrates with maximum displacement on itself. The resonance frequency thus identified shall be compared with the guaranteed value. A tolerance of ± 1 Hz at a frequency lower than 15 Hz and ± 2 Hz at a frequency higher than 15 Hz only shall be allowed.
- b) Clamp Slip Test: - Same as Clause 2.3 (ii) of Annexure – 8A.
- c) Clamp Bolt Torque Test: - The clamp shall be attached to a section of the conductor/earth wire. A torque of 150 percent of the manufacturer's specified torque shall be applied to the bolt. There shall be no failure of component parts. The test set up is as described in Clause 2.4 (c), Annexure-8A.
- d) Strength of the Messenger Cable: - The messenger cable shall be fixed in a suitable tensile testing machine and the tensile load shall be gradually applied until yield point is reached. Alternatively, each strand of messenger cable may be fixed in a suitable tensile testing machine and the tensile load shall be gradually applied until yield point is reached. In such a case, the 95% of yield strength of each wire shall be added to get the total strength of the cable. The load shall be not less than the value guaranteed by the Contractor
- e) Mass Pull off Test: - Each mass shall be pulled off in turn by fixing the mass in one jaw and the clamp in the other of a suitable tensile testing machine. The longitudinal pull shall be applied gradually until the mass begins to pull out of the messenger cable. The pull off loads shall not be less than the value guaranteed by the Contractor.

Sd/-

Addnl. CEO

REC Transmission Projects Company Limited

PART C
EXECUTION OF THE PACKAGE

SECTION - 9**TOWER FOUNDATION, ERECTION, STRINGING AND INSTALLATION OF LINE MATERIALS****TABLE OF CONTENT**

SL.No.	DESCRIPTION
PART - I TOWER FOUNDATION	
1.	SCOPE OF WORKS
1.1	CLASSIFICATION OF SOIL
1.2	CLASSIFICATION OF FOUNDATIONS
1.3	PROPERTIES OF CONCRETE
1.4	TECHNICAL SPECIFICATION FOR FOUNDATION OF TOWERS
1.5	EXCAVATION IN ALL KINDS OF SOIL, ORDINARY ROCK AND HARD ROCK
1.6	CONCRETING UNDER WATER
1.7	CONSTRUCTION OF TOWER FOUNDATION
PART - II TOWER ERECTION, STRINGING AND INSTALLATION OF LINE MATERIALS	
2.0	GENERAL
2.1	TOWER ERECTION
2.2	INSULATOR HOISTING
2.3	HANDLING OF CONDUCTOR AND EARTH WIRE
2.4	STRINGING OF CONDUCTOR AND EARTH WIRE
2.5	JOINTING
2.6	TENSIONING AND SAGGING OPERATIONS
2.7	FIXING OF CONDUCTORS AND EARTH WIRE ACCESSORIES
2.8	AERIAL MARKER BALLS & AVIATION SIGNAL
2.9	REPLACEMENT
2.10	PERMITTED EXTRA CONSUMPTION OF LINE MATERIALS
2.11	FINAL CHECKING, TESTING AND COMMISSIONING

SECTION - 9**TOWER FOUNDATION, ERECTION, STRINGING AND INSTALLATION OF LINE MATERIALS****PART - I TOWER FOUNDATION****1.0 SCOPE OF WORK**

This section covers the design requirements of plain and reinforced cement concrete foundations of self-supporting galvanized lattice towers for 220kV/110kV MCMV Transmission Lines under the scope of this specification.

The contractor shall complete the works as per the detailed design and drawings furnished by KSEBL for foundations for all types of normal towers with extensions as detailed in the design drawings.

The execution of works for foundation shall be as per relevant IS and in accordance with the CBI&P Publication No. 323 (Transmission Line Manual).

1.1 CLASSIFICATION OF SOILS

Depending upon the ground water table and types of soil and rock, the selection of soil types to suit appropriate isolated footings are classified as follows: -

i) Normal Dry Soil:

When water table is below the foundation level and when soil is cohesive and homogeneous up to the full depth having clay content of 10-15%.

ii) Wet Soil:

When water table is above foundation level and up to 1.5m below ground level. The foundations in the soil which have standing surface water with water penetration not exceeding 1.0m below ground level (*e.g. paddy fields*) are also classified as wet foundations.

iii) Fully submerged Soil:

When water table is within 0.75m below ground and when the soil is normal and cohesive.

iv) Black cotton Soil:

When the soil is cohesive having inorganic clay exceeding 15% and characterized by high shrinkage and swelling property (*need not be always black in colour*).

v) Soft Rock/Fissured Rock:

Decomposed or fissured rock, hard gravel or any other soil of similar nature which can be executed without blasting. Under cut foundation is to be used at these locations.

vi) Hard Rock:

Where chiselling, drilling and blasting is required for excavation.

1.2 CLASSIFICATION OF FOUNDATIONS:

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) 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.

(iv) Wet Black Cotton Soil

To be used at locations where soil is clayey type, not necessarily black in colour, which shrinks when dry and swells when wet, resulting in differential movement. For designing the foundation for such locations, where sub-soil water is met between 1.5 meters and the depth of foundation below the ground level.

(v) Fissured – Rock

To be used at locations, where decomposed or fissured rock, hard gravel, kankar, limestone, laterite or any other soil of similar nature is met. Under cut type foundation is to be used for fissured rock locations.

In case of fissured rock locations, where water table is met at 1.5M or more below ground level, wet fissured rock foundations shall be adopted. Where fissured rock is encountered with subsoil water table less than 1.5 meter below ground level, submerged fissured rock foundations shall be adopted. In case of dry locations dry fissured rock foundations shall be adopted.

(vi) Hard Rock

The locations where chiseling, drilling and blasting is required for excavation for monolithic rock for a particular leg/tower, hard rock type foundations are to be used. For these locations rock anchoring is to be provided to resist uplift forces.

The contractor shall be paid for the actual volume of concrete, excavation and weight of reinforcement executed as per Schedule of prices.

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 affect more economy.

The relevant characteristics of various types of soils are as given under this section. It shall be the responsibility of the contractor to draw the attention and obtain approval of KSEBL for any departure necessitated in these design data, based on geotechnical investigation at tower location, results of trial pits, etc.

1.2.1 GROUPING AND CLASSIFICATION OF FOUNDATIONS

The foundations for normal towers and normal towers with body extensions shall be grouped as under:

- (i). Normal Towers
- (ii). Normal Towers with body extensions.

1.3. PROPERTIES OF CONCRETE

1.3.1 The cement concrete used for the foundations shall generally be of grade M-20 having 1:1.5:3 nominal volumetric mix ratio with 20mm coarse aggregate for chimney portion and 20mm/40mm aggregates for pyramid or slab portion. All the properties of concrete regarding its strength under compression, tension, shear, punching and bending etc. as well as workmanship will conform to IS: 456

All the properties of concrete regarding its strength under compression, tension, shear, punching and bending etc. as well as workmanship will conform to IS: 456.

1.3.2 The weight of concrete to be considered for design of foundations is given in below table.

WEIGHT OF CONCRETE

TYPE OF CONCRETE	WEIGHT OF DRY REGION Kg/m ³	WEIGHT IN PRESENCE OF SUB-SOIL WATER Kg/m ³
Plain Concrete	2300	1300
Reinforced Concrete	2400	1400

1.3.3 The Quantity of minimum cement to be used per unit quantity of consumption for different mix (nominal mix) of concrete should be as follows. For richer mixes if any found necessary during execution of work, mix shall be designed, and cement content ascertained.

Concrete Grade	Ut	Quantity of Minimum cement to be used per Unit quantity of work
For M10	Kg	220
For M20	Kg	350
For M25	Kg	410
Random Rubble Masonry with 1:6 cement mortar	Kg	83

In this regard, utilisation record is to be maintained at site.

1.3.4 Alternatively, Ready Mix concrete from batching plant as per IS: 4925 can also be used with no extra payment and without any recovery. However, cement content shall be as per IS: 456. The ready mix concrete shall conform to IS: 4926. The selection and use of Materials for the ready mix concrete shall be in accordance with IS: 456. The concrete shall be of M20 grade design mix as per IS: 456. The transport of concrete and transportation time shall be as per IS: 4926.

a) Cement used shall be ordinary Portland Cement, unless mentioned otherwise, conforming to the latest Indian Standard Code IS: 269 or IS: 8112 or IS: 12269.

b) Alternatively, in special cases other varieties of cement other than ordinary Portland Cement can also be used subject to the approval from KSEBL. The Contractor shall submit the manufacturer's certificate, for each consignment of cement procured, to the KSEBL. However, KSEBL reserves the right to direct the Contractor to conduct tests for each batch/lot of cement used by the Contractor and Contractor will conduct those tests free of cost at the laboratory so directed by KSEBL. The Contractor shall also have no claim towards suspension of work due to time taken in conducting tests in the laboratory. Changing of brand or type of cement within the same structure shall not be permitted without the prior approval of the KSEBL. Sulphate Resistant Cement shall be used if sulphate content is more than the limits specified in IS: 456, as per Geotechnical investigation report.

1.3.5 The curing Time of cement shall be as per IS: 456-2000

1.3.6 Concrete aggregates shall conform to IS: 383-1970.

1.3.7 The water used for mixing concrete shall be fresh, clean and free from oil, acids and alkalis, organic materials or other deleterious substances. Potable water is generally preferred.

1.3.8 Reinforcement shall conform to IS: 432-1966 for M.S bars and hard drawn steel wires and to IS: 1138-1966 and IS: 1786-1985 for deformed and cold twisted bars respectively. All reinforcement shall be clean and free from loose mill scales, dust, loose rust, and coats of paint, oil or other coatings, which may destroy or reduce bond.

1.3.9 **Mixing:**

Concrete shall be mixed in mechanical batch type concrete mixers conforming to IS 1791-1985 having two blades and fitted with power loader (lifting hopper type). Half bag mixers and mixers without lifting hoppers shall not be used for mixing concrete. In exceptional circumstances, such as mechanical breakdown of mixer, work in remote areas or power breakdown and when the quantity of concrete work is very small, hand mixing may be done with the specific prior permission of the Engineer-in-Charge in writing subject to adding 10% extra cement. When hand mixing is permitted, it shall be carried out on a water tight platform and care shall be taken to ensure that mixing is continued until the concrete is uniform in colour & consistency. Before mixing the brick aggregate shall be well soaked with water for a minimum period of two hours and stone aggregate or gravel shall be washed with water to remove, dirt, dust and other foreign materials. For guidance. the mixing time maybe 1-1/2 to 2 minutes, for hydrophobic cement it may be taken as 2-1/2 to 3 minutes.

Mixer will be fitted with a power loader complying with the following requirements

- 1.3.10 The hopper shall be of adequate capacity to receive and discharge the maximum nominal batch of unmixed materials without spillage under normal operating conditions on a level site.

Note: In such a case the volume of the maximum nominal batch of mixed material is 50% greater than the nominal mixed batch capacity

- 1.3.11 The minimum inside width of the feeding edge of the hopper shall be as specified below in table:

Nominal size of mixer (T, NT or R), litre	Minimum inside width of hopper feeding edge in mm
140	1.0
200	1.1
280	1.2
375	1.4
500	1.5
1000	2.0
T=tilting NT=nontilting R=Reverse	

RANDOM RUBBLE MASONRY

The stone shall be of the type specified such as granite, trap, limestone, sand stone, quartzite, etc; and shall be obtained from the quarries, approved by the Engineer - in - Charge. Stone shall be hard, sound, durable and free from weathering decay and defects like cavities, cracks, flaws, sand holes, injurious veins, patches of loose or soft materials and other similar defects trigamy adversely affect its strength and appearance. As far as possible stones shall be of uniform colour, quality or texture. Generally stony shall not contain crypts crystalline silica or chart, mica and other deleterious materials like iron-oxide organic impurities etc.

Stones with round surface shall not be used. The compressive strength of common types of stones shall be as per table I and the percentage of water absorption shall generally not exceed 5% for stones other than specified in table I. For laterite this percentage is 12%.

Size of stones

Normally stones used should be small enough to be lifted and placed by hand. Unless otherwise indicated, the length of stones for stone masonry shall not exceed three times the height and the breadth or base shall not be greater than three fourth thickness of wall, or not less than 15cm. The height of stone may be up to 30 cm.

Random Rubble Masonry shall be uncoursed or brought to courses as specified (Fig. 8&9) Uncoursed random rubble masonry shall be constructed with stones of sizes as referred above and shapes picked up random from the stones brought from the approved quarry. Stones having sharp comers or round surfaces shall, however, not be used.

Random rubble masonry brought to the course is like uncoursed random rubble masonry except that the courses are roughly levelled at intervals varying from 30cm to 90cm in height according to the size of stones used.

CONSTRUCTION AND INSTALLATION OF RCC BORED CAST-IN-SITU PILES

For specific work requirements concerning construction or otherwise modifying or supplementing the provisions of this specification, reference may be made to 'Specific Requirements'. In case of any conflict between requirements set forth in 'Specific Requirement' and the provisions of this specification, the 'Specific Requirements' shall govern.

IS: 2911 (Part I /Sec.2) – Indian Standard Code of Practice for Design and Construction of pile foundations for Bored Cast-in-Situ Piles shall be referred to in conjunction with these specifications during the entire design, construction and installation work.

Reference to any code shall always mean reference to the latest revised edition of the code including all its amendments upto date, unless otherwise specified. In the event of any conflict between the requirements of this specification and those of the referred codes, the former shall govern.

MATERIALS

All materials, viz. cement, steel, aggregates, water, etc. which are to be used in the construction work, shall conform to Standard Specification for construction and installation of RCC bored cast-in-situ piles.

Concrete

Methods of the manufacture of cement concrete shall in general, be in accordance with IS: 2911 (Part I /Sec.2) and as per following clauses:

The grade of concrete shall be M-25 with a minimum cement content of 330 kg/m³.

Slump of Concrete Slump of concrete shall range between 100 to 180 mm depending on the manner of concreting. The table below gives the general guidance.

PILING	SLUMP (In MM)		TYPICAL CONDITIONS OF USE
	Min.	Max	
A	100	180	Pouring into water-free unlined bore having widely spaced reinforcement. Where reinforcement is not spaced widely enough, cut-off level of pile is within the casting and diameter of pile less than or equal to 600mm, higher order of slump within this range may be used.
B	100	180	Where concrete is to be placed under water or drilling mud by tremie or by placer

DESIGN CONSIDERATIONS

Structural Design: The piles shall have necessary structural strength to transmit the load imposed on it, to soil. Relevant part of IS: 2911 (Part I/ Sec.2) and specific requirements shall be considered to apply for assessing the structural capacity of piles.

The minimum longitudinal reinforcement shall be 0.4% of the cross sectional area of the pile.

Clear cover to the main reinforcement shall be 50 mm. This shall be increased to 75 mm in case of aggressive soils and ground water conditions.

The vertical reinforcement shall project 50 times its diameter above the cut-off level.

The minimum clear distance between the two adjacent main reinforcement bars should normally be 100 mm for the full depth of cage. The bars shall be so placed as not to impede the placing of concrete.

The lateral ties in the reinforcing cage shall be preferably spaced not closer than 150 mm centre to centre.

The minimum diameter of the lateral ties shall be 6 mm

EQUIPMENT AND ACCESSORIES

The equipment and accessories for installation of bored case-in-situ piles shall be selected giving due consideration to the subsoil conditions and the method of installation, etc. These shall be of standard type and shall have the approval of the Engineer-in-Charge.

The capacity of the rig shall be adequate to reach the desired depth

Provision shall be kept for chiselling within the borehole in case of any underground obstruction/hard strata. However, chiselling shall be carried out only with the approval of Engineer-in-Charge.

In case pile is required to be socketed in medium or good quality hard strata, the equipment mobilized shall have adequate capability to do so up to the required termination length. For classification of hard strata for the determination of length of socketing, pilot drill holes shall be carried out in the areas to be piled.

Pilot drill hole shall be of Nx or Bx size as per specific requirements. In case of encountering rock, the drilling shall be carried out using double tube core barrel. Drilling and storing of rock cores shall conform to relevant IS codes. Rock quality shall be classified as per depending upon the RQD.

PILING INSTALLATION

The piles shall be installed as accurately as possible as per the designs and drawings. The permissible positional deviations shall be governed by IS: 2911 (Part I /Sec.2). In case of piles deviating beyond such permissible limits, the piles shall be replaced or supplemented by additional piles, as directed by Engineer-in-Charge.

Boring

6The boring shall be done by one of the following methods:

- (a) Direct mud circulation
- (b) Reverse mud circulation
- (c) Bailer bentonite

The actual method of construction to be followed shall be as per specific requirements. In very soft soil a permanent liner shall be installed to ensure stability of borehole. A liner shall be used to protect the green concrete where a high hydrostatic pressure exists in the subsoil or where an underground flow of water exists, and which is likely to damage the concrete on withdrawal of casing.

Use of temporary liner only in lieu of bentonite to stabilize sides of boreholes shall not be permitted.

Properties of bentonite used, and quality control shall be as per IS: 2911 (Part I /Sec.2).

6.3 Concreting of Piles

6.3.1 Reinforcement

The reinforcements shall be made into cages sufficiently rigid to withstand handling without damage. In case the reinforcement cage is made up more than one segment, the same shall be assembled by providing necessary laps preferably by welding.

Care shall be taken to ensure that the reinforcement bars do not come closer while the cage is lowered down the hole. Proper cover and central placement of the reinforcement shall be ensured by use of suitable concrete spacers or rollers, case specifically for the purpose.

Concreting

Concreting shall not be commenced until the Engineer-in-Charge satisfies himself that at final borehole depth the soil is not weaker than that taken as the basis for pile design. If necessary, SPT or similar test shall be conducted to ensure the above.

Borehole bottom shall be thoroughly cleaned to make it free from sludge or any foreign matter before lowering the reinforcement cage. The full length of reinforcement cage shall be in position before start of concreting.

Concreting shall be done by tremie method. The operation of tremie concreting shall be governed by IS: 2911 (Part I / Sec.2).

The concrete placing shall not proceed if specific gravity of fluid near about the bottom of borehole exceeds 1.2. Determination of the specific gravity of the drilling mud from the base of the borehole shall be carried out by taking samples of fluid by suitable slurry sampler approved by the Engineer-in-Charge, in first few piles and at a suitable interval of piles thereafter and the results recorded. Control of consistency of drilling mud shall be carried out throughout boring as well as concreting operations.

Care shall be exercised to preserve correct cover and alignment of reinforcement and avoid any damage to it throughout the complete operation of placing the concrete.

The top of the pile shall be brought up above the cut off level minimum by 0.75 m to permit removal of all laitance and weak concrete before capping and to ensure good and sound concrete at the cut off level for proper embedment into the pile cap. Any defective concrete in the head of the completed piles shall be cut-away and made good with new concrete.

DEFECTIVE PILES

Defective piles shall be removed or left in place, as judged convenient by the Architect/Engineer-In Charge, without affecting the performance of adjacent piles of capping above and additional piles shall be provided to replace them.

RECORDING OF DATA

A competent supervisor shall be present to record the necessary information during the installation of piles. The data to be recorded shall include:

- a. The dimensions of the piles, including the reinforcement detail and the mark of the pile.
- b. The boring method employed.

- c. The type of soil in which pile is terminated
- d. The depth bored
- e. The depth of water table.
- f. When drilling mud is used, the specific gravity of the fresh supply and contaminated mud in the borehole before concreting is taken up, in case of first few piles and subsequently at suitable interval of piles.
- g. The time taken for concreting.
- h. The cut-off level/working level, and
- i. The consumption of cement.
- j. Any other important observations.

Any deviation from the designed location, alignment or load carrying capacity of any pile shall be noted and promptly reported to the Architect/Engineer-in-Charge.

1.4 TECHNICAL SPECIFICATION FOR FOUNDATION OF TOWERS

The Technical specification and measurement of various items under this contract, unless otherwise mentioned hereunder specifically, will be governed by the CPWD specifications 2009 vol. 1&2 and latest amendments thereafter published by Director General of works, CPWD, Nirman Bhawan, New Delhi.

1.4.1 ROCK EXCAVATION USING NON- EXPLOSIVES AGENTS (CHEMICAL):

Excavation in hard rock or rock boulders of size more than 0.5m³ in volume by non- explosives methods (Chemical) or any other methods without resorting to the use of conventional explosive methods at locations where such excavation is specifically ordered by the Engineer in charge. The location where the rock excavation is to be carried out by non- explosives methods (Chemical) will be decided by the Engineer in charge depending upon site conditions.

1.4.2 MEASUREMENT AND PAYMENT

1.4.2.1 All excavations in rock including removal of boulders up to 0.5m³ volume will be measured in solid from level measurements and paid for under the respective items in the schedule.

1.4.2.2 Before commencing the excavation works, sections with initial levels and final levels shall be plotted and got approved by the Engineer in charge. The intermediate levels for rock excavation shall also be taken stretch by stretch on completion of common excavation. The final grades and lines for excavation and finishing, that may be required, will be as per the drawings issued or as directed by the Engineer in charge.

1.4.2.3 The excavated soil/ muck shall be dumped at places within 1 Km as pointed out by the Engineer in charge. The contractor has to use the maximum quantity of serviceable rubble for using in the specified item of the work. Further, the contractor shall use the unserviceable quantity (Muck), for filling work, and disposal of the balance unserviceable materials, if any, will be the responsibility of the contractor.

1.4.2.4 The locations where chemical blasting is to be carried out will be as directed by the Engineer in charge and the decision of the Engineer in charge shall be final.

The quantity under removal by 'Chemical blasting' shall be restricted to the minimum as decided by the Engineer in charge.

- 1.4.2.5 The quoted rates for excavation of respective items in the schedule shall include cost of removal, handling and the disposal of all excavated materials wet or dry. The rates shall further include hire and operational charges of all machinery involved, cost of non-conventional explosives, drilling and all other processes involved in chemical blasting, de-watering, fencing, protection, care and diversion works, bailing out water by using pumps, conveyance of excavated soil to dump yard with all lead and lift and all other operations and incidental works necessary for the execution of works. The quoted rates for excavations at all elevations shall include all lifts and leads and shall include all contingent and temporary works such as shoring or timbering necessary to maintain the excavation in good order during construction and removing such temporary works when required. The rates in the schedule shall include the entire cost of transporting the materials directly or indirectly from the excavation to the points of the final disposal including temporary stock piling and re-handling, if required.
- 1.4.2.6 Any work required for protecting the cut slope during construction shall be done by the contractor at his own cost. The quoted rates shall be inclusive of all these works. No extra payment will be made in this regard.
- 1.4.2.7 Measurement for excavation by chemical blasting will be based on the actual quantity of rock in solid removed by the process. The unit rate will include all cost of excavation and of conveying and depositing the spoil at site pointed out by the Engineer in charge including all leads and lifts.
- 1.4.2.8 The payment will be made at the agreed rate for the relevant items in the accepted schedule.

1.5 EXCAVATION IN ALL KINDS OF SOIL, ORDINARY ROCK AND HARD ROCK

No Extra payment shall be made for quantities of works executed:

1. in or under water and/or liquid mud, including pumping out water as required.
2. in or under foul position, including pumping out water as required

1.6 CONCRETING UNDER WATER

1. No Extra payment shall be made for laying concrete in or under water and/or liquid mud including pumping or bailing out water and removing slush etc.
2. No Extra payment shall be made for laying concrete in or under foul positions.

1.7 CONSTRUCTION OF TOWER FOUNDATION

1.7.1 TESTING OF SOIL

The testing of soil if any, found necessary by KSEBL at any tower location shall be done in the manner specified under the relevant IS and as directed by the Engineer in charge of KSEBL and shall submit the report about the subsoil water table, type of soil encountered, bearing capacity of soil, possibility of submergence and other soil properties required for the design of foundations at such locations.

CLEARING:

The area to be excavated/ filled shall be cleared of fences, plants, logs, stumps, bush, vegetation, rubbish, slush etc. and other objectionable matter. If any roots or stumps of trees are met during excavation, they shall also be removed. The materials so removed shall be disposed off as directed by Engineer. Where earth fill is intended, the area shall be stripped of all loose/ soft patches, top soil containing objectionable mass/ materials before fill commences. All precious objects/relics objects of antiquity etc. which may be found in or upon the site shall be property of Employer.

1.7.2 EXCAVATION

1.7.2.1 The excavation work for foundations shall be taken up by the Contractor after obtaining approval from KSEBL for the proposed stretch wise / section wise tower schedule, profile etc. prepared during Check / Detailed survey along the approved route alignment.

1.7.2.2 Except as specifically otherwise provided, all excavation for footings shall be made to the lines and grades of the foundations. The excavation wall shall be vertical, and the pit dimensions shall be based on an assumed clearance of 150mm on all sides of the foundation pad. For footings with undercut, care shall be taken to carry out excavation as per drawings without any side clearance. All excavation shall be protected so as to maintain a clean sub grade and provide worker safety until the footing is placed, using timbering, shoring, shuttering, dewatering etc. as approved by the KSEBL. Contractor shall especially avoid disturbing the bearing surface of the pad. Any sand, mud, silt or other undesirable materials which may accumulate in the excavated pit or borehole shall be removed by Contractor before placing concrete.

Keeping in view of safety aspect, in case any sloped/stepped excavation is required, the same shall be done by the contractor. Payment of excavation in such cases shall be limited to design volume of excavation.

1.7.2.3 The soil to be excavated for tower foundations is **as per design specifications provided by KSEBL.**

1.7.2.4 However, where soil is of composite nature, classification of foundation shall be according to the type of soil predominant in the footing and payment shall be made accordingly.

1.7.2.5 Shoring and timbering / shuttering as approved by authorised representative of the KSEBL shall be provided by the Contractor when the soil condition is so bad that there is likelihood of accident due to the falling of earth.

1.7.2.6 Where rock is encountered, the holes for tower footings shall preferably be drilled. Blasting will not be permitted under any circumstances. However, the contractor can resort to blasting using non-explosive agents (Chemical blasting) as specified in the tender schedule. In cases where drilling is done, the stubs may be shortened suitably with the approval of the KSEBL or his authorised representatives.

The Contractor shall arrange & supply requisite chemicals for chemical blasting without any extra cost

This shall comprise excavation of Earth work in in all kinds of soil by mechanical not exceeding 1.5 m in width or 10 sqm on plan and to any depth in trenches (excluding trenches for pipes, cables, conduits etc.)

All excavation operations manually or by mechanical means shall include excavation and 'getting out' the excavated materials. In case of excavation for trenches, basements, water tanks etc. 'getting out' shall include throwing the excavated materials at a distance of at least one metre or half the depth of excavation, whichever is more, clear off the edge of excavation. In all other cases 'getting out' shall include depositing the excavated materials as specified. The subsequent disposal of the excavated material shall be either stated as a separate item or included with the items of excavation stating lead.

During the excavation the natural drainage of the area shall be maintained. Excavation shall be done from top to bottom. Undermining or undercutting shall not be done.

In firm soils, the sides of the trenches shall be kept vertical upto a depth of 2 metres from the bottom. For greater depths, the excavation profiles shall be widened by allowing steps of 50 cms on either side after every 2 metres from the bottom. Alternatively, the excavation can be done so as to give slope of 1:4 (1 horizontal: 4 vertical). Where the soil is soft, loose or slushy, the width of steps shall be suitably increased, or sides sloped, or the soil shored up as directed by the Engineer-in-Charge. It shall be the responsibility of the contractor to take complete instructions in writing from the Engineer-in-Charge regarding the stepping, sloping or shoring to be done for excavation deeper than 2 metres.

The excavation shall be done true to levels, slope, shape and pattern indicated by the Engineer-in-Charge. Only the excavation shown on the drawings with additional allowances for centering and shuttering or as required by the Engineer-in-Charge shall be measured and recorded for payment.

In case of excavation for foundation in trenches or over areas, the bed of excavation shall be to the correct level or slope and consolidated by watering and ramming. If the excavation for foundation is done to a depth greater than that shown in the drawings or as required by the Engineer-in-Charge, the excess depth shall be made good by the contractor at his own cost with the concrete of the mix used for levelling/ bed concrete for foundations. Soft/defective spots at the bed of the foundations shall be dugout and filled with concrete (to be paid separately) as directed by the Engineer-in-Charge.

While carrying out the excavation for drain work care shall be taken to cut the side and bottom to the required shape, slope and gradient. The surface shall then be properly dressed. If the excavation is done to a depth greater than that shown on the drawing or as required by the Engineer-in-Charge, the excess depth shall be made good by the contractor at his own cost with stiff clay puddle at places

where the drains are required to be pitched and with ordinary earth, properly watered and rammed, where the drains are not required to be pitched. In case the drain is required to be pitched, the back filling with clay puddle, if required, shall be done simultaneously as the pitching work proceeds. The brick pitched storm water drains should be avoided as far as possible in filled-up areas and loose soils.

In all other cases where the excavation is taken deeper by the contractor, it shall be brought to the required level by the contractor at his own cost by filling in with earth duly watered, consolidated and rammed.

In case the excavation is done wider than that shown on the drawings or as required by the Engineer-in-Charge, additional filling wherever required on the account shall be done by the contractor at his own cost.

The excavation shall be done manually or by mechanical means as directed by Engineer-in-charge considering feasibility, urgency of work, availability of labour /mechanical equipments and other factors involved. Contractor shall ensure every safety measures for the workers. Neither any deduction will be made, nor any extra payment will be made on this account.

This shall comprise excavation of earth work in ordinary rock by mechanical not exceeding 1.5m in width or 10 sqm. On plan and to any depth in trenches (excluding trenches for pipes, cables, conduits etc.)

All excavation operations shall include excavation and 'getting out' the excavated matter. In case of excavation for trenches, basements, water tanks etc. 'getting out' shall include throwing the excavated materials at a distance of at least one metre or half the depth of excavation, whichever is more, clear off the edge or excavation. In all other cases 'getting out' shall include depositing the excavated materials as specified. The subsequent disposal of the excavated material shall be either stated as a separate item or included with the item of excavation stating lead.

During the excavation, the natural drainage of the area shall be maintained. Excavation shall be done from top to bottom. Undermining or under cutting shall not be done.

Where hard rock is met with and blasting operations are considered necessary, the contractor shall obtain the approval of the Engineer-in-Charge in writing for resorting to the blasting operations. Blasting operations shall be done as specified in para 2.6 and chiseling shall be done to obtain correct levels, slopes, shape and pattern of excavation as per the drawings or as required by the Engineer-in-Charge and nothing extra shall be payable for chiseling.

Where blasting operations are prohibited or are not practicable, excavation in hard rock shall be done by chiseling.

In ordinary rock excavation shall be carried out by crowbars, pick axes or pneumatic drills and blasting operation shall not be generally adopted. Where blasting operations are not prohibited, and it is practicable to resort to blasting for excavation in ordinary rock, contractor may do so with the permission of the Engineer-in-Charge in writing but nothing extra shall be paid for this blasting. Blasting shall be done as specified in para 2.6.

If the excavation for foundations or drains is done to a depth greater than that shown in the drawings or as required by the Engineer-in-Charge. The excess depth shall be made good by the contractor at his own cost with the concrete of the mix used for levelling/ bed concrete for foundations. Soft/ defective spots at the bed of foundations shall be dug out and filled with concrete (to be paid separately) as directed by the Engineer-in-Charge.

In all other cases where the excavation is taken deeper by the contractor, it shall be brought to the required level by the contractor at his own cost by filling with earth duly watered, consolidated and rammed.

In case the excavation is done wider than that shown on the drawings or as required by the Engineer-in-Charge, filling wherever required on this account shall be done by the contractor at his own cost.

Only the excavation shown on the drawings or as required by the Engineer-in-Charge shall be measured and recorded for payment except in case of hard rock, where blasting operations have been resorted to, excavation shall be measured to the actual levels, provided the Engineer-in-Charge is satisfied that the contractor has not gone deeper than what was unavoidable.

The excavation shall be done manually or by mechanical means as desired by Engineer-in-Charge considering feasibility, urgency of work, availability of labour /mechanical equipments and other factors involved Contractor shall ensure every safety measures for the workers. Neither any deduction will be made, nor any extra payment will be made on this account.

This shall comprise excavation of earth work in hard rock (requiring blasting) by mechanical not exceeding 1.5m in width or 10 sqm. On plan and to any depth in trenches (excluding trenches for pipes, cables, conduits etc.)

Where hard rock is met with and blasting operations are considered necessary, the contractor shall obtain the approval of the Engineer-in-Charge in writing for resorting to blasting operation.

Note: In ordinary rock blasting operations shall not be generally adopted. However, the contractor may resort to blasting with the permission of the Engineer-in-charge, but nothing extra shall be paid for such blasting operations. The contractor shall obtain license from the competent authority for undertaking blasting work as well as for obtaining and storing the explosive as per the Explosive Act, 1884 as amended up to date and the Explosive Rules, 1983. The contractor shall purchase the explosives fuses, detonators, etc. only from a licensed dealer. The contractor

shall be responsible for the safe transportation, storage and custody as per explosive rules and proper accounting of the explosive materials. Fuses and detonators shall be stored separately and away from the explosives. The Engineer-in-Charge or his authorized representative shall have the right to check the contractor's store and account of explosives. The contractor shall provide necessary facilities for this. The contractor shall be responsible for any damage arising out of accident to workmen, public or property due to storage, transportation and use of explosive during blasting operation.

Blasting operations shall be carried out under the supervision of a responsible authorized agent of the contractor (referred subsequently as agent only), during specified hours as approved in writing by the Engineer-in-Charge. The agent shall be conversant with the rules of blasting. In case of blasting with dynamite or any other high explosive, the position of all the bore holes to be drilled shall be marked in circles with white paint. These shall be inspected by the contractor's agent. Bore holes shall be of a size that the cartridge can easily pass down. After the drilling operation, the agent shall inspect the holes to ensure that drilling has been done only at the marked locations and no extra hole has been drilled. The agent shall then prepare the necessary charge separately for each bore hole. The bore holes shall be thoroughly cleaned before a cartridge is inserted. Only cylindrical wooden tamping rods shall be used for tamping. Metal rods or rods having pointed ends shall never be used for tamping. One cartridge shall be placed in the bore hole and gently pressed but not rammed down. Other cartridges shall then be added as may be required to make up the necessary charge for the bore hole. The top most cartridge shall be connected to the detonator which shall in turn be connected to the safety fuses of required length. All fuses shall be cut to the length required before being inserted into the holes. Joints in fuses shall be avoided. Where joints are unavoidable a semi-circular notch shall be cut in one piece of fuse about 2 cm deep from the end and the end of another piece inserted into the notch. The two pieces shall then be wrapped together with string. All joints exposed to dampness shall be wrapped with rubber tape.

The maximum of eight bore holes shall be loaded and fired at one occasion. The charges shall be fired successively and not simultaneously. Immediately before firing, warning shall be given, and the agent shall see that all persons have retired to a place of safety. The safety fuses of the charged holes shall be ignited in the presence of the agent, who shall see that all the fuses are properly ignited.

Careful count shall be kept by the agent and others of each blast as it explodes. In case all the charged bore holes have exploded, the agent shall inspect the site soon after the blast but in case of misfire the agent shall inspect the site after half an hour and mark red crosses (X) over the holes which have not exploded. During this interval of half an hour, nobody shall approach the misfired holes. No driller shall work near such bore until either of the following operations have been done by the agent for the misfired boreholes.

- (a) The contractor's agent shall very carefully (when the tamping is of damp clay) extract the tamping with a wooden scraper and withdraw the fuse, pri-

mer and detonator. After this a fresh detonator, primer and fuse shall be placed in the misfired holes and fired, or

- (b) The holes shall be cleaned for 30 cm of tamping and its direction ascertained by placing a stick in the hole. Another hole shall then be drilled 15 cm away and parallel to it. This hole shall be charged and fired. The misfired holes shall also explode along with the new one.

Before leaving the site of work, the agent of one shift shall inform another agent relieving him for the next shift, of any case of misfire and each such location shall be jointly inspected and the action to be taken in the matter shall be explained to the relieving agent.

The Engineer-in-Charge shall also be informed by the agent of all cases of misfires, their causes and steps taken in that connection.

General Precautions

For the safety of persons red flags shall be prominently displayed around the area where blasting operations are to be carried out. All the workers at site, except those who actually ignite the fuse, shall withdraw to a safe distance of at least 200 metres from the blasting site. Audio warning by blowing whistle shall be given before igniting the fuse.

Blasting work shall be done under careful supervision and trained personnel shall be employed. Blasting shall not be done within 200 metres of an existing structure, unless specifically permitted by the Engineer-in-Charge in writing.

All procedures and safety precautions for the use of explosives drilling and loading of explosives drilling and loading of explosives before and after shot firing and disposal of explosives shall be taken by the contractor as detailed in IS 4081, safety code for blasting and related drilling operation.

Precautions against Misfire

The safety fuse shall be cut in an oblique direction with a knife. All saw dust shall be cleared from inside of the detonator. This can be done by blowing down the detonator and tapping the open end. No tools shall be inserted into the detonator for this purpose. If there is water present or if the bore hole is damp, the junction of the fuse and detonator shall be made water tight by means of tough grease or any other suitable material. The detonator shall be inserted into the cartridge so that about one third of the copper tube is left exposed outside the explosive. The safety fuse just above the detonator shall be securely tied in position in the cartridge. Water proof fuse only shall be used in the damp bore hole or when water is present in the bore hole. If a misfire has been found to be due to defective fuse, detonator or dynamite, the entire consignment from which the fuse detonator or dynamite was taken shall be got inspected by the Engineer-in-Charge or his authorized representative before resuming the blasting or returning the consignment.

This shall comprise excavation of earth work hard work (blasting prohibited) by mechanical-not exceeding 1.5m in width or 10 sqm. On plan and to any depth in trenches (excluding trenches for pipes, cables, conduits etc.)

Hard rock requiring blasting as described under (Item No33) but where the blasting is prohibited for any reason and excavation must be carried out by chiseling, wedging, use of rock hammers and cutters or any other agreed method

Close Timbering

This shall comprise of Excavation not exceeding 1.5 m in depth, Excavation exceeding 1.5 m in depth but not exceeding 3m, Excavation exceeding 3 m in depth but not exceeding 4.5m

Close planking and strutting shall be done by completely covering the sides of the trench generally with short upright, members called 'poling boards'. These shall be 250x38 mm in section or as directed by the Engineer-in-Charge.

The boards shall generally be placed in position vertically in pairs. One boards on either side of cutting.

These shall be kept apart by horizontal wallings of strong wood at a maximum spacing of 1.2 metres cross strutted with ballies, or as directed by Engineer-in-Charge. The length and diameter of the ballies strut shall depend upon the width of the trench. Where the soil is very soft and loose, the boards shall be placed horizontally against the sides of the excavation and supported by vertical 'wallings' which shall be strutted to similar timber pieces on the opposite face of the trench. The lowest boards supporting the sides shall be taken in the ground for a minimum depth of 75 mm. No portion of the vertical side of the trench shall remain exposed. The withdrawal of the timber members shall be done very carefully to prevent collapse of the trench. It shall be started at one end and proceeded systematically to the other end. Concrete or masonry shall not be damaged while removing the planks. No claim shall be entertained for any timber which cannot be withdrawn and is lost or buried, unless required by the Engineer-in-Charge to be left permanently in position.

Open Timbering

This shall comprise of Excavation not exceeding 1.5 m in depth, Excavation exceeding 1.5 m in depth but not exceeding 3m, Excavation exceeding 3.0 m in depth but not exceeding 4.5m

In case of open planking and strutting, the entire surface of the side of the trench is not required to be covered. The vertical boards 250 mm wide & 38 mm thick, shall be spaced sufficiency apart to leave unsupported strips of 50 cm average width. The detailed arrangement, sizes of the timber and the distance apart shall be subject to the approval of the Engineer-in-Charge. In all other respect, specifications for close planking and strutting shall apply to open planking and strutting.

Rates shall include use and waste of all necessary timber work as mentioned above including fixing and subsequent removal.

Pumping out water caused by springs, tidal or river seepage, broken water mains or drains and the like.

All water that may accumulate in excavations during the progress of the work from springs, tidal or river seepage, broken water mains or drains (not due to the negligence of the contractor), and seepage from subsoil aquifer shall be bailed, pumped out or otherwise removed. The contractor shall take adequate measures for bailing and/or pumping out water from excavations and/or pumping out water from excavations and construct diversion channels, bunds, sumps, coffer dams etc. as may be required. Pumping shall be done directly from the foundation trenches or from a sump out side the excavation in such a manner as to preclude the possibility of movement of water through any fresh concrete or masonry and washing away parts of concrete or mortar. During laying of concrete or masonry and for a period of at least 24 hours thereafter, pumping shall be done from a suitable sump separated from concrete or masonry by effective means.

Capacity and number of pumps, location at which the pumps are to be installed, pumping hours etc. shall be decided from time to time in consultation with the Engineer-in-Charge.

Pumping shall be done in such a way as not to cause damage to the work or adjoining property by subsidence etc. Disposal of water shall not cause inconvenience or nuisance in the area or cause damage to the property and structure nearby.

Pumping or bailing out water met within excavations from the sources specified above where envisaged and specifically ordered in writing by the Engineer-in-Charge shall be measured separately and paid. Quantity of water shall be recorded in kilolitres correct to two places of decimal. This payment shall be in addition to the payment under respective items of earthwork and shall be admissible only when pumping or bailing out water has been specifically ordered by the Engineer-in-Charge in writing.

Bailing or pumping out water, accumulated in excavation, due to rains is included under respective items of earthwork and is not to be paid separately.

The rates for respective items described above shall include cost of all the operations as may be applicable.

1.7.3 SETTING OF STUBS

The stubs shall be set correctly and precisely in accordance with approved method at the exact location, alignment and levels with the help of stub setting templates and levelling instruments. Minimum clearance between chimney concrete level and ground level shall be ensured as per foundation drawing. Stubs

setting shall be done in the presence of KSEBL's representative available at site where required and for which adequate advance intimation shall be given to KSEBL by Contractor. Tolerances as per provisions of IS: 5613 shall be allowed for stub setting.

Setting of stubs at each location shall be approved by KSEBL.

However, towers with unequal leg extensions for Multi circuit tower, Extensions for raised chimney foundations, for river crossing towers, Anchor tower and for foundations in highly collapsible soils, props may be used with complete accuracy and high skilled supervision, subject to prior approval from KSEBL. No recovery shall be made on account of using Props for stub setting.

1.7.4 STUB SETTING TEMPLATES

Stub setting templates shall be arranged by the Contractor at his own cost for all heights of towers as per KSEBL's supplied drawings. Stub templates shall be of adjustable type. Stub templates should be painted.

The Contractor shall deploy sufficient number of templates for timely completion of the line without any extra cost to KSEBL.

However, the number of template to be deployed shall depend upon type of terrain condition, number & type of towers etc. Hence the quantity of template to be deployed for timely completion of the line shall be finalized in consultation with site in-charge without any extra cost to the KSEBL. **One set of stubs setting template (if used) shall be supplied to the KSEBL, on completion of the project, at no extra cost to KSEBL.**

1.7.5 MIXING, PLACING AND COMPACTING OF CONCRETE

The concrete shall be mixed in the mechanical mixer. However, in case of difficult terrain, hand mixing may be permitted at the discretion of the KSEBL. The water for mixing concrete shall be fresh, clean and free from oil, acids and alkalis. Salty or blackish water shall not be used.

Mixing shall be continued until there is uniform distribution of material and mix is uniform in colour and consistency, but in no case the mixing be carried out for less than two minutes. Normal mixing shall be done close to the foundation but exceptionally, in difficult terrain, the concrete may be mixed at the nearest convenient place. The concrete shall be transported from the place of mixing to the place of final deposit as rapidly as practicable by methods which shall prevent the segregation or loss of any ingredient. The concrete shall be placed and compacted before setting commences.

Form boxes shall be used for casting all types of foundations except at an undercut interface for which the adjoining subsurface material shall provide adequate support.

The concrete shall be laid down in 150mm layers and consolidated well, so that the cement cream works, up to the top and no honey-combing occurs in the concrete. A mechanical vibrator shall be employed for compaction of the

concrete. However, in case of difficult terrain, manual compaction may be permitted at the discretion of the KSEBL. Monolithic casting of foundations must be carried out. However, in case of unavoidable circumstances, a key construction joint can be provided at the chimney-pad interface subject to approval of the KSEBL. However, nothing extra shall be paid to the Contractor for providing such construction joints. After concreting the chimney portion to the required height, the top surface should be finished smooth with a slight slope towards the outer edge for draining rain water.

Wet locations shall be kept completely dewatered, both during and 24 hours after placing the concrete, without disturbance of the concrete.

If minor defects in concrete surface is found after the form work is removed, the damage shall be repaired with a rich cement sand mortar to the satisfaction of the KSEBL before the foundation is back filled.

1.7.6 CURING

The concrete shall be cured by maintaining the concrete wet for a period of at least 10 days after placing. Once the concrete has set for 24 hours the pit may be back filled with selected moistened soil and well consolidated in layers thereafter both the backfill earth and exposed chimney shall be kept wet for the remainder of the prescribed 10 days. The exposed concrete chimney shall also be kept wet by wrapping gunny bags around it and wetting the bags continuously during the initial 10 days period.

1.7.7 BACKFILLING AND REMOVAL OF STUB TEMPLATES

After opening of form work and removal of shoring, timbering, etc., back filling shall be started after repairs, if any, to the foundation concrete. Back filling shall normally be done with the excavated soil, unless it is a clay type, or it consists of large boulders/stones, in which case the boulders shall be broken to a maximum size of 80-mm. At locations where, borrowed earth is required for back filling, Contractor shall bear the cost irrespective of leads & lift.

The back-filling materials shall be clean and free from organic or other foreign materials. A clay type soil with a grain size distribution of 50% or more passing the number 200 sieve as well as a black cotton soil is unacceptable for back filling. The earth shall be deposited in maximum 200mm layers, levelled, wetted if necessary, and compacted properly before another layer is deposited. The moisture content for compaction shall be based on the Proctor compaction test results. The density of the compacted back fill material may further be verified to the satisfaction of the KSEBL based on the sand-cone method described in the IS 2720-28 standard.

The backfilling and grading shall be carried to an elevation of about 75mm above the finished ground level to drain out water. After backfilling 50mm high, earthen embankment (Bandh) will be made along the sides of excavation pits and sufficient water will be poured in the backfilling earth for at least 24 hours. After the pits have been backfilled to full depth, the stub template can be removed.

1.7.8 BENCHING

When the line passes through hilly / undulated terrain, levelling the ground may be required for casting of tower footings. All such activities shall be termed benching and shall include cutting of excess earth and removing the same to a suitable point of disposal as required by KSEBL. Benching shall be resorted to only after approval from KSEBL. Volume of the earth to be cut shall be measured before cutting and approved by KSEBL for payment purposes. Further, to minimize benching, unequal leg extensions shall be considered and provided if found economical. If the levels of the pit centres be in sharp contrast with the level of tower centre, suitable leg extensions may be deployed as required. The proposal shall be submitted by the Contractor with detailed justification to the KSEBL.

1.7.9 PROTECTION OF TOWER AND TOWER FOOTING

Tower shall be spotted such that the quantity of revetment is optimum. For tower locations in undulated terrain such as hill / mountain slopes, options like use of unequal leg extensions for towers, unequal chimney extensions etc. shall be explored by the contractor for optimizing the need for revetment & benching.

The work shall include all necessary stone revetments, concreting and earth filling above ground level, the clearing from site of all surplus excavated soil, special measures for protection of foundation close to or in small water streams (Nalas), river bank / bed, undulated terrain, protection of uphill / downhill slopes required for protection of tower etc., including suitable revetment or galvanized wire netting and meshing packed with boulders. The top cover of stone revetment shall be sealed with M-15 concrete (1:2:4 mix). Contractor shall recommend protection at such locations wherever required. Details of protection of tower/tower footing are given in drawing enclosed with these specifications for reference purpose only.

In protection of tower footings works the back filling shall generally be done using soil excavated at site unless deemed unsuitable for back filling. In the latter case, back filling shall be done with contractor's earth for which provision is given in the tender schedule. The unit rate for back filling quoted in Price Schedules shall include the required lead and consolidation and levelling of earth after back filling.

The provisional quantities for protection work of foundations are furnished in Price Schedule of Bid. The unit rates shall also be applicable for adjusting the actual quantities of protection works done. These unit rates shall hold good for protection work carried out on down hills or up hills slopes applicable for the tower locations.

The unit rates for random rubble masonry revetment quoted in price schedule shall include random rubble masonry in cm 1:6 and top sealing with M-15 concrete. For payment purposes the volume of random rubble masonry revetment shall be measured from bottom to top sealing coat and paid at the quoted rates indicated in price schedule.

No deduction shall be made for the volume enclosed by weep holes. The locations where both benching and protection of tower footing are envisaged, an economy got to be established against providing unequal leg extension.

PART - II TOWER ERECTION, STRINGING AND INSTALLATION OF LINE MATERIALS**2.0 GENERAL**

2.0.1 The scope of erection work shall include the cost of all labour, tools and plant such as tension stringing equipment and all other incidental expenses in connection with erection and stringing work. The stringing equipment shall be of sufficient capacity to string the bundle conductors of specified size.

2.0.2 The Contractor shall be responsible for transportation to site of all the materials to be supplied by the Contractor as well as proper storage and preservation of the same at his own cost, till such time the erected line is taken over by the Owner. Similarly, the Contractor shall be responsible for transportation, proper storage, safe custody, and loss or damage of all Owner's supplied items for incorporation in the lines and shall maintain and render proper account of all such materials at all times. The Contractor shall reimburse the cost of any of the materials lost or damaged during storage and erection.

2.0.3 Contractor shall set up required number of stores along the line and the exact location of such stores shall be discussed and agreed upon with the Owner.

Owner supplied items shall be dispatched to the railway stations situated nearest to the stores set up by the Contractor. From the railway stations, receipt, unloading and transportation to the stores shall be the entire responsibility of the Contractor.

2.0.4 Payment for stringing shall be done on the basis of per kilometer and irrespective of number of tension/suspension towers. However, stringing for river crossing spans have been given separately in the BPS. The units of measurement for tower erection and other line materials, like, earth wire, Hard ware fittings and Accessories for conductor & earth wire are indicated in the BPS.

2.0.5 TREATMENT OF MINOR GALVANISATION DAMAGE

Minor defects in hot-dip galvanised members shall be repaired by applying zinc rich primer and two coats of enamel paint to the satisfaction of the Owner before erection.

2.1 TOWER ERECTION

2.1.1 The towers shall be erected on the foundations not less than 14 days after concreting or till such time the concrete has acquired sufficient strength. The towers are erected as per the erection drawings furnished by the designer to facilitate erection.

2.1.2 For the convenience of assembling the tower parts during erection operations, each member is marked in the factory to correspond with a number shown in the erection drawing. Any damage to the steel and injuring of galvanizing shall be avoided. No member shall be subjected to any undue over stress, during erection

2.1.3 The contractor shall give complete details of the erection procedures.

The method for the erection of towers shall ensure the following:

- a) Straining of the members shall not be permitted for positioning. It may, however, be necessary to match hole positions at joints using tommy bars not more than 450mm in length;
- b) Prior to erection of an upper section, the lower sections shall be completely braced, and all bolts provided tightened adequately in accordance with approved drawings to prevent any mishap during tower erection;
- c) All plan diagonals, oblique bracings etc for relevant section of tower shall be in place prior to assembly of an upper Section;
- d) The bolt positions in assembled towers shall be as per IS-5613 (Part II/Section 2);
- e) Tower shall be fitted with number, danger and phase plates as well as anti-climbing device, as described;
- f) After complete erection of the tower, all blank holes, if any, are to be filled by bolts and nuts of correct size.
- g) Before starting erection of an upper section, the lower section shall be completely braced and all bolts provided in accordance with approved drawings.

2.1.4 The 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.

2.1.5 A reasonable amount of drifting as permissible in IS:5613 (Part 3, section-2)-1989 shall be allowed in assembling but reaming for correction of mismatched holes due to shop errors will not be permitted. If any shop errors are discovered, the 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 galvanized surfaces damaged as a result of correction shall be made good to the satisfaction of the department.

2.1.6 Tower shall be fitted with number plate, danger plate, phase plates, circuit plates and anti-climbing device as described. After complete erection of tower, all blank holes, if any, are to be filled by Bolts and nuts of correct size. Suspension towers shall be fitted with Bird guards.

2.1.7 TIGHTENING OF BOLTS AND NUTS

2.1.7.1 All nuts shall be tightened properly using correct size spanner and torque wrench. Before tightening, it will be verified that filler washers and plates are placed in relevant gap between members, bolts of proper size and length are inserted, and one spring washer is inserted under each nut. In case of step bolts, spring washers shall be 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 their position on the diameter to ensure that the nuts are not loosened in course 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.

2.1.7.2 The threads of all the bolts except for Anti-theft bolts projected outside the nuts shall be welded at two diametrically opposite places, the circular length of each welding shall be at least 10mm. The welding shall be provided from ground level to waist level for single circuit towers and to bottom cross arm for double circuit towers. However, for towers, with +18-meter, +25 meter extensions and river crossing towers, the welding shall be provided from ground level to 30m height from stub level. After welding zinc-rich primer having approximately 90% zinc content shall be applied to the welded portion. At least two coats of the paint shall be applied. The surface coated with zinc rich primer shall be further applied with two finish coats of high build enamel of the grade recommended by the manufacturer of the zinc rich primer. The cost of welding and paint including application of paint shall be deemed to be included in the erection price.

STRINGING OF CONDUCTORS AND EARTH WIRE

2.2 INSULATOR HOISTING

Suspension insulator strings shall be used on Suspension towers (A/DA) and tension insulator strings on angle and dead-end towers. These shall be fixed on all the towers just prior to the stringing. Damaged insulators and strings, if any, shall not be employed in the assemblies. Prior to hoisting, all insulators shall be cleaned in a manner that will not spoil, injure or scratch the surface of the insulator, but in no case shall any oil be used for that purpose. For checking the soundness of insulators, IR measurement using 10kV (DC) Meager shall be carried out on 100% insulators. Corona control rings/arcing horn shall be fitted in an approved manner. Torque wrench shall be used for fixing various line materials and components, such as suspension clamp for conductor and earth wire, etc., whenever recommended by the manufacturer of the same.

2.3 HANDLING OF CONDUCTOR AND EARTH WIRE

2.3.1 RUNNING OUT OF THE CONDUCTORS

2.3.1.1 The conductors shall be run out of the drums from the top in order to avoid damage. The Contractor shall be entirely responsible for any damage to tower or conductors during stringing.

2.3.1.2 A suitable braking device shall be provided to avoid damaging, loose running out and kinking of the conductors. Care shall be taken that the conductors do not touch and rub against the ground or objects which could scratch or damage the strands.

2.3.1.3 The sequence of running out shall be from the top down i.e. the earth wire/OPGW shall be run out first followed in succession by the conductors. Unbalanced loads on towers shall be avoided as far as possible. Inner phase of line conductors shall be strung before the stringing of the outer phases is taken up.

- 2.3.1.4 The Contractor shall take adequate steps to prevent clashing of sub conductors until installation of the spacers/spacer dampers. Care shall be taken that sub conductors of a bundle are from the same Contractor and preferably from the same batch so that creep behavior of sub conductors remains identical. During sagging, care shall be taken to eliminate differential sag in sub-conductors as far as possible. However, in no case shall sag mismatch be more than 25mm.
- 2.3.1.5 Towers not designed for one sided stringing shall be well guyed and steps taken by the Contractor to avoid damage. Guying proposal along with necessary calculations shall be submitted by the Contractor to Owner for approval. All expenditure related to this work is deemed to be included in the bid price and no extra payment shall be made for the same.
- 2.3.1.6 When the transmission lines runs parallel to existing energised power lines, the Contractor shall take adequate safety precautions to protect personnel; from the potentially dangerous voltage built up due to electromagnetic and electrostatic coupling in the pulling wire, conductors and earth wires during stringing operations.
- 2.3.1.7 The Contractor shall also take adequate safety precautions to protect personnel from potentially dangerous voltage build up due to distant electrical storms.

2.3.2 RUNNING BLOCKS

- 2.3.2.1 The groove of the running blocks shall be of such a design that the seat is semicircular and larger than the diameter of the conductor/earth wire and it does not slip over or rub against the slides. The grooves shall be lined with hard rubber or neoprene to avoid damage to conductor and shall be mounted on properly lubricated bearings.
- 2.3.2.2 The running blocks shall be suspended in a manner to suit the design of the cross-arm. All running blocks, especially at the tensioning end will 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.

2.3.3 REPAIRS TO CONDUCTORS

- 2.3.3.1 The conductor shall be continuously observed for loose or broken strands or any other damage during the running out operations.
- 2.3.3.2 Repairs to conductor if accidentally damaged, shall be carried out with repair sleeve with the permission of the Engineer in charge.
- 2.3.3.3 Repairing of the conductor surface shall be carried out only in case of minor damage, scuff marks, etc. The final conductor surface shall be clean, smooth and free from projections, sharp points, cuts, abrasions, etc.
- 2.3.3.4 The Contractor shall be entirely responsible for any damage to the towers during stringing.

2.3.4 CROSSINGS

Derricks or other equivalent methods ensuring that normal services need not be interrupted, nor damage caused to property shall be used during stringing operations where roads, channels, telecommunication lines, power lines and railway lines have to be crossed. However, shut down shall be obtained when working at crossings of overhead power lines. The Contractor shall be entirely responsible for the proper handling of the conductor, earth wire and accessories in the field. The shutdown schedule and number of days will be intimated at the time of execution after consulting with Load Dispatch Center. The shutdown will be arranged by the KSEBL as per requirement.

2.4 STRINGING OF CONDUCTOR AND EARTH WIRE

- 2.4.1 The stringing of the conductor shall be done by the control tension method. The equipment shall be capable of maintaining a continuous tension per bundle such that the sag for each conductor is about twenty percent greater than the sags specified in the stringing sag table.
- 2.4.2 The bidder shall give complete details of the stringing methods he proposes to follow. Prior to stringing the Contractor shall submit the stringing charts for the conductor and earth wire showing the initial and final sags and tension for various temperatures and spans alongwith equivalent spans in the lines for the approval of the Owner.
- 2.4.3 A controlled stringing method suitable for simultaneous stringing of the sub conductors shall be used. The two conductors making up one phase bundle shall be pulled in and paid out simultaneously. These conductors shall be of matched length. Conductors or earth wires shall not be allowed to hang in the stringing blocks for more than 96 hours before being pulled to the specified sag.

Conductor creep are to be compensated by over tensioning the conductor at a temperature of 26°C lower than the ambient temperature or by using the initial sag and tensions indicated in the tables.

2.5 JOINTING

- 2.5.1 When approaching the end of a drum length at least three coils shall be left in place when the stringing operations are 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 specifications.
- 2.5.2 Conductor splices shall not crack or otherwise be susceptible to damage in the stringing operation. The Contractor shall use only such equipment/methods during conductor stringing which ensures complete compliance in this regard.
- 2.5.3 All the joints on the conductor and earth wire shall be of the compression type, in accordance with the recommendations of the manufacturer, for which all necessary tools and equipment like compressors, dies etc., shall be obtained by the Contractor. Each part of the joint shall be cleaned by wire brush till it is free of dust or dirt etc. and be properly greased with anti-corrosive compound. If required and as recommended by the manufacturer, before the final compression is carried out with the compressors.

- 2.5.4 All the joints of splices shall be made at least 30 meters away from the tower structures. No joints or splices shall be made in spans crossing over main roads, railways, power lines and small river spans up to 650m. Not more than one joint per sub conductor per span shall be allowed. The compression type fittings shall be of the self centering 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 compressing the joint the aluminium sleeve shall have all corners rounded, burrs and sharp edges removed and smoothed.
- 2.5.5 During stringing of conductor to avoid any damage to the joint, the Contractor shall use a suitable protector for mid span compression joints in case they are to be passed over pulley blocks/aerial rollers. The pulley groove size shall be such that the joint along with protection can be passed over it smoothly.

2.6 TENSIONING AND SAGGING OPERATIONS

- 2.6.1 The tensioning the sagging shall be done in accordance with the approved stringing charts or sag tables. The "initial" stringing chart shall be used for the conductor and final stringing chart for the earth wire. The conductors shall be pulled up to the desired sag and left in running blocks for at least one hour after which the sag shall be rechecked and adjusted, if necessary, before transferring the conductors from the running blocks to the suspension clamps. The conductor shall be clamped within 96 hours of sagging in.
- 2.6.2 The sag will be checked in the first and the last section span for sections up to eight spans, and in one additional intermediate span 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.
- 2.6.3 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.
- 2.6.4 At sharp vertical angles, conductor and earth wire sags and tensions shall be checked for equality on both sides of the angle and running block. The suspension insulator assemblies will normally assume verticality when the conductor is clamped.
- 2.6.5 Tensioning and sagging operations shall be carried out in calm whether when rapid changes in temperature are not likely to occur.

2.6.6 CLIPPING IN

- 2.6.6.1 Clipping of the conductors into position shall be done in accordance with the manufacturer's recommendations.
- 2.6.6.2 Jumpers at section and angle towers shall be formed to parabolic shape to ensure maximum clearance requirements. Pilot suspension insulator strings shall be used, if found necessary, to restrict jumper swing to design values.

2.6.6.3 Fasteners in all fittings and accessories shall be secured in position. The security clip shall be properly opened and sprung into position.

2.7 FIXING OF CONDUCTORS AND EARTH WIRE ACCESSORIES

Conductor and earth wire accessories including spacers, spacer dampers (for bundle conductor) and vibration dampers shall be installed by the Contractor as per the design requirements and manufacturer's instruction within 24 hours of the conductor/earth wire clamping. While installing the conductor and earth wire accessories, proper care shall be taken to ensure that the surfaces are clean and smooth and that no damage occurs to any part of the accessories or of the conductors. Torque wrench shall be used for fixing the Dampers/Spacer Dampers, Suspension Clamps etc. and torque recommended by the manufacturer of the same shall be applied.

2.8 AERIAL MARKER BALLS & AVIATION SIGNAL

The line route shall be at a sufficient distance from the aerodromes / airports so that clearance from the aerodrome / airport authorities is not required or, otherwise, can be obtained easily. Aviation obstruction fixtures / lights / painting have been provided, if required.

Aircraft warning sphere/ aerial marker ball will be provided where ever required, is designed to provide daytime visual warning or nighttime visual warning if comes with reflective tape, for electricity transmission line and overhead wire for aircraft pilots, especially cross river high voltage transmission lines. An aircraft warning marker should be of one color such as aviation orange, white and red. Generally, the marking spheres are placed on the highest line. Where there is more than one line at the highest level, white and red, or white and orange spheres should be displayed alternately. This alternating color scheme provides the most conspicuity against all back ground.

2.9 REPLACEMENT

If any replacement is to be affected after stringing and tensioning or during maintenance, leg member and bracing shall not be removed without first reducing the tension on the tower by proper guying techniques or releasing of the conductor. For replacement of cross arms, the conductor shall be suitably tied to the tower at tension points or transferred to suitable roller pulleys at suspension points.

2.10 PERMITTED EXTRA CONSUMPTION OF LINE MATERIALS

2.10.1 The quantity of conductor and earth wire to be incorporated in the line shall be worked as per the following norms.

Quantify of Conductor = Line length as per detailed survey x 3 phases x Nos. of conductor per bundle (for Single Circuit Line)

= Line Length as per detailed survey x 3 phases x Nos. of conductor per bundle x 2 (for Double Circuit Line)

Quantity of Earth wire = Line length as per detailed survey x nos. of ground wires

- For calculation of conductor & Earth wire requirement in hilly stretches, inclined distance between the towers may be considered instead of horizontal distance (considered for line length).

2.10.2 The Contractor shall make every effort to minimize breakage, losses and wastage of the line materials during erection. However, the Contractor shall be permitted and extra consumption of line materials up to the limits specified in Table 2.10.2.1 and shall be permitted to dispose of the scrap, if any at the end.

Table 2.10.2.1 Permitted extra consumption of line materials

Item	% of permitted extra consumption
Conductor & earth wire	1
Insulators	1

2.10.3 In case of conductor and earth wire, the permitted extra consumption limit of one percent is inclusive of sag, jumpering, damage, loss and wastage etc.

2.10.4 The Contractor shall not be required to return to the Owner empty conductor and earth wire drums and shall dispose of the same at his cost.

2.10.5 Any conductor and earth wire drum which has been opened by the Contractor shall not be taken back by Board and the unused conductor or earth wire in such drums may be treated as waste permissible within the overall limits specified in Table 2.10.2.1.

2.10.6 The Contractor shall return to the Board all Board supplied material not incorporated in the works, except those permitted by Board as scrap in terms of Table 2.10.2.1. Otherwise, the Contractor shall pay in respect of such excess materials which he is unable to return at rates corresponding to the actual cost of procurement plus 15% for OSM procured under domestically funded packages. The "cost of procurement" for the above purpose shall be F O R destination site cost of OSM as per LOA of the respective packages plus taxes & duties plus price variation (if positive) applicable as on the date of issuance of TOC for Tower Package.

2.10.7 For calculation of conductor & earth wire consumption in hilly (mountainous) stretches inclined distance between towers may be considered, instead of horizontal distance between them.

2.10.8 The quantities of line materials to be supplied by the contractor (i.e. earth wire, Hardware fittings & accessories) as indicated in the bill of quantities are provisional and the actual quantity shall depend upon detailed survey.

Contractor shall be responsible for regulating the supplies of contractor supplied materials in the basis of actual requirements. The Owner shall have right, not to take any surplus contractor supplied line materials.

2.11 FINAL CHECKING, TESTING AND COMMISSIONING

2.11.1 After completion of the works, final checking of the line shall be carried out by the Contractor to ensure that all foundation works, tower erection and stringing have been done strictly according to the specifications and as approved by the Owner. All the works shall be thoroughly inspected in order to ensure that:

- a) Sufficient back filled earth covers each foundation pit and is adequately compacted;
- b) Concrete chimneys and their copings are in good condition and finely shaped.
- c) All tower members are used strictly according to final approved drawing and are free of any defect or damage whatsoever.
- d) All bolts are properly tightened, punched, tack welded and painted with zinc rich paint;
- e) The stringing of the conductors and earth wire has been done as per the approved sag and tension charts and desired clearances are clearly available;
- f) All conductor and earth wire accessories are properly installed;
- g) All other requirements for completion of works such as fixing of danger plate, phase plate, number plate, anti-climbing device, Aerial marker balls, aviation signal have been fulfilled.
- h) Wherever required, that proper revetment (erosion protection) is provided;
- i) The original tracings of profile and route alignment as well as tower design, structural drawings, bill of material and shop drawings of all towers are submitted to the Owner for reference and record.
- j) The insulation of the line as a whole is tested by the Supplier through provision of his own equipment, labour etc., to the satisfaction of the Owner.
- k) All towers are properly grounded.
- l) The line is tested satisfactorily for commissioning purpose.

Sd/-

Addnl. CEO

REC Transmission Projects Company Limited

**PART D
DOCUMENTATION AND DELIVERABLES**

**(To be submitted with the proposal of vendor approval by the successful bidder
after placement of order)**

PART D
DOCUMENTATION AND DELIVERABLES

This section describes the documentation requirements and provides a list of deliverable that the Contractor shall provide to the KSEBL. Complete documentation necessary for the operation and maintenance of the fibre optic cabling system is required. All the documentation shall be provided in hard copy and also on CD-ROMs in full compliance with the specification. Conditions pertaining to Document Review and Approval Rights and Document Submission Scheduling are specified in this section.

The documentation shall include the following:

- (a) Detailed list of the deliverables
- (b) Description of the products
- (c) Technical particulars
- (d) Installation manuals
- (e) Maintenance manuals
- (f) Quality assurance manuals, Manufacturing Quality Plan (MQP) & Field Quality Plan (FQP)
- (g) Tests documentation

1. System Documentation

A detailed documentation plan and document submission schedule shall be prepared and submitted for approval. The guidelines specified in table 5-1 & table 5-2 shall be followed.

2. Supplementary Documentation

While performing maintenance during the warranty period, the KSEBL determines that additional information is required to perform the maintenance function, the Contractor and/or its subcontractors shall provide the specific supplemental information necessary to perform the maintenance function. This information shall be documented in a form suitable for incorporation into the appropriate maintenance document.

3. Test Documentation

The Contractor shall provide documentation for all Type tests, Factory Acceptance tests and site tests (SAT).

The test documentation shall include the following:

- a. Type test Documents (Procedures & Reports)
- b. Factory Acceptance Test Documents (Procedures & Reports)
- c. Site Acceptance Test Documents (Procedures & Reports)

h) Drawings

All drawings submitted by the Contractor including those submitted at the time of bid shall be in sufficient detail to indicate the type, size, arrangement, dimensions, material description, Bill of Materials, weight of each component, break-up for packing and shipment, shipping arrangement required, the

dimensions required for installation and any other information specifically requested in the Specifications.

Each drawing submitted by the Contractor shall be clearly marked with the KSEBL name, the unit designation, the specification title, the specification number and the name of the Project. All titles, notes, markings and writings on the drawing shall be in English. All the dimensions should be to the scale and in metric units. The drawing revision level/ issue no, issue date shall be marked on each drawing and the drawing shall carry issue history information and appropriate signatures (eg: originator, checker and approving authority).

4. Drawing and Document Approval Procedure

The drawings/documents submitted by the Contractor shall be reviewed by the KSEBL as far as practicable within stipulated duration and shall be modified by the Contractor if any modifications and/or corrections are required by the KSEBL in compliance with the Specifications. The Contractor shall incorporate such modifications and/or corrections and submit the final drawings for approval. Any delays arising out of failure by the Contractor to rectify the drawings in good time shall not alter the contract completions date.

The drawings/documents submitted for approval to the KSEBL shall be in quadruplicate. One print of such drawings shall be returned to the Contractor by the KSEBL marked with one of the categories as listed below: -

Category Inference

Cat I	Approved/Released for implementation.
Cat II	Approved/Released for implementation subject to incorporation of comments. Revised drawing required
Cat III	To be resubmitted for approval after incorporating comments.
Cat IV	For information and record.

The approval of the drawing/document conveyed vide above marked copy shall neither relieve the Contractor of its contractual obligations and its responsibilities towards weights, qualities, design details, assembly fits, performance particulars and conformity of supplies with the Indian Statutory Laws as may be applicable, nor shall it limit KSEBL's and/or KSEBL's right under the contract.

Depending upon the category of approval the Contractor shall resubmit the drawings/documents for review by KSEBL after incorporating all corrections.

Further work by the Contractor shall be strictly in accordance with the Cat-I, Cat-II or Cat-IV approved drawings and no deviation shall be permitted without the written approval of the KSEBL.

All manufacturing and fabrication work in connection with the equipment/material prior to the approval of the drawings shall be at the Contractor's risk. The Contractor may make any changes in the design which are necessary to make the equipment/material conform to the provisions and intent of the Contract and such changes will again be subject to approval by the KSEBL. Approval of Contractor's drawing or work by the KSEBL shall not relieve the Contractor of any of his

responsibilities and liabilities under the Contract.

5. Final Documentation

Final documentation shall consist of all the documents approved in Cat I and Cat IV. The documents will be used by the KSEBL personnel for operating and maintaining the equipment after acceptance.

Until acceptance of the equipment by the KSEBL, the Contractor shall be responsible for supplying documentation revisions or changes necessitated by inaccuracies, installation requirements, omissions determined by usage, and design or production alterations to the equipment. All changes shall be issued in the form of replacements for the affected drawings, diagrams, charts, graphs, tables, lists, and pages in the various documentation such that all documentation describes the equipment "as delivered".

For all the documents listed in Table D.1 (except Type, FAT & SAT related), five(5) sets of the final approved documentation shall be provided for the engineering office of the KSEBL in CD-ROM and two (2) sets in hard copy.

All final Contractor-supplied documentation shall be easily reproducible by the KSEBL.

Table D-1: Documentation Plan

S. No	Document	Applicable Equipment's/Item	Brief Description	Approval Category
1.	Documentation Plan and Schedule		This document shall contain the list of all documents to be submitted for approval and their submission/approval schedule.	Cat - I
2.	Survey guidelines & formats		As per technical specifications.	Cat - I
3.	Data Requirement Sheets (DRS) and Guaranteed Technical Parameters & Drawings	For each and every item to be supplied including fibre, OPGW cable, approach cable, joint box, FODP, All FO cable Hardware & fittings (suspension clamp assembly, tension clamp assembly, vibration damper etc.), test equipment.	These document(s) shall describe all the technical parameters of the item being offered. The formats for some items provided in the appendices shall be used, which may be expanded as required. The GTP shall be submitted for all items. The GTP shall be supported by technical brochures / product manuals.	Cat - I (for DRS) & Cat - IV (for brochure)
4.	Sag tension charts	For OPGW cable	Shall accompany the DRS	Cat - I

5.	Previous type test reports	For all items for which type testing is required. (fibre, OPGW cables, Hardware & fittings for OPGW cable, approach cable, joint box,)	Shall be complete in all respect including all test graphs, curves, calculations, photographs etc.	Acceptance Letter
6	Manufacturing Quality Plan	For all items to be supplied	Refer technical specifications.	Cat- IV
7	Survey reports & engineering analysis	For FO cable link	Line wise survey reports, indicating tower schedules, drum schedules, crossing details, hardware & fitting requirements etc. Shall include line wise sag-tension charts and other engineering analysis etc.	Cat- I (for Drum Schedule) and Cat-IV for other detailed report
8	Link and survey reports & engineering analysis	For each Fibre Optic link and site	Link wise survey reports as per specifications, link calculations etc.	Cat- I
9	Numbering, Marking, labelling Document	As applicable.	Must include numbering, marking, labelling and naming conventions for channels, cables, connectors, sub racks, cubicles etc	Cat- I
10	Bill of Quantities	For each item and each line	Line wise survey reports, indicating tower schedules, drum schedules, crossing details, Hardware & fitting requirements etc. Shall include line wise sag-tension charts and other engineering analysis such as tower strengthening analysis etc. Shall include site wise	Cat- I

			detailed quantities of each equipment	
11.	Factory Acceptance tests: test plan, procedures and report format	For all items to be supplied	This document shall include the list of Factory acceptance tests, the administrative & functional test plans, test procedures and formats for recording & reporting factory acceptance test results.	Cat- I
12.	Factory acceptance test report	For all Factory acceptance tests	This document shall provide all factory acceptance reports for all materials used in this project.	Cat- IV
13.	Transportation & Handling Procedures	For OPGW cable	This document shall describe the procedures & precautions to be observed during overseas & inland transportation, cable & cable drum handling during transport, storage & pre-installation. It shall also include drum details and drum labelling details.	Cat- IV
14.	Jointing Manual	For each type of FO cable/ joint box to be supplied	This document shall describe the installation of joint box (In line splice enclosures) and other jointing gang activities	Cat- I
15.	Installation procedure	For OPGW cable & joint box	The expected content of this document are presented in table D-2 below.	Cat- IV

16.	Site Acceptance tests (SAT) test plan, procedures and report format	System document	This document shall include the list of Site acceptance tests, the administrative & functional test plans, test procedures and formats for recording & reporting site acceptance test results.	Cat- I
17.	Field Quality Plan	One Document with multiple subdocuments if required	Field Quality Plan shall describe the quality control to be exercised during the field activities. This document can include the following information: (a.) The list of performance & safety checks applied to installation equipment, tools & tackles, checks, check on physical health & training records of installation crew etc. (b.) The list of Site Acceptance tests (including statement of acceptance criteria). The inclusion of list of site acceptance tests in FQP is analogous to the inclusion of list of FAT in the MQP. The formats for recording & reporting Site acceptance tests can also be reproduced.	Cat- I
18	Field Safety Plan	Safe Execution procedures	Instructions and Procedures for safe practices at site.	Cat- I
19	Approach Cable & FODP layout document – site wise	For each site	To describe the layout of approach cable at each site and the floor plan of the FODP.	Cat - I
20	Site test records as per approved SAT procedures	Per Link and per Location		*

- To be reviewed & approved by the Site

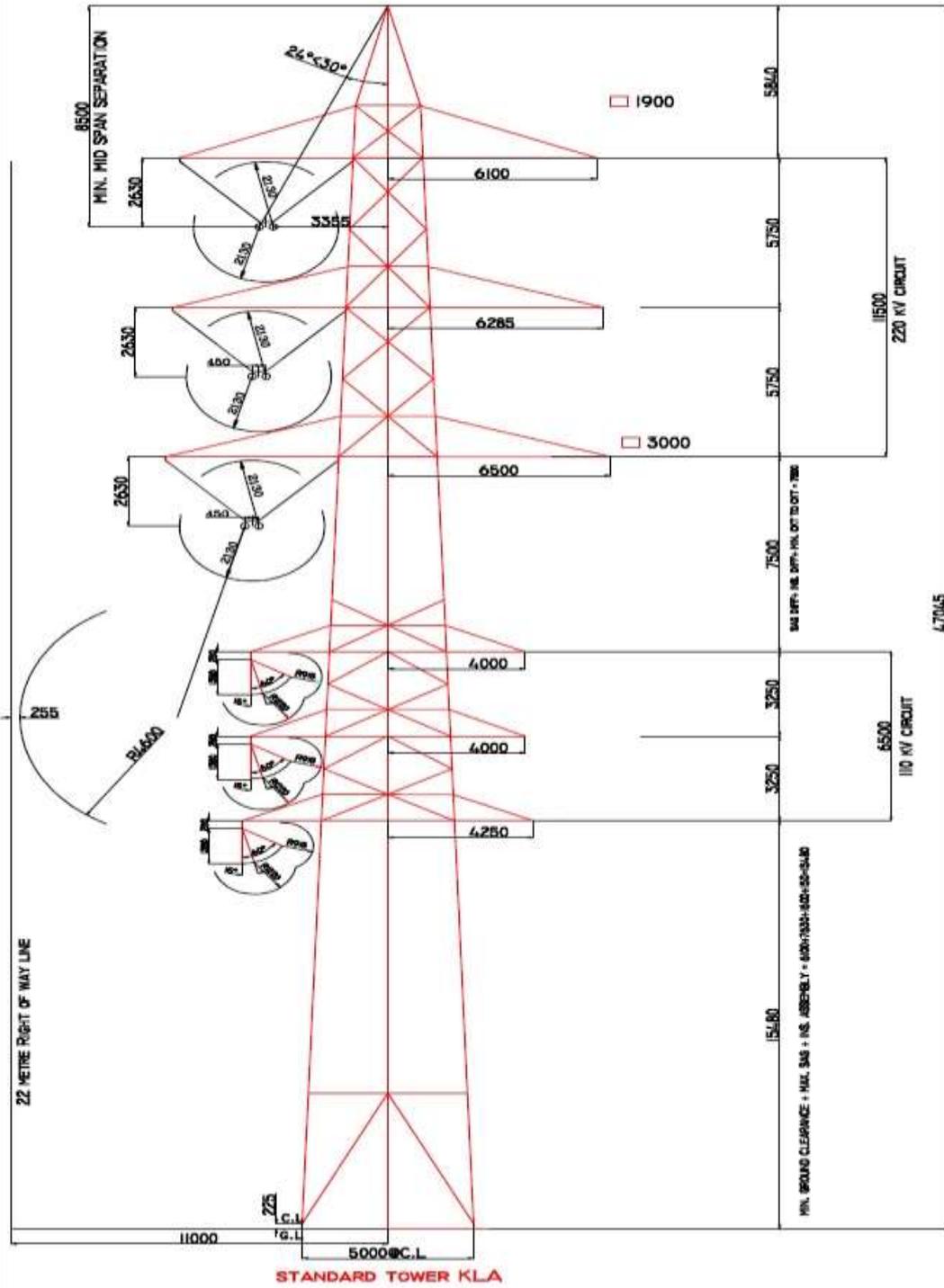
Table D-2: Expected Contents & Structure of FO Cable / Equipment Installation Manual

1	Installation procedure	Description of activities of installation gangs: Preparation & Setting up, Stringing, sagging, attaching hardware, attaching down lead clamps & cable routing on the tower, securing cable ends (for protection before work by jointing gang). Precautions for preventing cable damage shall be highlighted.
2	Safety Instructions	Instructions & procedures related to ensuring installation crew safety: personnel grounding & safety, installation equipment safety, Safety for power system & environment (viz preventing accidental tripping, precaution for railway crossings etc)
3	Description of Installation Equipment	Sketches, drawings, photographs, safe working ratings of installation equipment, tools & tackles etc., handling instructions & precautions.
4	Cable routing	Illustrations of the positions of tower attachment clamps (down lead clamps), routing of FO cable on the tower, service loop(s), joint box position.
5	References	References to other related documents covering the installation, jointing & testing, like: SAT administrative & functional test plans & test procedures, Jointing Procedures, Field Quality Plan & Field Quality Audit, Storage & Handling Instructions, FO cable & hardware drawings, technical parameters, GTP etc. KSEBL & Statutory safety rules, safety manuals, standards, codes of practices etc.

PART E
DRAWINGS

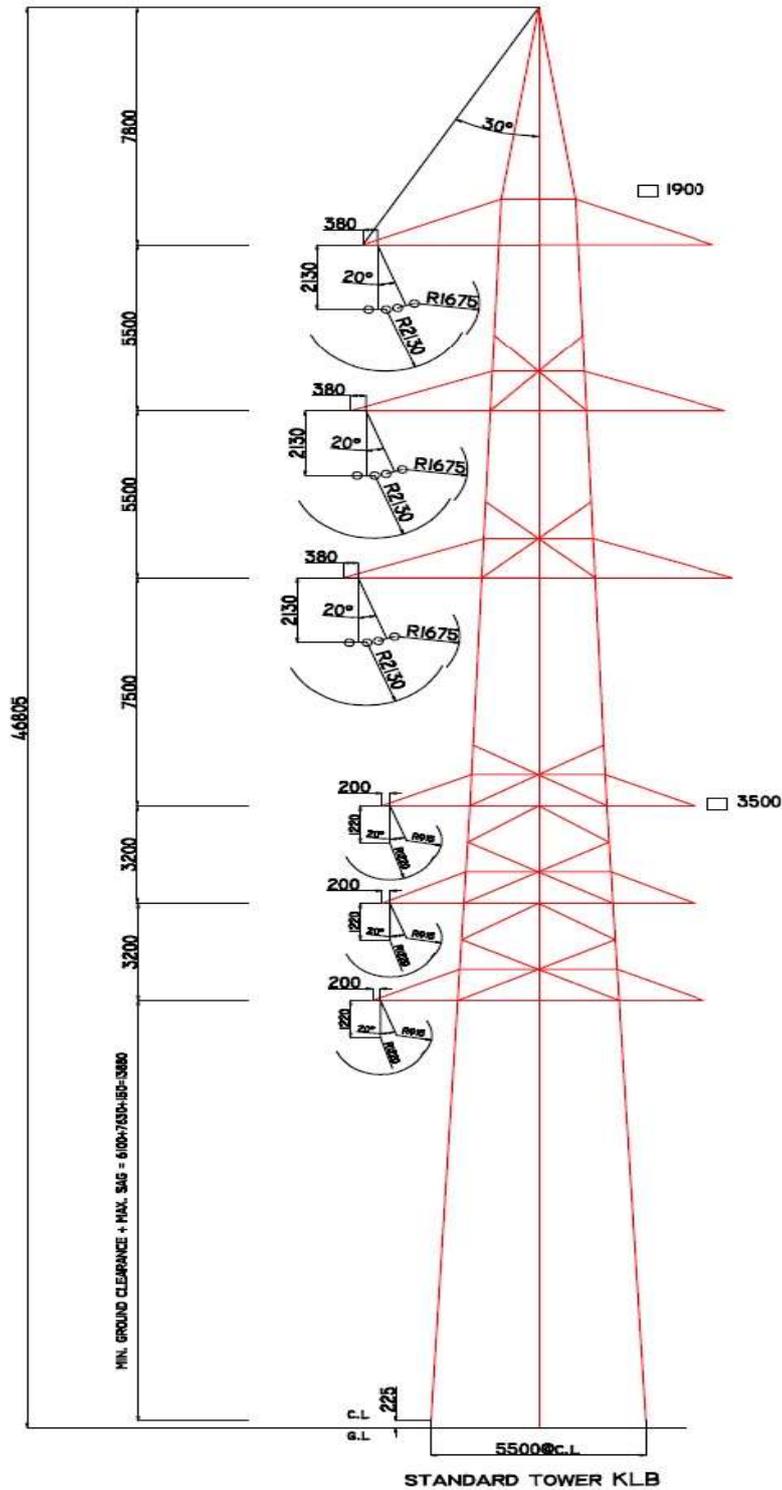
TABLE OF CONTENT

Sl No.	DESCRIPTION
1	INDICATIVE DRAWINGS OF TOWERS
2	SAMPLE FOUNDATION DRAWING
3	220KV V-TYPE SUSPENSION STRING
4	220KV PILOT SUSPENSION STRING
5	220KV SINGLE TENSION STRING
6	220KV DOUBLE TENSION STRING
7	EARTHWIRE SUSPENSION CLAMP
8	EARTHWIRE TENSION CLAMP
9	EARTH BOND
10	VIBRATION DAMPER
11	DANGER PLATE
12	NUMBER PLATE
13	CIRCUIT PLATE
14	PHASE PLATE
15	BIRD GUARD
16	ANTI CLIMBING DEVICE
16	EARTHING – COUNTER-POISE
17	EARTHING – PIPE TYPE
18	STEP BOLT
19	MID SPAN COMPRESION JOINT
20	TEE CLAMP
21	SINGLE TENSION HARDWARE FITTINGS FOR ACSR TWIN PANTHER
22	SINGLE SUSPENSION HARDWARE FITTINGS FOR ACSR TWIN PANTHER
23	SINGLE TENSION HARDWARE FITTINGS FOR ACSR PANTHER
24	SINGLE TENSION HARDWARE FITTINGS FOR ACSR PANTHER
25	COMPOSITE SILICONE RUBBER LONG ROD TENSION INSULATOR
26	SUSPENSION STRING FOR OPGW
27	TENSION STRING FOR OPGW
28	DOWN LEAD CLAMPS FOR DOUBLE OPGW
29	JOINTING BOX FOR OPGW
30	RACK FOR COILING OPGW



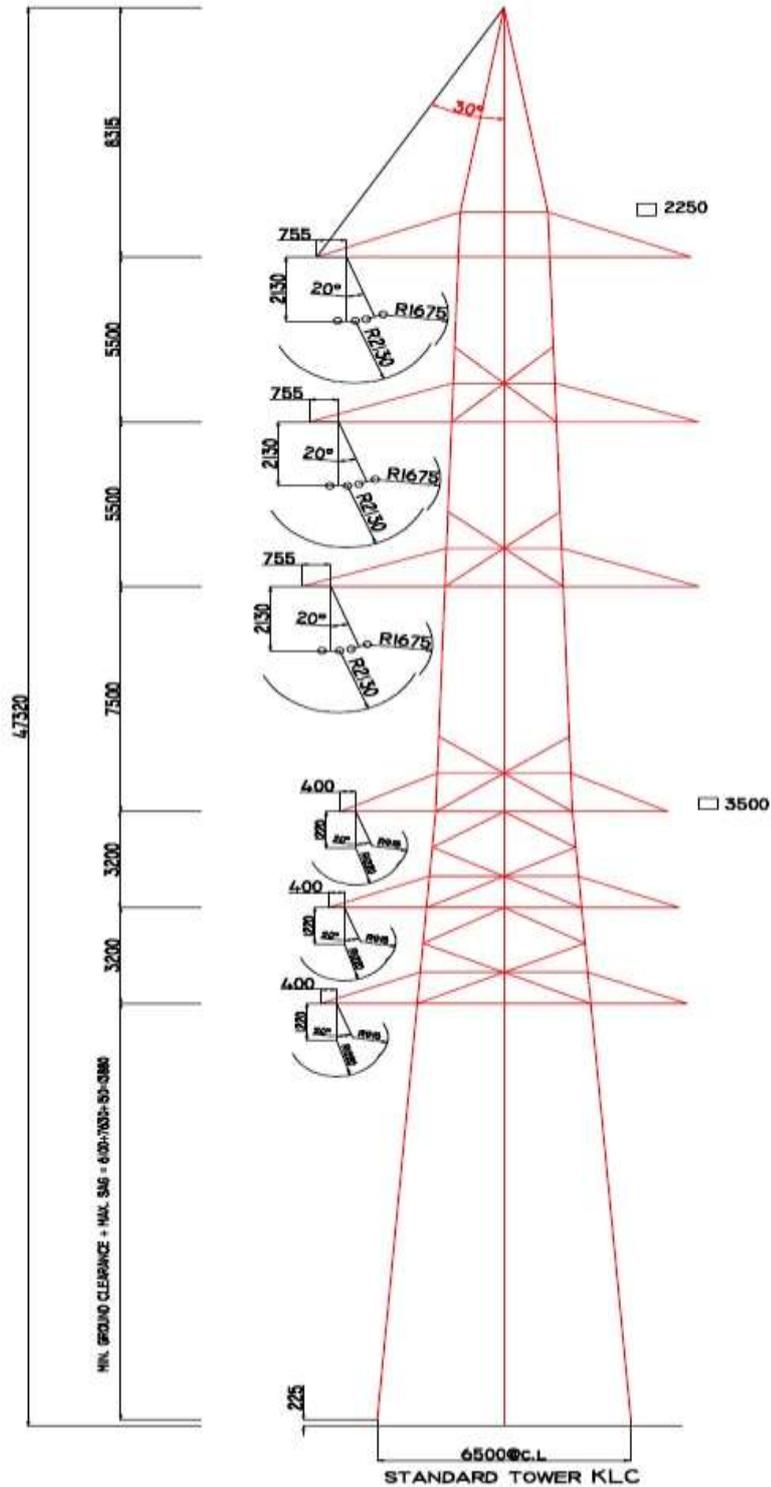
220/110kV MCMV TOWER - KLA

FOR TENDER PURPOSE ONLY



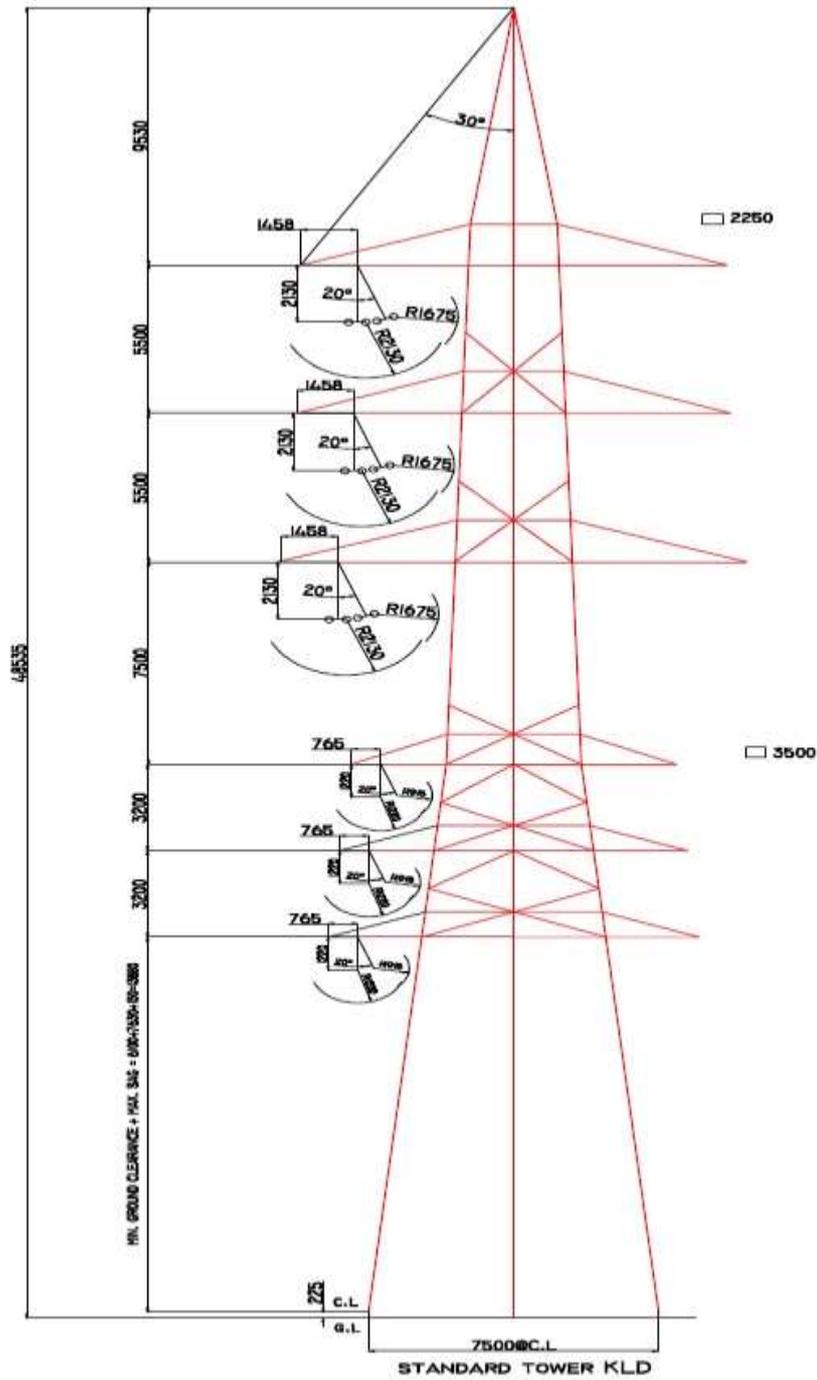
220/110kV MCMV TOWER - KLB

FOR TENDER PURPOSE ONLY



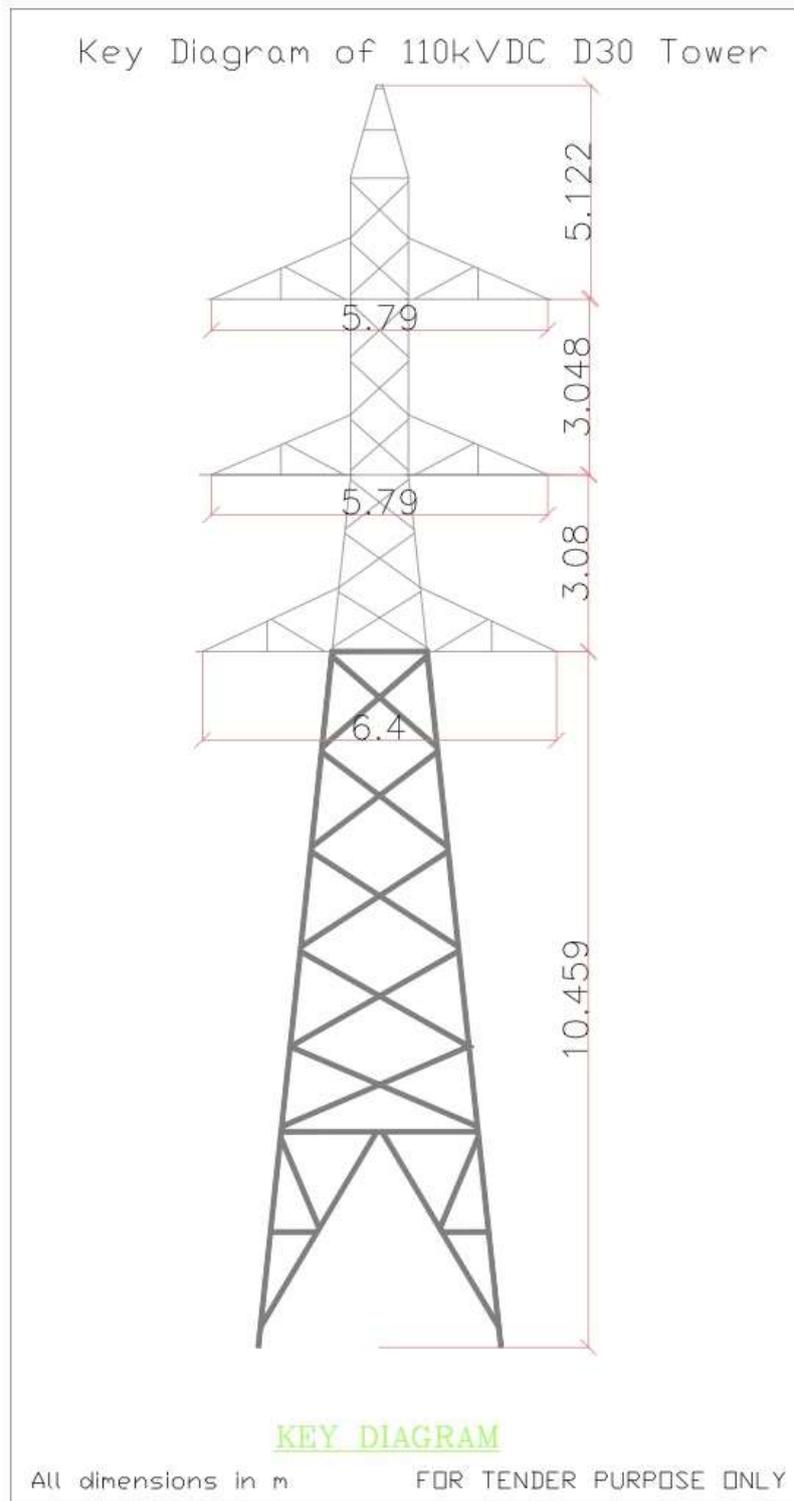
220/110kV MCMV TOWER - KLC

FOR TENDER PURPOSE ONLY

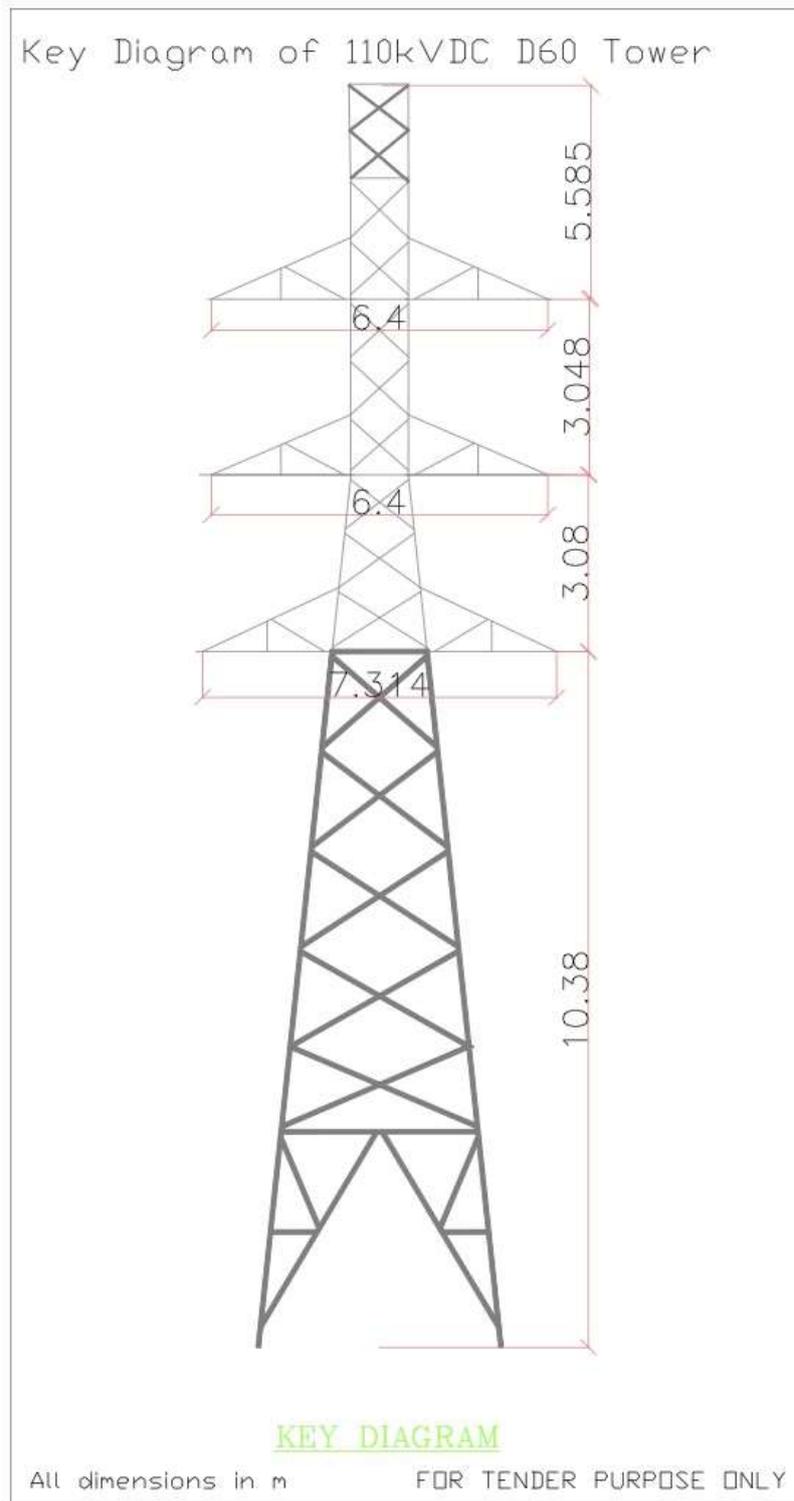


220/110kV MCMV TOWER - KLD

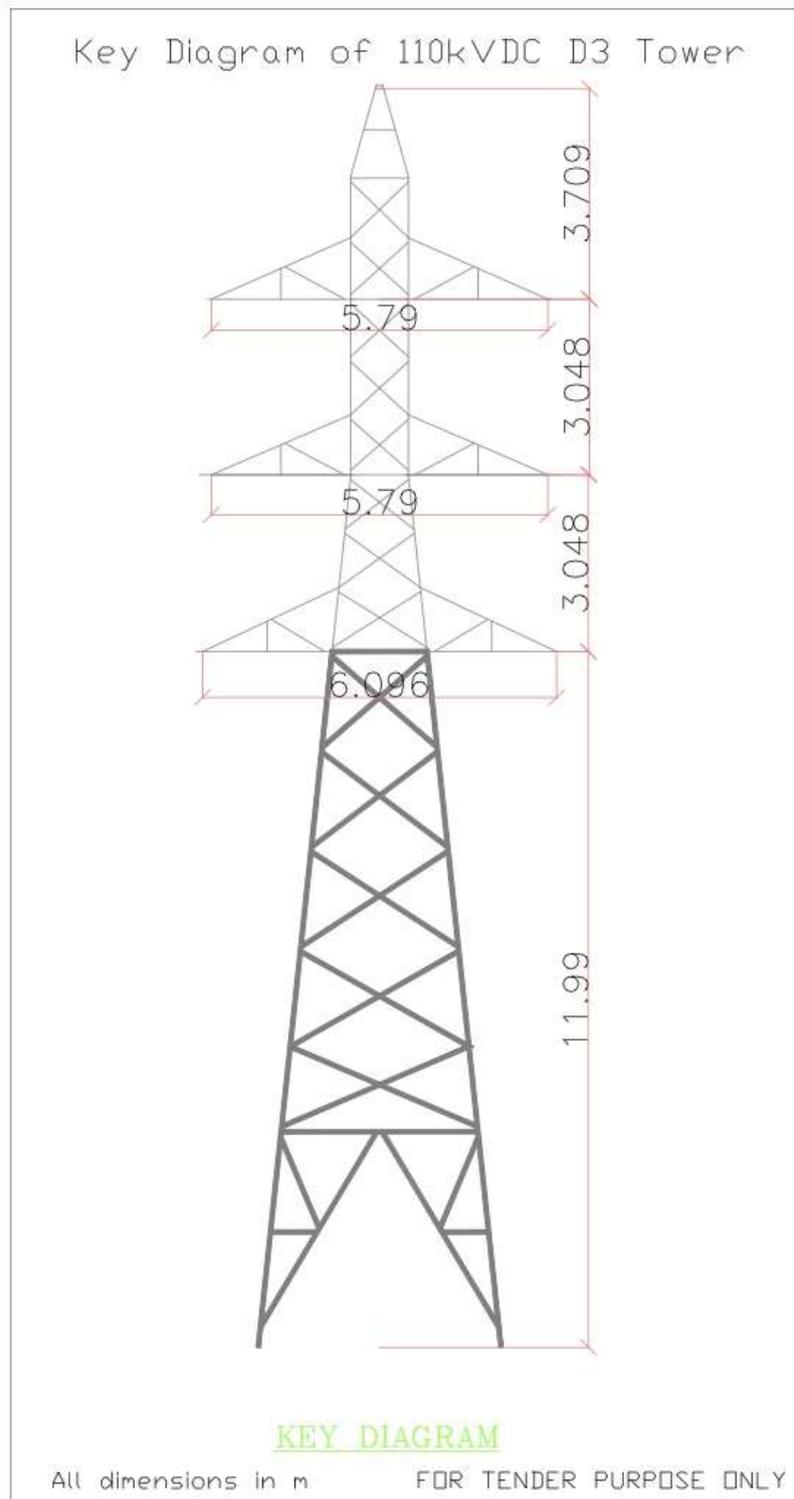
FOR TENDER PURPOSE ONLY



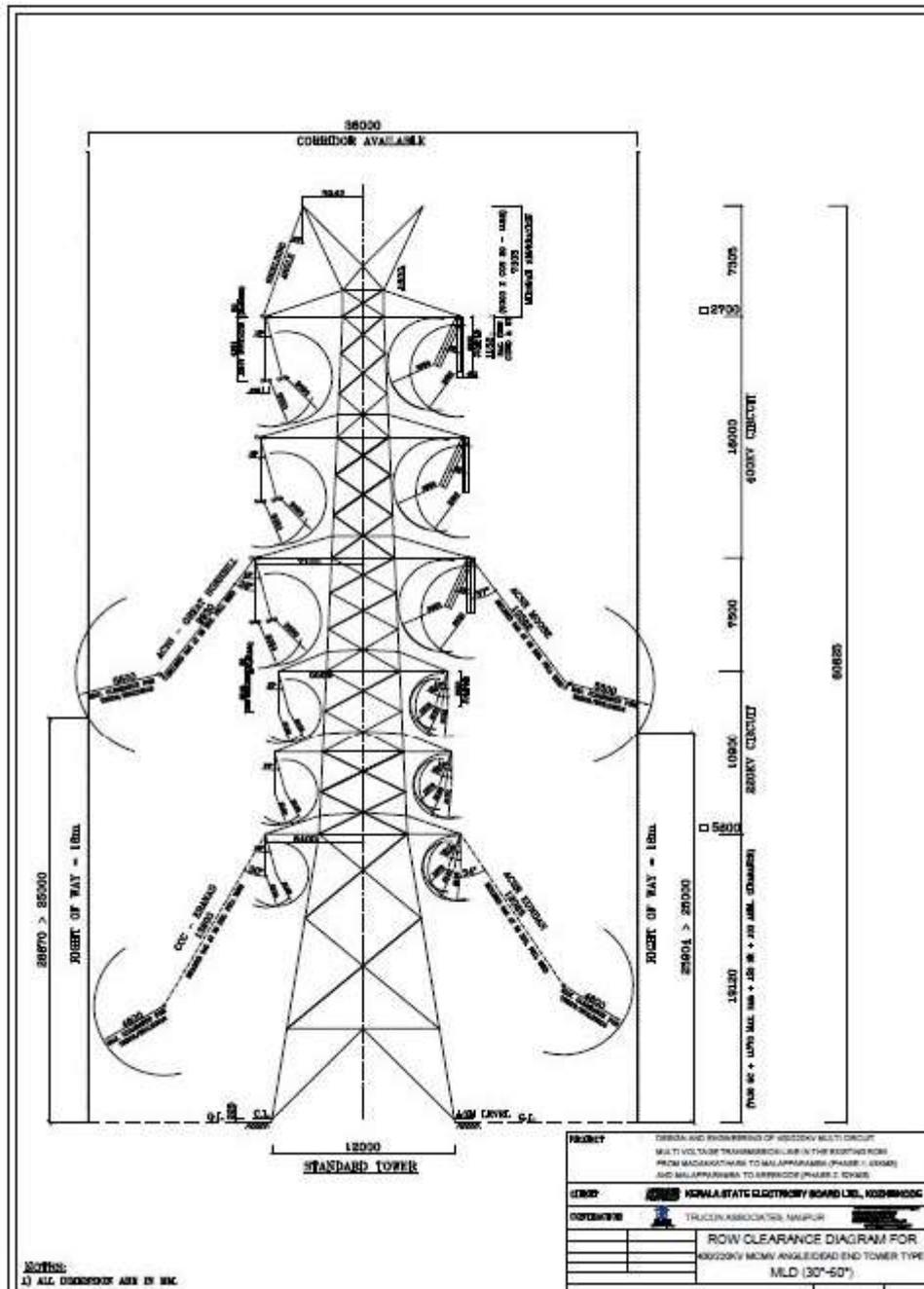
FOR TENDER PURPOSE ONLY



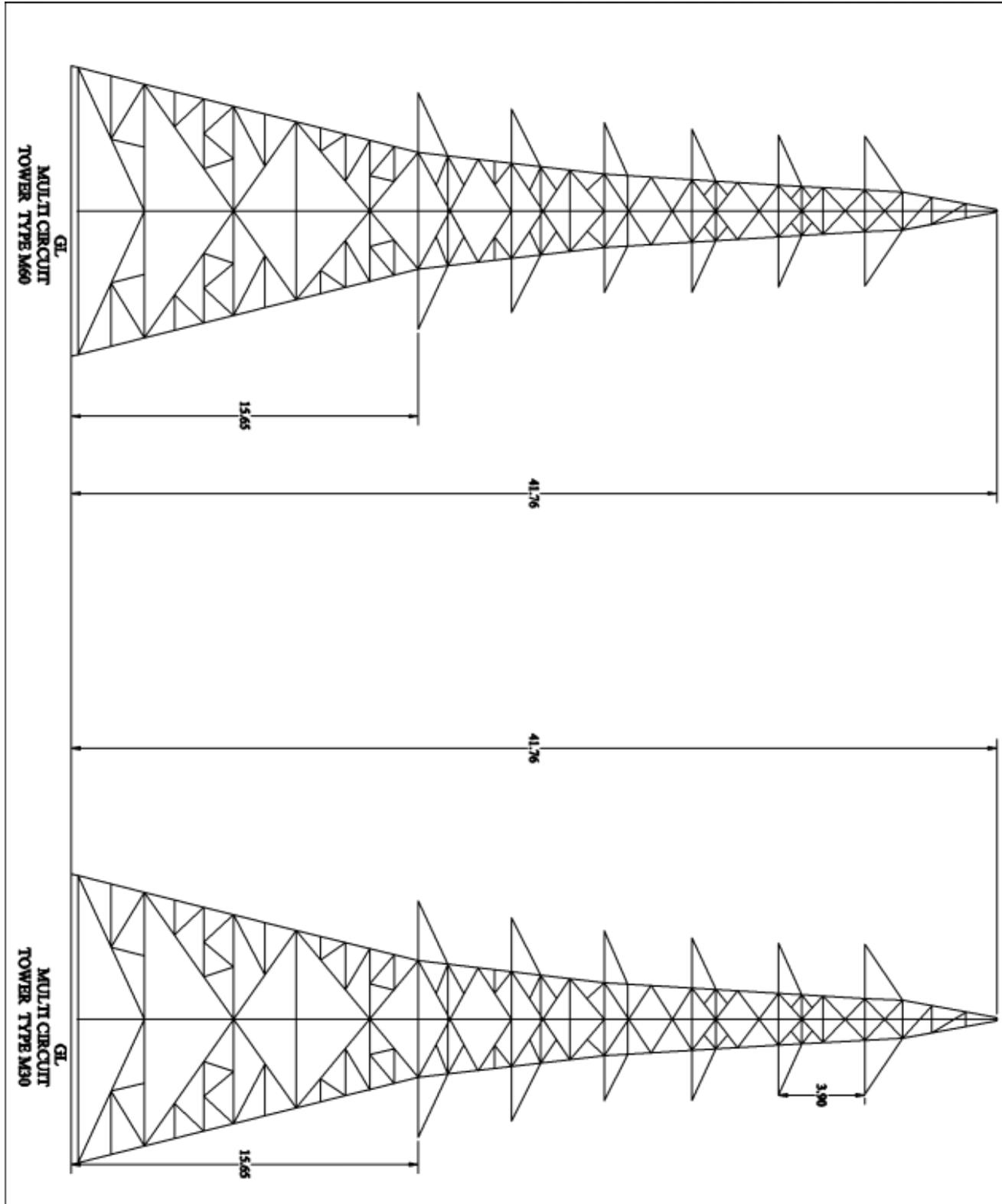
FOR TENDER PURPOSE ONLY



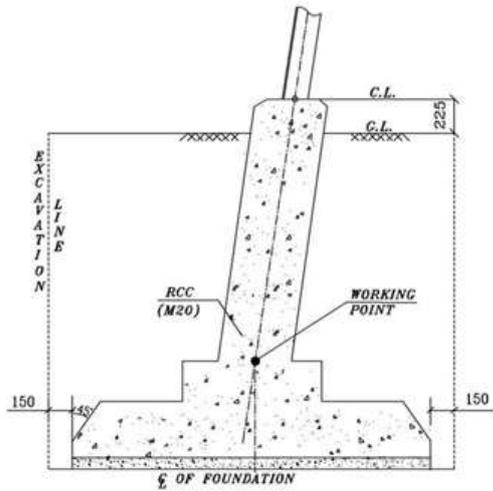
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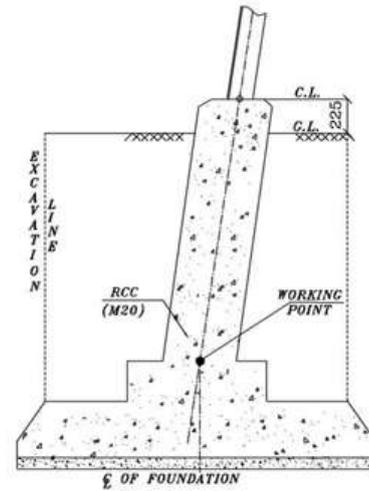
FOR TENDER PURPOSE ONLY



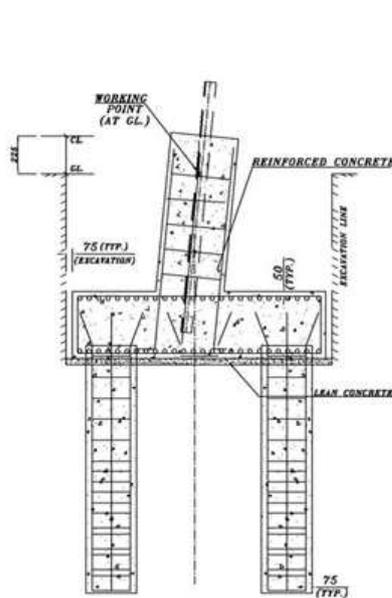
FOR TENDER PURPOSE ONLY



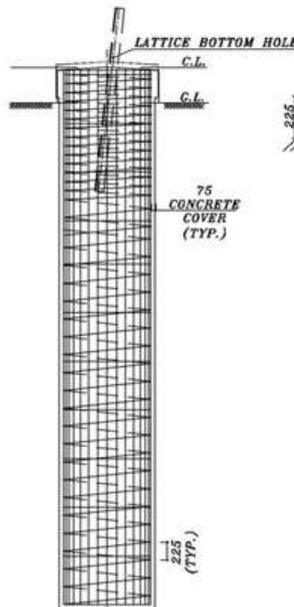
**PAD & CHIMNEY FOUNDATION
FOR NORMAL DRY/WET/FS/WBC SOIL**



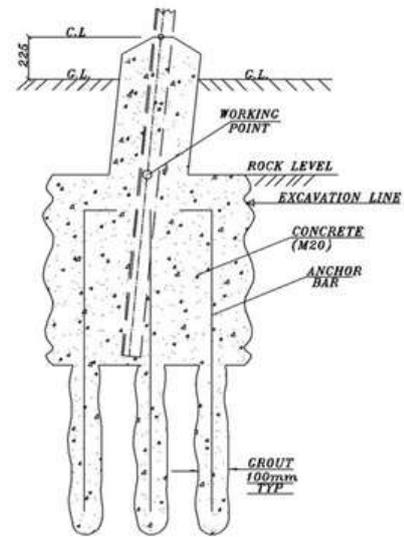
**PAD & CHIMNEY FOUNDATION
FOR SUBMERGED FISSURED ROCK**



MULTIPLE PILE



SINGLE PILE

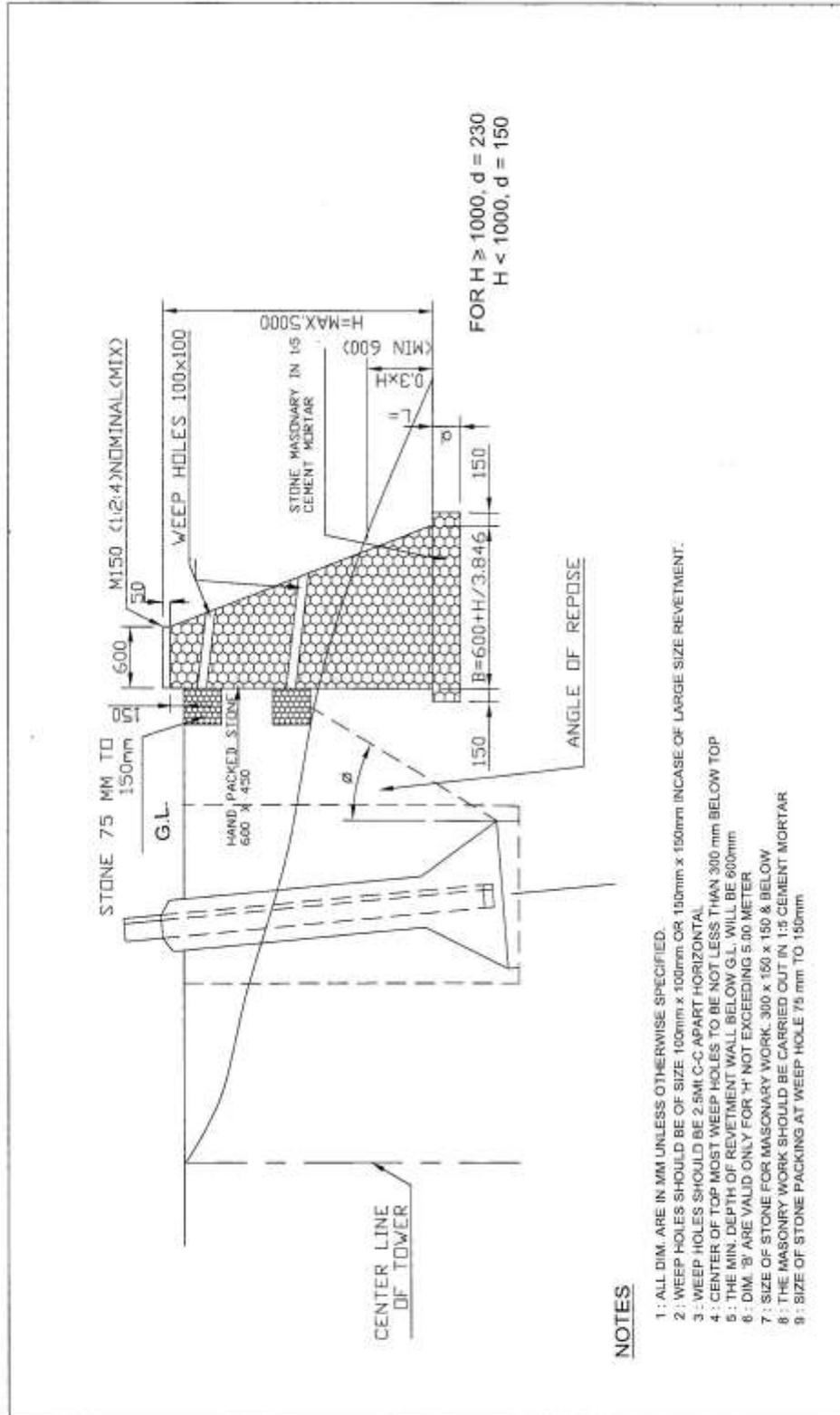


HARD ROCK FOUNDATION

SPECIAL TYPE FOUNDATION

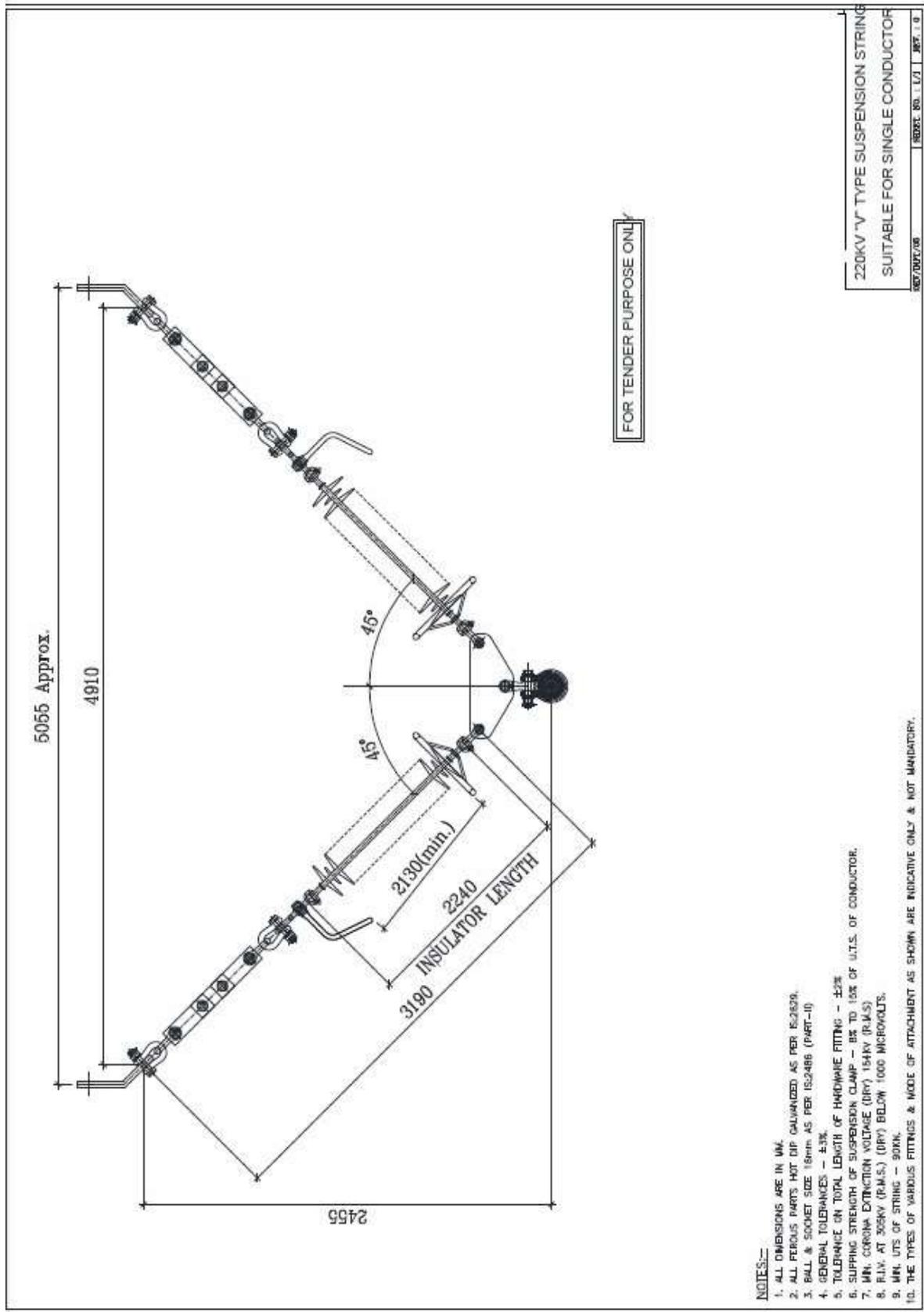
SAMPLE FOUNDATION DRAWINGS

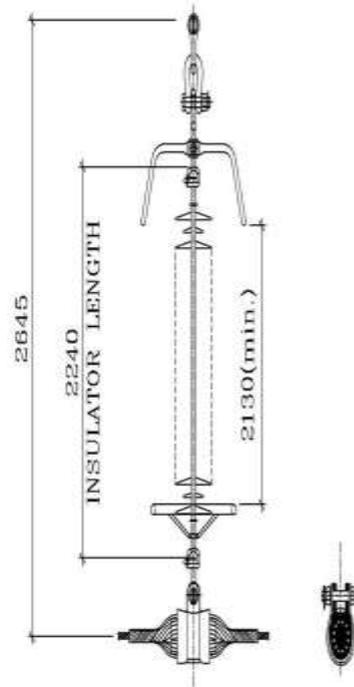
FOR TENDER PURPOSE ONLY



NOTES

- 1 : ALL DIM. ARE IN MM UNLESS OTHERWISE SPECIFIED.
- 2 : WEEP HOLES SHOULD BE OF SIZE 100mm x 100mm OR 150mm x 150mm IN CASE OF LARGE SIZE REVETMENT.
- 3 : WEEP HOLES SHOULD BE 2.5M C-C APART HORIZONTAL
- 4 : CENTER OF TOP MOST WEEP HOLES TO BE NOT LESS THAN 300 mm BELOW TOP
- 5 : THE MIN. DEPTH OF REVETMENT WALL BELOW G.L. WILL BE 800mm
- 6 : DIM. 'B' ARE VALID ONLY FOR 'H' NOT EXCEEDING 5.00 METER
- 7 : SIZE OF STONE FOR MASONRY WORK. 300 x 150 x 150 & BELOW
- 8 : THE MASONRY WORK SHOULD BE CARRIED OUT IN 1:5 CEMENT MORTAR
- 9 : SIZE OF STONE PACKING AT WEEP HOLE 75 mm TO 150mm





FOR TENDER PURPOSE ONLY

NOTES:-

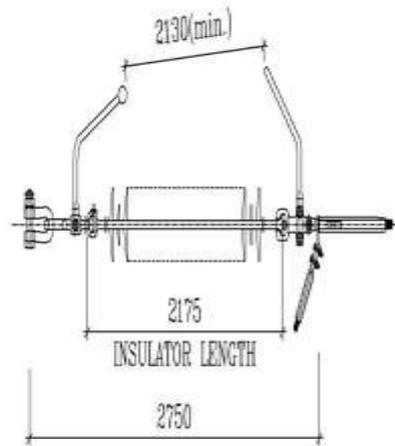
1. ALL DIMENSIONS ARE IN MM.
2. ALL FERROUS PARTS HOT DIP GALVANIZED AS PER IS:2628.
3. BALL & SOCKET SIZE 16mm AS PER IS:2486 (PART-I)
4. GENERAL TOLERANCES - ±3%
5. TOLERANCE ON TOTAL LENGTH OF HARDWARE FITTING - ±2%
6. SLIPPING STRENGTH OF SUSPENSION CLAMP - 8% TO 15% OF U.T.S. OF CONDUCTOR.
7. MIN. CORONA EXTINCTION VOLTAGE (DRY) 154KV (P.M.S)
8. P.I.V. AT 305KV (R.M.S.) (DRY) BELOW 1000 MICROVOLTS.
9. MIN. U.T.S OF STRING - 90KN.
10. THE TYPES OF VARIOUS FITTINGS & MODE OF ATTACHMENT AS SHOWN ARE INDICATIVE ONLY & NOT MANDATORY.

KSEB KERALA STATE ELECTRICITY BOARD LTD.

220KV PILOT SUSPENSION STRING
SUITABLE FOR SINGLE CONDUCTOR

DRAWING NO - C256/10255/108-220KV/10PT/04

SHEET NO. - 1/1 REV. - 0



FOR TENDER PURPOSE ONLY

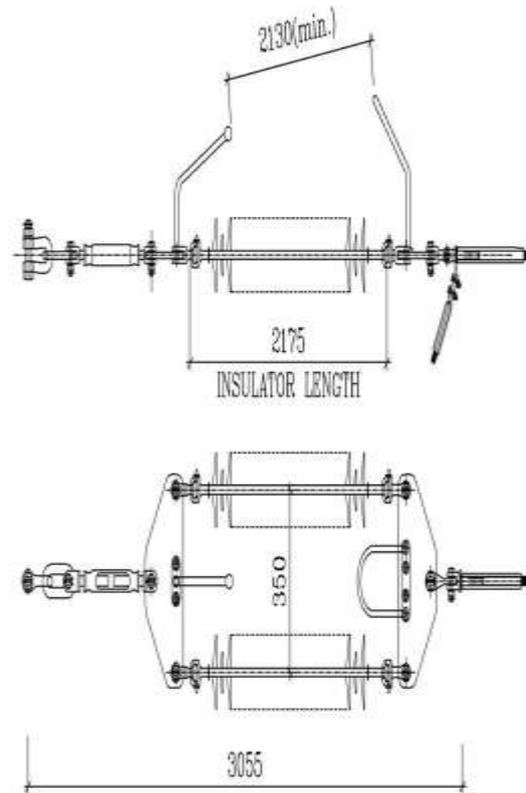
NOTES:-

1. ALL DIMENSIONS ARE IN MM.
2. ALL FERROUS PARTS HOT DIP GALVANIZED AS PER IS:2925.
3. BALL & SOCKET SIZE 20mm AS PER IS:2486 (PART-I)
4. GENERAL TOLERANCES - ±0.3.
5. TOLERANCE ON TOTAL LENGTH OF HARDWARE FITTING - ±2%
6. SLIPPING STRENGTH OF SUSPENSION CLAMP - 85% OF U.T.S. OF CONDUCTOR.
7. MIN. CORONA EXTINCTION VOLTAGE (DRY) 154KV (P.M.S)
8. P.L.V. AT 305KV (P.M.S.) (DRY) BELOW 1000 MICROVOLTS.
9. MIN. UTS OF STRING - 120KN.
10. THE TYPES OF VARIOUS FITTINGS & MODE OF ATTACHMENT AS SHOWN ARE INDICATIVE ONLY & NOT MANDATORY.

KSEB KERALA STATE ELECTRICITY BOARD LTD.

220KV SINGLE TENSION STRING
SUITABLE FOR SINGLE CONDUCTOR

SHEET NO. : 1/1 | REV. : 0



FOR TENDER PURPOSE ONLY

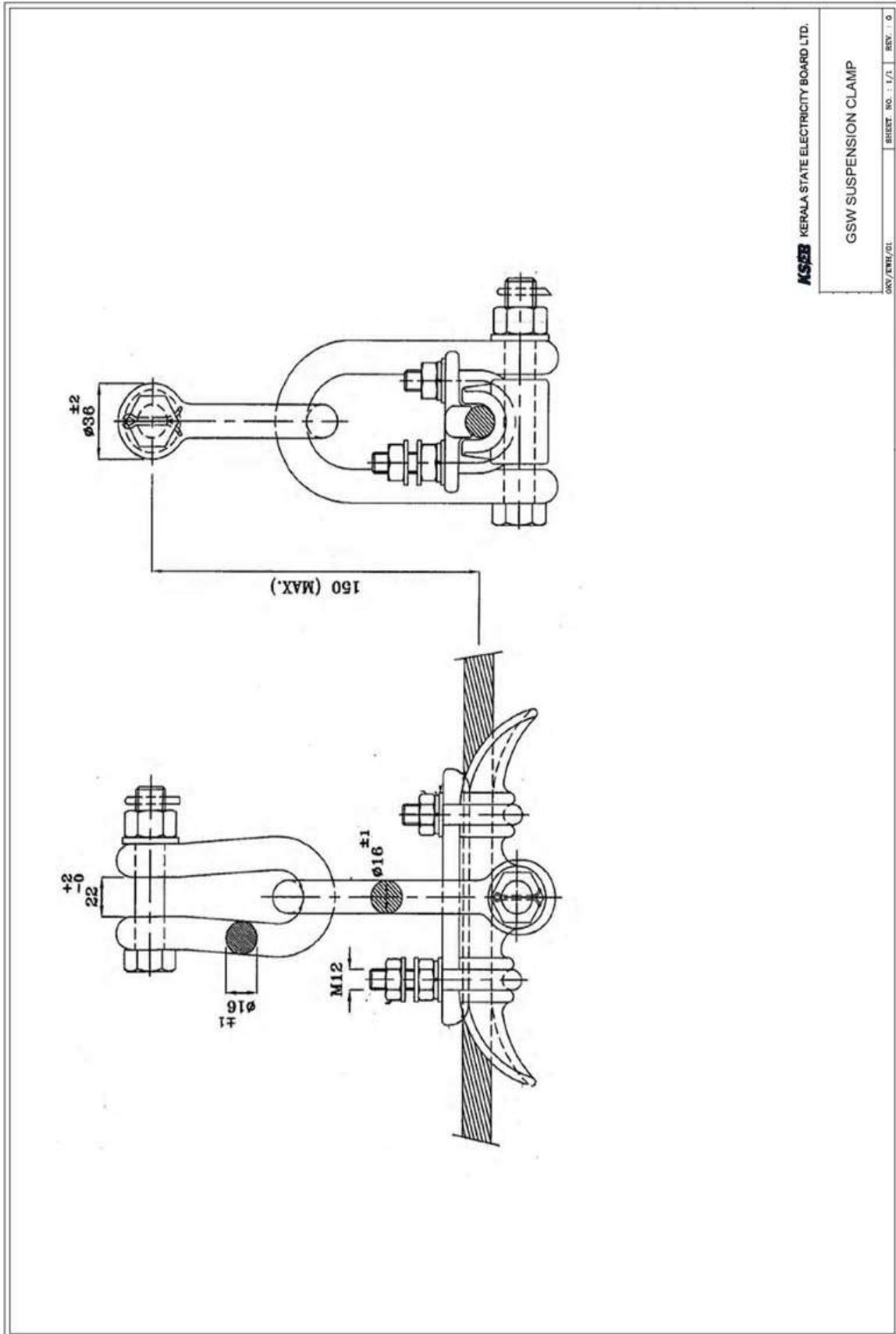
NOTES:-

1. ALL DIMENSIONS ARE IN MM.
2. ALL FERROUS PARTS HOT DIP GALVANIZED AS PER IS:2028.
3. BALL & SOCKET SIZE 20mm AS PER IS:2486 (PART-I)
4. GENERAL TOLERANCES - ±3%
5. TOLERANCE ON TOTAL LENGTH OF HARDWARE FITTING - ±2%
6. SLIPPING STRENGTH OF SUSPENSION CLAMP - 85% OF U.T.S. OF CONDUCTOR.
7. MIN. CORONA EXTINCTION VOLTAGE (DRY) 154KV (R.M.S)
8. P.I.X AT 305KV (R.M.S.) (DRY) BELOW 1000 MICROVOLTS.
9. MIN. U.T.S OF STRING - 242KN.
10. THE TYPES OF VARIOUS FITTINGS & MODE OF ATTACHMENT AS SHOWN ARE INDICATIVE ONLY & NOT MANDATORY.

KSEBL KERALA STATE ELECTRICITY BOARD LTD.

220KV DOUBLE TENSION STRING
SUITABLE FOR SINGLE CONDUCTOR

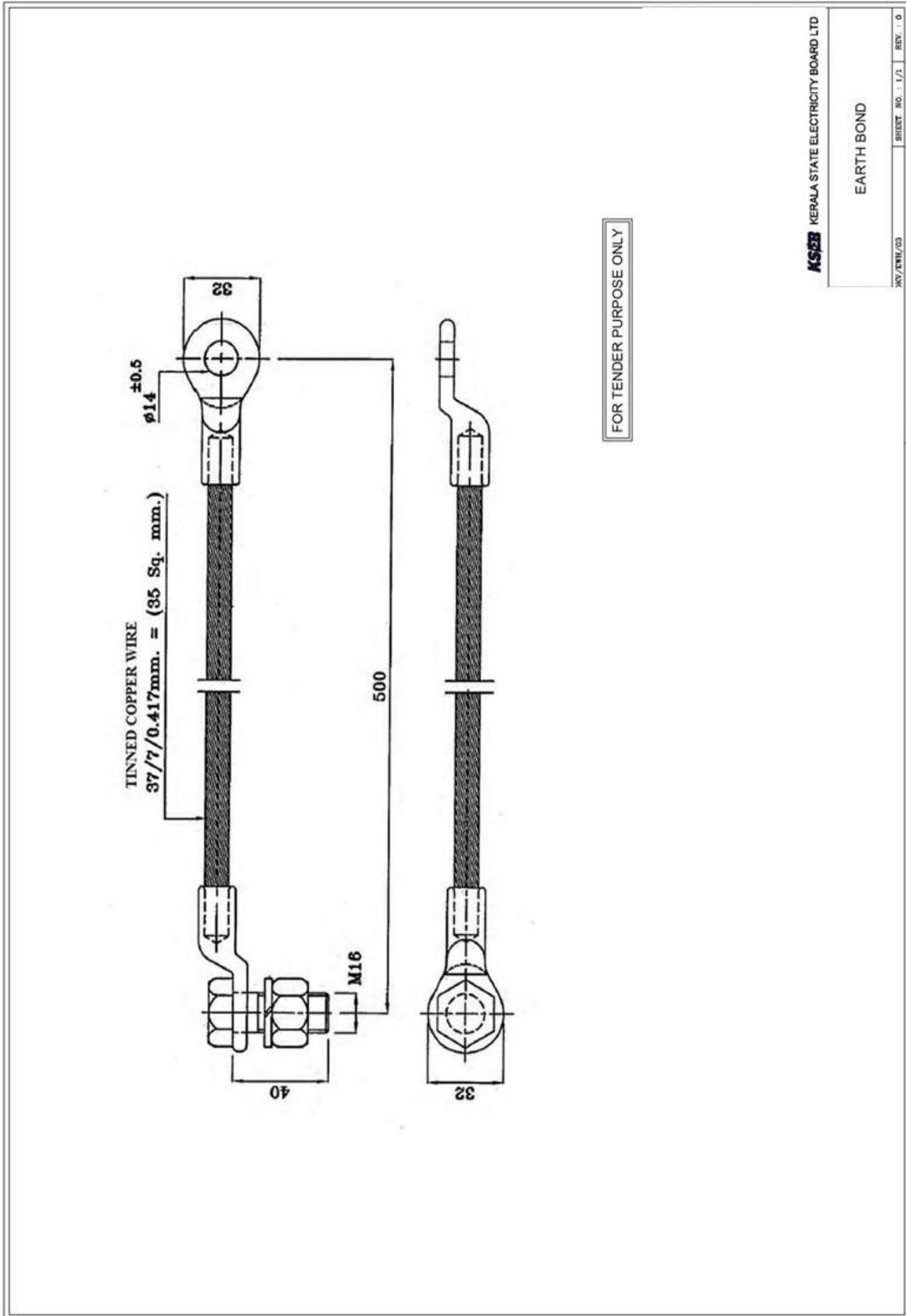
SHEET NO. : 1/1 REV : 0

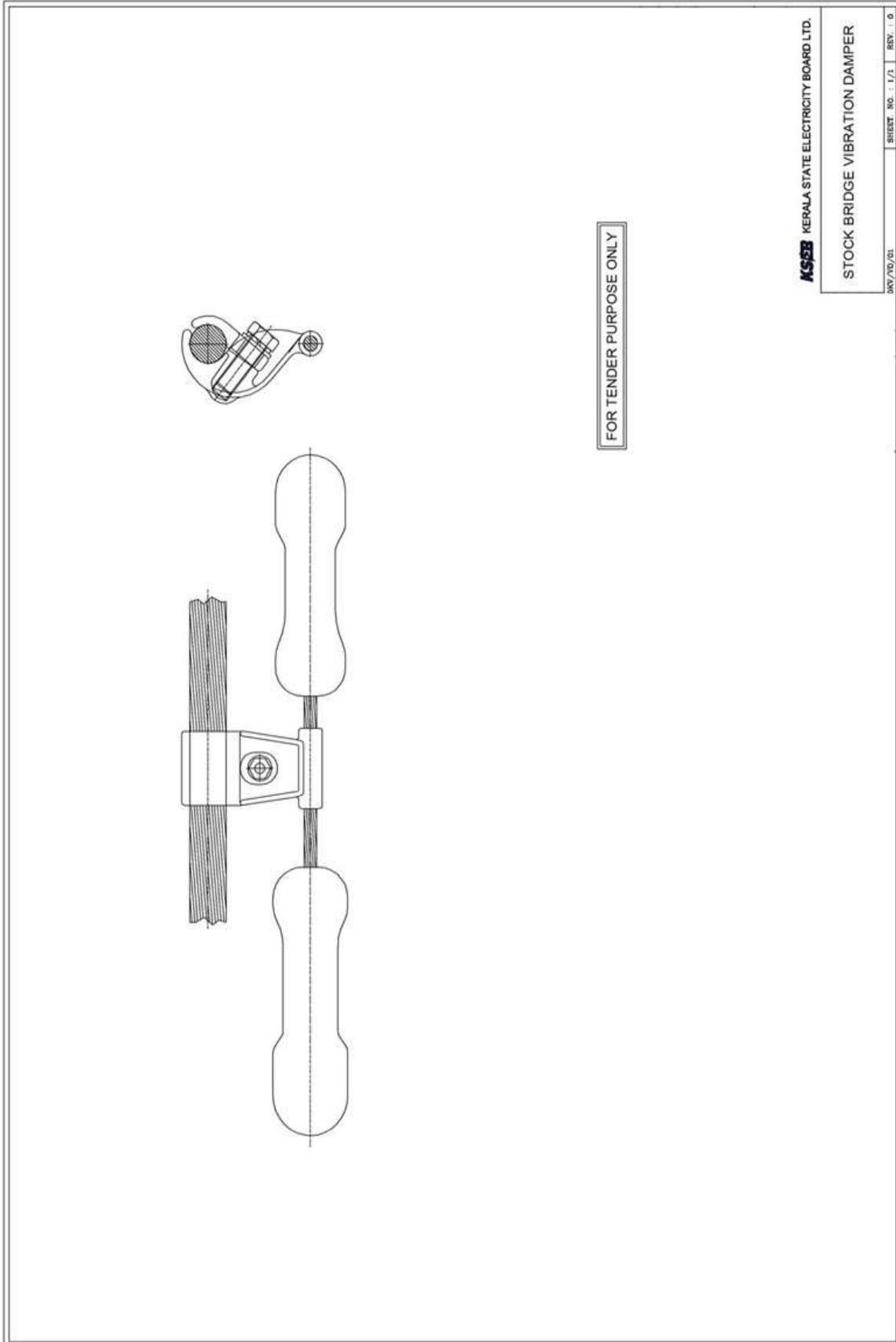


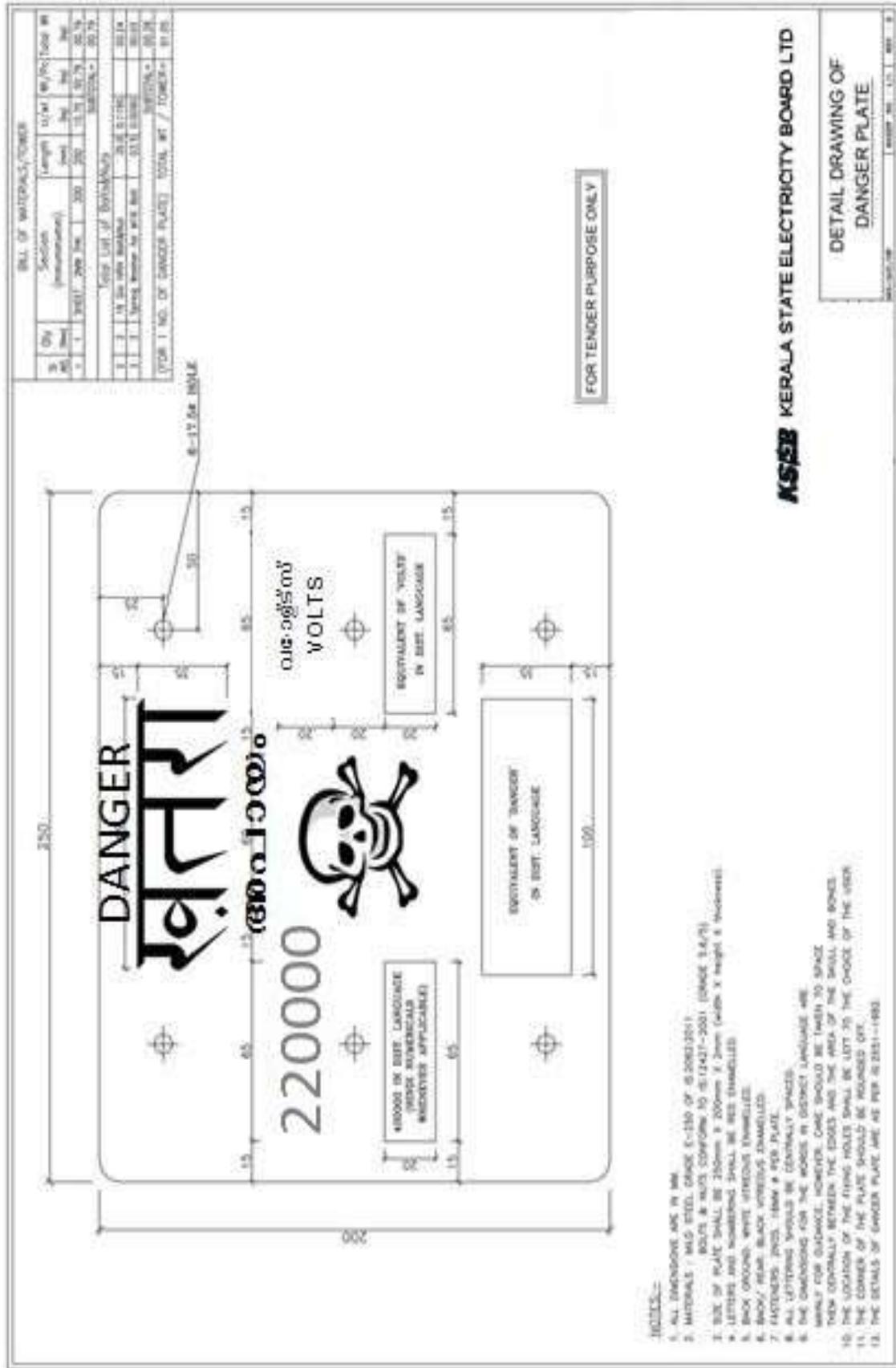
KSEBL KERALA STATE ELECTRICITY BOARD LTD.

GSW SUSPENSION CLAMP

DRY/ENR/01 SHEET NO. : 1/1 REV. : 0







BILL OF MATERIALS/TOWER						
Sl NO.	Qty (Nos)	Section (mmmmmmmm)	Length (mm)	U/wt (kg)	Wt/Pc (kg)	Total Wt (kg)
1	1	SHEET 2MM THK.	150 x 200	15.70	00.47	00.47
SUBTOTAL=						00.47
Total List of Bolts&Nuts						
2	2	16 Dia HRH Bolt&Nut	35.0	0.1190		00.24
3	2	Spring Washer for M16 Bolt	03.5	0.0090		00.02
SUBTOTAL=						00.26
(FOR 1 NO. OF NUMBER PLATE) TOTAL WT / TOWER=						00.73

FOR TENDER PURPOSE ONLY

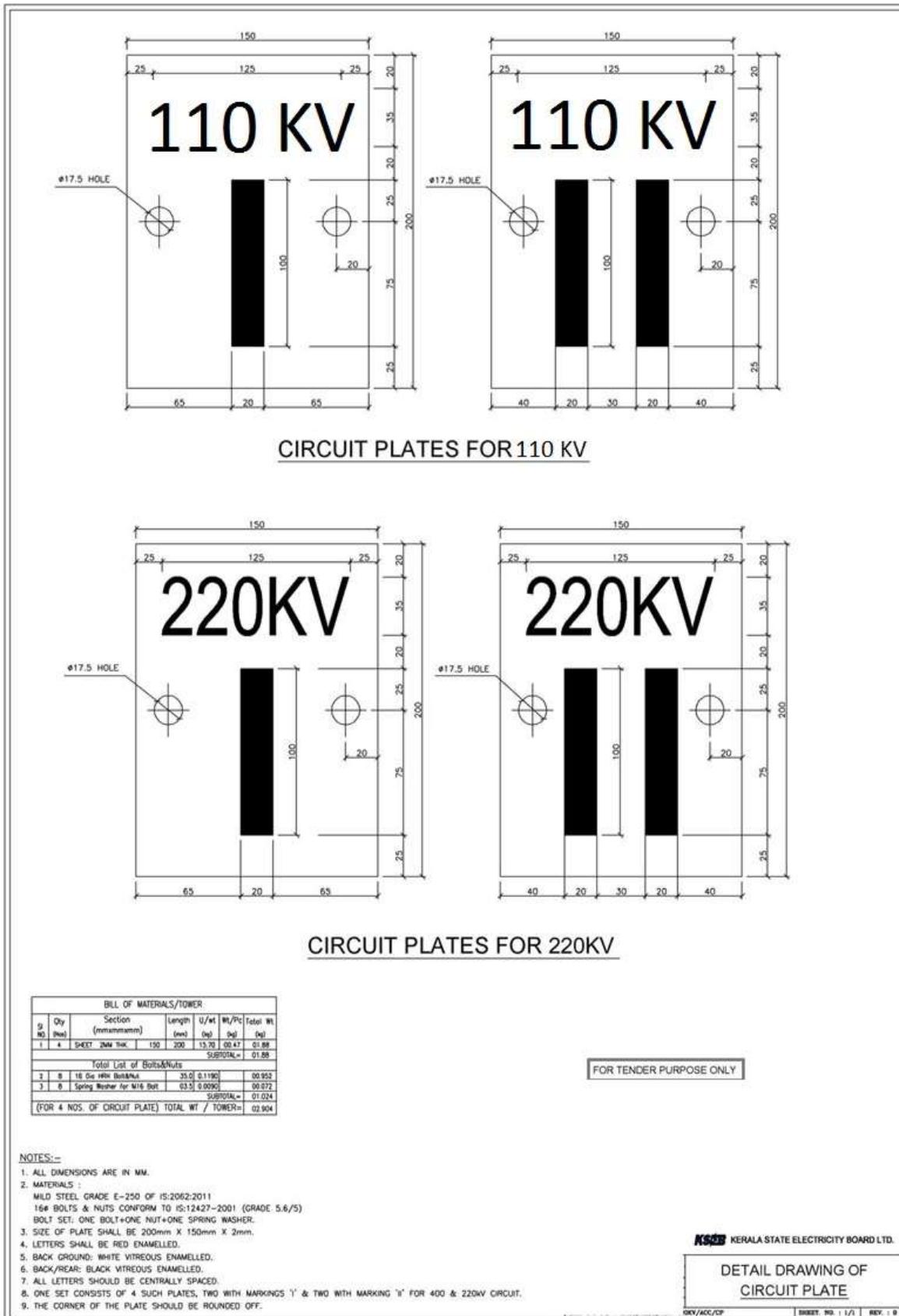
KSEBL KERALA STATE ELECTRICITY BOARD LTD.

DETAIL DRAWING OF
NUMBER PLATE

DRY/ACC/JP SHEET NO. : 1/1 REV. : 0

NOTES:-

1. ALL DIMENSIONS ARE IN MM.
2. MATERIALS : MILD STEEL GRADE E-250 OF IS:2062:2011
3. BOLTS & NUTS CONFORM TO IS:12427-2001 (GRADE 5.6/5)
4. SIZE OF PLATE SHALL BE 200mm x 150mm X 2mm.
5. LETTERS AND NUMBERING SHALL BE RED ENAMELLED.
6. BACK GROUND: WHITE VITREOUS ENAMELLED.
7. BACK / REAR: BLACK VITREOUS ENAMELLED.
8. FASTENERS: 2NOS. 16MM Ø PER PLATE.
9. 'SC' REPRESENTS FIRST LETTER OF STARTING & ENDING PLACE OF LINE.
10. '234' REPRESENTS TOWER NOS.
11. THE CORNER OF THE PLATE SHOULD BE ROUNDED OFF.
12. DRAWING IS MADE AS PER IS:5613 (PART3/SEC 1) -1989.



BILL OF MATERIALS/SET						
Sl No	Qty (Nos)	Section (mmxmmxmm)	Length (mm)	U/wt (kg)	Wt/Pc (kg)	Total Wt (kg)
1	12	SHEET 2MM THK.	145	15.70	00.23	02.76
				SUBTOTAL = 02.76		
Total List of Bolts&Nuts						
2	12	16 Dia HRH Bolt&nut	35.0	0.1190		01.428
3	12	Spring Washer for M16 Bolt	03.5	0.0090		00.108
				SUBTOTAL = 01.536		
(FOR 3 NOS. OF PHASE PLATES)				TOTAL WT / SET = 04.29		

FOR TENDER PURPOSE ONLY

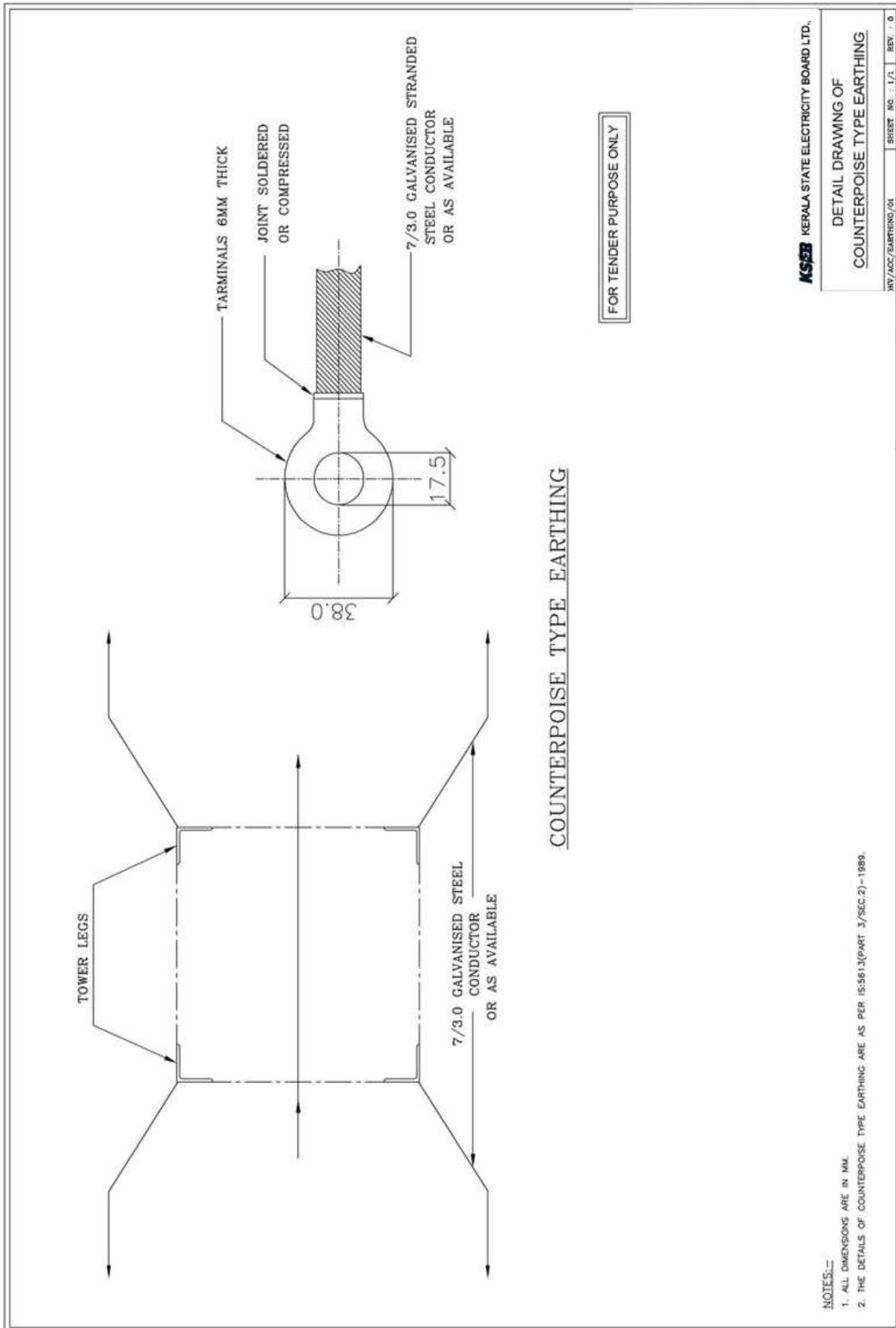
NOTES:-

1. ALL DIMENSIONS ARE IN MM.
2. MATERIALS :
MILD STEEL GRADE E-250 OF IS:2062:2011
BOLTS & NUTS 16φ - GRADE 5.6/5 (IS: 12427-2001)
3. DRAWING IS MADE AS PER IS:5613 (PART3/SEC I) -1989.
4. SIZE OF PLATE SHALL BE 145mm X 100mm X 2mm.
5. FOUR SETS EACH CONSISTING OF 3 PLATES HAVING RED, BLUE & YELLOW COLOURS.
TWO FOR 400KV & TWO FOR 220KV CKT.
6. FRONT: WITH COLOUR AS PER NOTE 5.
7. BACK/REAR: BLACK VITREOUS ENAMELLED.

KSEBL KERALA STATE ELECTRICITY BOARD LTD.,

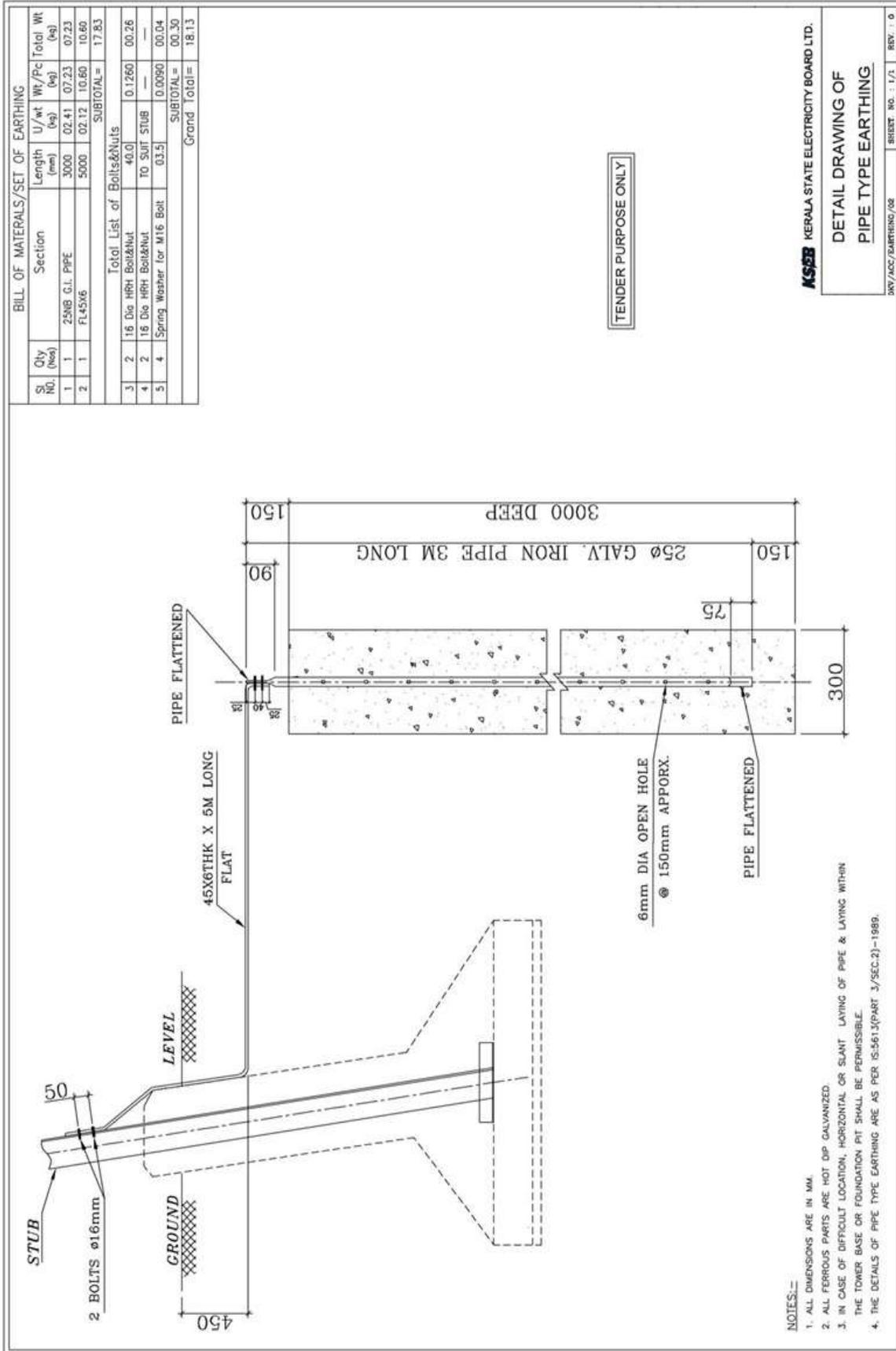
**DETAIL DRAWING OF
PHASE PLATE**

DWY/ACC/PP SHEET NO. : 1/1 REV. : 0

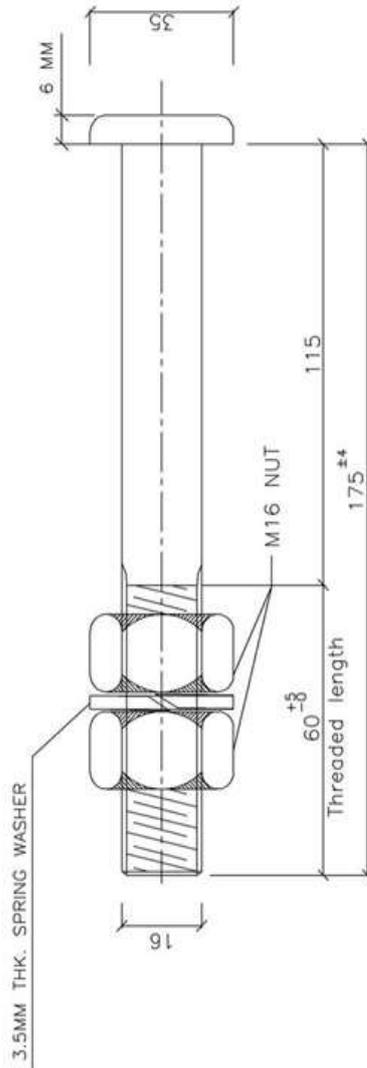


KSEBL KERALA STATE ELECTRICITY BOARD LTD.
 DETAIL DRAWING OF
 COUNTERPOISE TYPE EARTHING
 XNY/ACC/EARTHING/01 SHEET NO. : 1/1 REV. : 0

- NOTES:-
1. ALL DIMENSIONS ARE IN MM.
 2. THE DETAILS OF COUNTERPOISE TYPE EARTHING ARE AS PER IS:5613(PART 3/SEC-2)-1989.



KSEBL KERALA STATE ELECTRICITY BOARD LTD.
DETAIL DRAWING OF
PIPE TYPE EARTHING
 SHEET NO. : 1/1 REV : 0



STEP BOLT
(M16X175MM LONG)

FOR TENDER PURPOSE ONLY

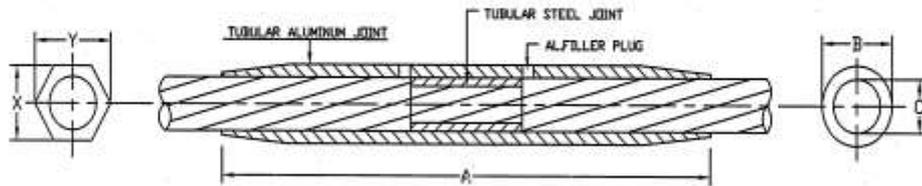
NOTES:-

1. ALL DIMENSIONS ARE IN MM.
2. MATERIALS :
BOLTS & NUTS 16φ - GRADE 5.6/5 (IS: 12427-2001)
BOLT SET: ONE BOLT+TWO NUT+ONE SPRING WASHER.
3. STEP BOLT CONFORMING TO THE IS:10238.
4. APPROX. WT. OF STEP BOLT WITH TWO NUTS + ONE SPRING WASHER = 0.374 Kg

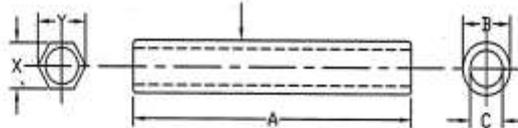
KSEBL KERALA STATE ELECTRICITY BOARD LTD.

DETAIL DRAWING OF
STEP BOLT
(M16x175MM LG.)

REV/ACC/BB | SHEET NO. : 1/1 | REV. : 0



S.No.	CONDUCTOR	DIA.	A	B	C	X	Y	APP.WT. IN KG.
1.	PANTHER	21.00	610	38	23	32	37	1.160

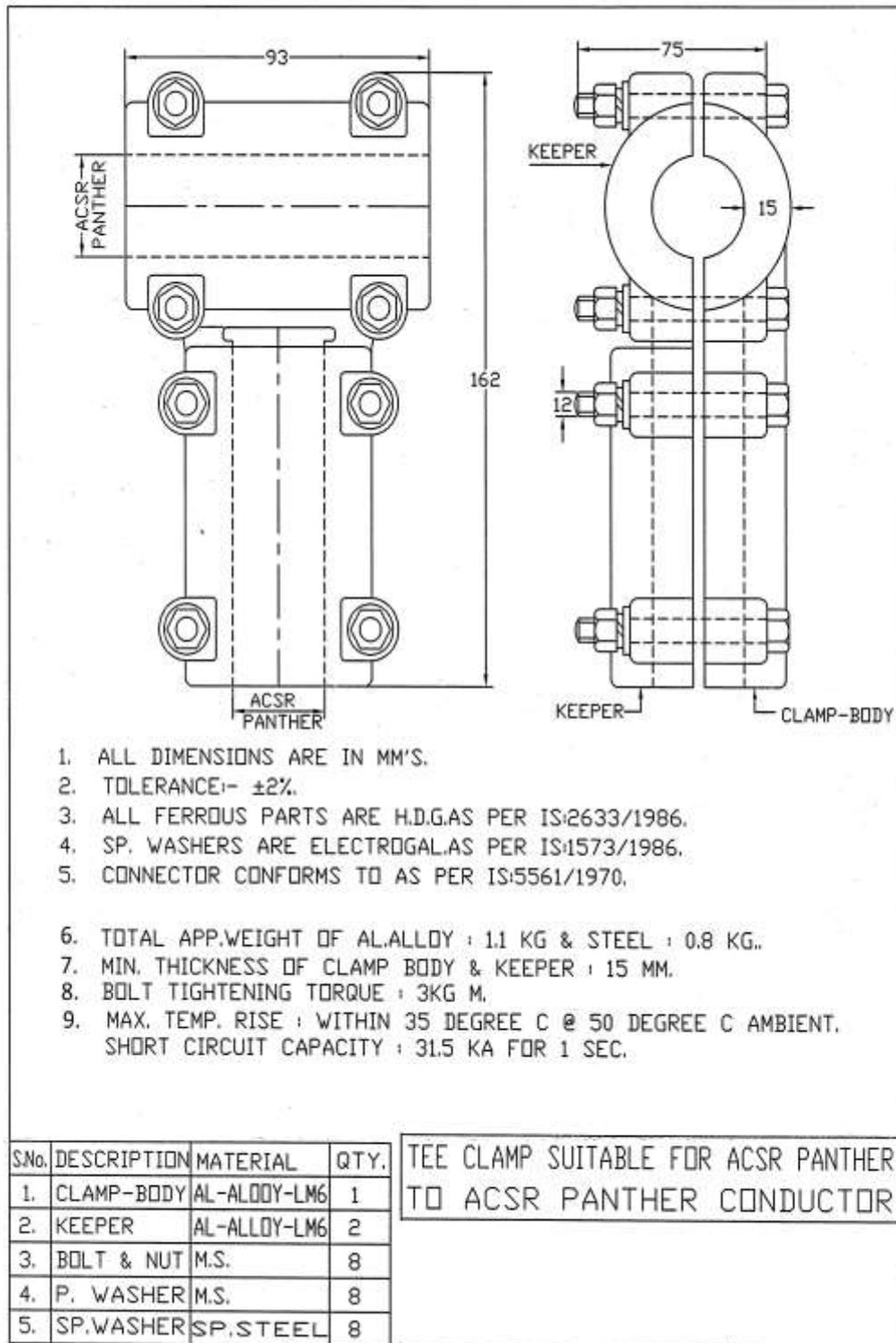


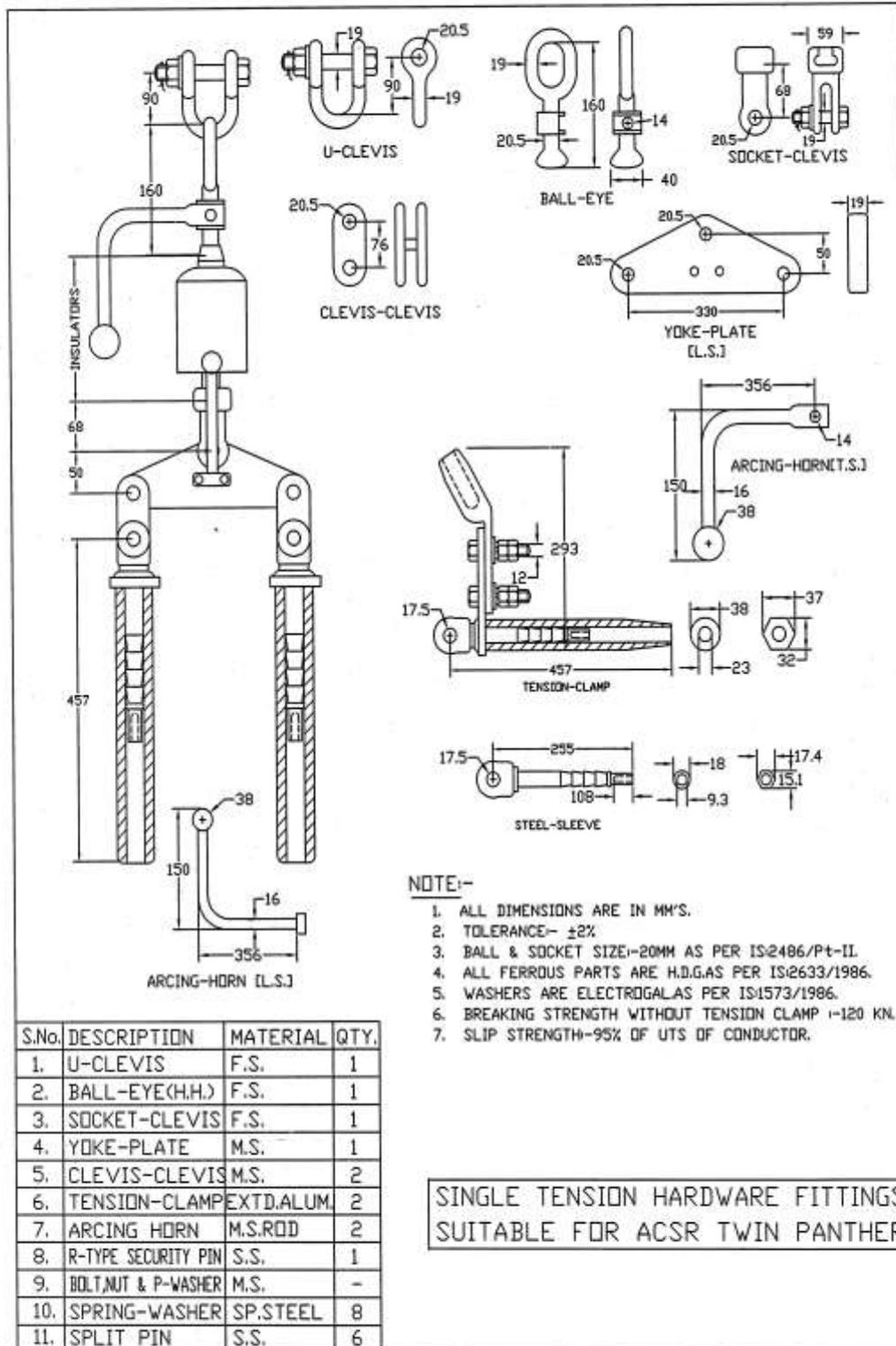
S.No.	CONDUCTOR	DIA.	A	B	C	X	Y	APP.WT. IN KG.
1.	PANTHER	9.0	200	18.0	9.3	15.1	17.4	0.280

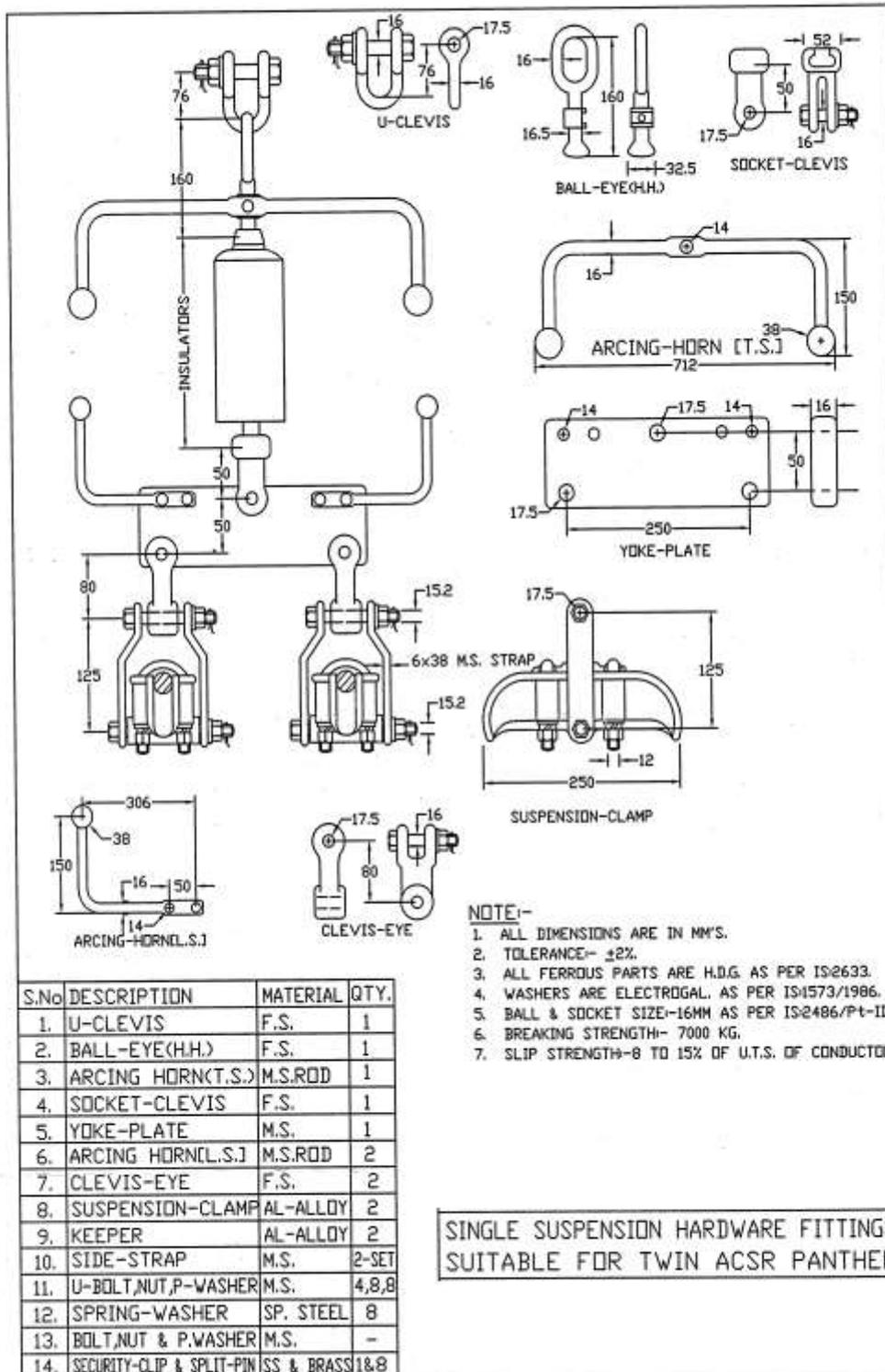
NOTE:-

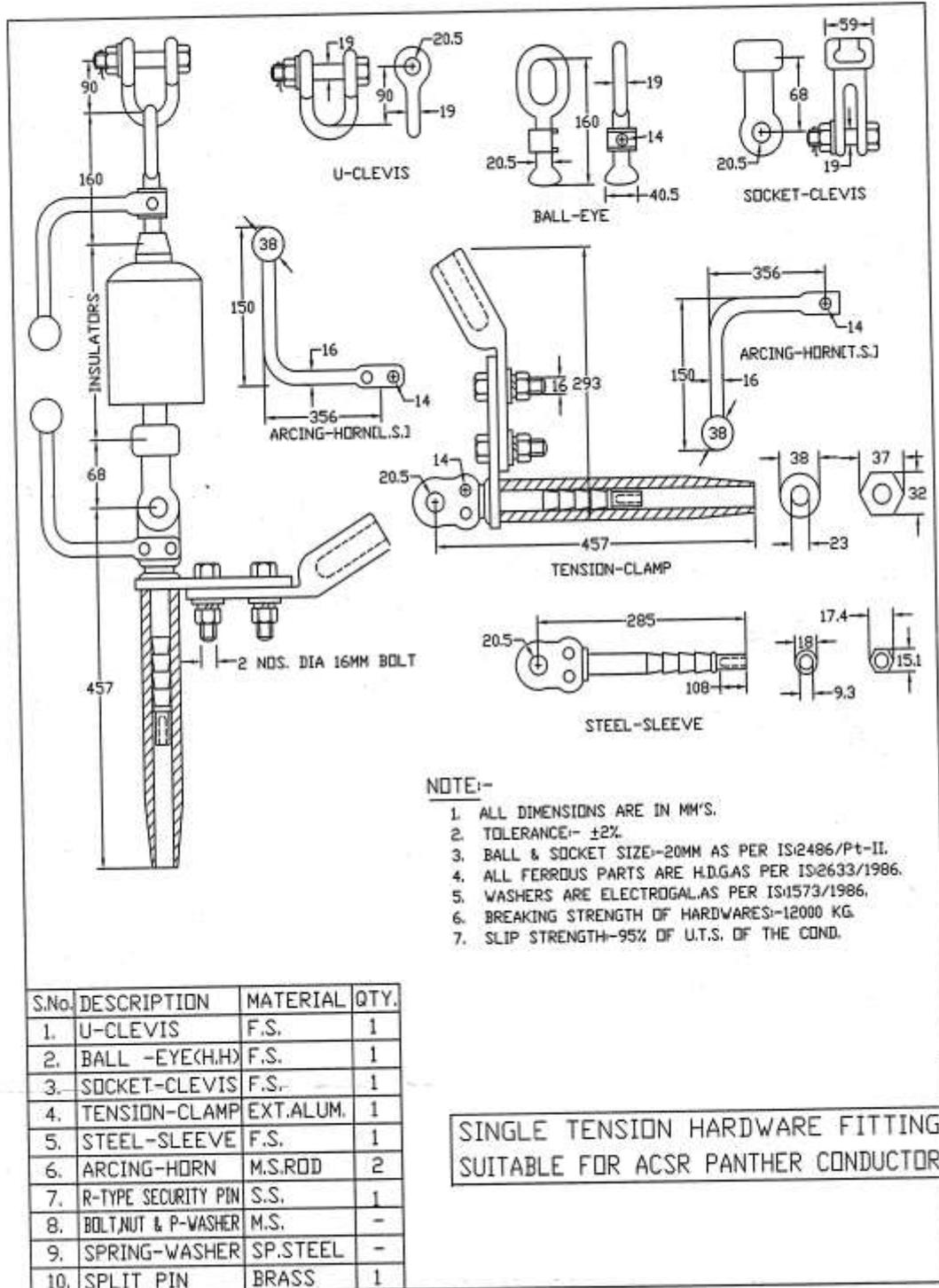
1. ALL DIMENSIONS ARE IN MM'S.
2. TOLERANCE:- $\pm 2\%$.
3. STEEL JOINT IS H.D.G. AS PER IS:2633/1986.
4. BREAKING STRENGTH:-100% OF U.T.S. OF THE CONDUCTOR.
5. MID SPAN JOINT CONFORMS TO AS PER IS:2121/Pt-II/1981.
6. MATERIAL:-EXTRUDED AL. PIPE & MILD STEEL.
7. RESISTANCE:-BELOW 75% OF THE EQUIVALENT LENGTH OF COND.
8. SLIP STRENGTH:-NOT LESS THAN 95% OF U.T.S. OF CONDUCTOR.

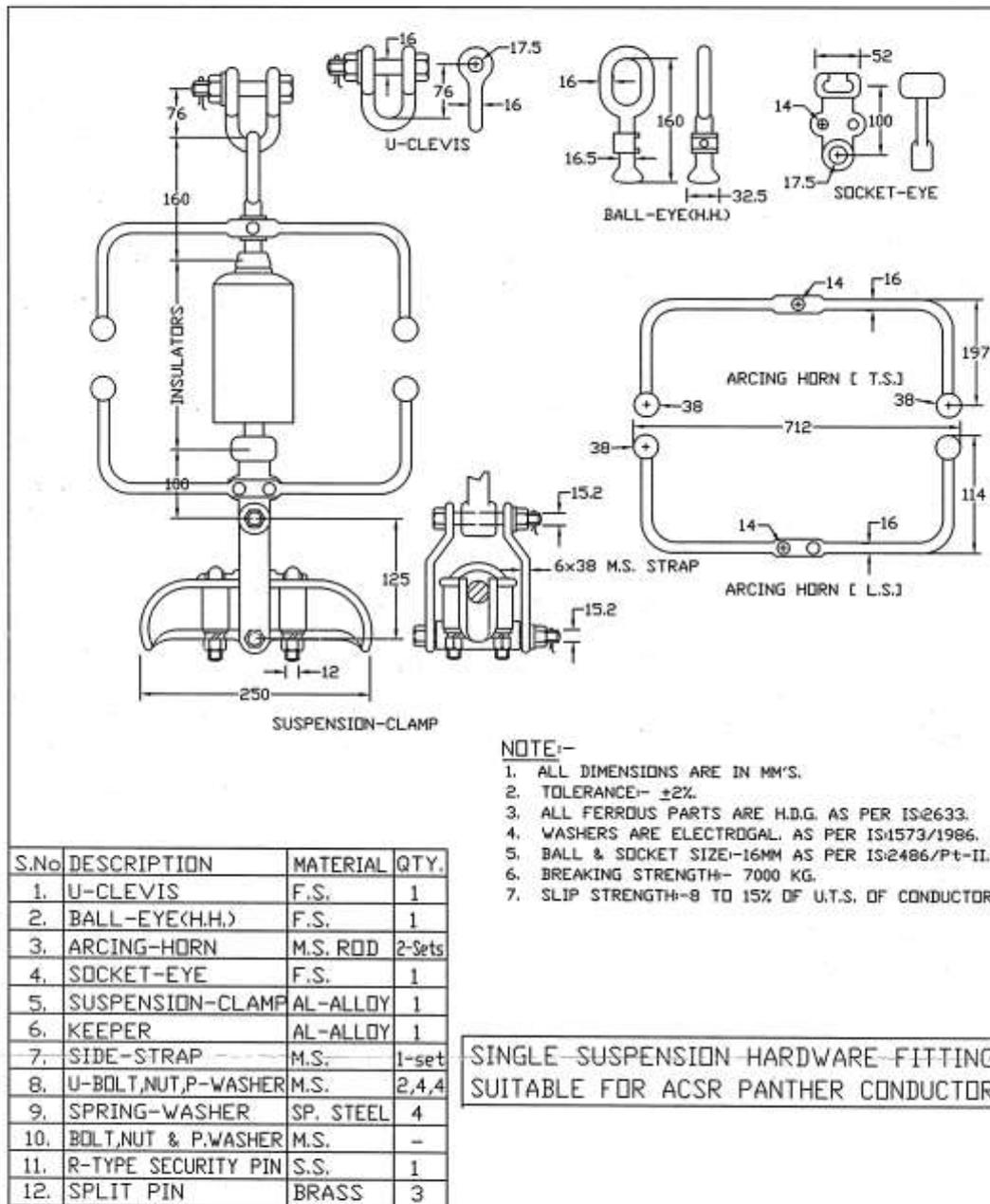
MID SPAN COMPRESSION JOINT FOR ACSR PANTHER

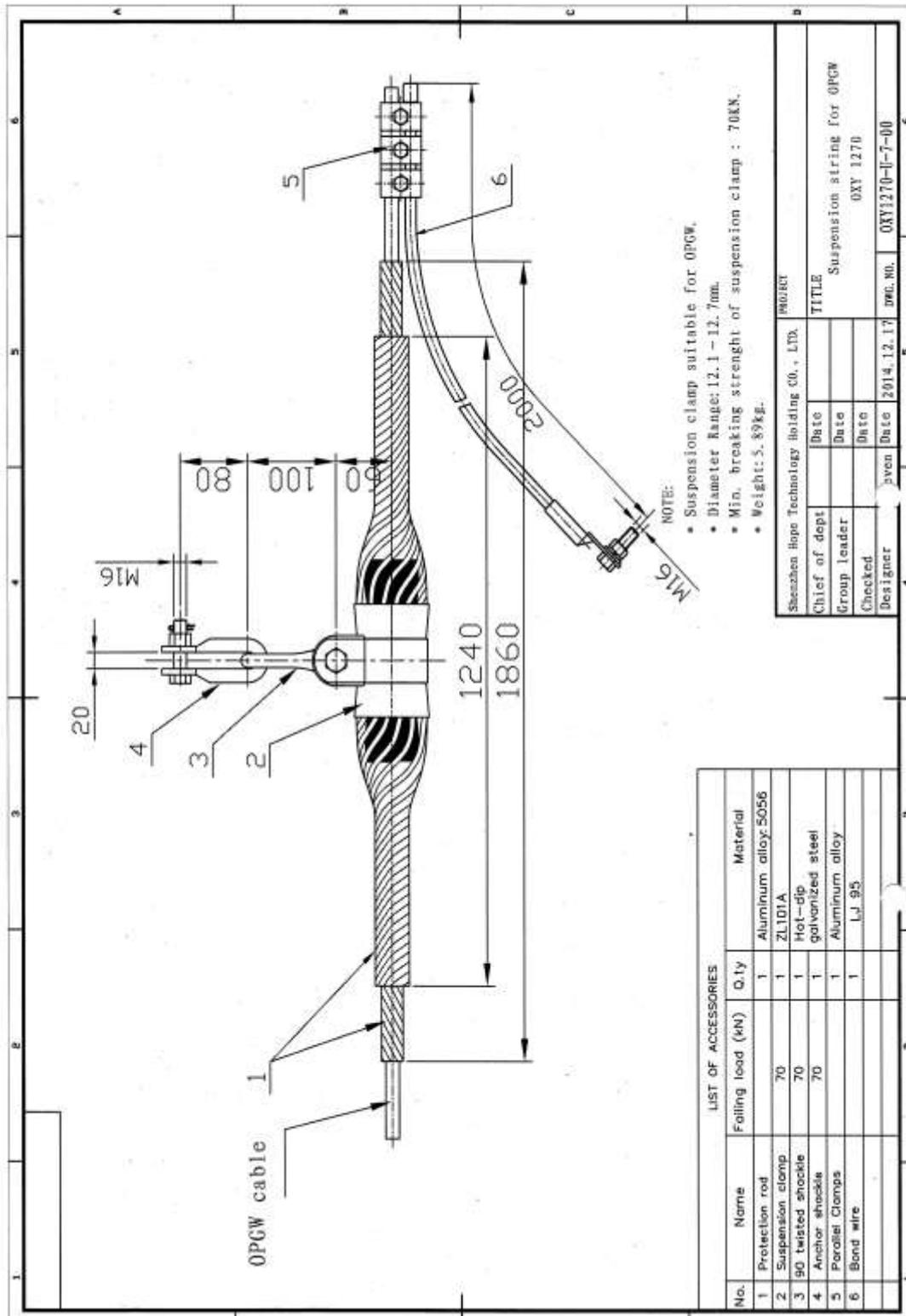


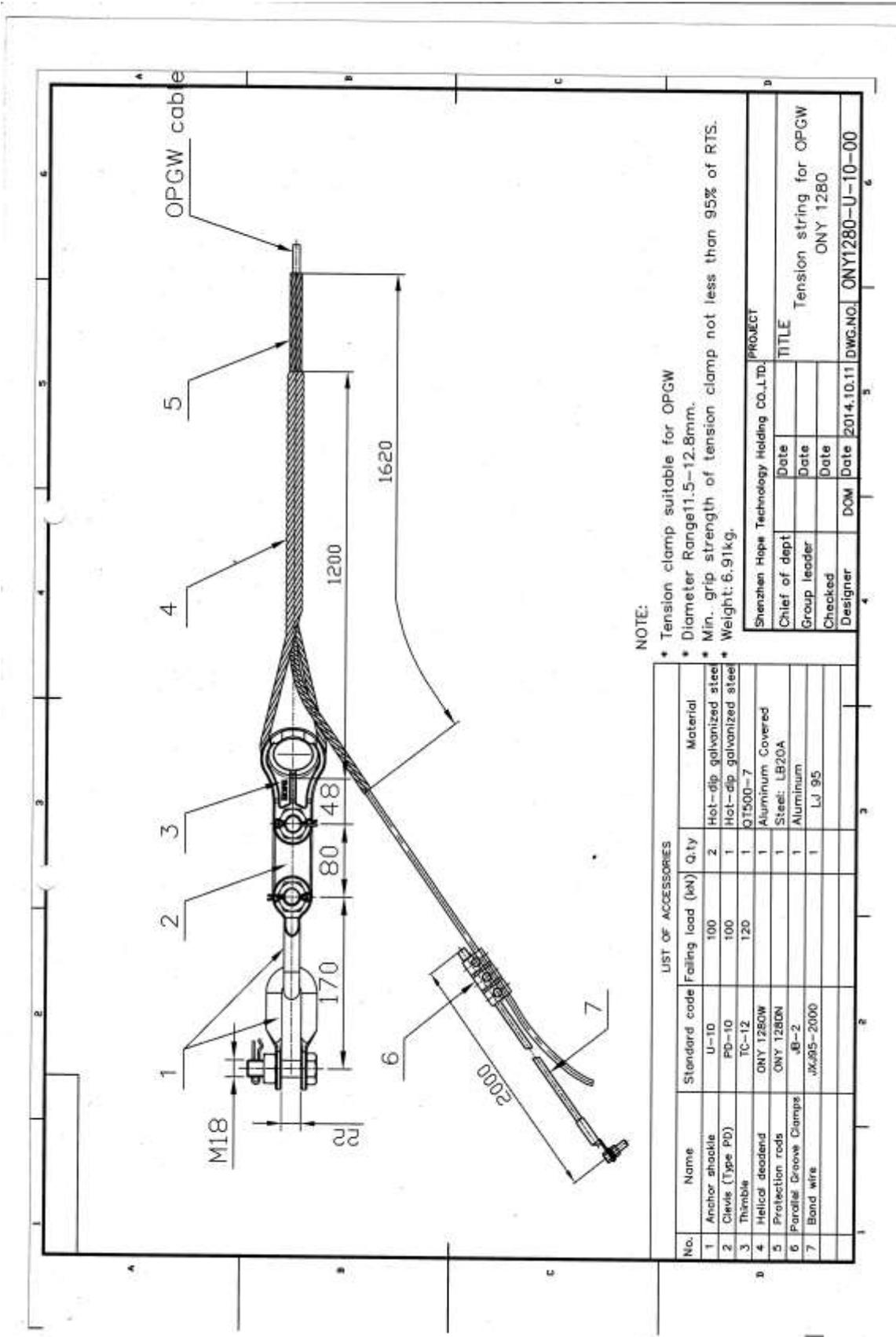










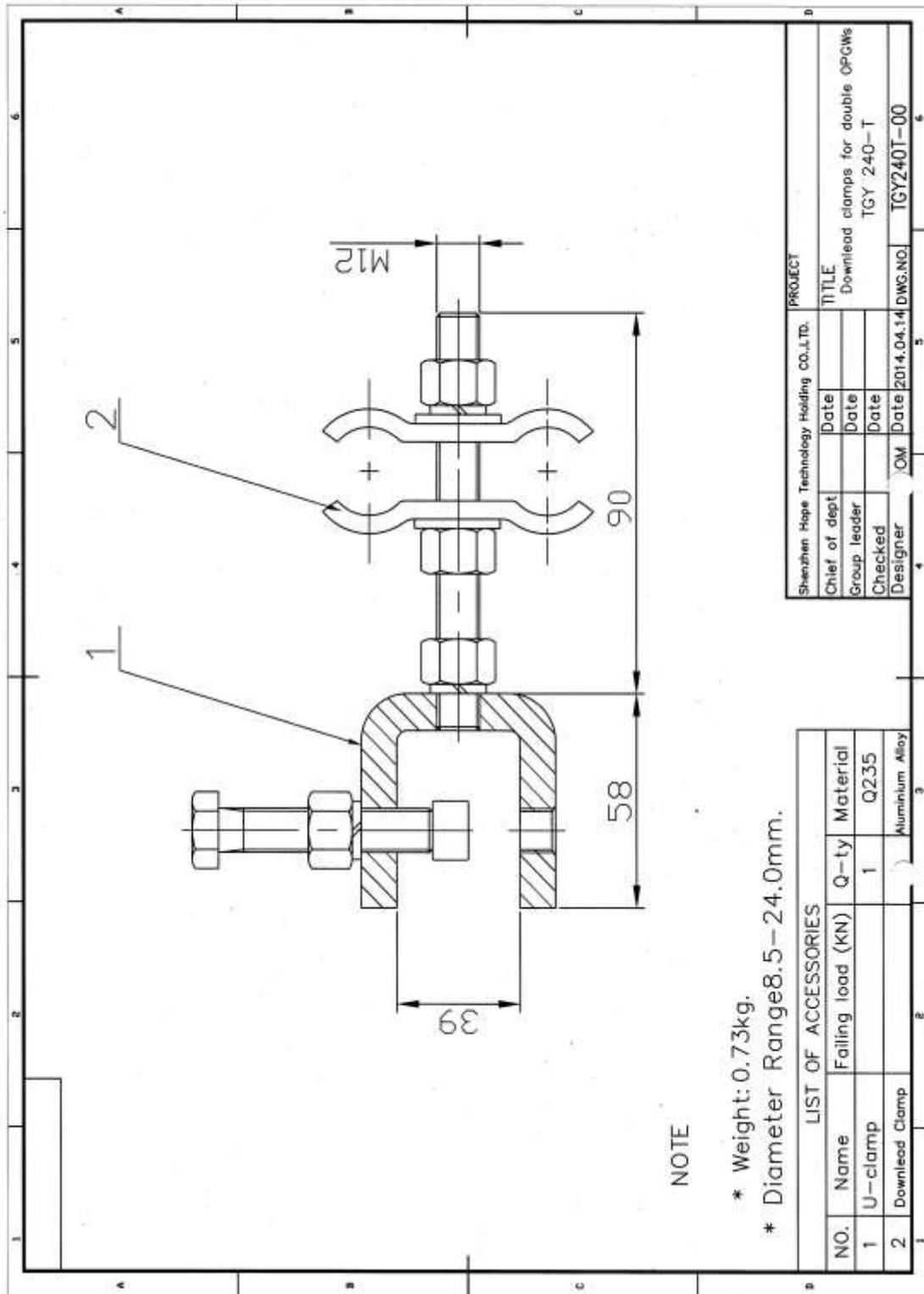


NOTE:

- * Tension clamp suitable for OPGW
- * Diameter Range 11.5-12.8mm.
- * Min. grip strength of tension clamp not less than 95% of RTS.
- * Weight: 6.91kg.

Shenzhen Hope Technology Holding Co.,LTD.		PROJECT	
Chief of dept	Date	TITLE	
Group leader	Date	Tension string for OPGW	
Checked	Date	ONY 1280	
Designer	DOM	Date	2014.10.11
		DWG.NO.	ONY1280-U-10-00

LIST OF ACCESSORIES					
No.	Name	Standard code	Falling load (kN)	Q.ty	Material
1	Anchor shackle	U-10	100	2	Hot-dip galvanized steel
2	Clevis (Type PD)	PD-10	100	1	Hot-dip galvanized steel
3	Thimble	TC-12	120	1	QT500-7
4	Helical deadend	ONY 1280W		1	Aluminum Covered
5	Protection rods	ONY 1280N		1	Steel: LB20A
6	Parallel Groove Clamps	GB-2		1	Aluminum
7	Band wire	JK-905-2000		1	LJ 95

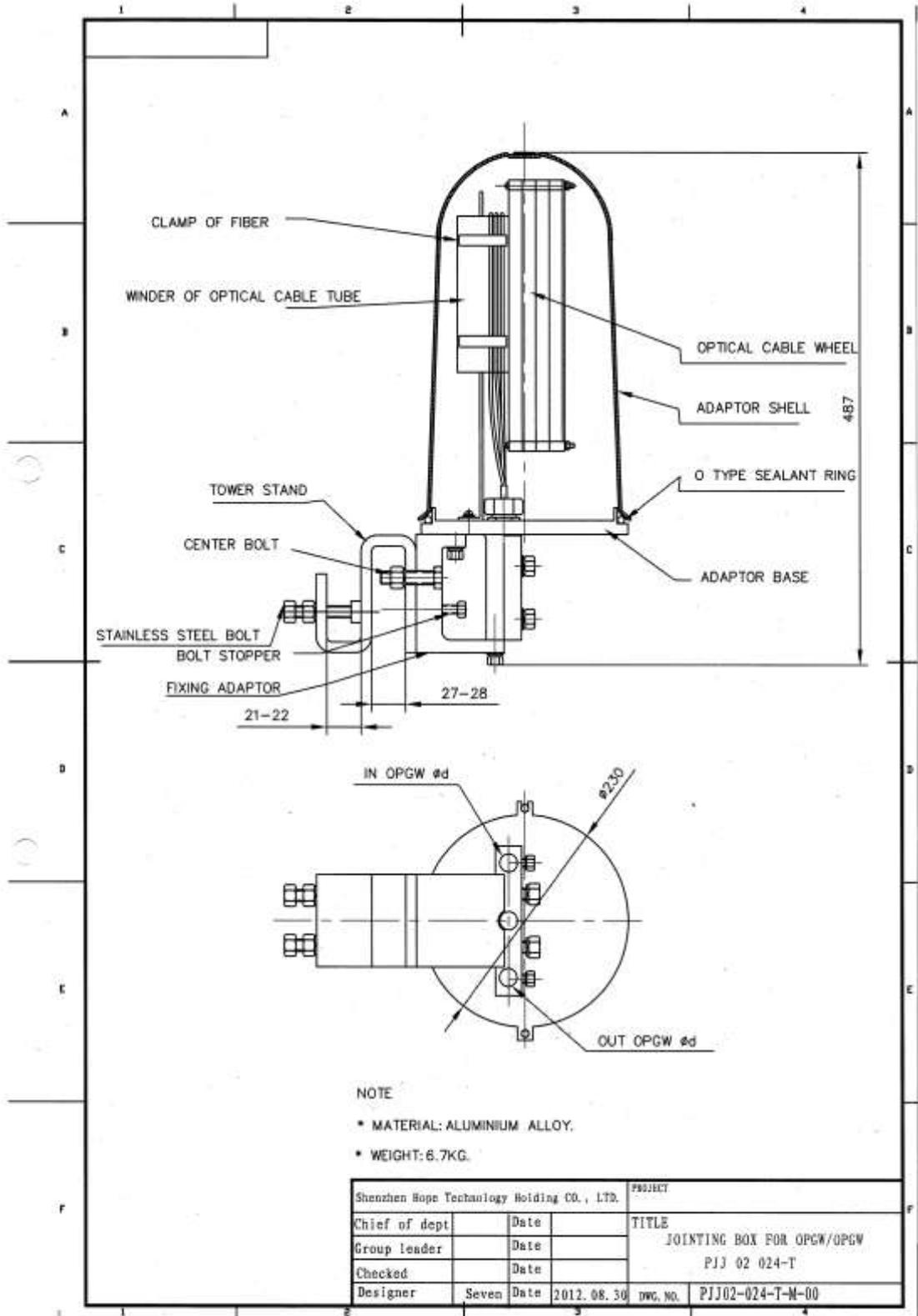


NOTE

- * Weight: 0.73kg.
- * Diameter Range 8.5 – 24.0mm.

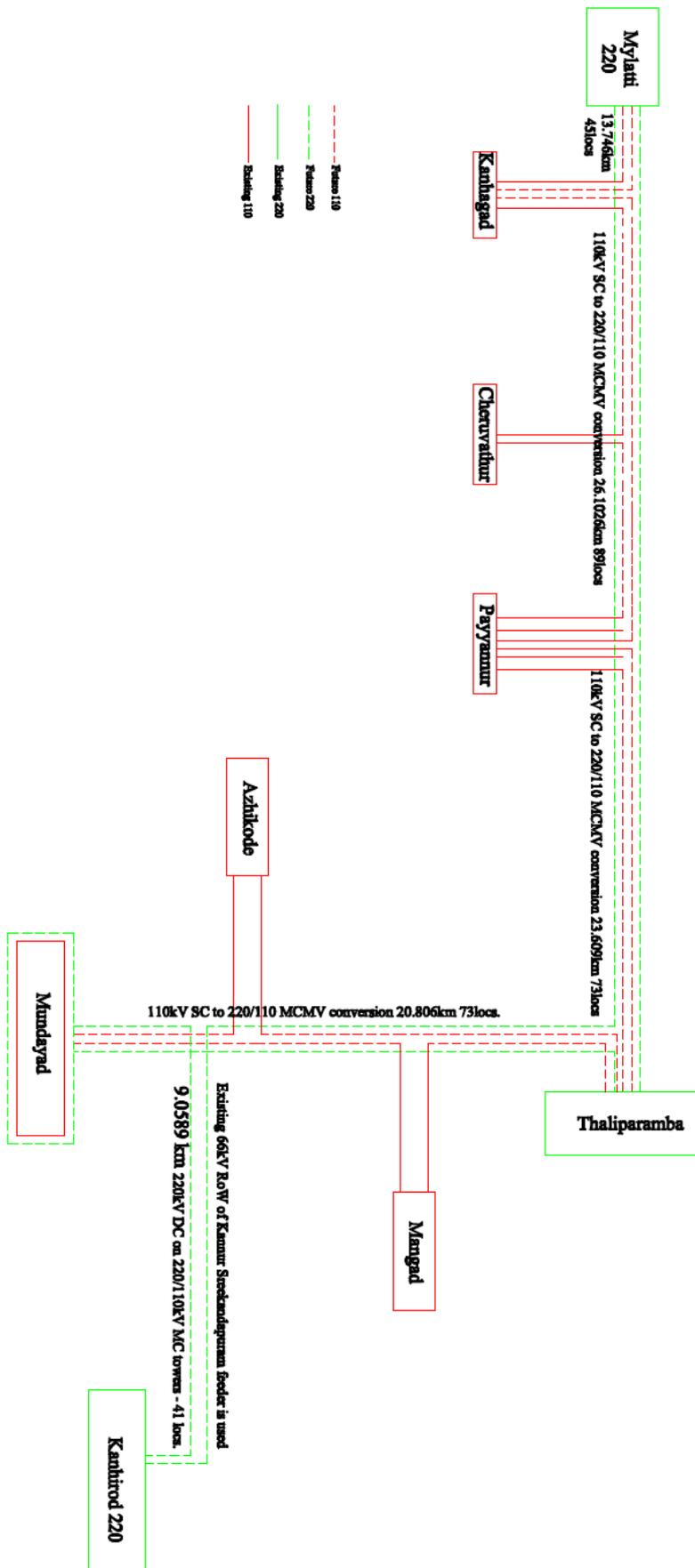
LIST OF ACCESSORIES			
NO.	Name	Falling load (KN)	Q-ty Material
1	U-clamp		1 Q235
2	Download Clamp		1 Aluminium Alloy

PROJECT			
Shenzhen Hope Technology Holding CO.,LTD.		Date	Date
Chief of dept			
Group leader			
Checked			
Designer		OM	Date 2014.04.14
		DWG.NO.	TGY240T-00
		TITLE	Download clamps for double OP-GWs
			TGY 240-T



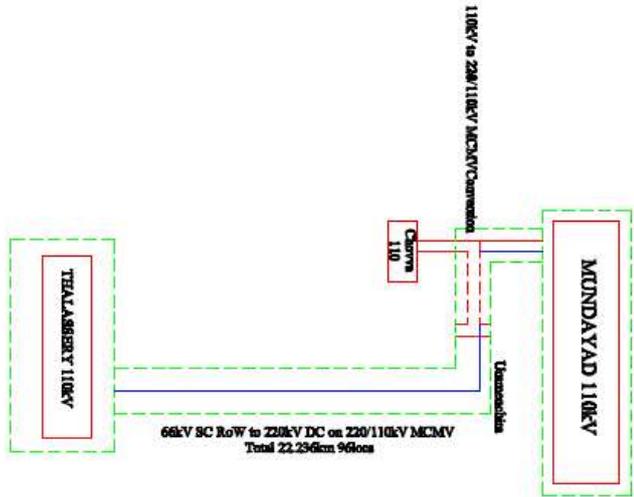
ANNEXURE - A
BLOCK DIAGRAM REPRESENTATION FOR KOLATHUNAD AND NORTH MALABAR
LINES PACKAGE

TRANSGRID 2.0 KOLATHUNAD PACKAGE NETWORK DIAGRAM

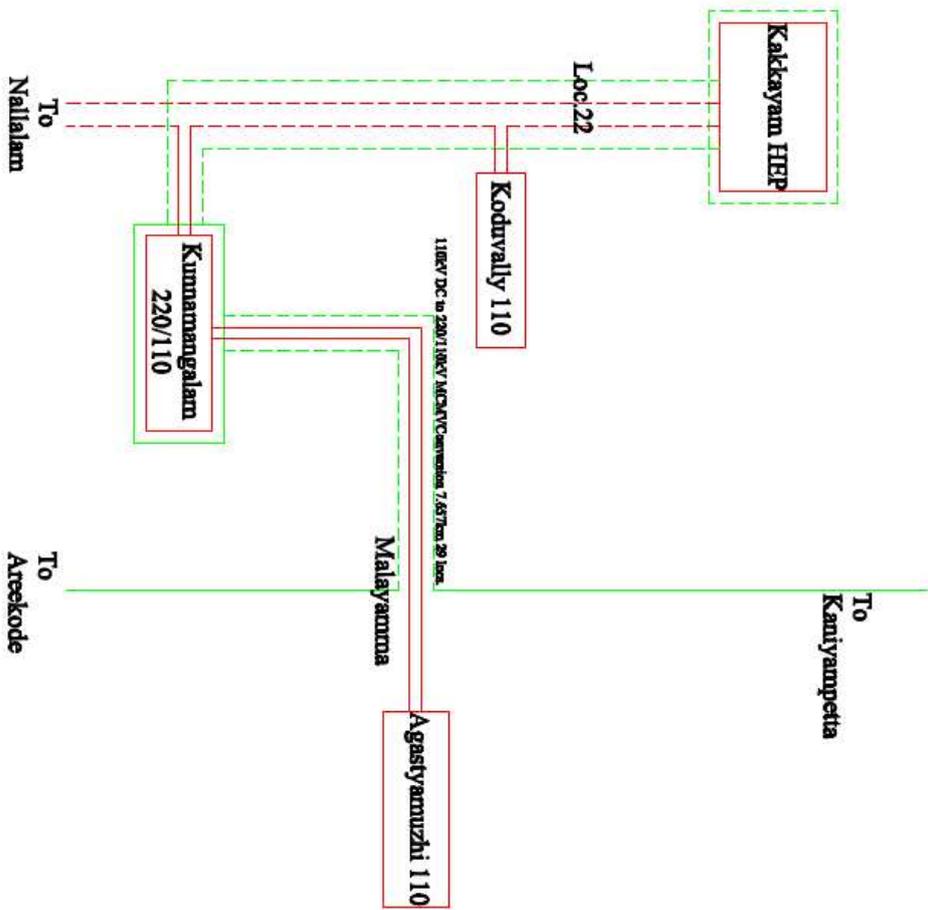


NORTH MALABAR LINES PACKAGE NETWORK DIAGRAM

PROJECT A
MUNDAYAD - THALASSERY



PROJECT B
MALAYAMMA - KUNNAMANGALAM



ANNEXURE - B

LIST OF MATERIALS & SPARES FOR ALL LINE PACKAGE MATERIALS

ATTACHED SEPARATELY

ANNEXURE - C

ATTACHED SEPARATELY