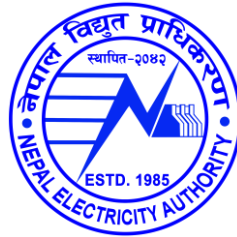


NEPAL ELECTRICITY AUTHORITY

(An Undertaking of Government of Nepal)

TRANSMISSION DIRECTORATE

HIGH VOLTAGE GRID DEVELOPMENT DEPARTMENT



KOSHI CORRIDOR 220kV TRANSMISSION LINE PROJECT

BIDDING DOCUMENT

FOR

**Procurement of Plant Design, Supply, Installation, Testing and
Commissioning of Second Circuit Stringing of Inaruwa-Basantapur-
Baneshwar-Tumlingtar 220 kV Transmission Line**

National Competitive Bidding (NCB)

(Single-Stage Two-Envelope Bidding Procedure)

Issued on:

Issued to:

Invitation for Bids No.: KOSHI/NEA/KC-5
NCB No.: KOSHI/NEA/KC-5
Employer: Nepal Electricity Authority
Country: Nepal

VOLUME I OF III

October 2025



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Abbreviations

BD	Bidding Document
BDF	Bidding Forms
BDS	Bid Data Sheet
BOQ	Bill of Quantities
COF	Contract Forms
DP	Development Partners
DoLI	Department of Local Infrastructure
e-GP	Electronic Government Procurement
ELI	Eligibility
EQC	Evaluation and Qualification Criteria
EXP	Experience
FIN	Financial
GCC	General Conditions of Contract
GoN ¹	Government of Nepal
ICC	International Chamber of Commerce
IFB	Invitation for Bids
ITB	Instructions to Bidders
JV	Joint Venture
LIT	Litigation
NCB	National Competitive Bidding
PAN	Permanent Account Number
PPA	Public Procurement Act
PPMO	Public Procurement Monitoring Office
PPR	Public Procurement Regulations
PL	Profit & Loss
PS	Provisional Sum
SBD	Standard Bidding Document
SCC	Special Conditions of Contract
TS	Technical Specifications
VAT	Value Added Tax
WRQ	Works Requirements

¹ “GoN” word indicates all public entities according to Public Procurement Act, 2063



Invitation for Bids

Nepal Electricity Authority

Transmission Directorate

High Voltage Grid Development Department

Koshi Corridor 220kV Transmission Line Project

Invitation for Bids (NCB)

Date of publication: 12th October, 2025

Invitation for Bids for the "**Procurement of Plant Design, Supply, Installation, Testing and Commissioning of Second Circuit Stringing of Inaruwa-Basantapur-Baneshwar-Tumlingtar 220 kV Transmission Line**"

Contract Identification No: **KOSHI/NEA/KC-5**

1. **Government of Nepal (GoN)/Nepal Electricity Authority (NEA) has allocated funds** towards the cost of **Koshi Corridor 220kV Transmission Line Project** and intends to apply part of the funds to cover eligible payments under the Contract **for Procurement of Plant Design, Supply, Installation, Testing and Commissioning of Second Circuit Stringing of Inaruwa-Basantapur-Baneshwar-Tumlingtar 220 kV Transmission Line**. Bidding is open to all eligible as per Section V of bidding document.
2. **NEA** invites electronic bids from eligible bidders for the construction of **Second Circuit Stringing of Inaruwa-Basantapur-Baneshwar-Tumlingtar 220 kV Transmission Line** under National Competitive Bidding – Single Stage Two Envelope Bidding procedures.

Only eligible bidders with the following key qualifications should participate in this bidding:

- Minimum Average Annual Construction Turnover of the best 3 years within the last 10 years: **NPR 833.5 million**
- Minimum Work experience of similar size and nature: at least One (1) Contract with a value of at least **NPR 1000 million**

Detailed qualification criteria of the bidder, sub-vendors (manufacturers) and construction period are more elaborately described in the bidding documents. The contract duration is **Twenty-four (24) months** from the date of contract effectiveness.

3. Under the Single Stage, Two Envelope Procedure, Bidders are required to submit their bid electronically, Bidders are required to submit two separate bid response documents, one containing (i) the Technical Bid and the other (ii) the Price Bid, as per the provision of ITB 21 of the Bidding Document.
4. Eligible Bidders may obtain further information and inspect the Bidding Documents may visit PPMO e-GP system www.bolpatra.gov.np/egp.
5. Bidding Documents is available online and can be downloaded from e-GP system: <https://bolpatra.gov.np/egp>. Interested bidders shall register in the e-GP system and deposit the non-refundable fee of **NPR 20,000.00 (In words, Nepalese Rupees Twenty Thousand only)** for bidding document in the following Bank.

Name of the Bank: **Nabil Bank Ltd, Chyamasing**

Name of the Account: **NEA Koshi Corridor 220kV TLP**

Account No.: **00201017505582**

6. Pre-bid meeting shall be held at **Employer's address** at **12:00 Hrs NST on 31st October, 2025**.
7. Sealed or electronic bids must be submitted through PPMO's e-GP system

www.bolpatra.gov.np/egp on or before **12:00 Hrs NST** on **18th November, 2025**. Bids received after this deadline will be rejected.

8. The bids will be opened in the presence of Bidders' representatives who choose to attend at **13:00 Hrs NST** on **18th November, 2025** at the office of *address below*. Bids must be valid for a period of **120 days** from the bid submission deadline and must be accompanied by a bid security or scanned copy of the bid security in pdf format in case of e-bid, amounting to a minimum of **NPR 41,500,000/- (In words Forty-one million Five Hundred Thousand only)**, which shall be valid for 30 days beyond the validity period of the bid (*i.e. 16th April, 2026*).
9. If the last date of purchasing and /or submission falls on a government holiday, then the next working day shall be considered as the last date. In such case the validity period of the bid and bid security shall remain the same as specified for the original last date of bid submission.
10. In the case of discrepancies or error in bid documents, bid notice or any other document, NEA reserves the right to amend and correct at any time.
11. After the completion of evaluation of Technical Bid for substantial responsiveness, substantially responsive bidders will be invited to attend the opening of Price Bids.
12. The date, time and location of opening of Price Bid shall be notified in writing and/or published in national daily. The contract will be awarded to the Bidder whose offer has been determined to be the lowest evaluated bid and is substantially responsive to the Bidding Documents.
13. The bidder shall bear all costs associated with the preparation and submission of its bid, and NEA will in no case be responsible or liable for these costs, regardless of the conduct or outcome of the bidding process.
14. NEA reserves the right to accept or reject any bid, and to annul the bidding process and reject all bids at any time prior to award of contract, without thereby incurring any liability to the affected bidder(s) or any obligation to inform the affected bidder(s) of the grounds for NEA's action.
15. The office address of the Employer:

Koshi Corridor 220kV Transmission Line project

Transmission Directorate

Nepal Electricity Authority

NEA Training Centre Building, Kharipati, Bhaktapur, Nepal

Telephone: **+977-1-6616865**

Electronic mail: koshi220kv@nea.org.np; koshi.kc5@gmail.com

Part I: BIDDING PROCEDURES

Section I: Instructions to Bidders (ITB)

This section specifies the procedures to be followed by Bidders in the preparation and submission of their Bids. Information is also provided on the submission, opening, and evaluation of bids and on the award of contract.

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Section I: Instructions to Bidders

A. General	
1. Scope of Bid	1.1 In connection with the Invitation for Bids indicated in the Bid Data Sheet (BDS), the Employer, as indicated in the BDS, issues this Bidding Document for the procurement of Works as specified in Section VI (Works Requirements). The name, identification, and number of lots (contracts) / multiple contracts of the National Competitive Bidding (NCB) are provided in the BDS. 1.2 Throughout this Bidding Document: (a) the term “in writing” means communicated in written form and delivered against receipt through e-GP system or email or fax or courier; (b) except where the context requires otherwise, words indicating the singular also include the plural and words indicating the plural also include the singular; and (c) “day” means calendar day.
2. Source of Funds	2.1 GoN Funded: In accordance with its annual program and budget, approved by the GoN, the implementing agency indicated in the BDS plans to apply a portion of the allocated budget to eligible payments under the contract(s) for which this Bidding Document is issued. Or Public Entities' own Resource Funded: In accordance with its annual program and budget, approved by the public entity, the implementing agency indicated in the BDS plans to apply a portion of the allocated budget to eligible payments under the contract(s) for which this Bidding Document is issued. Or DP Funded: The GoN has applied for or received financing (hereinafter called “funds”) from the Development Partner (hereinafter called “the DP”) indicated in the BDS toward the cost of the project named in the BDS. The GoN intends to apply a portion of the funds to eligible payments under the contract(s) for which this Bidding Document is issued. 2.2 DP Funded: Payment by the DP will be made only at the request of the GoN and upon approval by the DP in accordance with the terms and conditions of the financing agreement between the GoN and the DP (hereinafter called the “Loan/Grant Agreement”), and will be subject in all respects to the terms and conditions of that Loan/Grant Agreement. No party other than the GoN shall derive any rights from the Loan Agreement or have any claim to the funds.
3. Fraud and Corruption	3.1 Procuring Entities as well as Bidders, suppliers and contractors and their sub-contractors shall adhere to the highest standard of ethics during the procurement and execution of such contracts. In pursuance of this; (a) the Employer adopts, for the purposes of this provision, the terms as defined below:

(i) “corrupt practice” means the offering, giving, receiving, or soliciting, directly or indirectly, anything of value to influence improperly the actions of another party;

(ii) “fraudulent practice” means any act or omission, including a misrepresentation, that knowingly or recklessly misleads, or attempts to mislead, a party to obtain a financial or other benefit or to avoid an obligation;

(iii) “coercive practice” means impairing or harming, or threatening to impair or harm, directly or indirectly, any party or the property of the party to influence improperly the actions of a party;

(iv) “collusive practice” means an arrangement between two or more parties designed to achieve an improper purpose, including influencing improperly the actions of another party.

v) “obstructive practice” means (a) deliberately destroying, falsifying, altering, or concealing of evidence material to an investigation; (b) making false statements to investigators in order to materially impede an investigation; (c) failing to comply with requests to provide information, documents, or records in connection with an investigation; (d) threatening, harassing, or intimidating any party to prevent it from disclosing its knowledge of matters relevant to the investigation or from pursuing the investigation; or (e) materially impeding GoN/DP’s contractual rights of audit or access to information; and

vi) “integrity violation” is any act which violates Anticorruption Policy, including (i) to (v) above and the following: abuse, conflict of interest, violations of GoN/DP sanctions, retaliation against whistleblowers or witnesses, and other violations of Anticorruption Policy, including failure to adhere to the highest ethical standard.

(b) the Employer will reject a proposal for award if it determines that the Bidder recommended for award has, directly or through an agent, engaged in corrupt, fraudulent, collusive, coercive, or obstructive practices or other integrity violations in competing for the contract;

(c) DP will cancel the portion of the financing allocated to a contract if it determines at any time that representative(s) of the GoN/or of a beneficiary of DP-financing engaged in corrupt, fraudulent, collusive, or coercive practices or other integrity violations during the procurement or the execution of that contract, without the GoN having taken timely and appropriate action satisfactory to DP to remedy the situation.

d) DP will impose remedial actions on a firm or an individual, at any time, in accordance with DP’s Anticorruption Policy and related Guidelines (as amended from time to time), including declaring ineligible, either indefinitely or for a stated period of time, to participate in DP-financed, -administered, or -supported activities or to benefit from an DP-financed, -administered, or -supported contract, financially or otherwise, if it at any time determines that the firm or individual has, directly or through an agent, engaged in corrupt, fraudulent, collusive, coercive, or obstructive practices or other integrity

	violations; and (e) The Contractor shall permit the GoN/DP to inspect the Contractor's accounts and records relating to the performance of the Contractor and to have them audited by auditors appointed by the GoN /DP, if so, required by the GoN/DP. 3.2 The Bidder shall not carry out or cause to carry out the following acts with an intention to influence the implementation of the procurement process or the procurement agreement: (a) give or propose improper inducement directly or indirectly, (b) distortion or misrepresentation of facts, (c) engaging in corrupt or fraudulent practice or involving in such act, (d) interference in participation of other competing bidders, (e) coercion or threatening directly or indirectly to cause harm to the person or the property of any person to be involved in the procurement proceedings, (f) collusive practice among bidders before or after submission of bids for distribution of works among bidders or fixing artificial/uncompetitive bid price with an intention to deprive the Employer the benefit of open competitive bid price, (g) Contacting the Employer with an intention to influence the Employer with regards to the bids or interference of any kind in examination and evaluation of the bids during the period from the time of opening of the bids until the notification of award of contract. 3.3 PPMO, on the recommendation of the Procuring Entity may blacklist a Bidder for a period of one (1) to three (3) years for its conduct including on the following grounds and seriousness of the act committed by the bidder: (a) if convicted by a court of law in a criminal offence which disqualifies the Bidder from participating in the contract, (b) if it is established that the contract agreement signed by the Bidder was based on false or misrepresentation of Bidder's qualification information, (c) if it at any time determines that the firm has, directly or through an agent, engaged in corrupt, fraudulent, collusive, coercive, or obstructive practices in competing for, or in executing, a GoN/DP-financed contract. (d) if the Successful Bidder fails to sign the Contract. (e) if the bidder fails to inform about the saturation of maximum number of contracts as per ITB 4.10. 3.4 A bidder declared blacklisted and ineligible by the GoN, Public Procurement Monitoring Office (PPMO), by a competent authority under the prevailing law for failure to repay a loan disbursed by a bank or financial institution, and/or the DP in case of DP funded project, shall be ineligible to bid for a contract during the period of time determined by the GoN, PPMO, the competent authority, and/or the DP. 3.5 In case of a natural person or firm/institution/company which is already declared blacklisted and ineligible by the GoN, any other new or existing firm/institution/company owned partially or fully by such Natural person or Owner or Board of director of blacklisted firm/institution/company; shall not be eligible bidder.

	3.6 Furthermore, Bidders shall be aware of the provisions of GCC 28.3 and GCC 72.3(j).
4. Eligible Bidders	4.1 A Bidder may be a natural person, private entity, or government owned entity subject to ITB 4.5 or any combination of them in the form of a Joint Venture (JV) under an existing agreement, or with the intent to constitute a legally-enforceable joint venture. In the case of a JV: (a) all partners shall be jointly and severally liable for the execution of the Contract in accordance with the Contract terms. Maximum number of JV shall be as specified in the BDS and (b) the JV shall nominate a Representative who shall have the authority to conduct all business for and on behalf of any and all the parties of the JV during the bidding process and, in the event the JV is awarded the Contract, during Contract execution.
	4.2 A Bidder, and all parties constituting the Bidder, shall have the nationality of an eligible country, in accordance with Section V (Eligible Countries). A Bidder shall be deemed to have the nationality of a country if the Bidder is a citizen or is constituted, or incorporated, and operates in conformity with the provisions of the laws of that country. This criterion shall also apply to the determination of the nationality of proposed sub-contractors or suppliers for any part of the Contract including related services.
	4.3 A Bidder shall not have a conflict of interest. A Bidder found to have a conflict of interest shall be disqualified. A Bidder may be considered to be in a conflict of interest with one or more parties in this bidding process, if any of, including but not limited to, the following apply: (a) they have controlling shareholders in common; or (b) they receive or have received any direct or indirect subsidy from any of them; or (c) they have the same legal representative for purposes of this bid; or (d) they have a relationship with each other, directly or through common third parties, that puts them in a position to have access to material information about or improperly influence the Bid of another Bidder, or influence the decisions of the Employer regarding this bidding process; or (e) a Bidder participates in more than one bid in this bidding process either individually or as a partner in a joint venture. This will result in the disqualification of all Bids in which it is involved. However, subject to any finding of a conflict of interest in terms of ITB 4.3 (a)-(d) above, this does not limit the participation of the same subcontractor in more than one bid; or (f) a Bidder or any of its affiliated entity, participated as a consultant in the preparation of the design or technical specifications of the works that are the subject of the Bid; or (g) a Bidder was affiliated with a firm or entity that has been hired (or is proposed to be hired) by the Employer as Engineer for the Contract. (h) a Bidder that has a close business or family relationship with a professional

	staff of the Procuring Entity.
	4.4 A firm that is under a declaration of ineligibility by the GoN in accordance with ITB 3, at the date of the deadline for bid submission or thereafter, shall be disqualified. A firm shall not be eligible to participate in any procurement activities under an DP-financed, -administered, or -supported project while under temporary suspension or debarment by DP pursuant to the DP's Anticorruption Policy (see ITB 3), whether such debarment was directly imposed by the DP, or enforced by other DPs pursuant to the Agreement for Mutual Enforcement of Debarment Decisions. A bid from a temporary suspended or debarred firm will be rejected.
	4.5 Enterprises owned by Government shall be eligible only if they can establish that they are legally and financially autonomous and operate under commercial law, and that they are not a dependent agency of the GoN.
	4.6 Bidders shall provide such evidence of their continued eligibility satisfactory to the Employer, as the Employer shall reasonably request.
	4.7 Firms shall be excluded in any of the cases, if (a) by an act of compliance with a decision of the United Nations Security Council taken under Chapter VII of the Charter of the United Nations, Nepal prohibits any import of goods or contracting of works or services from that country or any payments to persons or entities in that country. Where Nepal prohibits payments to a particular firm or for particular goods by such an act of compliance, that firm may be excluded; (b) DP Funded: as a matter of law or official regulation, Nepal prohibits commercial relations with that country, provided that the DP is satisfied that such exclusion does not preclude effective competition for the supply of goods or related services required; (c) DP Funded: a firm sanctioned or temporarily suspended by the DP in relation to their guidelines or appropriate provisions on preventing and combating fraud and corruption in projects financed by them.
	4.8 In case a prequalification process has been conducted prior to the bidding process, this bidding is open only to prequalified Bidders.
	4.9 The Bidder, including all parties constituting the Bidder, shall be ineligible to participate in the open competitive bidding process if it has already secured maximum number of construction contracts (in open competitive bidding) as specified in BDS and has not yet completed the work as stipulated in the respective contracts
	4.10 For the purpose of ITB 4.9 above, the bidder shall declare that the bidder, and all parties constituting the Bidder have not already secured maximum number of construction contract (in open competitive bidding) as specified in BDS. If the bidder, and all parties constituting the Bidder has participated in bidding processes of many public entities and during that period the maximum number of contracts have been attained as specified saturates due to issuance of letters of acceptance by a particular public entity, the bidder shall inform in writing to all other concerned public entities, where the bidder have participated in bidding

	process, within three days of issuance of last letter of acceptance that saturates the maximum number of contracts as specified.
5. Eligible Materials, Equipment and Services	5.1 The materials, equipment and services to be supplied under the Contract shall have their origin in any source countries as defined in accordance with Section V (Eligible Countries) and all expenditures under the Contract will be limited to such materials, equipment, and services. At the Employer's request, Bidders may be required to provide evidence of the origin of materials, equipment and services.
	5.2 For purposes of ITB 5.1 above, "origin" means the place where the materials and equipment are mined, grown, produced or manufactured, and from which the services are provided. Materials and equipment are produced when, through manufacturing, processing, or substantial or major assembling of components, a commercially recognized product results that differs substantially in its basic characteristics or in purpose or utility from its components.
B. Contents of Bidding Documents	
6. Sections of Bidding Document	6.1 The Bidding Document consist of Parts I, II, and III, which include all the Sections indicated below, and should be read in conjunction with any Addenda issued in accordance with ITB 8. PART I Bidding Procedures Section I Instructions to Bidders (ITB) Section II Bid Data Sheet (BDS) Section III Evaluation and Qualification Criteria (EQC) Section IV Bidding Forms (BDF) Section V Eligible Countries PART II Requirements Section VI Works Requirements (WRQ) Section VII Bill of Quantities (BOQ) PART III Conditions of Contract and Contract Forms Section VIII General Conditions of Contract (GCC) Section IX Special Conditions of Contract (SCC) Section X Contract Forms (COF)
	6.2 The Invitation for Bids (IFB) issued by the Employer is not part of the Bidding Document.
	6.3 The Employer is not responsible for the completeness of the Bidding Document and their Addenda, if they were not obtained directly from the source stated by the Employer in the Invitation for Bids.
	6.4 The Bidder is expected to examine all instructions, forms, terms, and specifications in the Bidding Document and to furnish with its bid all information and documentation as is required by the Bidding Documents. Failure to furnish all information or documentation required by the Bidding Document may result in the rejection of the bid.
7. Clarification of Bidding Document, Site Visit, Pre-Bid Meeting	7.1 A prospective Bidder requiring any clarification of the Bidding Document shall contact the Employer in writing at the Employer's address indicated in BDS or raise any question or curiosity during the pre-bid meeting if provided for in accordance with ITB 7.4. The Employer will respond in writing to any

	request for clarification, provided that such request is received within the period as mentioned in ITB 7.5. The Employer shall forward copies of its response to all Bidders who have acquired the Bidding Document in accordance with ITB 6.3, including a description of the inquiry but without identifying its source. Should the Employer deem it necessary to amend the Bidding Document as a result of a request for clarification, it shall do so following the procedure under ITB 8 and ITB 22.2.
	7.2 The Bidder is advised to visit and examine the Site of Works and its surroundings and obtain for itself, on its own risk and responsibility, all information that may be necessary for preparing the bid and entering into a Contract for construction of the Works. The costs of visiting the Site shall be at the Bidder's own expense.
	7.3 The Bidder and any of its personnel or agents will be granted permission by the Employer to enter upon its premises and lands for the purpose of such visit, but only upon the express condition that the Bidder, its personnel, and agents will release and indemnify the Employer 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.
	7.4 The Bidder's designated representative is invited to attend a pre-bid meeting, if provided for in the BDS . The purpose of the meeting will be to clarify issues and to answer questions on any matter that may be raised at that stage.
	7.5 The Bidder is requested, to submit any questions in writing, to reach the Employer as mentioned in BDS .
	7.6 Minutes of the pre-bid meeting, including the text of the questions raised, without identifying the source, and the responses given, together with any responses prepared after the meeting, will be transmitted promptly to all Bidders who have acquired the Bidding Document in accordance with ITB 6.3. Any modification to the Bidding Document that 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 8 and not through the minutes of the pre-bid meeting.
	7.7 Nonattendance at the pre-bid meeting will not be a cause for disqualification of a Bidder.
8. Amendment of Bidding Document	8.1 At any time prior to the deadline for submission of bids, the Employer may amend the Bidding Document by issuing addendum or several addenda.
	8.2 Any addendum issued shall be part of the Bidding Document and shall be communicated in writing to all who have obtained the Bidding Document from the Employer in accordance with ITB 6.3.
	8.3 To give prospective Bidders reasonable time in which to take an addendum into account in preparing their Bids, the Employer may, at its discretion, extend the deadline for the submission of Bids, pursuant to ITB 22.2. However, the time available to submit bids shall not be less than five (5) days since amendment in

	bidding document.
C. Preparation of Bids	
9. Cost of Bidding	9.1 The Bidder shall bear all costs associated with the preparation and submission of its Bid, and the Employer shall in no case be responsible or liable for those costs, regardless of the conduct or outcome of the bidding process.
10. Language of Bid	10.1 The Bid, as well as all correspondence and documents relating to the bid exchanged by the Bidder and the Employer, shall be written in the language specified in the BDS . Supporting documents and printed literature that are part of the Bid may be in another language provided they are accompanied by an accurate translation of the relevant passages in the language specified in the BDS , in which case, for purposes of interpretation of the Bid, such translation shall govern.
11. Documents Comprising the Bid	11.1 The Bid shall comprise two envelopes submitted simultaneously, one called the Technical Bid containing the documents listed in ITB 11.2 and the other the Price Bid containing the documents listed in ITB 11.3, both envelopes enclosed together in an outer single envelope. 11.2 The Technical Bid shall comprise the following: (a) Letter of Technical Bid; (b) Bid Security in accordance with ITB 19; (c) alternative Technical Bid, at Bidder's option and if permissible, in accordance with ITB 13; (d) written confirmation authorizing the signatory of the Bid to commit the Bidder, in accordance with ITB 20.2; (e) documentary evidence in accordance with ITB 17, establishing the Bidder's qualifications to perform the contract; (f) Technical Proposal in accordance with ITB 16; (g) Bids submitted by a Joint Venture shall include a copy of the Joint Venture Agreement entered into by all partners. Alternatively, a Letter of Intent to execute a Joint Venture Agreement in the event of a successful Bid shall be signed by all partners and submitted with the Bid, together with a copy of the proposed agreement. The Joint Venture agreement, or letter of intent to enter into a Joint Venture including a draft agreement shall indicate at least the parts of the Works to be executed by the respective partners; (h) list of subcontractors, in accordance with ITB 34 (If any); and (i) Any other documents required in the BDS. 11.3 The Price Bid shall comprise the following: (a) Letter of Price Bid; (b) completed Bill of Quantities (BoQ), in accordance with ITB 12 and ITB 14, or as stipulated in the BDS; (c) alternative price Bids, at Bidder's option and if permissible, in accordance with ITB 13;

	(d) Table of Price adjustment (if applicable) ; and (e) Any other document required in the BDS .
	11.4 The Bidder is solely responsible for the authenticity of the submitted documents. 11.5 The Technical Bid shall not include any financial information related to the Price Bid. A Technical Bid containing such material financial information shall be declared non-responsive.
12. Letter of Bid and Schedules	12.1 The Letters of Technical Bid and Price Bid, Schedules, and all documents listed under ITB 11, shall be prepared using the relevant forms in Section IV (Bidding Forms) and in Section VII (Bill of Quantities). The forms must be completed without any alterations to the text, and no substitutes shall be accepted. All blank spaces shall be filled in with the information requested.
13. Alternative Bids	13.1 Unless otherwise specified in the BDS , alternative bids shall not be considered.
	13.2 When alternative times for completion are explicitly invited, a statement to that effect will be included in the BDS , as will the method of evaluating different times for completion.
	13.3 When specified in the BDS pursuant to ITB 13.1, and subject to ITB 13.4 below, Bidders wishing to offer technical alternatives to the requirements of the Bidding Document must first price the Employer's design as described in the Bidding Document and shall further provide all information necessary for a complete evaluation of the alternative by the Employer, including drawings, design calculations, technical specifications, breakdown of prices, and proposed construction methodology and other relevant details. Only the technical alternatives, if any, of the lowest evaluated Bidder conforming to the basic technical requirements shall be considered by the Employer.
	13.4 When specified in the BDS , Bidders are permitted to submit alternative technical solutions for specified parts of the Works. Such parts will be identified in the BDS and described in Section VI (Works Requirements). The method for their evaluation will be stipulated in Section III (Evaluation and Qualification Criteria).
14. Bid Prices and Discounts	14.1 The prices and discounts quoted by the Bidder in the Letter of Price Bid and in the Schedules shall conform to the requirements specified below.
	14.2 The Bidder shall submit a bid for the whole of the works described in ITB 1.1 by filling in prices for all items of the Works, as identified in Section VII (Bill of Quantities). In case of Unit Rate Contracts, the Bidder shall fill in rates and prices for all items of the Works described in the Bill of Quantities. Items against which no rate or price is entered by the Bidder will not be paid for by the Employer when executed and shall be deemed covered by the rates for other items and prices in the Bill of Quantities.
	14.3 The price to be quoted in the Letter of Price Bid shall be the total price of the Bid, excluding any discounts offered. Absence of the total price in the Letter of Price Bid may result in rejection of the Bid.
	14.4 The Bidder shall quote any discounts and the methodology for their application

	in the Letter of Price Bid, in accordance with ITB 12.1.
	14.5 If so indicated in ITB 1.1 and ITB 35.4, bids are invited for individual Contracts or for any combination of Contracts (packages). Bidders wishing to offer any price reduction for the award of more than one Contract shall specify in their bid the price reductions applicable to each package, or alternatively, to individual Contracts within the package. Price reductions or discounts shall be submitted in accordance with ITB 14.4, provided the Bids for all Contracts are submitted and opened at the same time.
	14.6 Unless otherwise provided in the BDS and the Conditions of Contract, the prices quoted by the Bidder shall be fixed. If the prices quoted by the Bidder are subject to adjustment during the performance of the Contract in accordance with the provisions of the Conditions of Contract, the Bidder shall furnish the indices and weightings for the price adjustment formulae in the Table of Adjustment Data in Section IV (Bidding Forms) and the Employer may require the Bidder to justify its proposed indices and weightings.
	14.7 All duties, taxes, and other levies payable by the Contractor under the Contract, or for any other cause, as of the date 30 days prior to the deadline for submission of bids, shall be included in the rates and prices and the total bid price submitted by the Bidder.
15. Currency of Bid and Payment	15.1 The currency of the bid and payment shall be in Nepalese Rupees.
16. Documents Comprising the Technical Proposal	16.1 The Bidder shall furnish a Technical Proposal including a statement of work methods, equipment, personnel, schedule and any other information as stipulated in Section IV (Bidding Forms), in sufficient detail to demonstrate the adequacy of the Bidders' proposal to meet the work requirements and the completion time.
17. Documents Establishing the Qualifications of the Bidder	17.1 To establish its qualifications to perform the Contract in accordance with Section III (Evaluation and Qualification Criteria) the Bidder shall provide the information requested in the corresponding information sheets included in Section IV (Bidding Forms).
18. Period of Validity of Bids	18.1 Bids shall remain valid for the period specified in the BDS . The bid validity period shall start from the bid submission deadline as prescribed by the Employer in accordance with ITB 22.1. If the prescribed bid submission deadline date falls on a government holiday, then the next working day shall be considered as the bid submission deadline date. In such case the validity period of the bids shall be considered from the original bid submission deadline date. In the case of electronic bid submission, if any technical issue arises in the handling of the e-GP system, the PPMO may extend the deadline for bid submission. However, the validity period of the bids shall still be counted from the original bid submission deadline. A bid valid for a shorter period shall be rejected by the Employer as nonresponsive.
	18.2 In exceptional circumstances, prior to the expiration of the bid validity period,

	the Employer may request Bidders to extend the period of validity of their Bids. The request and the responses shall be made in writing. If a bid security is requested in accordance with ITB 19, it shall also be extended 30 days beyond the deadline of the extended validity period. A Bidder may refuse the request without forfeiting its bid security. A Bidder granting the request shall not be required or permitted to modify its Bid and to include any additional conditions against the provisions specified in Bid Documents.
19. Bid Security	19.1 The Bidder shall furnish as part of its bid, in original form, a bid security as specified in the BDS. In case of e-submission of bid, the Bidder shall upload scanned copy of Bid security letter at the time of electronic submission of the bid. The Bidder accepts that the scanned copy of the Bid security shall, for all purposes, be equal to the original. The details of original Bid Security and the scanned copy submitted with e-bid should be the same otherwise the bid shall be non-responsive. 19.2 The bid security shall be, at the Bidder's option, in any of the following forms: (a) an unconditional bank guarantee from Commercial Bank or Financial Institution eligible to issue Bank Guarantee as per prevailing Law or; (b) a cash deposit voucher in the Employer's Account as specified in BDS. In the case of a bank guarantee, the bid security shall be submitted either using the Bid Security Form included in Section IV (Bidding Forms) or in another Form acceptable to the employer. The form must include the complete name of the Bidder. The bid security shall be valid for minimum thirty (30) days beyond the original validity period of the bid, or beyond any period of extension if requested under ITB 18.2. A bid security valid for a shorter period shall be rejected by the Employer as nonresponsive. 19.3 The bid security issued by any foreign Bank outside Nepal must be counter guaranteed by Commercial Bank or Financial Institution eligible to issue Bank Guarantee as per prevailing Law in Nepal. 19.4 Any bid not accompanied by an enforceable and substantially compliant bid security shall be rejected by the Employer as nonresponsive. In case of e-Submission, if the scanned copy of an acceptable Bid Security letter is not uploaded with the electronic Bid then Bid shall be rejected. 19.5 The public entity shall return the bid securities except those that are to be forfeited as per ITB 19.6 to the respective bidders within three (3) days after the successful bidder has furnished the required performance security and signed the Contract Agreement pursuant, to ITB 40.1 and ITB 41.1. 19.6 The bid security shall be forfeited if: GoN funded: (a) a Bidder requests for withdrawal or modification of its bid, except as provided in ITB 18.2: (i) during the period of bid validity specified by the Bidder on the Letter of

	Technical Bid and Price Bid, in case of electronic submission; (ii) from the period twenty-four hours prior to bid submission deadline up to the period of bid validity specified by the Bidder on the Letter of Technical Bid and Price Bid, in case of hard copy submission. (b)a Bidder changes the prices or substance of the bid while providing information pursuant to clause 27.1; (c) a Bidder involves in fraud and corruption pursuant to clause 3.1; (d) the successful Bidder fails to: (i) furnish a performance security in accordance with ITB 35.5 and ITB 40.1; or (ii) sign the Contract in accordance with ITB 41.1; or (iii) accept the correction of arithmetical errors pursuant to clause 33.1 DP funded: The bid security shall be forfeited (a) if a Bidder withdraws its bid during the period of bid validity specified by the Bidder on the Letters of Technical Bid and Price Bid, except as provided in ITB 18.2; or (b) if the successful Bidder fails to (i) furnish a performance security in accordance with ITB 35.5 and ITB 40.1; or (ii) sign the Contract in accordance with ITB 41.1; or (iii) accept arithmetical corrections in accordance with ITB 33.1; 19.7 The Bid Security of a Joint Venture shall be in the name of the Joint Venture that submits the bid. If the Joint Venture has not been legally constituted at the time of bidding, the Bid Security shall be in the names of all future partners as named in the letter of intent mentioned in ITB 4.1.
20. Format and Signing of Bid	20.1 The Bidder shall prepare one original set of the Technical Bid and one original of the Price Bid comprising the Bid as described in ITB 11 and clearly mark it “ORIGINAL – TECHNICAL BID” and “ORIGINAL – PRICE BID.” Alternative bids, if permitted in accordance with ITB 13, shall be clearly marked “ALTERNATIVE”. In addition, the Bidder shall submit copies of the bid in the number specified in the BDS, and clearly mark each of them “COPY.” In the event of any discrepancy between the original and the copies, the original shall prevail. In case of e-submission of bid, the Bidder shall submit his bid electronically in PDF or web forms files as specified in ITB Clause 21.1(b). 20.2 The original and all copies of the bid shall be typed or written in indelible ink and shall be signed by a person duly authorized to sign on behalf of the Bidder. This authorization shall consist of a written confirmation as specified in the BDS and shall be attached to the bid. The name and position held by each person signing the authorization must be typed or printed below the signature. All pages of the bid, except for un amended printed literature, shall be signed or initialed by

	the person signing the bid.
	20.3 Any amendments such as interlineations, erasures, or overwriting shall be valid only if they are signed or initialed by the person signing the bid.
D. Submission and Opening of Bids	
21. Sealing and Marking of Bids	21.1 Unless otherwise specified in BDS, Bidders shall submit their bids by electronic or by mail/by hand/by courier. Procedures for submission, sealing and marking are as follows: (a) Bidders submitting bids by mail, by hand or by courier shall enclose the original of the Technical Bid, and the original of the Price Bid and each copy of the Technical Bid and Price Bid, including alternative bids, if permitted in accordance with ITB 13, in separate sealed envelopes, duly marking the envelopes as “ORIGINAL TECHNICAL BID”, “ORIGINAL – PRICE BID”, “ALTERNATIVE” and “COPY No. – TECHNICAL BID” and “COPY NO. PRICE BID” These envelopes containing the original and the copies shall then be enclosed in one single envelope. (b) Bidders submitting Bids electronically shall follow the electronic bid submission procedure specified in this clause. - The bidder is required to register in the e-GP system https://www.bolpatra.gov.np/egp following the procedure specified in e-GP guideline. - Interested bidders may either purchase the bidding document from the Employer's office as specified in the Invitation for Bid (IFB) or bidders may download the IFB and bidding document from e-GP system. - The registered bidders need to maintain their profile data required during preparation of bids. - In order to submit their bids, the cost of the bidding document can be deposited as specified in IFB. In addition, electronic scanned copy (.pdf format) of the bank deposit voucher/cash receipt should also be submitted along with the technical bid. - The bidder can prepare their technical and price bids using data and documents maintained in bidder's profile and forms/format provided in bidding document by Employer. The bidder may submit bids as a single entity or as a joint venture. The bidder submitting bid in joint venture shall have to upload joint venture agreement along with partner(s) Bolpatra ID provided during bidder's registration. - Bidders (all partners in case of JV) should update their profile data and documents required during preparation and submission of their technical bids. - In case of bid submission in JV, the consent of the partners shall be obtained through the confirmation link sent to the registered email address and the partners shall have to acknowledge their confirmation.

The required forms and documents shall be part of technical bids.

No.	Document	Requirement	Remarks
1.	Letter of Technical Bid	Mandatory	PDF
2.	Bid Security / Bank Guarantee	Mandatory	PDF
3.	Firm or Company registration Certificate	Mandatory	PDF
4.	VAT and PAN registration Certificate	Mandatory (for domestic bidders only)	PDF
5.	Business Registration Licence	Mandatory	PDF
6.	Tax Clearance Certificate/Tax return submission evidence/evidence of time extension	Mandatory (for domestic bidders only)	PDF
7.	Power of Attorney of Bid signatory	Mandatory	PDF
8.	Bank Voucher for cost of bid document	Mandatory	PDF
9.	Joint venture agreement	Mandatory in case of JV Bids Only	PDF
10.	Qualification Documents	Mandatory	Using profile data(financial details, contract details etc.) and Technical Proposal
11.	Additional documents] specified in ITB 11.2 (i)	Mandatory (If any)	PDF

The required forms and documents shall be part of price bids.

No.	Document	Requirement	Remarks
1.	Letter of Price Bid	Mandatory	PDF
2.	Completed Bill of Quantities (BoQ)	Mandatory	Online Forms
3.	Price Adjustment Table	Mandatory (If applicable)	Online Forms
4.	Additional Documents specified in ITB 11.3 (e)	Mandatory (If any)	PDF

Note:

- a) The documents specified as “Mandatory” should be included in e-submission and non-submission of the documents shall be considered as non-responsive bid.
- b) Bidders (all partners in case of JV) should verify/update their profile documents as appropriate for the specific bid before submitting their bid electronically.

viii. After providing all the details and documents, two separate bid response documents i.e technical bids and price bids will be generated from the system. Bidders are advised to download and verify the response

	documents prior to bid submission. ix. For verifying the authentic user, the system will send one time password (OTP) in the registered e-mail address of the bidder. System will validate the OTP and allow bidder to submit their bid. x. Electronically submitted bids can be modified and/or withdrawn through system. The bidder may modify their bids multiple times online within bid submission date and time specified in e-GP system. Once a Bid is withdrawn, bidder won't be able to submit another bid response for the same bid. xi. The Bidder / Bid shall meet the following requirements and conditions for e-submission of bids; aa) The e-submitted bids must be readable through PDF reader. bb) The facility for submission of bid electronically through e-submission is to promote transparency, non-discrimination, equality of access, and open competition in the bidding process. The Bidders are fully responsible to use the e- submission facility properly in e-GP system as per specified procedures and in no case the Employer shall be held liable for Bidder's inability to use this facility. cc) When a bidder submits electronic bid through the PPMO e-GP portal, it is assumed that the bidder has prepared the bid by studying and examining the complete set of the Bidding documents including specifications, drawings and conditions of contract. 21.2. The inner and outer envelopes shall: (aa) bear the name and address of the Bidder; (bb) be addressed to the Employer as provided in BDS 22.1; (cc) bear the specific identification of this bidding process indicated in BDS 1.1; and 21.3 The outer envelope and the inner envelope containing Technical Proposal shall bear a warning not to open before the time and date for the opening of Technical Bid in accordance with ITB 25.1. 21.4 The inner envelope containing the Price Bid shall bear a warning not to open until advised by the Employer in accordance with ITB 25.7 21.5 If all envelopes are not sealed and marked as required, the Employer will assume no responsibility for the misplacement or premature opening of the bid.
22. Deadline for Submission of Bids	22.1 Bids must be received by the Employer at the address and no later than the date and time indicated in the BDS. In case of e-submission, the standard time for e-submission is Nepal Standard Time as set out in the server. The e-procurement system will accept the e-submission of bid from the date of publishing of notice and will automatically not allow the e-submission of bid after the deadline for submission of bid. 22.2 The Employer may, at its discretion, extend the deadline for the submission of bids by amending the Bidding Document in accordance with ITB 8, in which case all rights and obligations of the Employer and Bidders previously subject to the deadline shall thereafter be subject to the deadline as extended.
23. Late Bids	23.1 The Employer shall not consider any bid that arrives after the deadline for

	submission of bids, in accordance with ITB 22. Any bid received by the Employer after the deadline for submission of bids shall be declared late, rejected, and returned unopened to the Bidder.
24. Withdrawal, and Modification of Bids	24.1 A Bidder may withdraw, or modify its bid- Technical or Price - after it has been submitted either in hard copy or by e-submission. Once a Bid is withdrawn, bidder shall not be able to submit another bid for this bidding process. Procedures for withdrawal or modification of submitted bids are as follows: (i) Bids submitted in Hard Copy GoN Funded: a) Bidders may withdraw or modify its bids by sending a written notice in a sealed envelope, duly signed by an authorized representative, and shall include a copy of the authorization in accordance with ITB 20.2. The corresponding modification of the bid must accompany the respective written notice. All notices must be: (aa) prepared and submitted in accordance with ITB 20 and ITB 21, and in addition, the respective envelopes shall be clearly marked “WITHDRAWAL”, “MODIFICATION”; and (bb) received by the Employer twenty; four hours prior to the deadline prescribed for submission of bids, in accordance with ITB 22. DP Funded: A Bidder may withdraw or modify its Bid – Technical or Price – after it has been submitted by sending a written notice, duly signed by an authorized representative, and shall include a copy of the authorization in accordance with ITB 20.2, (except that withdrawal notices do not require copies). The corresponding modification of the Bid must accompany the respective written notice. All notices must be i) prepared and submitted in accordance with ITB 20 and ITB 21 (except that withdrawal notices do not require copies), and in addition, the respective envelopes shall be clearly marked “WITHDRAWAL”, and “MODIFICATION”; and ii) received by the Employer prior to the deadline prescribed for submission of Bids, in accordance with ITB 22. ii) E-submitted bids. a) Bidder may submit modification or withdrawal prior to the deadline prescribed for submission of bids through e-GP system by using the forms and instructions provided by the system.
	24.2 Bids requested to be withdrawn in accordance with ITB 24.1 shall not be opened. In case of hard copy submission, the Bid will be returned unopened to the Bidders.
	24.3 The following provisions apply for withdrawal or modification of the Bids: GoN Funded: (i) In case of bids submitted in hard copy no bid shall be withdrawn or modified in the interval between 24 hours prior to the deadline for submission of bids and the expiration of the period of bid validity specified by the Bidder on the Letter of Bid or any extension thereof. (ii) In case of e-submitted bids no bids shall be withdrawn or modified in the interval between deadline for submission of bids and the expiration of the

	period of bid validity specified by the Bidder on the Letter of Technical Bid and Price Bid or any extension thereof. DP Funded: No Bid may be withdrawn or modified in the interval between the deadline for submission of Bids and the expiration of the period of bid validity specified by the Bidder on the Letters of Technical Bid and Price Bid or any extension thereof. 24.4 Except in case of any modification or correction in bid document made by procuring entity, Bidder may submit request for withdrawal or modification only one time. 24.5 In case of hard copy bid, no bid may be withdrawn if the bid has already been modified; except in case of any modification or correction in bid document by procuring entity. 24.6 Request for withdrawal or modification must be made through the same medium of submission. Request for withdrawal or modifications through different medium shall not be considered.
25. Bid Opening	25.1 The Employer shall open the Technical Bids in public at the address, on the date and time specified in the BDS in the presence of Bidders' designated representatives who choose to attend. The Price Bids will remain unopened and will be held in custody of the Employer until the specified time of their opening. If the Technical Bid and Price Bid are submitted together in one envelope, the Employer shall reject the Bid as nonresponsive. 25.2 The Employer shall download the e-submitted Technical Bid. The e-GP system allows the Employer to download the e-submitted technical bid only after bid opening date and time after login simultaneously by at least two members of the Bid Opening Committee. 25.3 Electronically submitted Technical Bid shall be opened at first in the same time and date as specified above. Electronic Bids shall be opened one by one and read out. The e-submitted technical bids must be readable through open standards interfaces. Unreadable and or partially submitted bid files shall be considered incomplete. 25.4 Thereafter, envelopes marked "WITHDRAWAL" shall be opened and read out and the envelope with the corresponding Bid shall not be opened, but returned to the Bidder. No bid withdrawal shall be Permitted unless the corresponding withdrawal notice contains a valid authorization to request the withdrawal and is read out at bid opening. Next, envelopes marked "MODIFICATION" shall be opened and read out with the corresponding bid. No Technical Bid and/or Price Bid modification shall be permitted unless the corresponding modification notice contains a valid authorization to request the modification and is read out and recorded at bid opening. Only the Technical Bid, both Original as well as Modification, are to be opened, read out, and recorded at the opening. Price Bids, both Original and Modification, will remain unopened in accordance with ITB 25.1. 25.5 All other envelopes holding the Technical Bid shall be opened one at a

	time, reading out: the name of the Bidder; whether there is a modification; the presence of a bid security and any other details as the Employer may consider appropriate. Only Technical Bids read out and recorded at bid opening shall be considered for evaluation. No bid shall be rejected at opening of Technical Bids except for late bids, in accordance with ITB 23.1. 25.6 The Employer shall prepare a record of the opening of Technical Bids that shall include, as a minimum: the name of the Bidder and whether there is a withdrawal, or modification; and the presence or absence of a bid security. The Bidders' representatives who are present shall be requested to sign the record. The omission of a Bidder's signature on the record shall not invalidate the contents and effect of the record. 25.7 At the end of the evaluation of the Technical Bids, the Employer will invite bidders who have submitted substantially responsive Technical Bids and who have been determined as being qualified for award to attend the opening of the Price Bids. The date, time, and location of the opening of Price Bids will be advised in writing by the Employer. Bidders shall be given at least 7 days' notice for the opening of Price Bids. 25.8 The Employer will notify Bidders in writing who have been rejected on the grounds of their Technical Bids being substantially nonresponsive to the requirements of the Bidding Document and return their Price Bids unopened. 25.9 The Employer shall conduct the opening of Price Bids of all Bidders who submitted substantially responsive Technical Bids, in the presence of Bidders' representatives who choose to attend at the address, on the date, and time specified by the Employer. The Bidder's representatives who are present shall be requested to sign a register evidencing their attendance. 25.10 All envelopes containing Price Bids shall be opened one at a time and the following read out and recorded: (a) the name of the Bidder; (b) whether there is a modification; (c) the Bid Prices, including any discounts and alternative offers; and (d) any other details as the Employer may consider appropriate. Only Price Bids, discounts, modifications, and alternative offers read out and recorded during the opening of Price Bids shall be considered for evaluation. No Bid shall be rejected at the opening of Price Bids. 25.11 The Employer shall prepare a record of the opening of Price Bids that shall include, as a minimum, the name of the Bidder, the Bid Price (per lot if applicable), any discounts, modifications and alternative offers. The Bidders' representatives who are present shall be requested to sign the record. The omission of a Bidder's signature on the record shall not invalidate the contents and effect of the record.
E. Evaluation and Comparison of Bids	

26. Confidentiality	26.1 Information relating to the examination, evaluation, comparison, and post-qualification of bids and recommendation of Contract award, shall not be disclosed to Bidders or any other persons not officially concerned with such process until information on Contract award is communicated to all Bidders. 26.2 Any attempt by a Bidder to influence the Employer in the evaluation of the bids or Contract award decisions may result in the rejection of its bid. 26.3 Notwithstanding ITB 26.2, from the time of bid opening to the time of Contract award, if any Bidder wishes to contact the Employer on any matter related to the bidding process, it may do so in writing.
27. Clarification of Bids	27.1 To assist in the examination, evaluation, and comparison of the Technical and Price Bids, the Employer may, at its discretion, ask any Bidder for a clarification of its Bid. Any clarification submitted by a Bidder that is not in response to a request by the Employer shall not be considered. The Employer's request for clarification and the response shall be in writing. No change in the substance of the Technical Bid or prices in the Price Bid shall be sought, offered, or permitted, except to confirm the correction of arithmetic errors discovered by the Employer in the evaluation of the Price Bids, in accordance with ITB 33. In case of e-submission of bid, upon notification from the employer, the bidder shall also submit the original of documents comprising the Technical and Price Bid as per ITB 11.2 and ITB 11.3 for verification of submitted documents for acceptance of the e-submitted bid. 27.2 If a Bidder does not provide clarifications of its Bid by the date and time set in the Employer's request for clarification, its Bid may be rejected.
28. Deviations, Reservations, and Omissions	28.1 During the evaluation of bids, the following definitions apply: (a) "Deviation" is a departure from the requirements specified in the Bidding Document; (b) "Reservation" is the setting of limiting conditions or withholding from complete acceptance of the requirements specified in the Bidding Document; and (c) "Omission" is the failure to submit part or all of the information or documentation required in the Bidding Document.
29. Examination of Technical Bid	29.1 The Employer shall examine the Technical Bid to confirm that all documents and technical documentation requested in ITB 11.2 have been submitted. If any of these documents or information (except alternative Technical Bid which is optional) is missing, the bid shall be rejected. 29.2 In case of e-submission bids, the Employer shall confirm that all the documents and information requested in ITB 21.1 have been submitted. If any of these documents or information is missing, the bid shall be rejected.
30. Determination of Responsiveness of	30.1 The Employer's determination of a Bid's responsiveness is to be based on the contents of the bid itself, as defined in ITB 11.2.

Technical Bid	30.2 A substantially responsive Technical Bid is one that meets the requirements of the Bidding Document without material deviation, reservation, or omission. A material deviation, reservation, or omission is one that, (a) if accepted, would: (i) affect in any substantial way the scope, quality, or performance of the Works specified in the Contract; or (ii) limit in any substantial way, inconsistent with the Bidding Document, the Employer's rights or the Bidder's obligations under the proposed Contract; or (b) if rectified, would unfairly affect the competitive position of other Bidders presenting substantially responsive bids. 30.3 The Employer shall examine the technical aspects of the Bid submitted in accordance with ITB 16, Technical Proposal, in particular, to confirm that all requirements of Section VI (Works Requirements) have been met without any material deviation, reservation or omission. 30.4 If a bid is not substantially responsive to the requirements of the Bidding Document, it shall be rejected by the Employer and may not subsequently be made responsive by correction of the material deviation, reservation, or omission. 30.5 In case of e-submission bids, the Employer evaluates the bid on the basis of the information in the electronically submitted bid files. If the Bidder cannot substantiate or provide evidence to establish the information provided in e-submitted bid through documents/ clarifications as per ITB Clause 27.1, the bid shall not be considered for further evaluation.
	30.6 In Case, a corruption case is being filed to Court against the Natural Person or Board of Director of the firm/institution /company or any partner of JV, such Natural Person or Board of Director of the firm/institution /company or any partner of JV such bidder's bid shall be excluded from the evaluation, if public entity receives instruction from Government of Nepal. 30.7 Except in case of e-submission, the Price Bid of the bidder, which is evaluated as substantially non-responsive in technical bid, shall be returned to the respective bidders.
31. Non-conformities Errors, and Omissions	31.1 Provided that a bid is substantially responsive, the Employer may waive any non-conformities in the bid that do not constitute a material deviation, reservation, or omission. 31.2 Provided that a Technical Bid is substantially responsive, the Employer may request that the Bidder submit the necessary information or documentation, within a reasonable period of time, to rectify nonmaterial nonconformities in the Technical Bid related to documentation requirements. Requesting information or documentation on such nonconformities shall not be related to any aspect of the Price Bid. Failure of the Bidder to comply with the request may result in the

	rejection of its bid.
	31.3 Provided that a Technical Bid is substantially responsive, the Employer shall rectify quantifiable nonmaterial nonconformities related to the Bid Price. To this effect, the Bid Price shall be adjusted, for comparison purposes only, to reflect the price of a missing or non-conforming item or component. The adjustment shall be made using the methods indicated in Section III (Evaluation and Qualification Criteria).
	31.4 If the monetary value of such non-conformities is found to be more than fifteen percent of the Bid Price of the bidder pursuant to ITB 31.3 , such bid shall be considered nonresponsive and shall not be involved in evaluation.
32 Eligibility and Qualification of the Bidder	32.1 The Employer shall determine to its satisfaction during the evaluation of Technical Bids whether Bidders meet the eligibility and qualifying criteria specified in Section III (Evaluation and Qualification Criteria).
	32.2 The determination shall be based upon an examination of the documentary evidence of the Bidder's qualifications submitted by the Bidder, pursuant to ITB 17.1.
	32.3 An affirmative determination shall be a prerequisite for the opening and evaluation of a Bidder's Price Bid. A negative determination shall result into the disqualification of the Bid, in which event the Employer shall return the unopened Price Bid to the Bidder.
33. Correction of Arithmetical Errors	33.1 During the evaluation of Price Bids, the Employer shall correct arithmetical errors on the following basis: (a) only for unit price Contracts, if there is a discrepancy between the unit price and the total price that is obtained by multiplying the unit price and quantity, the unit price shall prevail and the total price shall be corrected, unless in the opinion of the Employer there is an obvious misplacement of the decimal point in the unit price, in which case the total price as quoted shall govern and the unit price shall be corrected; (b) if there is an error in a total corresponding to the addition or subtraction of subtotals, the subtotals shall prevail and the total shall be corrected; (c) If there is a discrepancy between the bid price in the Summary of Bill of Quantities and the bid amount in item (c) of the Letter of Price Bid, the bid price in the Summary of Bill of Quantities will prevail and the bid amount in item (c) of the Letter of Price Bid will be corrected. (d) If there is a discrepancy between words and figures, the amount in words shall prevail, unless the amount expressed in words is related to an arithmetic error, in which case the amount in figures shall prevail subject to (a), (b) and (c) above.
	33.2 If the Bidder that submitted the lowest evaluated bid does not accept the correction of errors, its bid shall be disqualified and its bid security shall be forfeited.
34 Subcontractors	34.1 In case of Prequalification, the Bidder's Bid shall name the same subcontractor as submitted in the prequalification application and approved by the Employer.

	In case of Post-qualification, the Employer may permit subcontracting for certain specialized works as indicated in Section III. When subcontracting is permitted by the Employer, the sub-contractor shall meet the qualifications criteria as indicated in section III. Sub-contractors' qualification and experience will not be considered for evaluation of the Bidder. The Bidder on its own (without taking into account the qualification and experience of the sub-contractor) should meet the qualification criteria. Bidders may propose subcontracting up to the percentage of total value of contracts or the volume of works as specified in the BDS.
35. Evaluation of Price Bids	35.1 The Employer shall use the criteria and methodologies listed in this Clause. No other evaluation criteria or methodologies shall be permitted.
	35.2 To evaluate a Price Bid, the Employer shall consider the following: (a) the bid price, excluding Value Added Tax, and Provisional Sums, in the Summary Bill of Quantities, for Unit Rate Contracts, or Schedule of Prices for lump sum Contracts, but including Day work items, where priced competitively; (b) adjustment for correction of arithmetic errors in accordance with ITB 33.1; (c) adjustment due to discounts offered in accordance with ITB 14.4; (d) adjustment for nonconformities in accordance with ITB 31.3; (e) application of all the evaluation factors indicated in Section III (Evaluation and Qualification Criteria);
	35.3 The estimated effect of the price adjustment provisions of the Conditions of Contract, applied over the period of execution of the Contract, shall not be taken into account in bid evaluation.
	35.4 If this Bidding Document allows Bidders to quote separate prices for different lots (Contracts), and to award multiple Contracts to a single Bidder as specified in BDS , the methodology to determine the lowest evaluated price of the Contract combinations, including any discounts offered in the Letter of Price Bid, is specified in Section III (Evaluation and Qualification Criteria).
	35.5 if the bid for an Unit Rate Contract, which results in the lowest Evaluated Bid Price is seriously unbalanced or front loaded or extremely low in the opinion of the Employer, the Employer may require the Bidder to produce detailed price analysis for any or all items of the Bill of Quantities, to demonstrate the internal consistency of those prices with the construction methods and schedule proposed. After evaluation of the price analysis, taking into consideration the schedule of estimated Contract payments, the Employer may require that the amount of the performance security be increased at the expense of the Bidder as mentioned in BDS to protect the Employer against financial loss in the event of default of the successful Bidder under the Contract or may consider the bid as non-responsive .

	35.6 In case of e-submission bids, the Employer evaluates the bid on the basis of the information in the electronically submitted bid files. If the Bidder cannot substantiate or provide evidence to establish the information provided in e-submitted bid through documents/ clarifications as per ITB Clause 27.1, the bid shall not be considered for further evaluation.
	35.7 In Case, a corruption case is being filed to Court against the Natural Person or Board of Director of the firm/institution /company or any partner of JV, such Natural Person or Board of Director of the firm/institution /company or any partner of JV such bidder's bid shall be excluded from the evaluation, if public entity receives instruction from Government of Nepal.
36. Comparison of Bids	36.1 The Employer shall compare all substantially responsive bids in accordance with ITB 35.2 to determine the lowest evaluated bid.
37. Employer's Right to Accept Any Bid, and to Reject Any or All Bids	37.1 The Employer reserves the right to accept or reject any bid, and to annul the bidding process and reject all Bids at any time prior to contract award, without thereby incurring any liability to Bidders. In case of annulment, all Bids submitted and specifically, bid securities, shall be promptly returned to the Bidders.
	37.2 The public entity shall give notice of the rejection of bids or the cancellation of the procurement proceedings pursuant to ITB 37.1, along with the reasons for such rejection or cancellation, to all bidders.
	37.3 Where any bidder requests, within thirty (30) days of the communication of the notice pursuant to ITB 37.2, the grounds for the rejection of all bids or the cancellation of the procurement proceedings, the public entity shall provide such information to that bidder.
F. Award of Contract	
38. Award Criteria	38.1 The Employer shall award the Contract to the Bidder whose offer has been determined to be the lowest evaluated bid and is substantially responsive to the Bidding Document, provided further that the Bidder is determined to be qualified to perform the Contract satisfactorily.
39. Letter of Intent to Award the Contract/Notification of Award	39.1 The Employer shall notify the concerned Bidder whose bid has been selected in accordance with ITB 38.1 within seven days of the selection of the bid, in writing that the Employer has intention to accept its bid and the information regarding the name, address and amount of selected bidder shall be given to all other bidders who submitted the bid.
	39.2 After issuance of the notice under ITB 39.1 if the concerned bidder provides information pursuant to ITB 4.10 regarding saturation of maximum number of contracts, the employer shall disqualify the bidder and shall select the next lowest evaluated Bidder in accordance with ITB 38.1 and notify accordingly as per ITB 39.1.
	39.3 If no bidder submits an application pursuant to ITB 42 within a period of seven days of the notice provided under ITB 39.1, the Employer shall, accept the bid selected in accordance with ITB 38.1 and Letter of Acceptance shall be communicated to the selected bidder prior to the expiration of period of Bid

	validity, to furnish the performance security and sign the contract within fifteen days. 39.4 After communicating letter of acceptance under ITB 39.3, if the concerned bidder provides information pursuant to ITB 4.10 regarding saturation of maximum number of contracts, the employer shall reject the bid of that bidder and shall select the next lowest evaluated Bidder in accordance with ITB 38.1 and shall issue the notice accordingly as per ITB 39.1. In such case bid security of the rejected bidder shall not be forfeited. 39.5 In Case, a corruption case is being filed to Court against the Natural Person or Board of Director of the firm/institution /company or any partner of JV, such Natural Person or Board of Director of the firm/institution /company or any partner of JV such bidder's bid shall be excluded from the evaluation, if public entity receives instruction from Government of Nepal.
40. Performance Security	40.1 Within Fifteen (15) days of the receipt of Letter of Acceptance from the Employer, the successful Bidder shall furnish the performance security in accordance with the Conditions of Contract, subject to ITB 35.5, as specified below from Commercial Bank or Financial Institution eligible to issue Bank Guarantee as per prevailing Law in Nepal using Sample Form for the Performance Security included in Section X (Contract Forms), or another form acceptable to the Employer. The performance security issued by any foreign Bank outside Nepal must be counter guaranteed by Commercial Bank or Financial Institution eligible to issue Bank Guarantee as per prevailing Law in Nepal. i) If bid price of the bidder selected for acceptance is up to 15 (fifteen) percent below the approved cost estimate, the performance security amount shall be 5 (five) percent of the bid price. ii) For the bid price of the bidder selected for acceptance is more than 15 (fifteen) percent below of the cost estimate, the performance security amount shall be determined as follows: Performance Security Amount = [(0.85 x Cost Estimate – Bid Price) x 0.5] + 5% of Bid Price. The Bid Price and Cost Estimate shall be without VAT and Contingencies but including Provisional Sum. 40.2 Failure of the successful Bidder to submit the above-mentioned Performance Security or to sign the Contract Agreement shall constitute sufficient grounds for the annulment of the award and forfeiture of the bid security. In that event the Employer may award the Contract to the next lowest evaluated Bidder whose offer is substantially responsive and is determined by the Employer to be qualified to perform the Contract satisfactorily. The process shall be repeated according to ITB 39.
41 Signing of Contract	41.1 The Employer and the successful Bidder shall sign the Contract Agreement within the period as stated ITB 40.1. 41.2 At the same time, the Employer shall affix a public notice on the result of the award on its notice board and make arrangement for causing such notice to be affixed on the notice board also of the <i>District Coordination Committee, District Administration Office, Provincial Treasury and Controller Office and District Treasury and Controller Office.</i> The Employer may make arrangements to post

	the notice into its website, if it has; and if it does not have, into the website of the Public Procurement Monitoring Office, identifying the bid and lot numbers and the following information: (i) the result of evaluation of bid; (ii) date of publication of notice inviting bids; (iii) name of newspaper; (iv) reference number of notice; (v) item of procurement; (vi) name and address of bidder making contract and (viii) contract price 41.3 Within thirty (30) days from the date of issuance of notification pursuant to ITB 39.1 unsuccessful bidders may request in writing to the Employer for a debriefing seeking explanations on the grounds on which their bids were not selected. The Employer shall promptly respond in writing to any unsuccessful Bidder who, requests for debriefing. 41.4 If the bidder whose bid has been accepted fails to sign the contract as stated ITB 40.1, the Public Procurement Monitoring Office shall blacklist the bidder on recommendation of the Public Entity.
42. Complaint and Review	42.1 If a Bidder is dissatisfied with the Procurement proceedings or the decision made by the Employer in opening of the price bid or the intention to award the Contract, it may file an application to the Chief of the Public Entity within Seven (7) days of providing the notice under ITB 25.8 and ITB 39.1 by the Public Entity, for review of the proceedings stating the factual and legal grounds. 42.2 Late application filed after the deadline pursuant to ITB 42.1 shall not be processed. 42.3 The chief of Public Entity shall, within five (5) days after receiving the application, give its decision with reasons, in writing pursuant to ITB 42.1: (a) whether to suspend the procurement proceeding and indicate the procedure to be adopted for further proceedings; or (b) to reject the application. The decision of the chief of Public Entity shall be final for the Bid amount up to the value as stated in 42.4. 42.4 If the Bidder is not satisfied with the decision of the Public Entity in accordance with ITB 42.3, or the decision is not given within five (5) days of receipt of application pursuant to ITB 42.1, it can, within seven (7) days of receipt of such decision, file an application to the Public Procurement Review Committee of the GoN, stating the reason of its disagreement on the decision of the chief of Public Entity and furnishing the relevant documents, provided that its Bid amount ,equal or more than Rupees Twenty Million (NRs. 20,000,000). The application may be sent by hand, by post, by courier, or by electronic media at the risk of the Bidder itself. 42.5 Late application filed after the deadline pursuant to ITB 42.4 shall not be processed. 42.6 Within three (3) days of the receipt of application from the Bidder, pursuant to ITB 42.4, the Public Procurement Review Committee shall notify the concerning Public Entity to furnish its procurement proceedings, pursuant to ITB 42.3.

	42.7 Within three (3) days of receipt of the notification pursuant to ITB 42.6, the Public Entity shall furnish the copy of the related documents to the Public Procurement Review Committee.
	42.8 The Public Procurement Review Committee, after inquiring from the Bidder and the Public Entity, if needed, shall give its decision within thirty (30) days of the receipt of the application filed by the Bidder, pursuant to ITB 42.4.
	42.9 The Bidder, filing application pursuant to ITB 42.4, shall have to furnish a cash amount or Bank guarantee from Commercial Bank or Financial Institution eligible to issue Bank Guarantee as per prevailing Law equivalent to ten percent (10 %) of amount of bid security in case of complaint against decision pursuant to ITB 25.8 and one percent (1%) of its quoted Bid amount in case of complaint against decision pursuant to ITB 39.1 with the validity period of at least ninety (90) days from the date of the filing of application pursuant to ITB 42.4.
	42.10 If the claim made by the Bidder pursuant to ITB 42.4 is justified, the Public Procurement Review Committee shall have to return the security deposit to the applicant, pursuant to ITB 42.9, within seven (7) days of such decision made.
	42.11 If the application submitted by the Bidder pursuant to ITB 42.4 is dismissed by the Public Procurement Review Committee, the security deposit (Cash or Bank Guarantee) submitted by the Bidder pursuant to ITB 42.9 shall be forfeited.

Section II: Bid Data Sheet

This section consists of provisions that are specific to each procurement and supplement the information or requirements included in Section I. Instructions to Bidders.

A. General	
ITB 1.1	The number of the Invitation for Bids is: KOSHI/NEA/KC-5
ITB 1.1	The Employer is: Nepal Electricity Authority
ITB 1.1	The number and identification of lots (contracts) comprising this bidding process is: Procurement of Plant Design, Supply, Installation, Testing and Commissioning of Second Circuit Stringing of Inaruwa-Basantapur-Baneshwar-Tumlingtar 220 kV Transmission Line The contract number is: KOSHI/NEA/KC-5
ITB 1.1	Multiple Contract or lots (contracts) is “not applicable”
ITB 2.1	The name of the Project is Koshi Corridor 220kV Transmission Line Project The DP is “not applicable” The implementing agency is Nepal Electricity Authority GoN Funded or DP Funded: GoN Funded
ITB 3.6	Delete the clause ITB 3.6. Add the clause ITB 3.6: Furthermore, Bidders shall be aware of the provisions of GCC 42.4(i). Also, The Contractor shall permit the GoN and/or persons appointed by the GoN to inspect the Site and/or the accounts and records of the Contractor and its sub-contractors relating to the performance of the Contract, and to have such accounts and records audited by auditors appointed by the GoN if required by the GoN. The Contractor’s attention is drawn to Sub-Clause GCC 6.1 which provides, inter alia, that acts intended to materially impede the exercise of the GoN’s inspection and audit rights provided for under this Sub-Clause constitute a obstructive practice subject to contract termination.
ITB 4.1 (a)	Maximum number of partners in a joint venture shall be: 3 (three)
ITB 4.4	For DP: Not Applicable
ITB 4.9 & ITB 4.10	For GoN Funded: The Bidder, including all parties constituting the Bidder, shall be ineligible to participate in the open competitive bidding process if it has already secured five (5) number of construction contracts (in open competitive bidding) and has not yet completed the work as stipulated in the respective contracts. Following Procurement of Works contracts shall not be counted for this purpose: a) The works for which tender were invited or contracts accepted before 2078-12-03 B.S (March 17, 2022 A.D). b) The works for which tender were invited and contracts accepted after 2078-12-03 B.S (March 17, 2022 A.D) but the work acceptance report has been approved according to Rule

	117 of PPR. c) The works for which tenders were invited or contracts accepted under all types of foreign assistance.
B. Bidding Document	
ITB 7.1	For clarification purposes only, the Employer's address is: The Project Manager Koshi Corridor 220kV Transmission Line Project NEA Training Center, Kharipati, Bhaktapur, Nepal Telephone: +977-1-6616891 Electronic Mail Address: koshi220kv@nea.org.np ; koshi.kc5@gmail.com
ITB 7.4	A Pre-Bid meeting "shall" be held. Pre-Bid Meeting will Take place at the following date, time and place: Date: 31 st October, 2025 Time: 12:00 Hrs NST Place: NEA Training Center, Kharipati, Bhaktapur, Nepal A site visit shall not be organized by the Employer.
ITB 7.5	Time for request: Requests for clarification should be received by the Employer no later than 10 days prior to the deadline for submission of bids.
C. Preparation of Bids	
ITB 10.1	The language of the bid is: English
ITB 11.2 (i)	The Bidder shall submit with its Technical Bid the following additional documents: 1) <i>Notarized Company Legal Firm Registration Certificate (Bidder and of each JV partner in the case of JV).</i> 2) <i>Notarized copy of Business Registration Certificate (Bidder and of each JV partner in the case of JV).</i> 3) <i>Notarized JV agreement if bidder in not a single firm or single entity.</i> 4) <i>Work Completion Certificate (on the letter head of the End-user) for all relevant projects completed with contact person's address and Tel no.</i> 5) <i>Audited Balance Sheet as per Section III: Evaluation and Qualification Criteria.</i> 6) <i>Manufacturer Authorization Letter for major items as mentioned in Section III – Evaluation and Qualification Criteria.</i> 7) <i>Tax Clearance Certificate for: last fiscal year 2080/81 (Bidder and of each JV partner in the case of JV).</i> 8) <i>PAN/VAT registration certificate (Bidder and of each JV partner in the case of JV).</i> 9) <i>Type Test Certificate for major items as mentioned in Section III – Evaluation and Qualification Criteria.</i>
ITB 11.3 (b)	In accordance with ITB 12 and ITB 14, the following schedules shall be submitted with the bid, including the priced Bill of Quantities for Unit Rate Contracts and Schedule of Prices for lump

	sum contracts: None
ITB 11.3 (e)	The Bidder shall submit with its Price Bid the following additional documents: None
ITB 13.1	Alternative bids shall not be permitted.
ITB 13.2	Alternative times for completion shall not be permitted.
ITB 13.4	Alternative technical solutions shall be permitted for the following parts of the Works: Not Applicable
ITB 14.6	The prices quoted by the Bidder shall not be subject to adjustment during the performance of the Contract.
ITB 18.1	The bid validity period shall be: One Hundred Twenty (120) days.
ITB 19.1	The Bidder shall furnish a bid security, from Commercial Bank or Financial Institution eligible to issue Bank Guarantee as per prevailing Law in Nepal with a minimum of NPR 41,500,000/- (In words Forty-one million Five Hundred Thousand only) , which shall be valid for 30 days beyond the validity period of the bid (i.e. 16 th April, 2026).
ITB 19.2 (b)	Office Name: Koshi Corridor 220kV Transmission Line Project Name of the Bank: Nabil Bank Ltd, Chyamasing Name of the Account: NEA Koshi Corridor 220kV TLP Account No.: 00201017505582
ITB 20.1	In addition to the original of the bid, the number of copy/ies is/are: Not Applicable
ITB 20.2	The written confirmation of authorization to sign on behalf of the Bidder shall indicate: (a) The name and description of the documentation required to demonstrate the authority of the signatory to sign the Bid such as a Power of Attorney; and (b) In the case of Bids submitted by an existing or intended JV, an undertaking signed by all parties (i) stating that all parties shall be jointly and severally liable, and (ii) nominating a Representative who shall have the authority to conduct all business for and on behalf of any and all the parties of the JV during the bidding process and, in the event the JV is awarded the Contract, during contract execution.
D. Submission and Opening of Bids	
ITB 21.1	Bidders shall have the option of submitting their bids by electronic only
ITB 22.1	For bid submission purposes only, the Employer's address is: No hardcopy submission permitted The deadline for bid submission is: Date: 18 th November, 2025 Time: 12:00 Hrs NST
ITB 25.1	The Technical Bid opening shall take place at: Address: NEA Training Center, Kharipati, Bhaktapur, Nepal Date: 18 th November, 2025 Time: 13:00 Hrs NST

E. Evaluation and Comparison of Bids	
ITB 34.1	Contractor's proposed subcontracting: Maximum percentage of subcontracting permitted is: 25% of the total contract amount without VAT but including PS. (Not applicable for manufacturer)
ITB 35.4	Bidders are <i>not permitted</i> to quote separate prices for lots (Contracts).
ITB 35.5	The amount of the performance security be increased by Eight (8) percent of the quoted bid price without VAT but Including PS.
ITB 41.4	For DP Funded: Not Applicable

Section III: Evaluation and Qualification Criteria

This Section contains all the criteria that the Employer shall use to evaluate bids and qualify Bidders by post-qualification exercise. GoN/DP requires bidders to be qualified by meeting predefined, precise minimum requirements. The method sets pass-fail criteria, which, if not met by the bidder, results in disqualification. In accordance with ITB 32 and ITB 35, no other methods, criteria and factors shall be used. The Bidder shall provide all the information requested in the forms included in Section IV (Bidding Forms).

1. Evaluation

In addition to the criteria listed in ITB 35.2 (a) - (e) the following criteria shall apply:

1.1 Adequacy of Technical Proposal

Evaluation of the Bidder's Technical Proposal will include an assessment of the Bidder's technical capacity, to mobilize key equipment and personnel for the contract consistent with its proposal regarding work methods, scheduling, and material sourcing in sufficient detail and fully in accordance with the requirements stipulated in Section VI (Works Requirements).

1.2 Multiple Contracts

Multiple Contracts, if permitted under ITB 35.4, will be evaluated as follows: ***“Not Applicable”***

1.3 In Case, other than Multiple Contracts

“Not Applicable”

1.4 Completion Time

An alternative Completion Time, if permitted under ITB 13.2, will be evaluated as follows:

“Not Applicable”

1.5 Alternative Technical Solutions

Alternative technical solutions, if permitted under ITB 13.4, will be evaluated as follows:

“Not Applicable”

1.6 Quantifiable Nonconformities and Omissions

Subject to ITB 14.2 and ITB 35.2, the evaluated cost of quantifiable nonconformities including omissions, is determined as follows:

“Pursuant to ITB 31.3, the cost of all quantifiable nonmaterial nonconformities shall be evaluated, but excluding omission of prices in the BoQ. The Employer will make its own assessment of the cost of any nonmaterial nonconformities and omissions for the purpose of ensuring fair comparison of bids.”

2. Qualification

2.1 Eligibility

Criteria	Compliance Requirements				Documents
Requirement	Single Entity	Joint Venture			Submission Requirements
		All Partners Combined	Each Partner	One Partner	
2.1.1 Nationality					
Nationality in accordance with ITB sub-clause 4.2	must meet requirement	must meet requirement	must meet requirement	not applicable	Letter of Technical Bid, Forms ELI –1; ELI –2 with attachments
2.1.2 Conflict of Interest					
No conflicts of interest in accordance with ITB Sub-Clause 4.3.	must meet requirement	existing or intended JV must meet requirement	must meet requirement	not applicable	Letter of Technical Bid
2.1.3 Government/ DP Eligibility					
Not having been declared ineligible by government /DP, as described in ITB Sub-Clause 4.4.	must meet requirement	must meet requirement	must meet requirement	not applicable	Letter of Technical Bid
2.1.4 Government-owned Entity					
Bidder required to meet conditions of ITB Sub-Clause 4.5.	must meet requirement	existing or intended JV must meet requirement	must meet requirement	not applicable	Letter of Technical Bid, Forms ELI - 1, ELI - 2, with attachments
2.1.5 UN Eligibility					

Not having been declared ineligible based on a United Nations resolution or Employer's country law, as described in ITB Sub-Clause 4.7.	must meet requirement	existing or intended JV must meet requirement	must meet requirement	not applicable	Letter of Technical Bid
2.1.6 Bidder's Running Contracts					
Bidders have not yet secured five (5) number of construction Contracts (in open competitive bidding) as described in ITB Sub-Clause 4.9.	must meet requirement	existing or intended JV must meet requirement	must meet requirement	not applicable	Letter of Technical Bid, Form ELI-3
2.1.7 Other Eligibility					
Firm or Company Registration Certificate	must meet requirement	not applicable	must meet requirement	not applicable	Document attachment
Business Registration License	must meet requirement	not applicable	must meet requirement	not applicable	Document attachment
VAT and PAN Registration certificate <i>(only for domestic bidders)</i>	must meet requirement	not applicable	must meet requirement	not applicable	Document attachment
Tax Clearance Certificate/Tax return submission evidence/evidence of time extension for the F/Y 2081/82	must meet requirement	not applicable	must meet requirement	not applicable	Document attachment

2.2 Pending Litigation

Criteria	Compliance Requirements				Documents
Requirement	Single Entity	Joint Venture			Submission Requirements
		All Partners Combined	Each Partner	One Partner	
2.2.1 Pending Litigation					
All pending litigation shall be treated as resolved against the Bidder and so shall in total not represent more than 50 percent of the Bidder's net worth.	must meet requirement by itself or as partner to past or existing JV	not applicable	must meet requirement by itself or as partner to past or existing JV	not applicable	Form LIT - 1

2.3 Financial Situation**2.3.1 Historical Financial Performance**

Submission of audited balance sheets and income statements, for the last 3 years to demonstrate the current soundness of the Bidder's financial position. As a minimum, a Bidder's net worth for the last year calculated as the difference between total assets and total liabilities should be positive.	must meet requirement	not applicable	must meet requirement	not applicable	Form FIN - 1 with attachments

2.3.2 Average Annual Construction Turnover

Minimum average annual construction turnover of NPR 833.5 million calculated as total certified payments received for construction contracts in progress or completed, within best three years out of last ten fiscal years.	must meet requirement	must meet requirement	must meet 25% of the requirement	must meet 40% of the requirement	Form FIN -2

Only the net amount shall be calculated after deducting the amount for VAT and such amount shall be adjusted to present value by applying wholesale price index of Nepal Rastra Bank.

2.3.3 Financial Resources

Using Forms FIN - 3 and FIN - 4 in Section IV (Bidding Forms) the Bidder must demonstrate access to, or availability of, financial resources such as liquid assets ² , unencumbered real assets, and other financial resources, (other than any contractual advance payments) to meet the cash-flow requirement of NPR139 million	must meet requirement	must meet requirement	must meet 25% of the requirement	must meet 40% of the requirement	Form FIN - 3

2.3.4 Required Bid Capacity

The bidding capacity of the bidder should be equal to or more than the NRs 1333.5 million	must meet requirement	must meet requirement	must meet 25% of the requirement	must meet 40% of the requirement	Form FIN - 4 and Form FIN - 5

2.4 Experience

Criteria	Compliance Requirements				Documents
Requirement	Single Entity	Joint Venture			Submission Requirement
		All Partners Combined	Each Partner	One Partner	
2.4.1 General Construction Experience					
Experience under construction contracts in the role of contractor, subcontractor, or management contractor for at least the last 5 years prior to the applications submission deadline.	must meet requirement	not applicable	must meet requirement	not applicable	Form EXP - 1

² Liquid Assets mean cash and cash equivalents, short-term financial instruments, short term available-for-sale-securities, marketable securities, trade receivables, short-term financing receivables and other assets that can be converted into cash within ONE YEAR.

Criteria	Compliance Requirements				Documents
Requirement	Single Entity	Joint Venture			Submission Requirement
		All Partners Combined	Each Partner	One Partner	
2.4.2 Specific Construction Experience					
(a) Contracts of Similar Size and Nature					
Participation as Prime contractor, management contractor, or subcontractor, within the last ten (10)) years, that have been successfully or are substantially* completed and that are similar to the proposed works. The similarity shall be based on the physical size, complexity, methods, technology or other characteristics as described Section VI, Employer’s Requirements.;	must meet requirement, in at least One (1) Contract with a value of at least NPR 1000 million	Must Meet Requirement as follows: I. Either one partner in at least One Contract with a value of at least NPR 1000 million OR II. JV partners in two contracts with a value of at least NPR 1000 million (total of two contracts).	not applicable	not applicable	Form EXP – 2(a)
<i>The similar to proposed works here shall mean the contracts of Transmission/distribution system.</i>					

Only the net amount shall be calculated after deducting the amount for VAT and such amount shall be adjusted to present value by applying wholesale price index of Nepal Rastra Bank.

* A contract for which a Taking-Over Certificate has been issued shall be considered as substantially completed.

Criteria	Compliance Requirements				Documents
Requirement	Single Entity	Joint Venture			Submission Requirement
		All Partners Combined	Each Partner	One Partner	

(b) Construction Experience in Key Activities					
Participation as Prime contractor, management or contractor,	must meet all requirement	must meet all requirements	not applicable	not applicable	Form EXP - 2(b)

subcontractor, within a last ten (10) years, For the above or other contracts stipulated in 2.4.2(a) above, in the following key activities that have been successfully or substantially completed: <i>supply, installation, testing and commissioning of transmission line stringing works of 132 kV or above voltage class having cumulative route length of at least 43 ckt-km for single conductor per phase stringing or 22 ckt-km per phase for bundle conductor stringing.</i>	S				

2.5 Personnel

The Bidder must demonstrate that it has the personnel for the key positions that meet the following requirements:

SN	Position	Required No.	Academic Qualification	Total Work Experience [Years]	Experience in Similar Works [years]
1.	Project Manager	1 (one)	Master's degree in Civil/ Electrical Engineering or Equivalent	10 (ten)	5 (five)
2.	Electrical Engineer	3 (Three)	Bachelor's degree in Electrical Engineering or Equivalent	5 (five)	3 (three)
3.	Civil Engineer	2 (Two)	Bachelor's degree in Civil Engineering or Equivalent	5 (five)	3 (three)
4.	Surveyor	1 (one)	Diploma in Surveying	5 (five)	3 (three)
5	Public relation officer (PRO)	3 (Three)	+2 or equivalent and preferably local person of affected transmission Line districts	10 (Ten)	7 (Seven)

In case the bidder proposes to consider Personnel that may be spared from committed/ongoing contracts for evaluation, the bidder shall provide details of personnel which will be spared from such committed/ongoing contracts based on the physical progress at the date of bid submission.

The Bidder shall provide details of the proposed personnel and their experience records in the relevant Information Forms included in Section IV (Bidding Forms). In case of PRO bidder may provide their details during contract negotiation.

2.6 Equipment

The Bidder must demonstrate that it has the key equipment listed hereafter:

No.	Equipment Type and Characteristics	Min. Number Requirement
1.	Four-wheeler vehicle	3 (three)
2.	Hydraulic Compression Tools	3 (three)
3.	Dynamometer 10T	3 (three)
4.	Winch – motorized/ manual of 10T capacity	3 (three)
5.	Tension stringing equipment of 10T capacity	2 (two)
6.	Drone	2 (two)
7.	Total Station	3 (three)

In case the Bidder proposes to consider Equipment that may be spared from committed/ongoing contracts for evaluation, the Bidder shall provide details of Equipment which will be spared from committed / ongoing contracts clearly demonstrating the availability of such equipment with respect to the physical progress of the ongoing contracts on the date of bid submission.

In case of Equipment to be leased/hired the same procedure as mentioned above shall apply.

The Bidder shall provide further details of proposed items of equipment using the relevant Form in Section IV (Bidding Forms)

2.7 Subcontractors

Subcontractors or Manufacturers for the following major items of plant and services must meet the following minimum criteria, herein listed for that item. Failure to comply with this requirement will result in rejection of the subcontractor but not the Bidder. **The Employer reserves right to choose/ select manufacturers from list of qualified manufacturers.**

Item No.	Description of Item	Minimum Criteria to be met
1	Disc Insulator	Must have designed manufactured, tested and supplied at least 12640 units 90kN and 196470 units 160kN Disc Insulators within last 5 years prior to bid opening
2	ACSR Conductor	Must have designed, manufactured, tested and supplied at least 2235 km ACSR Bear and above size conductor within last 5 years prior to bid opening
3	Galvanized Steel Earth wire	Must have designed, manufactured, tested and supplied at 216 km GS Earth wire within last 5 years prior to bid opening.
4	Insulator's Hardware	Must have designed, manufactured, tested and supplied at least 4258 units Insulator hardware and fittings for 220kV and above voltage class within last 5 years prior to bid opening
5	Conductor and earth wire accessories	Must have designed, manufactured, tested and supplied at least twice the units required for this contract within last 5 years prior to bid opening

Note:

- i) All the manufactures offered by the bidder must have manufacturing experience of at least 5 (Five) years prior to bid opening.

- ii) *The Bidder must submit evidence of business registration date, sales/supply record, ISO certificate, type-test certificate, end user certificate wherever applicable of the offered manufacturer to substantiate the experience of proposed manufacturers.*
- iii) *In the case of a Bidder who offers to supply and install major items of supply under the contract that the Bidder did not manufacture or otherwise produce, the Bidder must provide the manufacturer's authorization, using the form provided in Section IV (Bidding Forms), showing that the Bidder has been duly authorized by the manufacturer or producer of the related plant and equipment or component to supply and install that item in the Employer's country. The Bidder is responsible for ensuring that the manufacturer or producer complies with the requirements of ITB 4 and 5 and meets the minimum criteria listed above for that item.*
- iv) *The name of subcontractor(s)/manufacturer(s), designer(s) whom the Bidder proposes to engage for the execution of the contract shall be indicated in the Bid. Failure to comply with the minimum criteria stipulated above will result in the rejection of the named subcontractor(s)/manufacturer(s), designer(s), but the Bid shall not be rejected as the Bidder shall be required and allowed to substitute an acceptable designer, manufacturer or subcontractor without any change to the Bid Price. The Bidder is responsible for ensuring that the manufacturer or producer complies with the requirements of ITB 4 and 5 and meets the minimum criteria listed above for that item.*
- v) *The Bidder shall propose the type tested materials. The Successful Bidder shall also submit the type test certificates for each of the above-mentioned items. The type test report shall meet the minimum criteria set forth in Technical Specification of Section 6- Employers Requirement.*
- vi) *The offered equipment, plants and materials shall be in conformity with the specifications. In order to prove that the equipment, plants, and materials offered are of acceptable quality and standard and in conformity with the specifications, the Bidder shall furnish Documentary evidence in the form of literature, drawing and data and shall furnish.*
- vii) *The Bidder shall fill and submit the technical data sheet for all the major items with the bid as per Section V: Employer's works requirements.*

Section IV: Bidding Forms

This Section contains the forms which are to be completed by the Bidder and submitted as part of its Bid.

Letter of Technical Bid

The Bidder must accomplish the Letter of Technical Bid in its letter head clearly showing the Bidder's complete name and address.

Date:

Name of the contract:

Invitation for Bid No.:

To: **[Insert Complete name of Employer]**

We, the undersigned, declare that:

- (a) We have examined and have no reservations to the Bidding Documents, including Addenda issued in accordance with Instructions to Bidders (ITB) Clause 8.
- (b) We offer to execute in conformity with the Bidding Documents the following Works: **[Insert Description of the works]**
- (c) Our Bid consisting of the Technical Bid and the Price Bid shall be valid for a period of **[insert validity period as specified in ITB 18.1 of the BDS]** days from the date fixed for the bid submission deadline in accordance with the Bidding Documents, and it shall remain binding upon us and may be accepted at any time before the expiration of that period.
- (d) Our firm, including any subcontractors or suppliers for any part of the Contract, have nationalities from eligible countries in accordance with ITB 4.2 and meet the requirements of ITB 3.4, & ITB 3.5
- (e) We are not participating, as a Bidder or as a subcontractor, in more than one Bid in this bidding process in accordance with ITB 4.3(e), other than alternative offers submitted in accordance with ITB 13.
- (f) Our firm, its affiliates or subsidiaries, including any Subcontractors or Suppliers for any part of the contract, has not been declared ineligible by DP, under the Employer's country laws or official regulations or by an act of compliance with a decision of the United Nations Security Council;
- (g) [We are not a government owned entity] / [We are a government owned entity but meet the requirements of ITB 4.5];¹
- (h) We declare that, we including any subcontractors or suppliers for any part of the contract do not have any conflict of interest in accordance with ITB 4.3 and we have not been punished for an offense relating to the concerned profession or business.
- (i) We declare that we are solely responsible for the authenticity of the documents submitted by us. The document and information submitted by us are true and correct. If any document/information given is found to be concealed at a later date, we shall accept any legal actions by the Employer.
- (j) We agree to permit the Employer/DP or its representative to inspect our accounts and records and other documents relating to the bid submission and to have them audited by auditors appointed by

the Employer.

- (k) If our Bid is accepted, we commit to mobilizing key equipment and personnel in accordance with the requirements set forth in Section VI (Works Requirement) and our technical proposal, or as otherwise agreed with the Employer.
- (l) We declare that we have not yet secured five (5)³ number of construction contract (in open competitive bidding) as described in ITB Sub-Clause 4.9.

Name: *[insert complete name of the person signing the Bid]*.....

In the capacity of *[insert legal capacity of person signing the Bid]*.....

Signed *[signature of the person whose name and capacity are shown above]*.....

Duly authorized to sign the Bid for and on behalf of *[insert complete name of the Bidder]*.....

Date *[insert date of signing]*.....

¹ Note: Use one of the two options as appropriate.

³ Note: Following Procurement of Works contracts shall not be counted for this purpose:

- a) The works for which tender were invited or contracts accepted before 2078-12-03 B.S (March 17, 2022 A.D).
- b) The works for which tender have been invited and contracts accepted after 2078-12-03 B.S (March 17, 2022 A.D) but the work acceptance report has been approved according to Rule 117 of PPR.
- c) The works for which tenders were invited or contracts accepted under all types of foreign assistance.

Letter of Price Bid

The Bidder must accomplish the Letter of Price Bid in its letterhead clearly showing the Bidder's complete name and address.

Date:

Name of the contract:

Invitation for Bid No.:

To: **[Insert Complete name of Employer]**

We, the undersigned, declare that:

- (a) We have examined and have no reservations to the Bidding Documents, including Addenda issued in accordance with Instructions to Bidders (ITB) Clause 8;

We offer to execute in conformity with the Bidding Documents the following Works: **[Insert Description of the works]** .

- (c) The total price of our Bid, excluding any discounts offered in item (d) below is: **[Insert one of the options below as appropriate]** or when left blank is the Bid Price indicated in the Bill of Quantities.

Option 1, in case of single contract: Total price is: **[insert the total price of the Bid in words and figures]**;

Or

Option 2, in case of multiple lots (contracts): (i) Total price of each lot (contracts): **[insert the total price of each lot in words and figures]**; (ii) Total price of subject contract [say Lot1] and Lot2 [another contract] **[insert the total price in words and figures]**; (iii) Total price of subject contract [say Lot1] and Lot3 [another contract] **[insert the total price in words and figures]**; Total price of subject contract [say Lot1], Lot2 [another contract], Lot3 [another contract], ...**[insert the total price in words and figures]**;

- (d) The discounts offered and the methodology for their application for subject contract [single contract] are:..... [For Bidding Documents not provisioning multiple contracts]

Add following if Bidding Document provisions applicability of multiple contracts:

The discounts offered and the methodology for their application for subject contract [say Lot1] and Lot2 [another contract] are:.....

The discounts offered and the methodology for their application for subject contract [say Lot1] and Lot3 [another contract] are:.....

The discounts offered and the methodology for their application for subject contract [say Lot1], Lot2 [another contract] and Lot3 [another contract],....., are:.....

[Note:

1. Formulate possible combinations depending upon the number of lots under Bidding Process and modify accordingly Paragraph (c) and (d)]

(e) Our bid shall be valid for a period of ***[insert validity period as specified in ITB 18.1]*** days from the date fixed for the bid submission deadline in accordance with the Bidding Documents, and it shall remain binding upon us and may be accepted at any time before the expiration of that period;

(f) If our bid is accepted, we commit to obtain a performance security in accordance with the Bidding Document;

(g) We have paid, or will pay the following commissions, gratuities, or fees with respect to the bidding process or execution of the Contract:⁴

Name of Recipient	Address	Reason	Amount
.....			
.....			

(h) We understand that this bid, *together with your written acceptance thereof* included in your notification of award, shall constitute a binding contract between us, until a formal contract is prepared and executed;

(i) We understand that you are not bound to accept the lowest evaluated bid or any other bid that you may receive; and

(j) We declare that we are solely responsible for the authenticity of the documents submitted by us.

(k) We agree to permit the Employer/DP or its representative to inspect our accounts and records and other documents relating to the bid submission and to have them audited by auditors appointed by the Employer.

Name: ***[insert complete name of the person signing the Bid]***.....

In the capacity of ***[insert legal capacity of person signing the Bid]***.....

Signed ***[signature of the person whose name and capacity are shown above]***

Duly authorized to sign the Bid for and on behalf of ***[insert complete name of the Bidder]***.....

Date ***[insert date of signing]***.....

⁴ If none has been paid or is to be paid, indicate "None".

Table of Price Adjustment Data⁵

[To be used if Price Adjustment is applicable]

Code	Index Description	Source of Index*	Base Value and Date	Employer's Proposed Weighting Range (coefficient)	Bidder's Proposed Weighting (coefficient)**
1	2	3	4	5	6
	Non - Adjustable (A)			0.15	0.15
	Labor (b)				
	Materials (c)				
	Equipment usage (d)				
		Total			1.00

*Normally following source of index shall apply. Public Entity shall choose applicable Index for each item.

(a) Labor: "National Salary and Wage Rate Index"- "Construction Labor" of Nepal Rastra Bank or rate fixed by District Rate Fixation Committee

(b) Material: "National Wholesale Price Index" - Construction Materials" of Nepal Rastra Bank

(c) Equipment usage: "National Wholesale Price Index" - Machinery and Equipment" of Nepal Rastra Bank or "Fuel" Price fixed by Nepal Oil Corporation.

** Bidders proposed weightings should be within the range specified by the Employer in column - 5

⁵ Non-compliance of the data (stipulated by the bidder in this table) with requirements described here shall not be grounds for bid rejection and such non-compliance will be subject to clarification and rectification prior to contract award.

Table of Price Adjustment Data⁶

[To be used if Price Adjustment is applicable]

Code	Construction Material*	Unit	Base Price (NRs/Unit) (Ex-factory)	Source (Factory)**
1	2	3	4	5

* Major construction materials to be specified by Employer in column - 2.

** Base Price and source normally to be specified by Employer (or alternatively informed to be proposed by bidder) in column 4 and 5.

Note:

The base prices of the construction materials shall be taken as of 30 days before the deadline for submission of the Bid as quoted by the Bidder and verified by the Employer. For the purpose of calculation of price adjustment, the Ex-factory price of the same source shall be taken into consideration.

⁶ Non-compliance of the data (stipulated by the bidder in this table) with requirements described here shall not be grounds for bid rejection and such non-compliance will be subject to clarification and rectification prior to contract award.

Bid Security

Bank Guarantee

Bank's Name, and Address of Issuing Branch or Office

(On Letter head of the Bank)

Beneficiary:**[Insert name and address of Employer]**

Date: Bid Security No.:

We have been informed that, ... **[insert name of the Bidder]** (hereinafter called "the Bidder") intends to submit its bid (hereinafter called "the Bid") to you for the execution of **[Insert name of Contract]** under Invitation for Bids No. **[insert IFB No.]** ("the IFB").

Furthermore, we understand that, according to your conditions, bids must be supported by a bid guarantee.

At the request of the Bidder, we..... **[Insert name of Bank]** hereby irrevocably undertake to pay you any sum or sums not exceeding in total an amount of Nepalese Rupees . . . **[Insert amount in figures and amount in words]** upon receipt by us of your first demand in writing accompanied by a written statement stating that the Bidder is in breach of its obligation(s) under the bid conditions, because the Bidder:

(a) has withdrawn or modifies its Bid:

i) during the period of bid validity specified by the Bidder on the Letter of Technical and Price Bid, in case of electronic submission

(ii) from the period twenty-four hours prior to bid submission deadline up to the period of bid validity specified by the Bidder on the Letter of Technical Bid and Price Bid, in case of hard copy submission; or

(b) does not accept the correction of errors in accordance with the Instructions to Bidders (hereinafter "the ITB"); or

(c) changes the prices or substance of the bid while providing information pursuant to clause 27.1 of ITB; or

(d) having been notified of the acceptance of its Bid by the Employer during the period of bid validity, (i) fails or refuses to execute the Contract Agreement, or (ii) fails or refuses to furnish the performance security, in accordance with the ITB.

(e) is involved in fraud and corruption in accordance with the ITB

This guarantee will remain in force up to and including the date **number** days after the deadline for submission of Bids as such deadline is stated in the instructions to Bidders or as it may be extended by the Employer, notice of which extension(s) to the Bank is hereby waived. Any demand in respect of this guarantee should reach the Bank not later than the above date.

This Bank guarantee shall not be withdrawn or released merely upon return of the original guarantee by the Bidder unless notified by you for the release of the guarantee.

This guarantee is subject to the Uniform Rules for Demand Guarantees (URDG), 2010 Revisions, ICC Publication No. 758, except that the supporting statement under Article 15(a) is hereby excluded.

... **Bank's seal and authorized signature(s)** ...

Note:

The bid security of has been counter guaranteed by the Bank on (Applicable for Bid Security of Foreign Banks).

Technical Proposal Format

Personnel

Equipment

Site Organization

Method Statement

Mobilization Schedule

Construction Schedule

Others

Personnel

Form PER - 1: Proposed Personnel

Bidders should provide the names of suitably qualified personnel to meet the specified requirements for each of the positions listed in Section VI (Work Requirements). The data on their experience should be supplied using the Form below for each candidate.

No.	Name	Position*	Academic Qualification	Total Work Experience [Years]	Experience in Similar Works [years]
1.					
2.					
3.					
4.					
5.					

Form PER - 2: Resume of Proposed Personnel

The Bidder shall provide all the information requested below.

Position*		
Personal Information	Name	Date of Birth
	Professional qualifications	
Present employment	Name of employer	
	Address of employer	
	Telephone	Contact (manager/personnel officer)
	Fax	E-mail
	Job title	Years with present employer

Summarize professional experience over the last twenty years in reverse chronological order. Indicate particular technical and managerial experience relevant to the project.

From	To	Company, Project, Position and Relevant Technical and Management Experience

Equipment

Form EQU: Equipment

The Bidder shall provide adequate information to demonstrate clearly that it has the capability to meet the requirements for the key equipment listed in Section VI (Work Requirements). A separate Form shall be prepared for each item of equipment listed, or for alternative equipment proposed by the Bidder.

(i) For the equipment under Bidder's ownership

No.	Equipment Type and Characteristics	Total Nos. of Equipment under Bidder's Ownership	No. of Equipment engaged/proposed for ongoing/committed contracts	Nos. of Equipment proposed for this contract
1.				
2.				
3.				
4.				
5.				

(ii) For the Equipment to be leased/hired

No.	Equipment Type and Characteristics	Total Nos. of Equipment under the ownership of lease/hire provider	No. of Equipment engaged/committed for other works	Nos. of Equipment proposed to be leased/hired for this contract
1.				
2.				
3.				
4.				
5.				

Type of Equipment		
Equipment Information	Name of manufacturer	Model and power rating
	Capacity	Year of manufacture
Current Status	Current location	
	Details of current commitments	
Source	Indicate source of the equipment ☐ Owned ☐ Rented ☐ Leased ☐ Specially manufactured	

The following information shall be provided only for equipment not owned by the Bidder.

Owner	Name of owner	
	Address of owner	
	Telephone	Contact name and title
	Fax	email
Agreements	Details of rental / lease / manufacture agreements specific to the project	

The Bidder shall be solely responsible for the data provided. However, this shall not limit the right of Employer to verify the authenticity of submitted information.

Proposed Subcontractors and/or Manufacturers for Major Items of Plant and Services

The following Subcontractors and/or Manufacturers are proposed for carrying out the item of the facilities indicated. Bidders are free to propose more than one for each item.

Major Items of Plant and Services	Proposed Subcontractors or Manufacturers	Nationality

Manufacturer's Authorization

Date: *[insert date (as day, month and year) of bid submission]*

NCB No.: *[insert number of bidding process]*

To: *[insert complete name of the employer]*

WHEREAS

We *[insert complete name of the manufacturer or manufacturer's authorized agent]*, who are official manufacturers or agent authorized by the Manufacturer of *[insert type of goods manufactured]*, having factories at *[insert full address of manufacturer's factories]*, do hereby authorize *[insert complete name of the bidder]* to submit a bid the purpose of which is to provide the following goods, manufactured by us *[insert name and/or brief description of the goods]*, and to subsequently negotiate and sign the Contract.

We hereby extend our full guarantee and warranty in accordance with Clause 27 of the General Conditions of Contract, with respect to the goods offered by the above firm.

Signed: *[insert signature(s) of authorized representative(s) of the manufacturer]*

Name: *[insert complete name(s) of authorized representative(s) of the manufacturer]*

Title: *[insert title]*

Duly authorized to sign this Authorization on behalf of *[insert complete name of the manufacturer]*

Dated on _____ day of _____, _____ *[insert date of signing]*

-- Note --

The bidder shall require the manufacturer to fill out this form in accordance with the instructions indicated. This letter of authorization should be signed by a person with the proper authority to sign documents that are binding on the manufacturer. The bidder shall include it in its bid, if so indicated in the BDS.

Bidder's Information and Qualification Format

Site Organization

Method Statement

Mobilization Schedule

Construction Schedule

Others

Bidder's Qualification

To establish its qualifications to perform the contract in accordance with Section III (Evaluation and Qualification Criteria) the Bidder shall provide the information requested in the corresponding Information Sheets included hereunder.

Form ELI - 1: Bidder's Information Sheet

Bidder's Information	
Bidder's legal name	
In case of JV, legal name of each partner	
Bidder's country of constitution	
Bidder's year of constitution	
Bidder's legal address in country of constitution	
Bidder's authorized representative (name, address, telephone numbers, fax numbers, e-mail address)	
Attached are copies of the following original documents.	
1. In case of single entity, articles of incorporation or constitution of the legal entity named above, in accordance with ITB 4.1 and 4.2. 2. Authorization to represent the firm or JV named in above, in accordance with ITB 20.2. 3. In case of JV, letter of intent to form JV or JV agreement, in accordance with ITB 4.1. 4. In case of a government-owned entity, any additional documents not covered under 1 above required to comply with ITB 4.5.	

Form ELI - 2: JV Information Sheet

Each member of a JV must fill in this form

JV / Specialist Subcontractor Information	
Bidder's legal name	
JV Partner's or Subcontractor's legal name	
JV Partner's or Subcontractor's country of constitution	
JV Partner's or Subcontractor's year of constitution	
JV Partner's or Subcontractor's legal address in country of constitution	
JV Partner's or Subcontractor's authorized representative information (name, address, telephone numbers, fax numbers, e-mail address)	
Attached are copies of the following original documents.	
1. articles of incorporation or constitution of the legal entity named above, in accordance with ITB 4.1 and 4.2. 2. Authorization to represent the firm named above, in accordance with ITB 20.2. 3. In the case of government-owned entity, documents establishing legal and financial autonomy and compliance with commercial law, in accordance with ITB 4.5.	

Form ELI - 3: Bidder's Running Contracts⁷

Each member of a JV must fill in this form

Bidder's Running Contracts					
Name of office	Contract Identification no.	Source of Fund*	Date of issuance of Letter of Acceptance	Status of contract**	Date of Issuance of Taking Over Certificate***

* Mention GON funded or DP funded or Other PE (Insert name) funded

** Mention "Yet to sign" if contract is not signed, "Running" if contract has been signed and contract is running and "Substantially completed" if taking over certificate has been issued.

*** Insert date of issuance of taking over certificate if the awarded contract has been substantially completed and taking over certificate has been issued.

⁷:Note Following **Procurement of Works** contracts shall not be counted for this purpose

- The **works for** which **tender** were invited or **contracts** accepted before 2078-12-03 B.S (March 17, 2022 A.D).
- The **works for** which **tender** have been invited **and contracts accepted** after 2078-12-03 B.S (March 17, 2022 A.D) but the work acceptance report has been approved according to Rule 117 of PPR.
- The **works for which tenders were invited or** contracts **accepted** under all types of foreign assistance

Form LIT - 1: Pending Litigation

Each member of a JV must fill in this form

Pending Litigation			
☐ No pending litigation in accordance with Criteria 2.2 of Section III (Evaluation and Qualification Criteria) ☐ Pending litigation in accordance with Criteria 2.2 of Section III (Evaluation and Qualification Criteria)			
Year	Matter in Dispute	Value of Pending Claim in NRS	Value of Pending Claim as a Percentage on Net Worth

Form FIN - 1: Financial Situation

Each Bidder or member of a JV must fill in this form

Financial Data for Previous 3 Years [in NRS]		
Year 1 :	Year 2 :	Year 3 :

Information from Balance Sheet

Total Assets			
Total Liabilities			
Net Worth			
Current Assets			
Current Liabilities			

Information from Income Statement

Total Revenues			
Profit Before Tax			
Profit After Tax			
○ Attached are copies of financial statements (balance sheets including all related notes, and income statements) for the last three or above years, as indicated above, complying with the following conditions. ○ All such documents reflect the financial situation of the Bidder or partner to a JV, and not sister or parent companies. ○ Historic financial statements must be audited by a certified auditor. ○ Historic financial statements must be complete, including all notes to the financial statements. ○ Historic financial statements must correspond to accounting periods already completed and audited (no statements for partial periods shall be requested or accepted).			

Form FIN - 2: Average Annual Construction Turnover

Each Bidder or member of a JV must fill in this form

The information supplied should be the Annual Turnover of the Bidder or each member of a JV in terms of the amounts billed to clients for each year for work in progress or completed to NRs at the end of the period reported.

Annual Turnover Data for the Last 10 Years (Construction only)	
Year	Amount Currency

- **Average Annual Construction Turnover
(Best three years within the last 10 years)**

Form FIN - 3: Financial Resources

Specify proposed sources of financing, such as liquid assets, unencumbered real assets and other financial means, net of current commitments, available to meet the total construction cash flow demands of the subject contract or contracts as indicated in Section III (Evaluation and Qualification Criteria).

Financial Resources		
No.	Source of financing	Amount (in NRS)
1		
2		
3		

Form FIN – 4: Bid Capacity

Each Bidder or member of a JV must fill in this form

$$\text{Bid Capacity} = [(5 \times A) - B]$$

A = Average Annual Turnover of best three years out of last ten fiscal years.

B = Annual Value of the existing commitments and works (ongoing) to be completed, calculated from FIN-4.

SN	Name of Bidder	Pan No.	A, in Million	B, in Million	Bid Capacity, in Million
1					
2					
3					

Total Bid Capacity :

Signature of Bidder

Form FIN- 5: Current Contract Commitments / Works in Progress

Bidders and each partner to a JV should provide information on their current commitments on all contracts that have been awarded, or for which a letter of intent or acceptance has been received, or for contracts approaching completion, but for which an unqualified, full completion certificate has yet to be issued.

Current Contract Commitments (For Calculation of B with reference of FIN-3)									
No.	Name of Contract	Name of the Contractor/s	Employer's Contact Address, Tel, Fax	Contract Share in % (a)	Contract Amount in Millions (b)	Contract Date(yyyy-mm) (c)	Initial or Revised Contract Duration (months) (d)	Value of outstanding works [In Millions, NRS] [#] (e)	Estimated Time in Month to Complete the outstanding works (f) = (c) + (d) – Date of Invitation of Bid (f)
1									
2									
3									
4									

Signature of Bidder

The Outstanding Works means Contract Price (excluding Vat) minus Work Evaluated by Employer till the reference date. Bidder shall have to submit the relevant documentary evidence to substantiate the facts/figures.

Note 1: “B” shall be calculated as : $B = \sum \left[\frac{(e) \times (a)}{(f)} \right] \times 12$, If (f) is less than 12, then value of (f) shall be taken as 12.

Note 2: If Initial or Revised Contract Date is run out with respect to Date of Invitation of Bid, the Estimated Time in Month to Complete the outstanding works shall be taken equal to 12 months.

Form EXP - 1: General Construction Experience

Each Bidder or member of a JV must fill in this form.

General Construction Experience				
Starting Month Year	Ending Month Year	Year	Contract Identification and Name and Address of Employer Brief Description of the Works Executed by the Bidder	Role of Bidder

Form EXP - 2(a): Specific Construction Experience

Fill up one (1) form per contract.

Contract of Similar Size and Nature			
Contract No..... of.....	Contract Identification		
Award Date		Completion Date	
Role in Contract	☐ Contractor	☐ Management Contractor	☐ Subcontractor
Total Contract Amount	☐ NRS		
If Partner in a JV or subcontractor, specify participation of total contract amount	Percent of Total	Amount	
Employer's Name Address Telephone/Fax Number E-mail			
Description of the similarity in accordance with Criteria 2.4.2 (a) of Section III			
Note : <i>The Employer should insert here contract size, complexity, methods, technology, or other characteristics as described in Section III (EQC), 2.4.2 (a) against which the bidder demonstrates similarity in the box on the right-hand-side.</i>			

Form EXP - 2(b): Specific Construction Experience in Key Activities

Fill up one (1) form per contract.

Contract of Similar Size and Nature			
Contract No..... of.....		Contract Identification	
Award Date		Completion Date	
Role in Contract	☐ Contractor	☐ Management Contractor	☐ Subcontractor
Total Contract Amount	☐ NRS		
If Partner in a JV or subcontractor, specify participation of total contract amount	Percent of Total	Amount	
Employer's Name Address Telephone/Fax Number E-mail			
Description of the similarity in accordance with Criteria 2.4.2 (a) of Section III			
Note : <i>The Employer should insert here production rate(s) for the key activity (activities) subject contract against which the bidder demonstrates in the box on the right-hand-side production rates achieved by him on previous contracts.</i>			

Form EXP - 3: Subcontractors / Manufacturers

Fill out one (1) form per contract.

Contract for the Major Items		
Contract No of	Contract Identification	
Award Date		Completion Date
Role in Contract	☐ Supplier ☐ Contractor ☐ Subcontractor	
Total Contract Amount		
If partner in a Joint Venture or subcontractor, specify participation of total contract amount	Percent of Total	Amount
Employer's name Address Telephone number Fax number E-mail		
Description of the Major Items in Accordance with Criterion 2.7 of Section 3 (Evaluation and Qualification Criteria)		

Section V - Eligible Countries

For the purpose of ITB 4.2: “**Nepal**”; and

For the purpose of Country-of-Origin ITB 5.1 and GCC 1.1: “**all Countries**”

Part II: REQUIREMENTS

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Section VII: Bill of Quantities

Section VI: Employer's Requirements

This Section contains the Scope of Work, Specification, the Drawings, supplementary information that describe the Works to be procured,

(Please refer to Volume II of III, Technical Specification)

Scope of Work

(Please refer to Volume II of III, Technical Specification)

Specifications

(Please refer to Volume II of III, Technical Specification)

Drawings

(Please refer to Volume II of III)

Supplementary Information

(Please refer to Volume II of III)

Section VII: Bill of Quantities

Bill of Quantities

(Please refer to Volume III of III, Price Bid)

Part III: CONDITIONS OF CONTRACT AND CONTRACT FORMS

Section VIII - General Conditions of Contract

The GCC in this section, read in conjunction with the Special Conditions of Contract in Section 8 and other documents listed therein, should be a complete document expressing all the rights and obligations of the contracting parties. The General Conditions herein shall not be altered.

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General Conditions of Contract

A. Contract and Interpretation

1. Definitions

1.1 The following words and expressions shall have the meanings hereby assigned them:

“Contract” means the Contract Agreement entered into between the Employer and the Contractor, together with the Contract Documents referred to therein; they shall constitute the Contract, and the term “the Contract” shall in all such documents be construed accordingly.

“Contract Documents” means the documents listed in Article 1.1 (Contract Documents) of the Contract Agreement (including any amendments thereto).

“GCC” means the General Conditions of Contract.

“SCC” means the Special Conditions of Contract.

“day” means calendar day.

“year” means 365 days.

“month” means calendar month.

“Party” means the Employer or the Contractor, as the context requires.

“Employer” means the person named as such in the SCC and includes the legal successors or permitted assigns of the Employer.

“Project Manager” means the person appointed by the Employer in the manner provided in GCC Subclause 17.1 (Project Manager) hereof and named as such in the SCC to perform the duties delegated by the Employer.

“Contractor” means the person(s) named as Contractor in the Contract Agreement, and includes the legal successors or permitted assigns of the Contractor.

“Contractor’s Representative” means any person nominated by the Contractor and approved by the Employer in the manner provided in GCC Subclause 17.2 (Contractor’s Representative and Construction Manager) hereof to perform the duties delegated by the Contractor.

“Construction Manager” means the person appointed by the Contractor’s Representative in the manner provided in GCC Subclause 17.2.4.

“Subcontractor,” including manufacturers, means any person to whom execution of any part of the Facilities, including preparation of any design or supply of any Plant, is sub-contracted directly or indirectly by the Contractor, and includes its legal successors or permitted assigns.

“Dispute Board” means the person or persons named as such in the SCC appointed by agreement between the Employer and the Contractor to make a decision on or to settle any dispute or difference

between the Employer and the Contractor referred to him or her by the parties pursuant to GCC Subclause 45.1 (Dispute Board) hereof.

“The Bank” means the financing institution named in the SCC.

“Contract Price” means the sum specified in Article 2.1 (Contract Price) of the Contract Agreement, subject to such additions and adjustments thereto or deductions therefrom, as may be made pursuant to the Contract.

“Facilities” means the Plant to be supplied and installed, as well as all the Installation Services to be carried out by the Contractor under the Contract.

“Plant” means permanent plant, equipment, machinery, apparatus, articles and things of all kinds to be provided and incorporated in the Facilities by the Contractor under the Contract (including the spare parts to be supplied by the Contractor under GCC Subclause 7.3 hereof), but does not include Contractor’s Equipment.

“Installation Services” means all those services ancillary to the supply of the Plant for the Facilities, to be provided by the Contractor under the Contract, such as transportation and provision of marine or other similar insurance, inspection, expediting, site preparation works (including the provision and use of Contractor’s Equipment and the supply of all construction materials required), installation, testing, precommissioning, commissioning, operations, maintenance, the provision of operations and maintenance manuals, training, etc. as the case may require.

“Contractor’s Equipment” means all facilities, equipment, machinery, tools, apparatus, appliances, or things of every kind required in or for installation, completion and maintenance of Facilities that are to be provided by the Contractor, but does not include Plant, or other things intended to form or forming part of the Facilities.

“Country of Origin” means the countries and territories eligible under the rules of the Bank as further elaborated in the SCC.

“Site” means the land and other places upon which the Facilities are to be installed, and such other land or places as may be specified in the Contract as forming part of the Site.

“Effective Date” means the date of fulfillment of all conditions stated in Article 3 (Effective Date) of the Contract Agreement, upon which the period until the Time for Completion shall be counted from.

“Time for Completion” means the time within which Completion of the Facilities as a whole (or of a part of the Facilities where a separate Time for Completion of such part has been prescribed) is to be attained, as referred to in GCC Clause 8 and in accordance with the relevant provisions of the Contract.

“Completion” means that the Facilities (or a specific part thereof where specific parts are specified in the Contract) have been completed operationally and structurally and put in a tight and clean condition, that all work in respect of Precommissioning of the Facilities or such

specific part thereof has been completed, and that the Facilities or specific part thereof are ready for Commissioning as provided in GCC Clause 24 (Completion) hereof.

“Precommissioning” means the testing, checking and other requirements specified in the Employer’s Requirements that are to be carried out by the Contractor in preparation for Commissioning as provided in GCC Clause 24 (Completion) hereof.

“Commissioning” means operation of the Facilities or any part thereof by the Contractor following Completion, which operation is to be carried out by the Contractor as provided in GCC Subclause 25.1 (Commissioning) hereof, for the purpose of carrying out Guarantee Test(s).

“Guarantee Test(s)” means the test(s) specified in the Employer’s Requirements to be carried out to ascertain whether the Facilities or a specified part thereof is able to attain the Functional Guarantees specified in the Appendix (Functional Guarantees) to the Contract Agreement in accordance with the provisions of GCC Subclause 25.2 (Guarantee Test) hereof.

“Operational Acceptance” means the acceptance by the Employer of the Facilities (or any part of the Facilities where the Contract provides for acceptance of the Facilities in parts), which certifies the Contractor’s fulfillment of the Contract in respect of Functional Guarantees of the Facilities (or the relevant part thereof) in accordance with the provisions of GCC Clause 28 (Functional Guarantees) hereof and shall include deemed acceptance in accordance with GCC Clause 25 (Commissioning and Operational Acceptance) hereof.

“Defect Liability Period” means the period of validity of the warranties given by the Contractor commencing at Completion of the Facilities or a part thereof, during which the Contractor is responsible for defects with respect to the Facilities (or the relevant part thereof) as provided in GCC Clause 27 (Defect Liability) hereof.

2. Contract Documents	2.1 Subject to Article 1.2 (Order of Precedence) of the Contract Agreement, all documents forming part of the Contract (and all parts thereof) are intended to be correlative, complementary and mutually explanatory. The Contract shall be read as a whole.
3. Interpretation	3.1 In the Contract, except where the context requires otherwise, (a) words indicating one gender include all genders; (b) words indicating the singular also include the plural and words indicating the plural also include the singular; (c) provisions including the word “agree,” “agreed,” or “agreement” require the agreement to be record in writing; (d) the word “tender” is synonymous with “bid,” “tenderer” with “Bidder,” and “tender documents” with “Bidding Documents;” and (e) “written” or “in writing” means handwritten, typewritten, printed or electronically made, and resulting in a permanent record.

The marginal words and other headings shall not be taken into consideration in the interpretation of these Conditions.

3.2 Incoterms

Unless inconsistent with any provision of the Contract, the meaning of any trade term and the rights and obligations of parties thereunder shall be as prescribed by Incoterms.

“Incoterms” means international rules for interpreting trade terms published by the International Chamber of Commerce (latest edition), 38 Cours Albert 1^{er}, 75008 Paris, France.

3.3 Entire Agreement

Subject to GCC Subclause 16.4 hereof, the Contract constitutes the entire agreement between the Employer and Contractor with respect to the subject matter of Contract and supersedes all communications, negotiations, and agreements (whether written or oral) of parties with respect thereto made prior to the date of Contract.

3.4 Amendment

No amendment or other variation of the Contract shall be effective unless it is in writing, is dated, expressly refers to the Contract, and is signed by a duly authorized representative of each party hereto.

3.5 Independent Contractor

The Contractor shall be an independent contractor performing the Contract. The Contract does not create any agency, partnership, joint venture, or other joint relationship between the parties hereto. Subject to the provisions of the Contract, the Contractor shall be solely responsible for the manner in which the Contract is performed. All employees, representatives, or Subcontractors engaged by the Contractor in connection with the performance of the Contract shall be under the complete control of the Contractor and shall not be deemed to be employees of the Employer, and nothing contained in the Contract or in any subcontract awarded by the Contractor shall be construed to create any contractual relationship between any such employees, representatives, or Subcontractors and the Employer.

3.6 Non-Waiver

3.6.1 Subject to GCC Subclause 3.6.2 below, no relaxation, forbearance, delay, or indulgence by either party in enforcing any of the terms and conditions of the Contract or the granting of time by either party to the other shall prejudice, affect, or restrict the rights of that party under the Contract, nor shall any waiver by either party of any breach of Contract operate as waiver of any subsequent or continuing breach of Contract.

3.6.2 Any waiver of a party's rights, powers, or remedies under the Contract must be in writing, must be dated, and signed by an authorized representative of the party granting such waiver, and must specify the right and the extent to which it is being

waived.

3.7 Severability

If any provision or condition of the Contract is prohibited or rendered invalid or unenforceable, such prohibition, invalidity, or unenforceability shall not affect the validity or enforceability of any other provisions and conditions of the Contract.

3.8 Country of Origin

“Origin” means the place where the plant and component parts thereof are mined, grown, produced, or manufactured, and from which the services are provided. Plant components are produced when, through manufacturing, processing, or substantial or major assembling of components, a commercially recognized product results that is substantially in its basic characteristics or in purpose or utility from its components.

4. Communications

4.1 Wherever these Conditions provide for the giving or issuing of approvals, certificates, consents, determinations, notices, requests, and discharges, these communications shall be

- (a) in writing and delivered against receipt; and
- (b) delivered, sent, or transmitted to the address for the recipient's communications as stated in the Contract Agreement.

When a certificate is issued to a Party, the certifier shall send a copy to the other Party. When a notice is issued to a Party, by the other Party or the Project Manager, a copy shall be sent to the Project Manager or the other Party, as the case may be.

5. Law and Language

5.1 The Contract shall be governed by and interpreted in accordance with laws of the country specified in the SCC.

5.2 The ruling language of the Contract shall be that stated in the SCC.

5.3 The language for communications shall be the ruling language unless otherwise stated in the SCC.

6. Fraud and Corruption

6.1 If the Employer determines that the Contractor and/or any of its personnel, or its agents, or its Subcontractors, sub-consultants, services providers, suppliers and/or their employees has engaged in corrupt, fraudulent, collusive coercive, or obstructive practices, in competing for or in executing the Contract, then the Employer may, after giving 14 days' notice to the Contractor, terminate the Contractor's employment under the Contract and expel him from the Site, and the provisions of Clause 42 shall apply as if such expulsion had been made under Sub-Clause 42.2.1 (c).

For the purposes of this Sub-Clause,

- (i) “corrupt practice” is the offering, giving, receiving or soliciting, directly or indirectly, of anything of value to influence improperly the actions of another party;
- (ii) “fraudulent practice” is any act or omission, including a misrepresentation, that knowingly or recklessly misleads, or attempts to mislead, a party to obtain a financial or other benefit or to avoid an obligation;

- (iii) “collusive practice” is an arrangement between two or more parties designed to achieve an improper purpose, including to influence improperly the actions of another party;
- (iv) “coercive practice” is impairing or harming, or threatening to impair or harm, directly or indirectly, any party or the property of the party to influence improperly the actions of a party;
- (v) “obstructive practice” is
- (aa) deliberately destroying, falsifying, altering or concealing of evidence material to the investigation or making false statements to investigators in order to materially impede a GoN investigation into allegations of a corrupt, fraudulent, coercive or collusive practice; and/or threatening, harassing or intimidating any party to prevent it from disclosing its knowledge of matters relevant to the investigation or from pursuing the investigation, or
- (bb) acts intended to materially impede the exercise of the GoN's inspection and audit rights provided for under Sub-Clause 9.6.

B. Subject Matter of Contract

7. Scope of Facilities

- 7.1 Unless otherwise expressly limited in the Employer's Requirements, the Contractor's obligations cover the provision of all Plant and the performance of all Installation Services required for the design, the manufacture (including procurement, quality assurance, construction, installation, associated civil works, pre-commissioning and delivery) of the Plant and the installation, completion, and commissioning of the Facilities in accordance with the plans, procedures, specifications, drawings, codes, and any other documents as specified in the section Employer's Requirements. Such specifications include, but are not limited to, the provision of supervision and engineering services; the supply of labor, materials, equipment, spare parts (as specified in GCC Subclause 7.3 below) and accessories; Contractor's Equipment; construction utilities and supplies; temporary materials, structures, and facilities; transportation (including, without limitation, unloading and hauling to, from and at the Site); and storage, except for those supplies, works, and services that will be provided or performed by the Employer, as set forth in the Appendix (Scope of Works and Supply by the Employer) to the Contract Agreement.
- 7.2 The Contractor shall, unless specifically excluded in the Contract, perform all such work and/or supply all such items and materials not specifically mentioned in the Contract but that can be reasonably inferred from the Contract as being required for attaining Completion of the Facilities as if such work and/or items and materials were expressly mentioned in the Contract.
- 7.3 In addition to the supply of Mandatory Spare Parts included in the Contract, the Contractor agrees to supply spare parts required for the operation and maintenance of the Facilities for the period specified in the SCC and the provisions, if any, specified in the SCC. However, the

identity, specifications, and quantities of such spare parts and the terms and conditions relating to the supply thereof are to be agreed between the Employer and the Contractor, and the price of such spare parts shall be that given in Price Schedule No. 6, which shall be added to the Contract Price. The price of such spare parts shall include the purchase price therefore and other costs and expenses (including the Contractor's fees) relating to the supply of spare parts.

8. Time for Commencement and Completion

8.1 The Contractor shall commence work on the Facilities within the period specified in the SCC and without prejudice to GCC Subclause 26.2 hereof, the Contractor shall thereafter proceed with the Facilities in accordance with the time schedule specified in the Appendix 4 (Time Schedule) to the Contract Agreement.

8.2 The Contractor shall attain Completion of the Facilities or of a part where a separate time for Completion of such part is specified in the Contract, within the time stated in the SCC or within such extended time to which the Contractor shall be entitled under GCC Clause 40 hereof.

9. Contractor's Responsibilities

9.1 The Contractor shall design, manufacture, including associated purchases and/or subcontracting, install, and complete the Facilities in accordance with the Contract. When completed, the Facilities should be fit for the purposes for which they are intended as defined in the Contract.

9.2 The Contractor confirms that it has entered into this Contract on the basis of a proper examination of the data relating to the Facilities, including any data as to boring tests provided by the Employer, and on the basis of information that the Contractor could have obtained from a visual inspection of the Site if access thereto was available and of other data readily available to it relating to the Facilities as of the date 30 days prior to bid submission. The Contractor acknowledges that any failure to acquaint itself with all such data and information shall not relieve its responsibility for properly estimating the difficulty or cost of successfully performing the Facilities.

9.3 The Contractor shall acquire and pay for all permits, approvals, and/or licenses from all local, state, or national government authorities or public service undertakings in the country where the Site is located, which such authorities or undertakings require the Contractor to obtain in its name and which are necessary for the performance of the Contract, including, without limitation, visas for the Contractor's and Subcontractor's personnel and entry permits for all imported Contractor's Equipment. The Contractor shall acquire all other permits, approvals, and/or licenses that are not the responsibility of the Employer under GCC Subclause 10.3 hereof and that are necessary for the performance of the Contract.

9.4 The Contractor shall comply with all laws in force in the country where the Facilities are to be implemented. The laws will include all local, state, national, or other laws that affect the performance of the Contract and bind upon the Contractor. The Contractor shall indemnify and hold harmless the Employer from and against any and all liabilities, damages, claims, fines, penalties, and expenses of whatever nature arising or resulting from the violation of such laws by the

Contractor or its personnel, including the Subcontractors and their personnel, but without prejudice to GCC Subclause 10.1 hereof.

- 9.5 Any plant and services that will be incorporated in or be required for the Facilities and other supplies shall have their origin as specified under GCC Clause 1 (Country of Origin). Any Subcontractors retained by the Contractor shall be from a country as specified in GCC Clause 1 (Country of Origin).
- 9.6 The Contractor shall permit GON/DP to inspect the Contractor's accounts and records relating to the performance of the Contractor and to have them audited by auditors appointed by GON/DP, if so required by GON/DP.
- 9.7 If the Contractor is a joint venture or consortium of two or more persons, all such persons shall be jointly and severally bound to the Employer for the fulfillment of the provisions of the Contract and shall designate one of such persons to act as a leader with authority to bind the joint venture or consortium. The composition or the constitution of the joint venture or consortium shall not be altered without the prior consent of the Employer.
- 9.8 Protection of the Environment
- (a) The Contractor shall take all reasonable steps to protect the environment (both on and off the Site) and to limit damage and nuisance to people and property resulting from pollution, noise, and other results of his operations.
- (b) The Contractor shall ensure that emissions, surface discharges, and effluent from the Contractor's activities shall not exceed the values stated in the Specification or prescribed by applicable Laws.

10. Employer's Responsibilities

- 10.1 All information and/or data to be supplied by the Employer as described in the Appendix (Scope of Works and Supply by the Employer) to the Contract Agreement shall be deemed to be accurate, except when the Employer expressly states otherwise.
- 10.2 The Employer shall be responsible for acquiring and providing legal and physical possession of the Site and access thereto, and for providing possession of and access to all other areas reasonably required for the proper execution of the Contract, including all requisite rights of way, as specified in the Appendix (Scope of Works and Supply by the Employer) to the Contract Agreement. The Employer shall give full possession of and accord all rights of access thereto on or before the date(s) specified in that Appendix.
- 10.3 The Employer shall acquire and pay for all permits, approvals, and/or licenses from all local, state, or national government authorities, or public service undertakings in the country where the Site is located which (a) such authorities or undertakings require the Employer to obtain in the Employer's name, (b) are necessary for the execution of the Contract, including those required for the performance by both the Contractor and the Employer of their respective obligations under the Contract, and (c) are specified in the Appendix (Scope of Works and

Supply by the Employer) to the Contract Agreement.

- 10.4 If requested by the Contractor, the Employer shall use its best endeavors to assist the Contractor in obtaining in a timely and expeditious manner all permits, approvals, and/or licenses necessary for the execution of the Contract from all local, state, or national government authorities, or public service undertakings that such authorities or undertakings require the Contractor or Subcontractors or the personnel of the Contractor or Subcontractors, as the case may be, to obtain.
- 10.5 Unless otherwise specified in the Contract or agreed upon by the Employer and the Contractor, the Employer shall provide sufficient, properly qualified operating and maintenance personnel; shall supply and make available all raw materials, utilities, lubricants, chemicals, catalysts, other materials and facilities; and shall perform all work and services of whatsoever nature, including those required by the Contractor to properly carry out Pre-commissioning, Commissioning, and Guarantee Tests, all in accordance with the provisions of the Appendix (Scope of Works and Supply by the Employer) to the Contract Agreement at or before the time specified in the program furnished by the Contractor under GCC Subclause 18.2 hereof and in the manner thereupon specified or as otherwise agreed upon by the Employer and the Contractor.
- 10.6 The Employer shall be responsible for the continued operation of the Facilities after Completion, in accordance with GCC Subclause 24.8, and shall be responsible for facilitating the Guarantee Test(s) for the Facilities, in accordance with GCC Subclause 25.2.
- 10.7 All costs and expenses involved in the performance of the obligations under this GCC Clause 10 shall be the responsibility of the Employer, except those incurred by the Contractor with respect to the performance of Guarantee Tests, in accordance with GCC Subclause 25.2.
- 10.8 In the event that the Employer shall be in breach of any of his obligations imposed by the Contract, then the additional cost reasonably incurred by the Contractor in consequence thereof shall be added to the Contract Price.

C. Payment

11. Contract Price

- 11.1 The Contract Price shall be as specified in Article 2 (Contract Price and Terms of Payment) of the Contract Agreement.
- 11.2 Unless an adjustment clause is provided for in the SCC, the Contract Price shall be a firm lump sum not subject to any alteration, except in the event of a Change in the Facilities or as otherwise provided in the Contract.
- 11.3 Subject to GCC Subclauses 9.2, 10.1, and 35 hereof, the Contractor shall be deemed to have satisfied itself as to the correctness and sufficiency of the Contract Price, which shall, except as otherwise provided for in the Contract, cover all its obligations under the Contract.

12. Terms of Payment

- 12.1 The Contract Price shall be paid as specified in Article 2 (Contract Price and Terms of Payment) of the Contract Agreement and in the Appendix (Terms and Procedures of Payment) to the Contract Agreement, which also outlines the procedures to be followed in making application for and processing payments.
- 12.2 No payment made by the Employer herein shall be deemed to constitute acceptance by the Employer of the Facilities or any part(s) thereof.
- 12.3 In the event that the Employer fails to make any payment by its respective due date or within the period set forth in the Contract, the Employer shall pay to the Contractor interest on the amount of such delayed payment at the rate(s) shown in the Appendix (Terms and Procedures of Payment) to the Contract Agreement for the period of delay until payment has been made in full, whether before or after judgment or arbitration award.
- 12.4 The currency or currencies in which payments are made to the Contractor under this Contract shall be specified in the Appendix (Terms and Procedures of Payment) to the Contract Agreement, subject to the general principle that payments will be made in the currency or currencies in which the Contract Price has been stated in the Contractor's bid.

13. Securities**13.1 Issuance of Securities**

The Contractor shall provide the securities specified below in favor of the Employer at the times, and in the amount, manner, and form specified below.

13.2 Advance Payment Security

13.2.1 The Contractor shall, within 30 days of the notification of contract award, provide a security in an amount equal to the advance payment calculated in accordance with the Appendix (Terms and Procedures of Payment) to the Contract Agreement, and in the same currency or currencies.

13.2.2 The security shall be in the form provided in the Bidding Documents or in another form acceptable to the Employer. The amount of the security shall be reduced in proportion to the value of the Facilities executed by and paid to the Contractor from time to time, and shall automatically become null and void when the full amount of the advance payment has been recovered by the Employer. The security shall be returned to the Contractor immediately after its expiration.

13.3 Performance Security

13.3.1 The Contractor shall, within 30 days of the notification of contract award, provide a security for the due performance of the Contract in the amount specified in the SCC.

13.3.2 The security shall be denominated in the currency or currencies of the Contract, or in a freely convertible currency acceptable to the Employer, and shall be in one of the forms of bank guarantees provided in the Bidding Documents, as stipulated by

the Employer in the SCC, or in another form acceptable to the Employer.

- 13.3.3 Unless otherwise specified in the SCC, the security shall be reduced by half on the date of the Operational Acceptance. The Security shall become null and void, or shall be reduced pro rata to the Contract Price of a part of the Facilities for which a separate Time for Completion is provided, 540 days after Completion of the Facilities or 365 days after Operational Acceptance of the Facilities, whichever occurs first; provided, however, that if the Defects Liability Period has been extended on any part of the Facilities pursuant to GCC Subclause 27.8 hereof, the Contractor shall issue an additional security in an amount proportionate to the Contract Price of that part. The security shall be returned to the Contractor immediately after its expiration, provided, however, that if the Contractor, pursuant to GCC Subclause 27.10, is liable for an extended defect liability obligation, the performance security shall be extended for the period and up to the amount specified in the SCC.

14. Taxes and Duties

- 14.1 Except as otherwise specifically provided in the Contract, the Contractor shall bear and pay all taxes, duties, levies, and charges assessed on the Contractor, its Subcontractors, or their employees by all municipal, state, or national government authorities in connection with the Facilities in and outside of the country where the Site is located.
- 14.2 Notwithstanding GCC Subclause 14.1 above, the Employer shall bear and promptly pay all customs and import duties as well as other local taxes like, e.g., a value-added tax (VAT), imposed by the law of the country where the Site is located on the Plant specified in Price Schedule No. 1 and that are to be incorporated into the Facilities.
- 14.3 If any tax exemptions, reductions, allowances, or privileges may be available to the Contractor in the country where the Site is located, the Employer shall use its best endeavors to enable the Contractor to benefit from any such tax savings to the maximum allowable extent.
- 14.4 For the purpose of the Contract, it is agreed that the Contract Price specified in Article 2 (Contract Price and Terms of Payment) of the Contract Agreement is based on the taxes, duties, levies, and charges prevailing at the date 30 days prior to the date of bid submission in the country where the Site is located (hereinafter called "Tax" in this GCC Subclause 14.4). If any rates of Tax are increased or decreased, a new Tax is introduced, an existing Tax is abolished, or any change in interpretation or application of any Tax occurs in the course of the performance of Contract, which was or will be assessed on the Contractor, Subcontractors, or their employees in connection with performance of the Contract, an equitable adjustment of the Contract Price shall be made to fully take into account any such change by addition to the Contract Price or deduction therefrom, as the case may be, in accordance with GCC Clause 36 hereof.

D. Intellectual Property

15. License/Use of Technical

- 15.1 For the operation and maintenance of the Plant, the Contractor hereby grants a non-exclusive and nontransferable license (without the right

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to sublicense) to the Employer under the patents, utility models, or other industrial property rights owned by the Contractor or by a third party from whom the Contractor has received the right to grant licenses thereunder, and shall also grant to the Employer a nonexclusive and nontransferable right (without the right to sublicense) to use the know-how and other technical information disclosed to the Employer under the Contract. Nothing contained herein shall be construed as transferring ownership of any patent, utility model, trademark, design, copyright, know-how, or other intellectual property right from the Contractor or any third party to the Employer.

- 15.2 The copyright in all drawings, documents, and other materials containing data and information furnished to the Employer by the Contractor herein shall remain vested in the Contractor or, if they are furnished to the Employer directly or through the Contractor by any third party, including suppliers of materials, the copyright in such materials shall remain vested in such third party.

16. Confidential Information

- 16.1 The Employer and the Contractor shall keep confidential and shall not, without the written consent of the other party hereto, divulge to any third party any documents, data or other information furnished directly or indirectly by the other party hereto in connection with the Contract, whether such information has been furnished prior to, during, or following termination of the Contract. Notwithstanding the above, the Contractor may furnish to its Subcontractor(s) such documents, data, and other information it receives from the Employer to the extent required for the Subcontractor(s) to perform its work under the Contract, in which event the Contractor shall obtain from such Subcontractor(s) an undertaking of confidentiality similar to that imposed on the Contractor under this GCC Clause 16.
- 16.2 The Employer shall not use such documents, data, and other information received from the Contractor for any purpose other than the operation and maintenance of the Facilities. Similarly, the Contractor shall not use such documents, data, and other information received from the Employer for any purpose other than the design, procurement of Plant, construction, or such other work and services as are required for the performance of the Contract.
- 16.3 The obligation of a party under GCC Subclauses 16.1 and 16.2 above, however, shall not apply to that information, which
- (a) now or hereafter enters the public domain through no fault of that party;
 - (b) can be proven to have been possessed by that party at the time of disclosure and which was not previously obtained, directly or indirectly, from the other party hereto; and
 - (c) otherwise lawfully becomes available to that party from a third party that has no obligation of confidentiality.
- 16.4 The above provisions of this GCC Clause 16 shall not in any way modify any undertaking of confidentiality given by either of the parties hereto prior to the date of the Contract in respect of the Facilities or any part thereof.

- 16.5 The provisions of this GCC Clause 16 shall survive termination, for whatever reason, of the Contract.

E. Execution of the Facilities

17. Representatives 17.1 Project Manager

If the Project Manager is not named in the Contract, then within 14 days of the Effective Date, the Employer shall appoint and notify the Contractor in writing of the name of the Project Manager. The Employer may from time to time appoint some other person as the Project Manager in place of the person previously so appointed, and shall give notice of the name of such other person to the Contractor without delay. No such appointment shall be made at such a time or in such a manner as to impede the progress of work on the Facilities. Such appointment shall only take effect upon receipt of such notice by the Contractor. The Project Manager shall represent and act for the Employer at all times during the performance of the Contract. All notices, instructions, orders, certificates, approvals, and all other communications under the Contract shall be given by the Project Manager, except as herein otherwise provided.

All notices, instructions, information, and other communications given by the Contractor to the Employer under the Contract shall be given to the Project Manager, except as herein otherwise provided.

17.2 Contractor's Representative and Construction Manager

17.2.1 If the Contractor's Representative is not named in the Contract, then within 14 days of the Effective Date, the Contractor shall appoint the Contractor's Representative and shall request the Employer in writing to approve the person so appointed. If the Employer makes no objection to the appointment within 14 days, the Contractor's Representative shall be deemed to have been approved. If the Employer objects to the appointment within 14 days giving the reason therefor, then the Contractor shall appoint a replacement within 14 days of such objection, and the foregoing provisions of this GCC Subclause 17.2.1 shall apply thereto.

17.2.2 The Contractor's Representative shall represent and act for the Contractor at all times during the performance of the Contract and shall give to the Project Manager all the Contractor's notices, instructions, information, and all other communications under the Contract.

All notices, instructions, information, and all other communications given by the Employer or the Project Manager to the Contractor under the Contract shall be given to the Contractor's Representative or, in its absence, its deputy, except as herein otherwise provided.

The Contractor shall not revoke the appointment of the Contractor's Representative without the Employer's prior written consent, which shall not be unreasonably withheld. If the Employer consents thereto, the Contractor shall appoint some other person as the Contractor's Representative, pursuant to the

procedure set out in GCC Subclause 17.2.1.

17.2.3 The Contractor's Representative may, subject to the approval of the Employer which shall not be unreasonably withheld, at any time delegate to any person any of the powers, functions and authorities vested in him or her. Any such delegation may be revoked at any time. Any such delegation or revocation shall be subject to a prior notice signed by the Contractor's Representative, and shall specify the powers, functions, and authorities thereby delegated or revoked. No such delegation or revocation shall take effect unless and until a copy thereof has been delivered to the Employer and the Project Manager.

Any act or exercise by any person of powers, functions and authorities so delegated to him or her in accordance with this GCC Subclause 17.2.3 shall be deemed to be an act or exercise by the Contractor's Representative.

17.2.4 From the commencement of installation of the Facilities at the Site until Completion, the Contractor's Representative shall appoint a suitable person as the Construction Manager. The Construction Manager shall supervise all work done at the Site by the Contractor and shall be present at the Site throughout normal working hours except when on leave, sick, or absent for reasons connected with the proper performance of the Contract. Whenever the Construction Manager is absent from the Site, the Contractor's Representative or the Construction Manager shall appoint a suitable person to act as the Construction Manager's deputy.

17.2.5 The Employer may by notice to the Contractor object to any representative or person employed by the Contractor in the execution of the Contract who, in the reasonable opinion of the Employer, may behave inappropriately, may be incompetent or negligent, or may commit a serious breach of the Site regulations provided under GCC Subclause 22.4. The Employer shall provide evidence of the same, whereupon the Contractor shall remove such person from the Facilities.

17.2.6 If any representative or person employed by the Contractor is removed in accordance with GCC Subclause 17.2.5, the Contractor shall, where required, promptly appoint a replacement.

18. Work Program

18.1 Contractor's Organization

The Contractor shall supply to the Employer and the Project Manager a chart showing the proposed organization to be established by the Contractor for carrying out work on the Facilities within 21 days of the Effective Date. The chart shall include the identities of the key personnel, and the curricula vitae of such key personnel to be employed shall be supplied together with the chart. The Contractor shall promptly inform the Employer and the Project Manager in writing of any revision or alteration of such an organization chart.

18.2 Program of Performance

Within 30 days after the Effective Date, the Contractor shall submit to the Project Manager a detailed program of performance of the

Contract, made in a form acceptable to the Project Manager and showing the sequence in which it proposes to design, manufacture, transport, assemble, install, and pre-commission the Facilities, as well as the date by which the Contractor reasonably requires that the Employer shall have fulfilled its obligations under the Contract so as to enable the Contractor to execute the Contract in accordance with the program and to achieve Completion, Commissioning, and Acceptance of the Facilities in accordance with the Contract. The program so submitted by the Contractor shall accord with the Time Schedule included in the Appendix (Time Schedule) to the Contract Agreement and any other dates and periods specified in the Contract. The Contractor shall update and revise the program as and when appropriate or when required by the Project Manager, but without modification in the Times for Completion given in the SCC and any extension granted in accordance with GCC Clause 40, and shall submit all such revisions to the Project Manager.

18.3 Progress Report

The Contractor shall monitor progress of all the activities specified in the program referred to in GCC Subclause 18.2 above, and supply a progress report to the Project Manager every month.

The progress report shall be in a form acceptable to the Project Manager and shall indicate: (a) percentage completion achieved compared with the planned percentage completion for each activity; and (b) where any activity is behind the program, giving comments and likely consequences and stating the corrective action being taken.

18.4 Progress of Performance

If at any time the Contractor's actual progress falls behind the program referred to in GCC Subclause 18.2, or it becomes apparent that it will so fall behind, the Contractor shall, at the request of the Employer or the Project Manager, prepare and submit to the Project Manager a revised program, taking into account the prevailing circumstances, and shall notify the Project Manager of the steps being taken to expedite progress so as to attain Completion of the Facilities within the Time for Completion under GCC Subclause 8.2, any extension thereof entitled under GCC Subclause 40.1, or any extended period as may otherwise be agreed upon between the Employer and the Contractor.

18.5 Procedures

The Contract shall be executed in accordance with the Contract Documents including the procedures given in the Forms and Procedures of the Employer's Requirements.

The Contractor may execute the Contract in accordance with its own standard project execution plans and procedures to the extent that they do not conflict with the provisions contained in the Contract.

19. Subcontracting

- 19.1 The Appendix 5 (List of Major Items of Plant and Services and List of Approved Subcontractors) to the Contract Agreement specifies major items of plant and services and a list of approved Subcontractors

against each item, including manufacturers. Insofar as no Subcontractors are listed against any such item, the Contractor shall prepare a list of Subcontractors for such item for inclusion in such list. The Contractor may from time to time propose any addition to or deletion from any such list. The Contractor shall submit any such list or any modification thereto to the Employer for its approval in sufficient time so as not to impede the progress of work on the Facilities. Such approval by the Employer for any of the Subcontractors shall not relieve the Contractor from any of its obligations, duties, or responsibilities under the Contract.

- 19.2 The Contractor shall select and employ its Subcontractors for such major items from those listed in the lists referred to in GCC Subclause 19.1.
- 19.3 For items or parts of the Facilities not specified in the Appendix (List of Major Items of Plant and Services and List of Approved Subcontractors for Major Items) to the Contract Agreement, the Contractor may employ such Subcontractors as it may select, at its discretion.
- 19.4 Each subcontract shall include provisions which would entitle the Employer to require the sub-contract to be assigned to the Employer under GCC 19.5 (if and when applicable), or in event of termination by the Employer under GCC 42.2.
- 19.5 If a Sub-contractor's obligations extend beyond the expiry date of the relevant Defects Liability Period and the Project Manager, prior to that date, instructs the Contractor to assign the benefits of such obligations to the Employer, then the Contractor shall do so.

20. Design and Engineering

20.1 Specifications and Drawings

20.1.1 The Contractor shall execute the basic and detailed design and the engineering work in compliance with the provisions of the Contract, or where not so specified, in accordance with good engineering practice.

The Contractor shall be responsible for any discrepancies, errors, or omissions in the specifications, drawings, and other technical documents that it has prepared, whether such specifications, drawings, and other documents have been approved by the Project Manager or not, provided that such discrepancies, errors, or omissions are not because of inaccurate information furnished in writing to the Contractor by or on behalf of the Employer.

20.1.2 The Contractor shall be entitled to disclaim responsibility for any design, data, drawing, specification, or other document, or any modification thereof provided or designated by or on behalf of the Employer, by giving a notice of such disclaimer to the Project Manager.

20.2 Codes and Standards

Wherever references are made in the Contract to codes and standards in accordance with which the Contract shall be executed, the edition or the revised version of such codes and standards current at the date 30 days prior to date of bid submission shall apply unless otherwise specified. During Contract execution, any changes in such codes and standards shall be applied subject to approval by the Employer and

shall be treated in accordance with GCC Clause 39.

20.3 Approval/Review of Technical Documents by Project Manager

20.3.1 The Contractor shall prepare or cause its Subcontractors to prepare, and furnish to the Project Manager the documents listed in the Appendix (List of Documents for Approval or Review) to the Contract Agreement for its approval or review as specified and in accordance with the requirements of GCC Subclause 18.2 (Program of Performance).

Any part of the Facilities covered by or related to the documents to be approved by the Project Manager shall be executed only after the Project Manager's approval thereof.

GCC Subclauses 20.3.2 through 20.3.7 shall apply to those documents requiring the Project Manager's approval, but not to those furnished to the Project Manager for its review only.

20.3.2 Within 14 days after receipt by the Project Manager of any document requiring the Project Manager's approval in accordance with GCC Subclause 20.3.1, the Project Manager shall either return one copy thereof to the Contractor with its approval endorsed thereon or shall notify the Contractor in writing of its disapproval thereof and the reasons therefor and the modifications that the Project Manager proposes.

If the Project Manager fails to take such action within the said 14 days, then the said document shall be deemed to have been approved by the Project Manager.

20.3.3 The Project Manager shall not disapprove any document, except on the grounds that the document does not comply with the Contract or that it is contrary to good engineering practice. If the Project Manager disapproves a document, he shall specify the reasons for his decision.

20.3.4 If the Project Manager disapproves the document, the Contractor shall modify the document and resubmit it for the Project Manager's approval in accordance with GCC Subclause 20.3.2. If the Project Manager approves the document subject to modification(s), the Contractor shall make the required modification(s), whereupon the document shall be deemed to have been approved.

20.3.5 If any dispute or difference occurs between the Employer and the Contractor in connection with or arising out of the disapproval by the Project Manager of any document and/or any modification(s) thereto that cannot be settled between the parties within a reasonable period, then such dispute or difference may be referred to an Dispute Board for determination in accordance with GCC Subclause 45.3 hereof. If such dispute or difference is referred to an Dispute Board, the Project Manager shall give instructions as to whether and, if so, how, performance of the Contract is to proceed. The Contractor shall proceed with the Contract in accordance with the Project Manager's instructions, provided that if the Dispute Board

upholds the Contractor's view on the dispute and if the Employer has not given notice under Subclause 45.3 hereof, then the Contractor shall be reimbursed by the Employer for any additional costs incurred by reason of such instructions and shall be relieved of such responsibility or liability in connection with the dispute and the execution of the instructions as the Dispute Board shall decide, and the Time for Completion shall be extended accordingly.

20.3.6 The Project Manager's approval, with or without modification of the document furnished by the Contractor, shall not relieve the Contractor of any responsibility or liability imposed upon it by any provisions of the Contract except to the extent that any subsequent failure results from modifications required by the Project Manager.

20.3.7 The Contractor shall not depart from any approved document unless the Contractor has first submitted to the Project Manager an amended document and obtained the Project Manager's approval thereof, pursuant to the provisions of this GCC Subclause 20.3.

If the Project Manager requests any change in any already approved document and/or in any document based thereon, the provisions of GCC Clause 39 shall apply to such request.

21. Procurement

21.1 Materials

Subject to GCC Subclause 14.2, the Contractor shall procure and transport all materials in an expeditious and orderly manner to the Site.

21.2 Employer-Supplied Materials

If the Appendix (Scope of Works and Supply by the Employer) to the Contract Agreement provides that the Employer shall furnish any specific items to the Contractor, the following provisions shall apply:

21.2.1 The Employer shall, at its own risk and expense, transport each item to the place on or near the Site as agreed upon by the parties and make such item available to the Contractor at the time specified in the program furnished by the Contractor, pursuant to GCC Subclause 18.2, unless otherwise mutually agreed.

21.2.2 Upon receipt of such item, the Contractor shall inspect the same visually and notify the Project Manager of any detected shortage, defect, or default. The Employer shall immediately remedy any shortage, defect, or default, or the Contractor shall, if practicable and possible, at the request of the Employer, remedy such shortage, defect, or default at the Employer's cost and expense. After inspection, such item shall fall under the care, custody, and control of the Contractor. The provision of this GCC Subclause 21.2.2 shall apply to any item supplied to remedy any such shortage or default or to substitute for any defective item, or shall apply to defective items that have been repaired.

21.2.3 The foregoing responsibilities of the Contractor and its obligations of care, custody, and control shall not relieve the Employer of liability for any undetected shortage, defect, or

default, nor place the Contractor under any liability for any such shortage, defect or default whether under GCC Clause 27 or under any other provision of Contract.

21.3 Transportation

21.3.1 The Contractor shall at its own risk and expense transport all the materials and the Contractor's Equipment to the Site by the mode of transport that the Contractor judges most suitable under all the circumstances.

21.3.2 Unless otherwise provided in the Contract, the Contractor shall be entitled to select any safe mode of transport operated by any person to carry the materials and the Contractor's Equipment.

21.3.3 Upon dispatch of each shipment of materials and the Contractor's Equipment, the Contractor shall notify the Employer by telex, cable, facsimile, or electronic means, of the description of the materials and of the Contractor's Equipment, the point and means of dispatch, and the estimated time and point of arrival in the country where the Site is located, if applicable, and at the Site. The Contractor shall furnish the Employer with relevant shipping documents to be agreed upon between the parties.

21.3.4 The Contractor shall be responsible for obtaining, if necessary, approvals from the authorities for transportation of the materials and the Contractor's Equipment to the Site. The Employer shall use its best endeavors in a timely and expeditious manner to assist the Contractor in obtaining such approvals, if requested by the Contractor. The Contractor shall indemnify and hold harmless the Employer from and against any claim for damage to roads, bridges, or any other traffic facilities that may be caused by the transport of the materials and the Contractor's Equipment to the Site.

21.4 Customs Clearance

The Contractor shall, at its own expense, handle all imported materials and Contractor's Equipment at the point(s) of import and shall handle any formalities for customs clearance, subject to the Employer's obligations under GCC Subclause 14.2, provided that if applicable laws or regulations require any application or act to be made by or in the name of the Employer, the Employer shall take all necessary steps to comply with such laws or regulations. In the event of delays in customs clearance that are not the fault of the Contractor, the Contractor shall be entitled to an extension in the Time for Completion, pursuant to GCC Clause 40.

22. Installation

22.1 Setting Out/Supervision

22.1.1 Benchmark

- (a) The Contractor shall be responsible for the true and proper setting-out of the Facilities in relation to bench marks, reference marks, and lines provided to it in writing by or on behalf of the Employer.

- (b) If, at any time during the progress of installation of the Facilities, any error shall appear in the position, level, or alignment of the Facilities, the Contractor shall forthwith notify the Project Manager of such error and, at its own expense, immediately rectify such error to the reasonable satisfaction of the Project Manager. If such error is based on incorrect data provided in writing by or on behalf of the Employer, the expense of rectifying the same shall be borne by the Employer.

22.1.2 Contractor's Supervision

The Contractor shall give or provide all necessary superintendence during the installation of the Facilities, and the Construction Manager or its deputy shall be constantly on the Site to provide full-time superintendence of the installation. The Contractor shall provide and employ only technical personnel who are skilled and experienced in their respective callings and supervisory staff who are competent to adequately supervise the work at hand.

22.2 Labor

22.2.1 Engagement of Staff and Labor

- (a) Except as otherwise stated in the Specification, the Contractor shall make arrangements for the engagement of all staff and labor, local or otherwise, and for their payment, housing, feeding, and transport.
- (b) The Contractor shall provide and employ on the Site in the installation of the Facilities such skilled, semi-skilled, and unskilled labor as is necessary for the proper and timely execution of the Contract. The Contractor is encouraged to use local labor that has the necessary skills.
- (c) The Contractor shall be responsible for obtaining all necessary permit(s) and/or visa(s) from the appropriate authorities for the entry of all labor and personnel to be employed on the Site into the country where the Site is located. The Employer will, if requested by the Contractor, use his best endeavors in a timely and expeditious manner to assist the Contractor in obtaining any local, state, national, or government permission required for bringing in the Contractor's personnel.
- (d) The Contractor shall at its own expense provide the means of repatriation to all of its and its Subcontractor's personnel employed on the Contract at the Site to the place where they were recruited or to their domicile. It shall also provide suitable temporary maintenance of all such persons from the cessation of their employment on the Contract to the date programmed for their departure. In the event that the Contractor defaults in providing such means of transportation and temporary maintenance, the Employer may provide the same to such personnel and

recover the cost of doing so from the Contractor.

22.2.2 Persons in the Service of Employer

The Contractor shall not recruit, or attempt to recruit, staff and labor from amongst the Employer's Personnel.

22.2.3 Labor Laws

- (a) The Contractor shall comply with all the relevant labor Laws applicable to the Contractor's Personnel, including Laws relating to their employment, health, safety, welfare, immigration, and emigration, and shall allow them all their legal rights.
- (b) The Contractor shall at all times during the progress of the Contract use its best endeavors to prevent any unlawful, riotous, or disorderly conduct or behavior by or amongst its employees and the labor of its Subcontractors.
- (c) The Contractor shall, in all dealings with its labor and the labor of its Subcontractors currently employed on or connected with the Contract, pay due regard to all recognized festivals, official holidays, religious, or other customs and all local laws and regulations pertaining to the employment of labor.

22.2.4 Rates of Wages and Conditions of Labor

- (a) The Contractor shall pay rates of wages, and observe conditions of labor, which are not lower than those established for the trade or industry where the work is carried out. If no established rates or conditions are applicable, the Contractor shall pay rates of wages and observe conditions which are not lower than the general level of wages and conditions observed locally by employers whose trade or industry is similar to that of the Contractor.
- (b) The Contractor shall inform the Contractor's Personnel about their liability to pay personal income taxes in the Country in respect of such of their salaries, wages, and allowances as are chargeable under the Laws for the time being in force, and the Contractor shall perform such duties in regard to such deductions thereof as may be imposed on him by such Laws.

22.2.5 Working Hours

- (a) No work shall be carried out on the Site on locally recognized days of rest, or outside the normal working hours stated in the SCC, unless
 - (i) otherwise stated in the Contract;
 - (ii) the Project Manager gives consent; or
 - (iii) the work is unavoidable, or necessary for the protection of life or property or for the safety of the Works, in which case the Contractor shall immediately advise the Project Manager.

- (b) If and when the Contractor considers it necessary to carry out work at night or on public holidays so as to meet the Time for Completion and requests the Project Manager's consent thereto, the Project Manager shall not unreasonably withhold such consent.
- (c) This Subclause shall not apply to any work which is customarily carried out by rotary or double shifts.

22.2.6 Facilities for Staff and Labor

- (a) Except as otherwise stated in the Specification, the Contractor shall provide and maintain all necessary accommodation and welfare facilities for the Contractor's Personnel. The Contractor shall also provide facilities for the Employer's Personnel as stated in the Specification.
- (b) The Contractor shall not permit any of the Contractor's Personnel to maintain any temporary or permanent living quarters within the structures forming part of the Permanent Works.

22.2.7 Health and Safety

- (a) The Contractor shall at all times take all reasonable precautions to maintain the health and safety of the Contractor's Personnel. In collaboration with local health authorities, the Contractor shall ensure that medical staff, first aid facilities, sick bay, and ambulance service are available at all times at the Site and at any accommodation for Contractor's and Employer's Personnel, and that suitable arrangements are made for all necessary welfare and hygiene requirements and for the prevention of epidemics/pandemic.
- (b) The Contractor shall appoint an accident prevention officer at the Site, responsible for maintaining safety and protection against accidents. This person shall be qualified for this responsibility, and shall have the authority to issue instructions and take protective measures to prevent accidents. Throughout the performance of the Contract, the Contractor shall provide whatever is required by this person to exercise this responsibility and authority.
- (c) The Contractor shall send to the Project Manager, details of any accident as soon as practicable after its occurrence. The Contractor shall maintain records and make reports concerning health, safety, and welfare of persons, and damage to property, as the Project Manager may reasonably require.

22.2.8 Funeral Arrangements

In the event of the death of any of the Contractor's personnel or accompanying members of their families, the Contractor shall be responsible for making the appropriate arrangements for their return or burial, unless otherwise specified in the SCC.

22.2.9 Records of Contractor's Personnel

The Contractor shall keep accurate records of the Contractor's personnel, including the number of each class of Contractor's Personnel on the Site and the names, ages, gender, hours worked, and wages paid to all workers. These records shall be summarized on a monthly basis in a form approved by the Project Manager and shall be available for inspection by the Project Manager until the Contractor has completed all work.

22.2.10 Supply of Foodstuff

The Contractor shall arrange for the provision of a sufficient supply of suitable food as may be stated in the Specification at reasonable prices for the Contractor's Personnel for the purposes of or in connection with the Contract.

22.2.11 Supply of Water

The Contractor shall, having regard to local conditions, provide on the Site an adequate supply of drinking and other water for the use of the Contractor's Personnel.

22.2.12 Measures against Insect and Pest Nuisance

The Contractor shall at all times take the necessary precautions to protect the Contractor's Personnel employed on the Site from insect and pest nuisance, and to reduce their danger to health. The Contractor shall comply with all the regulations of the local health authorities, including use of appropriate insecticide.

22.2.13 Alcoholic Liquor or Drugs

The Contractor shall not, otherwise than in accordance with the Laws of the Country, import, sell, give barter, or otherwise dispose of any alcoholic liquor or drugs, or permit or allow importation, sale, gift barter, or disposal by Contractor's Personnel.

22.2.14 Arms and Ammunition

The Contractor shall not give, barter, or otherwise dispose of, to any person, any arms or ammunition of any kind, or allow Contractor's Personnel to do so.

22.2.15 Prohibition of All Forms of Forced or Compulsory Labor

The contractor shall not employ "forced or compulsory labor" in any form. "Forced or compulsory labor" consists of all work or service, not voluntarily performed, that is extracted from an individual under threat of force or penalty.

22.2.16 Prohibition of Harmful Child Labor

The Contractor shall not employ any child to perform any work that is economically exploitative, or is likely to be hazardous to, or to interfere with, the child's education, or to be harmful to the child's health or physical, mental, spiritual, moral, or social

development.

22.3 Contractor's Equipment

- 22.3.1 All Contractor's Equipment brought by the Contractor onto the Site shall be deemed to be intended to be used exclusively for the execution of the Contract. The Contractor shall not remove the same from the Site without the Project Manager's consent that such Contractor's Equipment is no longer required for the execution of the Contract.
- 22.3.2 Unless otherwise specified in the Contract, upon completion of the Facilities, the Contractor shall remove from the Site all Equipment brought by the Contractor onto the Site and any surplus materials remaining thereon.
- 22.3.3 The Employer will, if requested, use its best endeavors to assist the Contractor in obtaining any local, state or national government permission required by the Contractor for the export of the Contractor's Equipment imported by the Contractor for use in the execution of the Contract that is no longer required for the execution of the Contract.

22.4 Site Regulations and Safety

The Employer and the Contractor shall establish Site regulations setting out the rules to be observed in the execution of the Contract at the Site and shall comply therewith. The Contractor shall prepare and submit to the Employer, with a copy to the Project Manager, proposed Site regulations for the Employer's approval, which approval shall not be unreasonably withheld.

Such Site regulations shall include, but shall not be limited to, rules in respect of security, safety of the Facilities, gate control, sanitation, medical care, and fire prevention.

22.5 Opportunities for Other Contractors

- 22.5.1 The Contractor shall, upon written request from the Employer or the Project Manager, give all reasonable opportunities for carrying out the work to any other contractors employed by the Employer on or near the Site.
- 22.5.2 If the Contractor, upon written request from the Employer or the Project Manager, makes available to other contractors any roads or ways the maintenance for which the Contractor is responsible, permits the use by such other contractors of the Contractor's Equipment, or provides any other service of whatsoever nature for such other contractors, the Employer shall fully compensate the Contractor for any loss or damage caused or occasioned by such other contractors in respect of any such use or service, and shall pay to the Contractor reasonable remuneration for the use of such equipment or the provision of such services.
- 22.5.3 The Contractor shall also so arrange to perform its work as to minimize, to the extent possible, interference with the work of other contractors. The Project Manager shall determine the resolution of any difference or conflict that may arise between

the Contractor and other contractors and the workers of the Employer in regard to their work.

- 22.5.4 The Contractor shall notify the Project Manager promptly of any defects in the other Contractors' work that come to its notice, and that could affect the Contractor's work. The Project Manager shall determine the corrective measures, if any, required to rectify the situation after inspection of the Facilities. Decisions made by the Project Manager shall be binding on the Contractor.

22.6 Emergency Work

If, by reason of an emergency arising in connection with and during the execution of the Contract, any protective or remedial work is necessary as a matter of urgency to prevent damage to the Facilities, the Contractor shall immediately carry out such work.

If the Contractor is unable or unwilling to do such work immediately, the Employer may do or cause such work to be done as the Employer may determine is necessary in order to prevent damage to the Facilities. In such event the Employer shall, as soon as practicable after the occurrence of any such emergency, notify the Contractor in writing of such emergency, the work done and the reasons therefor. If the work done or caused to be done by the Employer is work that the Contractor was liable to do at its own expense under the Contract, the reasonable costs incurred by the Employer in connection therewith shall be paid by the Contractor to the Employer. Otherwise, the cost of such remedial work shall be borne by the Employer.

22.7 Site Clearance

22.7.1 Site Clearance in Course of Performance

In the course of carrying out the Contract, the Contractor shall keep the Site reasonably free from all unnecessary obstruction, store, or remove any surplus materials, clear away any wreckage, rubbish, or temporary works from the Site, and remove any Contractor's Equipment no longer required for execution of the Contract.

22.7.2 Clearance of Site after Completion

After Completion of all parts of the Facilities, the Contractor shall clear away and remove all wreckage, rubbish, and debris of any kind from the Site, and shall leave the Site and Facilities in a clean and safe condition.

22.8 Watching and Lighting

The Contractor shall provide and maintain at its own expense all lighting, fencing, and watching when and where necessary for the proper execution and the protection of the Facilities, or for the safety of the owners and occupiers of adjacent property and for the safety of the public.

23. Test and Inspection

- 23.1 The Contractor shall at its own expense carry out at the place of manufacture and/or on the Site all such tests and/or inspections of the Plant and any part of the Facilities as are specified in the Contract.

23.2 The Employer and the Project Manager or their designated representatives shall be entitled to attend the aforesaid test and/or inspection, provided that the Employer shall bear all costs and expenses incurred in connection with such attendance including, but not limited to, all traveling and board and lodging expenses.

23.3 Whenever the Contractor is ready to carry out any such test and/or inspection, the Contractor shall give a reasonable advance notice of such test and/or inspection and of the place and time thereof to the Project Manager. The Contractor shall obtain from any relevant third party or manufacturer any necessary permission or consent to enable the Employer and the Project Manager or their designated representatives to attend the test and/or inspection.

23.4 The Contractor shall provide the Project Manager with a certified report of the results of any such test and/or inspection.

If the Employer or Project Manager or their designated representatives fails to attend the test and/or inspection, or if it is agreed between the parties that such persons shall not do so, then the Contractor may proceed with the test and/or inspection in the absence of such persons, and may provide the Project Manager with a certified report of the results thereof.

23.5 The Project Manager may require the Contractor to carry out any test and/or inspection not required by the Contract, provided that the Contractor's reasonable costs and expenses incurred in the carrying out of such test and/or inspection shall be added to the Contract Price. Further, if such test and/or inspection impedes the progress of work on the Facilities and/or the Contractor's performance of its other obligations under the Contract, due allowance will be made in respect of the Time for Completion and the other obligations so affected.

23.6 If any Plant or any part of the Facilities fails to pass any test and/or inspection, the Contractor shall either rectify or replace such Plant or part of the Facilities and shall repeat the test and/or inspection upon giving a notice under GCC Subclause 23.3.

23.7 If any dispute or difference of opinion shall arise between the parties in connection with or arising out of the test and/or inspection of the Plant or part of the Facilities that cannot be settled between the parties within a reasonable period of time, it may be referred to an Dispute Board for determination in accordance with GCC Subclause 45.3.

23.8 The Contractor shall afford the Employer and the Project Manager, at the Employer's expense, access at any reasonable time to any place where the Plant are being manufactured or the Facilities are being installed, in order to inspect the progress and the manner of manufacture or installation, provided that the Project Manager shall give the Contractor a reasonable prior notice.

23.9 The Contractor agrees that neither the execution of a test and/or inspection of Plant or any part of the Facilities, nor the attendance by the Employer or the Project Manager, nor the issue of any test certificate pursuant to GCC Subclause 23.4, shall release the

Contractor from any other responsibilities under the Contract.

23.10 No part of the Facilities or foundations shall be covered up on the Site without the Contractor carrying out any test and/or inspection required under the Contract. The Contractor shall give a reasonable notice to the Project Manager whenever any such parts of the Facilities or foundations are ready or about to be ready for test and/or inspection; such test and/or inspection and notice thereof shall be subject to the requirements of the Contract.

23.11 The Contractor shall uncover any part of the Facilities or foundations, or shall make openings in or through the same as the Project Manager may from time to time require at the Site, and shall reinstate and make good such part or parts.

If any parts of the Facilities or foundations have been covered up at the Site after compliance with the requirement of GCC Subclause 23.10 and are found to be executed in accordance with the Contract, the expenses of uncovering, making openings in or through, reinstating, and making good the same shall be borne by the Employer, and the Time for Completion shall be reasonably adjusted to the extent that the Contractor has thereby been delayed or impeded in the performance of any of its obligations under the Contract.

24. Completion of the Facilities

24.1 As soon as the Facilities or any part thereof has, in the opinion of the Contractor, been completed operationally and structurally and put in a tight and clean condition as specified in the Employer's Requirements, excluding minor items not materially affecting the operation or safety of the Facilities, the Contractor shall so notify the Employer in writing.

24.2 Within 7 days after receipt of the notice from the Contractor under GCC Subclause 24.1, the Employer shall supply the operating and maintenance personnel specified in the Appendix (Scope of Works and Supply by the Employer) to the Contract Agreement for Pre-commissioning of the Facilities or any part thereof.

Pursuant to the Appendix (Scope of Works and Supply by the Employer) to the Contract Agreement, the Employer shall also provide, within the said 7-day period, the raw materials, utilities, lubricants, chemicals, catalysts, facilities, services, and other matters required for Pre-commissioning of the Facilities or any part thereof.

24.3 As soon as reasonably practicable after the operating and maintenance personnel have been supplied by the Employer and the raw materials, utilities, lubricants, chemicals, catalysts, facilities, services, and other matters have been provided by the Employer in accordance with GCC Subclause 24.2, the Contractor shall commence Pre-commissioning of the Facilities or the relevant part thereof in preparation for Commissioning, subject to GCC Subclause 25.5.

24.4 As soon as all works in respect of Pre-commissioning are completed and, in the opinion of the Contractor, the Facilities or any part thereof is ready for Commissioning, the Contractor shall so notify the Project Manager in writing.

24.5 The Project Manager shall, within 14 days after receipt of the Contractor's notice under GCC Subclause 24.4, either issue a Completion Certificate in the form specified in the Employer's

Requirements (Forms and Procedures), stating that the Facilities or that part thereof have reached Completion as of the date of the Contractor's notice under GCC Subclause 24.4, or notify the Contractor in writing of any defects and/or deficiencies.

If the Project Manager notifies the Contractor of any defects and/or deficiencies, the Contractor shall then correct such defects and/or deficiencies, and shall repeat the procedure described in GCC Subclause 24.4.

If the Project Manager is satisfied that the Facilities or that part thereof have reached Completion, the Project Manager shall, within 7 days after receipt of the Contractor's repeated notice, issue a Completion Certificate stating that the Facilities or that part thereof have reached Completion as of the date of the Contractor's repeated notice.

If the Project Manager is not so satisfied, then it shall notify the Contractor in writing of any defects and/or deficiencies within 7 days after receipt of the Contractor's repeated notice, and the above procedure shall be repeated.

24.6 If the Project Manager fails to issue the Completion Certificate and fails to inform the Contractor of any defects and/or deficiencies within 14 days after receipt of the Contractor's notice under GCC Subclause 24.4 or within 7 days after receipt of the Contractor's repeated notice under GCC Subclause 24.5, or if the Employer makes use of the Facilities or part thereof, then the Facilities or that part thereof shall be deemed to have reached Completion as of the date of the Contractor's notice or repeated notice, or as of the Employer's use of the Facilities, as the case may be.

24.7 As soon as possible after Completion, the Contractor shall complete all outstanding minor items so that the Facilities are fully in accordance with the requirements of the Contract, failing which the Employer will undertake such completion and deduct the costs thereof from any monies owing to the Contractor.

24.8 Upon Completion, the Employer shall be responsible for the care and custody of the Facilities or the relevant part thereof, together with the risk of loss or damage thereto, and shall thereafter take over the Facilities or the relevant part thereof.

25. Commissioning and Operational Acceptance

25.1 Commissioning

25.1.1 Commissioning of the Facilities or any part thereof shall be commenced by the Contractor immediately after issue of the Completion Certificate by the Project Manager, pursuant to GCC Subclause 24.5, or immediately after the date of the deemed Completion, under GCC Subclause 24.6.

25.1.2 The Employer shall supply the operating and maintenance personnel and all raw materials, utilities, lubricants, chemicals, catalysts, facilities, services, and other matters required for Commissioning.

25.1.3 In accordance with the requirements of the Contract, the Contractor's and Project Manager's advisory personnel shall

attend the Commissioning, including the Guarantee Test, and shall advise and assist the Employer.

25.2 Guarantee Test

25.2.1 Subject to GCC Subclause 25.5, the Guarantee Test and repeats thereof shall be conducted by the Contractor during Commissioning of the Facilities or the relevant part thereof to ascertain whether the Facilities or the relevant part can attain the Functional Guarantees specified in the Appendix (Functional Guarantees) to the Contract Agreement. The Employer shall promptly provide the Contractor with such information as the Contractor may reasonably require in relation to the conduct and results of the Guarantee Test and any repeats thereof.

25.2.2 If for reasons not attributable to the Contractor, the Guarantee Test of the Facilities or the relevant part thereof cannot be successfully completed within the period from the date of Completion specified in the SCC or any other period agreed upon by the Employer and the Contractor, the Contractor shall be deemed to have fulfilled its obligations with respect to the Functional Guarantees, and GCC Subclauses 28.2 and 28.3 shall not apply.

25.3 Operational Acceptance

25.3.1 Subject to GCC Subclause 25.4 below, Operational Acceptance shall occur in respect of the Facilities or any part thereof when

- (a) the Guarantee Test has been successfully completed and the Functional Guarantees are met; or
- (b) the Guarantee Test has not been successfully completed or has not been carried out for reasons not attributable to the Contractor within the period from the date of Completion specified in the SCC, or any other agreed upon period as specified in GCC Subclause 25.2.2 above; or
- (c) the Contractor has paid the liquidated damages specified in GCC Subclause 28.3 hereof; and
- (d) any minor items mentioned in GCC Subclause 24.7 hereof relevant to the Facilities or that part thereof have been completed.

25.3.2 At any time after any of the events set out in GCC Subclause 25.3.1 have occurred, the Contractor may give a notice to the Project Manager requesting the issue of an Operational Acceptance Certificate in the form provided in the Employer's Requirements (Forms and Procedures) in respect of the Facilities or the part thereof specified in such notice as of the date of such notice.

25.3.3 The Project Manager shall, after consultation with the Employer, and within 7 days after receipt of the Contractor's notice, issue an Operational Acceptance Certificate.

25.3.4 If within 7 days after receipt of the Contractor's notice, the Project Manager fails to issue the Operational Acceptance

Certificate or fails to inform the Contractor in writing of the justifiable reasons why the Project Manager has not issued the Operational Acceptance Certificate, the Facilities or the relevant part thereof shall be deemed to have been accepted as of the date of the Contractor's said notice.

25.4 Partial Acceptance

25.4.1 If the Contract specifies that Completion and Commissioning shall be carried out in respect of parts of the Facilities, the provisions relating to Completion and Commissioning including the Guarantee Test shall apply to each such part of the Facilities individually, and the Operational Acceptance Certificate shall be issued accordingly for each such part of the Facilities.

25.4.2 If a part of the Facilities comprises facilities such as buildings, for which no Commissioning or Guarantee Test is required, then the Project Manager shall issue the Operational Acceptance Certificate for such facility when it attains Completion, provided that the Contractor shall thereafter complete any outstanding minor items that are listed in the Operational Acceptance Certificate.

25.5 Delayed Pre-Commissioning and/or Guarantee Test

25.5.1 In the event that the Contractor is unable to proceed with the Pre-commissioning of the Facilities pursuant to Subclause 24.3, or with the Guarantee Test pursuant to Subclause 25.2, for reasons attributable to the Employer either on account of non availability of other facilities under the responsibilities of other contractor(s), or for reasons beyond the Employer's control, the provisions leading to "deemed" completion of activities such as Completion, pursuant to GCC Subclause 24.6, and Operational Acceptance, pursuant to GCC Subclause 25.3.4, and Contractor's obligations regarding Defect Liability Period, pursuant to GCC Subclause 27.2, Functional Guarantee, pursuant to GCC Clause 28, and Care of Facilities, pursuant to GCC Clause 32, and GCC Clause 41.1, Suspension, shall not apply. In this case, the following provisions shall apply.

25.5.2 When the Contractor is notified by the Project Manager that he will be unable to proceed with the activities and obligations pursuant to above Subclause 25.5.1, the Contractor shall be entitled to the following:

- (a) the Time of Completion shall be extended for the period of suspension without imposition of liquidated damages pursuant to GCC Subclause 26.2;
- (b) payments due to the Contractor in accordance with the provision specified in the Appendix (Terms and Procedures of Payment) to the Contract Agreement, which would not have been payable in normal circumstances due to noncompletion of the subject activities, shall be released to the Contractor against submission of a security in the form of a bank guarantee of equivalent amount acceptable to the Employer, and

which shall become null and void when the Contractor will have complied with its obligations regarding those payments, subject to the provision of Subclause 25.5.3 below;

- (c) the expenses towards the above security and extension of other securities under the contract, of which validity needs to be extended, shall be reimbursed to the Contractor by the Employer;
- (d) the additional charges towards the care of the Facilities pursuant to GCC Subclause 32.1 shall be reimbursed to the Contractor by the Employer for the period between the notification mentioned above and the notification mentioned in Subclause 25.5.4 below. The provision of GCC Subclause 33.2 shall apply to the Facilities during the same period.

25.5.3 In the event that the period of suspension under above Subclause 25.5.1 actually exceeds 180 days, the Employer and Contractor shall mutually agree to any additional compensation payable to the Contractor.

25.5.4 When the Contractor is notified by the Project Manager that the plant is ready for Pre-commissioning, the Contractor shall proceed without delay in performing all the specified activities and obligations under the contract.

F. Guarantees and Liabilities

26. Completion Time Guarantee

26.1 The Contractor guarantees that it shall attain Completion of the Facilities (or a part for which a separate time for completion is specified) within the Time for Completion specified in the SCC pursuant to GCC Subclause 8.2, or within such extended time to which the Contractor shall be entitled under GCC Clause 40 hereof.

26.2 If the Contractor fails to attain Completion of the Facilities or any part thereof within the Time for Completion or any extension thereof under GCC Clause 40, the Contractor shall pay to the Employer liquidated damages in the amount specified in the SCC as a percentage rate of the Contract Price or the relevant part thereof. The aggregate amount of such liquidated damages shall in no event exceed the amount specified as "Maximum" in the SCC as a percentage rate of the Contract Price. Once the "Maximum" is reached, the Employer may consider termination of the Contract, pursuant to GCC Subclause 42.2.2.

Such payment shall completely satisfy the Contractor's obligation to attain Completion of the Facilities or the relevant part thereof within the Time for Completion or any extension thereof under GCC Clause 40. The Contractor shall have no further liability whatsoever to the Employer in respect thereof.

However, the payment of liquidated damages shall not in any way relieve the Contractor from any of its obligations to complete the

Facilities or from any other obligations and liabilities of the Contractor under the Contract.

Save for liquidated damages payable under this GCC Subclause 26.2, the failure by the Contractor to attain any milestone or other act, matter or thing by any date specified in the Appendix (Time Schedule) to the Contract Agreement and/or other program of work prepared pursuant to GCC Subclause 18.2 shall not render the Contractor liable for any loss or damage thereby suffered by the Employer.

- 26.3 If the Contractor attains Completion of the Facilities or any part thereof before the Time for Completion or any extension thereof under GCC Clause 40, the Employer shall pay to the Contractor a bonus in the amount specified in the SCC. The aggregate amount of such bonus shall in no event exceed the amount specified as "Maximum" in the SCC.

27. Defect Liability

- 27.1 The Contractor warrants that the Facilities or any part thereof shall be free from defects in the design, engineering, materials, and workmanship of the Plant supplied and of the work executed.

- 27.2 The Defect Liability Period shall be 540 days from the date of Completion of the Facilities (or any part thereof) or 1 year from the date of Operational Acceptance of the Facilities (or any part thereof), whichever first occurs, unless specified otherwise in the SCC pursuant to GCC Subclause 27.10.

If during the Defect Liability Period any defect should be found in the design, engineering, materials, and workmanship of the Plant supplied or of the work executed by the Contractor, the Contractor shall promptly, in consultation and agreement with the Employer regarding appropriate remedying of the defects, and at its cost, repair, replace, or otherwise make good as the Contractor shall determine at its discretion, such defect as well as any damage to the Facilities caused by such defect. The Contractor shall not be responsible for the repair, replacement, or making good of any defect or of any damage to the Facilities arising out of or resulting from any of the following causes:

- (a) improper operation or maintenance of the Facilities by the Employer,
- (b) operation of the Facilities outside specifications provided in the Contract, or
- (c) normal wear and tear.

- 27.3 The Contractor's obligations under this GCC Clause 27 shall not apply to:

- (a) any materials that are supplied by the Employer under GCC Subclause 21.2, are normally consumed in operation, or have a normal life shorter than the Defect Liability Period stated herein;
- (b) any designs, specifications or other data designed, supplied, or specified by or on behalf of the Employer or any matters for which the Contractor has disclaimed responsibility herein; or
- (c) any other materials supplied or any other work executed by or on behalf of the Employer, except for the work executed by the

Employer under GCC Subclause 27.7.

27.4 The Employer shall give the Contractor a notice stating the nature of any such defect together with all available evidence thereof, promptly following the discovery thereof. The Employer shall afford all reasonable opportunity for the Contractor to inspect any such defect.

27.5 The Employer shall afford the Contractor all necessary access to the Facilities and the Site to enable the Contractor to perform its obligations under this GCC Clause 27.

The Contractor may, with the consent of the Employer, remove from the Site any Plant or any part of the Facilities that are defective if the nature of the defect, and/or any damage to the Facilities caused by the defect, is such that repairs cannot be expeditiously carried out at the Site.

27.6 If the repair, replacement or making good is of such a character that it may affect the efficiency of the Facilities or any part thereof, the Employer may give to the Contractor a notice requiring that tests of the defective part of the Facilities shall be made by the Contractor immediately upon completion of such remedial work, whereupon the Contractor shall carry out such tests.

If such part fails the tests, the Contractor shall carry out further repair, replacement or making good, as the case may be, until that part of the Facilities passes such tests. The tests shall be agreed upon by the Employer and the Contractor.

27.7 If the Contractor fails to commence the work necessary to remedy such defect or any damage to the Facilities caused by such defect within a reasonable time (which shall in no event be considered to be less than 15 days), the Employer may, following notice to the Contractor, proceed to do such work, and the reasonable costs incurred by the Employer in connection therewith shall be paid to the Employer by the Contractor or may be deducted by the Employer from any monies due the Contractor or claimed under the Performance Security.

27.8 If the Facilities or any part thereof cannot be used by reason of such defect and/or making good of such defect, the Defect Liability Period of the Facilities or such part, as the case may be, shall be extended by a period equal to the period during which the Facilities or such part cannot be used by the Employer because of any of the aforesaid reasons.

27.9 Except as provided in GCC Clauses 27 and 33, the Contractor shall be under no liability whatsoever and howsoever arising, and whether under the Contract or at law, in respect of defects in the Facilities or any part thereof, the Plant, design, or engineering, or work executed that appear after Completion of the Facilities or any part thereof, except where such defects are the result of the gross negligence, fraud, criminal, or willful action of the Contractor.

27.10 In addition, any such component of the Facilities and during the period of time as may be specified in the SCC shall be subject to an extended Defect Liability Period. Such obligation of the Contractor shall be in addition to the Defect Liability Period specified under GCC Subclause

27.2.

28. Functional Guarantees

- 28.1 The Contractor guarantees that during the Guarantee Test, the Facilities and all parts thereof shall attain the Functional Guarantees specified in the Appendix (Functional Guarantees) to the Contract Agreement, subject to, and upon the conditions therein specified.
- 28.2 If, for reasons attributable to the Contractor, the minimum level of the Functional Guarantees specified in the Appendix (Functional Guarantees) to the Contract Agreement are not met either in whole or in part, the Contractor shall at its cost and expense make such changes, modifications, and/or additions to the Plant or any part thereof as may be necessary to meet at least the minimum level of such Guarantees. The Contractor shall notify the Employer upon completion of the necessary changes, modifications, and/or additions, and shall request the Employer to repeat the Guarantee Test until the minimum level of the Guarantees has been met. If the Contractor eventually fails to meet the minimum level of Functional Guarantees, the Employer may consider termination of the Contract, pursuant to GCC Subclause 42.2.2.
- 28.3 If, for reasons attributable to the Contractor, the Functional Guarantees specified in the Appendix (Functional Guarantees) to the Contract Agreement are not attained either in whole or in part, but the minimum level of the Functional Guarantees specified in the said Appendix to the Contract Agreement is met, the Contractor shall, at the Contractor's option, either
- (a) make such changes, modifications, and/or additions to the Facilities or any part thereof that are necessary to attain the Functional Guarantees at its cost and expense, and shall request the Employer to repeat the Guarantee Test or
 - (b) pay liquidated damages to the Employer in respect of the failure to meet the Functional Guarantees in accordance with the provisions in the Appendix (Functional Guarantees) to the Contract Agreement.
- 28.4 The payment of liquidated damages under GCC Subclause 28.3, up to the limitation of liability specified in the Appendix (Functional Guarantees) to the Contract Agreement, shall completely satisfy the Contractor's guarantees under GCC Subclause 28.3, and the Contractor shall have no further liability whatsoever to the Employer in respect thereof. Upon the payment of such liquidated damages by the Contractor, the Project Manager shall issue the Operational Acceptance Certificate for the Facilities or any part thereof in respect of which the liquidated damages have been so paid.

29. Patent Indemnity

- 29.1 The Contractor shall, subject to the Employer's compliance with GCC Subclause 29.2, indemnify and hold harmless the Employer and its employees and officers from and against any and all suits, actions, or administrative proceedings, claims, demands, losses, damages, costs, and expenses of whatsoever nature, including attorney's fees and expenses, which the Employer may suffer as a result of any infringement or alleged infringement of any patent, utility model, registered design, trademark, copyright, or other intellectual property right registered or otherwise existing at the date of the Contract by reason of (a) the installation of the Facilities by the Contractor or the

use of the Facilities in the country where the Site is located, and (b) the sale of the products produced by the Facilities in any country.

Such indemnity shall not cover any use of the Facilities or any part thereof other than for the purpose indicated by or to be reasonably inferred from the Contract, any infringement resulting from the use of the Facilities or any part thereof, or any products produced thereby in association or combination with any other equipment, plant, or materials not supplied by the Contractor, pursuant to the Contract Agreement.

- 29.2 If any proceedings are brought or any claim is made against the Employer arising out of the matters referred to in GCC Subclause 29.1, the Employer shall promptly give the Contractor a notice thereof, and the Contractor may at its own expense and in the Employer's name conduct such proceedings or claim and any negotiations for the settlement of any such proceedings or claim.

If the Contractor fails to notify the Employer within 30 days after receipt of such notice that it intends to conduct any such proceedings or claim, then the Employer shall be free to conduct the same on its own behalf. Unless the Contractor has so failed to notify the Employer within the 30-day period, the Employer shall make no admission that may be prejudicial to the defense of any such proceedings or claim.

The Employer shall, at the Contractor's request, afford all available assistance to the Contractor in conducting such proceedings or claim, and shall be reimbursed by the Contractor for all reasonable expenses incurred in so doing.

- 29.3 The Employer shall indemnify and hold harmless the Contractor and its employees, officers, and Subcontractors from and against any and all suits, actions or administrative proceedings, claims, demands, losses, damages, costs, and expenses of whatsoever nature, including attorney's fees and expenses, which the Contractor may suffer as a result of any infringement or alleged infringement of any patent, utility model, registered design, trademark, copyright, or other intellectual property right registered or otherwise existing at the date of the Contract arising out of or in connection with any design, data, drawing, specification, or other documents or materials provided or designed by or on behalf of the Employer.

30. Limitation of Liability

- 30.1 Except in cases of criminal negligence or willful misconduct,
- (a) the Contractor shall not be liable to the Employer, whether in contract, tort, or otherwise, for any indirect or consequential loss or damage, loss of use, loss of production, or loss of profits or interest costs, provided that this exclusion shall not apply to any obligation of the Contractor to pay liquidated damages to the Employer, and
 - (b) the aggregate liability of the Contractor to the Employer, whether under the Contract, in tort or otherwise, shall not exceed a multiple of the Contract Price specified in the SCC or, if a multiple is not so specified, the total Contract Price, provided that this limitation shall not apply to the cost of repairing or replacing defective equipment, or to any obligation of the Contractor to indemnify the Employer with respect to patent infringement.

G. Risk Distribution**31. Transfer of Ownership**

- 31.1 Ownership of the Plant (including spare parts) to be imported into the country where the Site is located shall be transferred to the Employer upon loading on to the mode of transport to be used to convey the Plant from the country of origin to that country.
- 31.2 Ownership of the Plant (including spare parts) procured in the country where the Site is located shall be transferred to the Employer when the Plant are brought on to the Site.
- 31.3 Ownership of the Contractor's Equipment used by the Contractor and its Subcontractors in connection with the Contract shall remain with the Contractor or its Subcontractors.
- 31.4 Ownership of any Plant in excess of the requirements for the Facilities shall revert to the Contractor upon Completion of the Facilities or at such earlier time when the Employer and the Contractor agree that the Plant in question are no longer required for the Facilities.
- 31.5 Notwithstanding the transfer of ownership of the Plant, the responsibility for care and custody thereof together with the risk of loss or damage thereto shall remain with the Contractor pursuant to GCC Clause 32 (Care of Facilities) hereof until Completion of the Facilities or the part thereof in which such Plant are incorporated.

32. Care of Facilities

- 32.1 The Contractor shall be responsible for the care and custody of the Facilities or any part thereof until the date of Completion of the Facilities pursuant to GCC Clause 24 or, where the Contract provides for Completion of the Facilities in parts, until the date of Completion of the relevant part, and shall make good at its own cost any loss or damage that may occur to the Facilities or the relevant part thereof from any cause whatsoever during such period. The Contractor shall also be responsible for any loss or damage to the Facilities caused by the Contractor or its Subcontractors in the course of any work carried out, pursuant to GCC Clause 27. Notwithstanding the foregoing, the Contractor shall not be liable for any loss or damage to the Facilities or that part thereof caused by reason of any of the matters specified or referred to in paragraphs (a), (b) and (c) of GCC Subclauses 32.2 and 38.1.
- 32.2 If any loss or damage occurs to the Facilities or any part thereof or to the Contractor's temporary facilities by reason of
- (a) insofar as they relate to the country where the Site is located, nuclear reaction, nuclear radiation, radioactive contamination, pressure wave caused by aircraft or other aerial objects, or any other occurrences that an experienced contractor could not reasonably foresee, or if reasonably foreseeable could not reasonably make provision for or insure against, insofar as such risks are not normally insurable on the insurance market and are mentioned in the general exclusions of the policy of insurance, including War Risks and Political Risks, taken out under GCC Clause 34 hereof; or
 - (b) any use or occupation by the Employer or any third party other

than a Subcontractor, authorized by the Employer of any part of the Facilities; or

- (c) any use of or reliance upon any design, data, or specification provided or designated by or on behalf of the Employer, or any such matter for which the Contractor has disclaimed responsibility herein,

the Employer shall pay to the Contractor all sums payable in respect of the Facilities executed, notwithstanding that the same be lost, destroyed, or damaged, and will pay to the Contractor the replacement value of all temporary facilities and all parts thereof lost, destroyed, or damaged. If the Employer requests the Contractor in writing to make good any loss or damage to the Facilities thereby occasioned, the Contractor shall make good the same at the cost of the Employer in accordance with GCC Clause 39. If the Employer does not request the Contractor in writing to make good any loss or damage to the Facilities thereby occasioned, the Employer shall either request a change in accordance with GCC Clause 39, excluding the performance of that part of the Facilities thereby lost, destroyed or damaged, or, where the loss or damage affects a substantial part of the Facilities, the Employer shall terminate the Contract pursuant to GCC Subclause 42.1 hereof.

- 32.3 The Contractor shall be liable for any loss of or damage to any Contractor's Equipment, or any other property of the Contractor used or intended to be used for purposes of the Facilities, except (i) as mentioned in GCC Subclause 32.2 with respect to the Contractor's temporary facilities, and (ii) where such loss or damage arises by reason of any of the matters specified in GCC Subclauses 32.2 (b) and (c) and 38.1.

- 32.4 With respect to any loss or damage caused to the Facilities or any part thereof or to the Contractor's Equipment by reason of any of the matters specified in GCC Subclause 38.1, the provisions of GCC Subclause 38.3 shall apply.

**33. Loss of or
Damage to
Property;
Accident or Injury
to Workers;
Indemnification**

- 33.1 Subject to GCC Subclause 33.3, the Contractor shall indemnify and hold harmless the Employer and its employees and officers from and against any and all suits, actions, or administrative proceedings, claims, demands, losses, damages, costs, and expenses of whatsoever nature, including attorney's fees and expenses, in respect of the death or injury of any person or loss of or damage to any property other than the Facilities whether accepted or not, arising in connection with the supply and installation of the Facilities and by reason of the negligence of the Contractor or its Subcontractors, or their employees, officers, or agents, except any injury, death, or property damage caused by the negligence of the Employer, its contractors, employees, officers, or agents.

- 33.2 If any proceedings are brought or any claim is made against the Employer that might subject the Contractor to liability under GCC Subclause 33.1, the Employer shall promptly give the Contractor a notice thereof and the Contractor may at its own expense and in the Employer's name conduct such proceedings or claim and any negotiations for the settlement of any such proceedings or claim.

If the Contractor fails to notify the Employer within 30 days after receipt

of such notice that it intends to conduct any such proceedings or claim, then the Employer shall be free to conduct the same on its own behalf. Unless the Contractor has so failed to notify the Employer within the 30-day period, the Employer shall make no admission that may be prejudicial to the defense of any such proceedings or claim.

The Employer shall, at the Contractor's request, afford all available assistance to the Contractor in conducting such proceedings or claim, and shall be reimbursed by the Contractor for all reasonable expenses incurred in so doing.

33.3 The Employer shall indemnify and hold harmless the Contractor and its employees, officers, and Subcontractors from any liability for loss of or damage to property of the Employer, other than the Facilities not yet taken over, that is caused by fire, explosion, or any other perils, in excess of the amount recoverable from insurances procured under GCC Clause 34, provided that such fire, explosion, or other perils were not caused by any act or failure of the Contractor.

33.4 The party entitled to the benefit of an indemnity under this GCC Clause 33 shall take all reasonable measures to mitigate any loss or damage which has occurred. If the party fails to take such measures, the other party's liabilities shall be correspondingly reduced.

34. Insurance

34.1 To the extent specified in the Appendix (Insurance Requirements) to the Contract Agreement, the Contractor shall at its expense take out and maintain in effect, or cause to be taken out and maintained in effect, during the performance of the Contract, the insurances set forth below in the sums and with the deductibles and other conditions specified in the said Appendix. The identity of the insurers and the form of the policies shall be subject to the approval of the Employer, who should not unreasonably withhold such approval.

(a) Cargo Insurance During Transport

Covering loss or damage occurring while in transit from the Contractor's or Subcontractor's works or stores until arrival at the Site, to the Plant (including spare parts therefor) and to the Contractor's Equipment.

(b) Installation All Risks Insurance

Covering physical loss or damage to the Facilities at the Site, occurring prior to Completion of the Facilities, with an extended maintenance coverage for the Contractor's liability in respect of any loss or damage occurring during the Defect Liability Period while the Contractor is on the Site for the purpose of performing its obligations during the Defect Liability Period.

(c) Third Party Liability Insurance

Covering bodily injury or death suffered by third parties including the Employer's personnel, and loss of or damage to property occurring in connection with the supply and installation of the Facilities.

(d) Automobile Liability Insurance

Covering use of all vehicles used by the Contractor or its Subcontractors, whether or not owned by them, in connection

with the execution of the Contract.

(e) Workers' Compensation

In accordance with the statutory requirements applicable in any country where the Contract or any part thereof is executed.

(f) Employer's Liability

In accordance with the statutory requirements applicable in any country where the Contract or any part thereof is executed.

(g) Other Insurances

Such other insurances as may be specifically agreed upon by the parties hereto as listed in the Appendix (Insurance Requirements) to the Contract Agreement.

34.2 The Employer shall be named as co-insured under all insurance policies taken out by the Contractor pursuant to GCC Subclause 34.1, except for the Third Party Liability, Workers' Compensation, and Employer's Liability Insurances, and the Contractor's Subcontractors shall be named as co-insureds under all insurance policies taken out by the Contractor pursuant to GCC Subclause 34.1 except for the Cargo Insurance During Transport, Workers' Compensation, and Employer's Liability Insurances. All insurer's rights of subrogation against such co-insureds for losses or claims arising out of the performance of the Contract shall be waived under such policies.

34.3 The Contractor shall, in accordance with the provisions of the Appendix (Insurance Requirements) to the Contract Agreement, deliver to the Employer certificates of insurance or copies of the insurance policies as evidence that the required policies are in full force and effect. The certificates shall provide that no less than 21 days' notice shall be given to the Employer by insurers prior to cancellation or material modification of a policy.

34.4 The Contractor shall ensure that, where applicable, its Subcontractor(s) shall take out and maintain in effect adequate insurance policies for their personnel and vehicles and for work executed by them under the Contract, unless such Subcontractors are covered by the policies taken out by the Contractor.

34.5 The Employer shall at its expense take out and maintain in effect during the performance of the Contract those insurances specified in the Appendix (Insurance Requirements) to the Contract Agreement, in the sums and with the deductibles and other conditions specified in the said Appendix. The Contractor and the Contractor's Subcontractors shall be named as co-insureds under all such policies. All insurers' rights of subrogation against such co-insureds for losses or claims arising out of the performance of the Contract shall be waived under such policies. The Employer shall deliver to the Contractor satisfactory evidence that the required insurances are in full force and effect. The policies shall provide that not less than 21 days' notice shall be given to the Contractor by all insurers prior to any cancellation or material modification of the policies. If so requested by the Contractor, the Employer shall provide copies of the policies taken out by the

Employer under this GCC Subclause 34.5.

- 34.6 If the Contractor fails to take out and/or maintain in effect the insurances referred to in GCC Subclause 34.1, the Employer may take out and maintain in effect any such insurances and may from time to time deduct from any amount due the Contractor under the Contract any premium that the Employer shall have paid to the insurer, or may otherwise recover such amount as a debt due from the Contractor. If the Employer fails to take out and/or maintain in effect the insurances referred to in GCC 34.5, the Contractor may take out and maintain in effect any such insurances and may from time to time deduct from any amount due the Employer under the Contract any premium that the Contractor shall have paid to the insurer, or may otherwise recover such amount as a debt due from the Employer. If the Contractor fails to or is unable to take out and maintain in effect any such insurances, the Contractor shall nevertheless have no liability or responsibility towards the Employer, and the Contractor shall have full recourse against the Employer for any and all liabilities of the Employer herein.
- 34.7 Unless otherwise provided in the Contract, the Contractor shall prepare and conduct all and any claims made under the policies effected by it pursuant to this GCC Clause 34, and all monies payable by any insurers shall be paid to the Contractor. The Employer shall give to the Contractor all such reasonable assistance as may be required by the Contractor. With respect to insurance claims in which the Employer's interest is involved, the Contractor shall not give any release or make any compromise with the insurer without the prior written consent of the Employer. With respect to insurance claims in which the Contractor's interest is involved, the Employer shall not give any release or make any compromise with the insurer without the prior written consent of the Contractor.

35. Unforeseen Conditions

- 35.1 If, during the execution of the Contract, the Contractor shall encounter on the Site any physical conditions other than climatic conditions, or artificial obstructions that could not have been reasonably foreseen prior to the date of the Contract Agreement by an experienced contractor on the basis of reasonable examination of the data relating to the Facilities including any data as to boring tests, provided by the Employer, and on the basis of information that it could have obtained from a visual inspection of the Site if access thereto was available, or other data readily available to it relating to the Facilities, and if the Contractor determines that it will in consequence of such conditions or obstructions incur additional cost and expense or require additional time to perform its obligations under the Contract that would not have been required if such physical conditions or artificial obstructions had not been encountered, the Contractor shall promptly, and before performing additional work or using additional Plant or Contractor's Equipment, notify the Project Manager in writing of
- (a) the physical conditions or artificial obstructions on the Site that could not have been reasonably foreseen;
 - (b) the additional work and/or Plant and/or Contractor's Equipment required, including the steps which the Contractor will or proposes to take to overcome such conditions or obstructions;

- (c) the extent of the anticipated delay; and
- (d) the additional cost and expense that the Contractor is likely to incur.

On receiving any notice from the Contractor under this GCC Subclause 35.1, the Project Manager shall promptly consult with the Employer and Contractor and decide upon the actions to be taken to overcome the physical conditions or artificial obstructions encountered. Following such consultations, the Project Manager shall instruct the Contractor, with a copy to the Employer, of the actions to be taken.

35.2 Any reasonable additional cost and expense incurred by the Contractor in following the instructions from the Project Manager to overcome such physical conditions or artificial obstructions referred to in GCC Subclause 35.1 shall be paid by the Employer to the Contractor as an addition to the Contract Price.

35.3 If the Contractor is delayed or impeded in the performance of the Contract because of any such physical conditions or artificial obstructions referred to in GCC Subclause 35.1, the Time for Completion shall be extended in accordance with GCC Clause 40.

36. Change in Laws and Regulations

36.1 If, after the date 30 days prior to the date of Bid submission, in the country where the Site is located, any law, regulation, ordinance, order or by-law having the force of law is enacted, promulgated, abrogated, or changed, which shall be deemed to include any change in interpretation or application by the competent authorities, that subsequently affects the costs and expenses of the Contractor and/or the Time for Completion, the Contract Price shall be correspondingly increased or decreased, and/or the Time for Completion shall be reasonably adjusted to the extent that the Contractor has thereby been affected in the performance of any of its obligations under the Contract. Notwithstanding the foregoing, such additional or reduced costs shall not be separately paid or credited if the same has already been accounted for in the price adjustment provisions where applicable, in accordance with the SCC, pursuant to GCC Subclause 11.2.

37. Force Majeure

37.1 "Force Majeure" shall mean any event beyond the reasonable control of the Employer or of the Contractor, as the case may be, and which is unavoidable notwithstanding the reasonable care of the party affected, and shall include, without limitation, the following:

- (a) war, hostilities, or warlike operations whether a state of war be declared or not, invasion, act of foreign enemy and civil war;
- (b) rebellion, revolution, insurrection, mutiny, usurpation of civil or military government, conspiracy, riot, civil commotion, and terrorist acts;
- (c) confiscation, nationalization, mobilization, commandeering or requisition by or under the order of any government or de jure or de facto authority or ruler or any other act or failure to act of any local state or national government authority;
- (d) strike, sabotage, lockout, embargo, import restriction, port congestion, lack of usual means of public transportation and

- communication, industrial dispute, shipwreck, shortage or restriction of power supply, epidemics, pandemic, quarantine, and plague;
- (e) earthquake, landslide, volcanic activity, fire, flood or inundation, tidal wave, typhoon or cyclone, hurricane, storm, lightning, or other inclement weather condition, nuclear, and pressure waves or other natural or physical disaster; and
 - (f) shortage of labor, materials, or utilities where caused by circumstances that are themselves Force Majeure.
- 37.2 If either party is prevented, hindered, or delayed from or in performing any of its obligations under the Contract by an event of Force Majeure, then it shall notify the other in writing of the occurrence of such event and the circumstances thereof within 14 days after the occurrence of such event.
- 37.3 The party who has given such notice shall be excused from the performance or punctual performance of its obligations under the Contract for so long as the relevant event of Force Majeure continues and to the extent that such party's performance is prevented, hindered, or delayed. The Time for Completion shall be extended in accordance with GCC Clause 40.
- 37.4 The party or parties affected by the event of Force Majeure shall use reasonable efforts to mitigate the effect thereof upon its or their performance of the Contract and to fulfill its or their obligations under the Contract, but without prejudice to either party's right to terminate the Contract under GCC Subclauses 37.6 and 38.5.
- 37.5 No delay or nonperformance by either party hereto caused by the occurrence of any event of Force Majeure shall
- (a) constitute a default or breach of the Contract; or
 - (b) give rise to any claim for damages or additional cost or expense occasioned thereby, subject to GCC Subclauses 32.2, 38.3 and 38.4
- if and to the extent that such delay or nonperformance is caused by the occurrence of an event of Force Majeure.
- 37.6 If the performance of the Contract is substantially prevented, hindered, or delayed for a single period of more than 60 days or an aggregate period of more than 120 days on account of one or more events of Force Majeure during the currency of the Contract, the parties will attempt to develop a mutually satisfactory solution, failing which either party may terminate the Contract by giving a notice to the other, but without prejudice to either party's right to terminate the Contract under GCC Subclause 38.5.
- 37.7 In the event of termination pursuant to GCC Subclause 37.6, the rights and obligations of the Employer and the Contractor shall be as specified in GCC Subclauses 42.1.2 and 42.1.3.
- 37.8 Notwithstanding GCC Subclause 37.5, Force Majeure shall not apply to any obligation of the Employer to make payments to the Contractor

herein.

38. War Risks

38.1 "War Risks" shall mean any event specified in paragraphs (a) and (b) of GCC Subclause 37.1 and any explosion or impact of any mine, bomb, shell, grenade, or other projectile, missile, munitions or explosive of war, occurring or existing in or near the country (or countries) where the Site is located.

38.2 Notwithstanding anything contained in the Contract, the Contractor shall have no liability whatsoever for or with respect to

- (a) destruction of or damage to Facilities, Plant, or any part thereof;
- (b) destruction of or damage to property of the Employer or any third party; or
- (c) injury or loss of life

if such destruction, damage, injury or loss of life is caused by any war risks, and the Employer shall indemnify and hold the Contractor harmless from and against any and all claims, liabilities, actions, lawsuits, damages, costs, charges, or expenses arising in consequence of or in connection with the same.

38.3 If the Facilities or any Plant or Contractor's Equipment or any other property of the Contractor used or intended to be used for the purposes of the Facilities shall sustain destruction or damage by reason of any war risks, the Employer shall pay the Contractor for

- (a) any part of the Facilities or the Plant so destroyed or damaged to the extent not already paid for by the Employer and so far as may be required by the Employer, and as may be necessary for completion of the Facilities;
- (b) replacing or making good any Contractor's Equipment or other property of the Contractor so destroyed or damaged; and
- (c) replacing or making good any such destruction or damage to the Facilities or the Plant or any part thereof.

If the Employer does not require the Contractor to replace or make good any such destruction or damage to the Facilities, the Employer shall either request a change in accordance with GCC Clause 39, excluding the performance of that part of the Facilities thereby destroyed or damaged or, where the loss, destruction, or damage affects a substantial part of the Facilities, shall terminate the Contract, pursuant to GCC Subclause 42.1.

If the Employer requires the Contractor to replace or make good on any such destruction or damage to the Facilities, the Time for Completion shall be extended in accordance with GCC 40.

38.4 Notwithstanding anything contained in the Contract, the Employer shall pay the Contractor for any increased costs or incidentals to the execution of the Contract that are in any way attributable to, consequent on, resulting from, or in any way connected with any war risks, provided that the Contractor shall as soon as practicable notify the Employer in writing of any such increased cost.

38.5 If during the performance of the Contract any war risks shall occur that financially or otherwise materially affect the execution of the Contract by the Contractor, the Contractor shall use its reasonable efforts to execute the Contract with due and proper consideration given to the safety of its and its Subcontractors' personnel engaged in the work on the Facilities, provided, however, that if the execution of the work on the Facilities becomes impossible or is substantially prevented for a single period of more than sixty (60) days or an aggregate period of more than one hundred and twenty (120) days on account of any war risks, the parties will attempt to develop a mutually satisfactory solution, failing which either party may terminate the Contract by giving a notice to the other.

38.6 In the event of termination pursuant to GCC Subclauses 38.3 or 38.5, the rights and obligations of the Employer and the Contractor shall be specified in GCC Subclauses 42.1.2 and 42.1.3.

H. Change in Contract Elements

39. Change in the Facilities

39.1 Introducing a Change

39.1.1 Subject to GCC Subclauses 39.2.5 and 39.2.7, the Employer shall have the right to propose, and subsequently require, that the Project Manager order the Contractor from time to time during the performance of the Contract to make any change, modification, addition, or deletion to, in or from the Facilities hereinafter called "Change," provided that such Change falls within the general scope of the Facilities and does not constitute unrelated work and that it is technically practicable, taking into account both the state of advancement of the Facilities and the technical compatibility of the Change envisaged with the nature of the Facilities as specified in the Contract.

39.1.2 The Contractor may from time to time during its performance of the Contract propose to the Employer with a copy to the Project Manager, any Change that the Contractor considers necessary or desirable to improve the quality, efficiency, or safety of the Facilities. The Employer may at its discretion approve or reject any Change proposed by the Contractor, provided that the Employer shall approve any Change proposed by the Contractor to ensure the safety of the Facilities.

39.1.3 Notwithstanding GCC Subclauses 39.1.1 and 39.1.2, no change made necessary because of any default of the Contractor in the performance of its obligations under the Contract shall be deemed to be a Change, and such change shall not result in any adjustment of the Contract Price or the Time for Completion.

39.1.4 The procedure on how to proceed with and execute Changes is specified in GCC Subclauses 39.2 and 39.3, and further details and forms are provided in the Employer's Requirements (Forms and Procedures).

39.2 Changes Originating from Employer

39.2.1 If the Employer proposes a Change pursuant to GCC Subclause 39.1.1, it shall send to the Contractor a "Request for Change

Proposal,” requiring the Contractor to prepare and furnish to the Project Manager as soon as reasonably practicable a “Change Proposal,” which shall include the following:

- (a) brief description of the Change,
- (b) effect on the Time for Completion,
- (c) estimated cost of the Change,
- (d) effect on Functional Guarantees (if any),
- (e) effect on the Facilities, and
- (f) effect on any other provisions of the Contract.

39.2.2 Prior to preparing and submitting the “Change Proposal,” the Contractor shall submit to the Project Manager an “Estimate for Change Proposal,” which shall be an estimate of the cost of preparing and submitting the Change Proposal.

Upon receipt of the Contractor’s Estimate for Change Proposal, the Employer shall do one of the following:

- (a) accept the Contractor’s estimate with instructions to the Contractor to proceed with the preparation of the Change Proposal,
- (b) advise the Contractor of any part of its Estimate for Change Proposal that is unacceptable and request the Contractor to review its estimate
- (c) advise the Contractor that the Employer does not intend to proceed with the Change.

39.2.3 Upon receipt of the Employer’s instruction to proceed under GCC Subclause 39.2.2 (a), the Contractor shall, with proper expedition, proceed with the preparation of the Change Proposal, in accordance with GCC Subclause 39.2.1.

39.2.4 The pricing of any Change shall, as far as practicable, be calculated in accordance with the rates and prices included in the Contract. If such rates and prices are inequitable, the parties thereto shall agree on specific rates for the valuation of the Change.

39.2.5 If before or during the preparation of the Change Proposal it becomes apparent that the aggregate effect of compliance therewith and with all other Change Orders that have already become binding upon the Contractor under this GCC Clause 39 would be to increase or decrease the Contract Price as originally set forth in Article 2 (Contract Price) of the Contract Agreement by more than 15%, the Contractor may give a written notice of objection thereto prior to furnishing the Change Proposal as aforesaid. If the Employer accepts the Contractor’s objection, the Employer shall withdraw the proposed Change and shall notify the Contractor in writing thereof.

The Contractor's failure to so object shall neither affect its right to object to any subsequent requested Changes or Change Orders herein, nor affect its right to take into account, when making such subsequent objection, the percentage increase or decrease in the Contract Price that any Change not objected to by the Contractor represents.

- 39.2.6 Upon receipt of the Change Proposal, the Employer and the Contractor shall mutually agree upon all matters therein contained. Within 14 days after such agreement, the Employer shall, if it intends to proceed with the Change, issue the Contractor with a Change Order.

If the Employer is unable to reach a decision within 14 days, it shall notify the Contractor with details of when the Contractor can expect a decision.

If the Employer decides not to proceed with the Change for whatever reason, it shall, within the said period of 14 days, notify the Contractor accordingly. Under such circumstances, the Contractor shall be entitled to reimbursement of all costs reasonably incurred by it in the preparation of the Change Proposal, provided that these do not exceed the amount given by the Contractor in its Estimate for Change Proposal submitted in accordance with GCC Subclause 39.2.2.

- 39.2.7 If the Employer and the Contractor cannot reach agreement on the price for the Change, an equitable adjustment to the Time for Completion, or any other matters identified in the Change Proposal, the Employer may nevertheless instruct the Contractor to proceed with the Change by issue of a "Pending Agreement Change Order."

Upon receipt of a Pending Agreement Change Order, the Contractor shall immediately proceed with effecting the Changes covered by such Order. The parties shall thereafter attempt to reach agreement on the outstanding issues under the Change Proposal.

If the parties cannot reach agreement within 60 days from the date of issue of the Pending Agreement Change Order, then the matter may be referred to the Dispute Board in accordance with the provisions of GCC Subclause 45.3.

39.3 Changes Originating from Contractor

- 39.3.1 If the Contractor proposes a Change pursuant to GCC Subclause 39.1.2, the Contractor shall submit to the Project Manager a written "Application for Change Proposal," giving reasons for the proposed Change and including the information specified in GCC Subclause 39.2.1.

Upon receipt of the Application for Change Proposal, the parties shall follow the procedures outlined in GCC Subclauses 39.2.6 and 39.2.7. However, should the Employer choose not to proceed, the Contractor shall not be entitled to recover the costs

of preparing the Application for Change Proposal.

40. Extension of Time for Completion

40.1 The Time(s) for Completion specified in the SCC shall be extended if the Contractor is delayed or impeded in the performance of any of its obligations under the Contract by reason of any of the following:

- (a) any Change in the Facilities as provided in GCC Clause 39;
- (b) any occurrence of Force Majeure as provided in GCC Clause 37, unforeseen conditions as provided in GCC Clause 35, or other occurrence of any of the matters specified or referred to in paragraphs (a), (b) and (c) of GCC Subclause 32.2;
- (c) any suspension order given by the Employer under GCC Clause 41 hereof or reduction in the rate of progress pursuant to GCC Subclause 41.2; or
- (d) any changes in laws and regulations as provided in GCC Clause 36; or
- (e) any default or breach of the Contract by the Employer, or any activity, act or omission of the Employer, or the Project Manager, or any other contractors employed by the Employer; or
- (f) any other matter specifically mentioned in the Contract; or
- (g) any delay on the part of a sub-contractor, provided such delay is due to a cause for which the Contractor himself would have been entitled to an extension of time under this Subclause

by such period as shall be fair and reasonable in all the circumstances and as shall fairly reflect the delay or impediment sustained by the Contractor.

40.2 Except where otherwise specifically provided in the Contract, the Contractor shall submit to the Project Manager a notice of a claim for an extension of the Time for Completion, together with particulars of the event or circumstance justifying such extension as soon as reasonably practicable after the commencement of such event or circumstance. As soon as reasonably practicable after receipt of such notice and supporting particulars of the claim, the Employer and the Contractor shall agree upon the period of such extension. In the event that the Contractor does not accept the Employer's estimate of a fair and reasonable time extension, the Contractor shall be entitled to refer the matter to a Dispute Board, pursuant to GCC Subclause 45.3.

40.3 The Contractor shall at all times use its reasonable efforts to minimize any delay in the performance of its obligations under the Contract.

In all cases where the Contractor has given a notice of a claim for an extension of time under GCC 40.2, the Contractor shall consult with the Project Manager in order to determine the steps (if any) which can be taken to overcome or minimize the actual or anticipated delay. The Contractor shall there after comply with all reasonable instructions, which the Project Manager shall give in order to minimize such delay. If compliance with such instructions shall cause the Contractor to incur extra costs and the Contractor is entitled to an extension of time under GCC 40.1, the amount of such extra costs shall be added to the

41. Suspension

- 41.1 The Employer may request the Project Manager, by notice to the Contractor, to order the Contractor to suspend performance of any or all of its obligations under the Contract. Such notice shall specify the obligation of which performance is to be suspended, the effective date of the suspension and the reasons therefor. The Contractor shall thereupon suspend performance of such obligation, except those obligations necessary for the care or preservation of the Facilities, until ordered in writing to resume such performance by the Project Manager.

If, by virtue of a suspension order given by the Project Manager, other than by reason of the Contractor's default or breach of the Contract, the Contractor's performance of any of its obligations is suspended for an aggregate period of more than 90 days, then at any time thereafter and provided that at that time such performance is still suspended, the Contractor may give a notice to the Project Manager requiring that the Employer shall, within 30 days of receipt of the notice, order the resumption of such performance or request and subsequently order a change in accordance with GCC Clause 39, excluding the performance of the suspended obligations from the Contract.

If the Employer fails to do so within such period, the Contractor may, by a further notice to the Project Manager, elect to treat the suspension, where it affects a part only of the Facilities, as a deletion of such part in accordance with GCC Clause 39 or, where it affects the whole of the Facilities, as termination of the Contract under GCC Subclause 42.1.

41.2 If

- (a) the Employer has failed to pay the Contractor any sum due under the Contract within the specified period, has failed to approve any invoice or supporting documents without just cause pursuant to the Appendix (Terms and Procedures of Payment) to the Contract Agreement, or commits a substantial breach of the Contract, the Contractor may give a notice to the Employer that requires payment of such sum, with interest thereon as stipulated in GCC Subclause 12.3, requires approval of such invoice or supporting documents, or specifies the breach and requires the Employer to remedy the same, as the case may be. If the Employer fails to pay such sum together with such interest, fails to approve such invoice or supporting documents or give its reasons for withholding such approval, or fails to remedy the breach or take steps to remedy the breach within 14 days after receipt of the Contractor's notice; or
- (b) the Contractor is unable to carry out any of its obligations under the Contract for any reason attributable to the Employer, including but not limited to the Employer's failure to provide possession of or access to the Site or other areas in accordance with GCC Subclause 10.2, or failure to obtain any governmental permit necessary for the execution and/or completion of the Facilities,

then the Contractor may by 14 days' notice to the Employer suspend performance of all or any of its obligations under the Contract, or reduce

the rate of progress.

41.3 If the Contractor's performance of its obligations is suspended, or the rate of progress is reduced pursuant to this GCC Clause 41, then the Time for Completion shall be extended in accordance with GCC Subclause 40.1, and any and all additional costs or expenses incurred by the Contractor as a result of such suspension or reduction shall be paid by the Employer to the Contractor in addition to the Contract Price, except in the case of suspension order or reduction in the rate of progress by reason of the Contractor's default or breach of the Contract.

41.4 During the period of suspension, the Contractor shall not remove from the Site any Plant, any part of the Facilities or any Contractor's Equipment, without the prior written consent of the Employer.

42. Termination

42.1 In no case, the contractor shall terminate the contract unilaterally, without duly notifying the Employer.

42.2 The Employer may terminate the Contract at any time if the contractor :

- a) does not commence the work as per the Contract,
- b) abandons the work without completing,
- c) fails to achieve progress as per the Contract.

42.3 The Employer or the Contractor may terminate the Contract if the other party causes a fundamental breach of the Contract.

42.4 Fundamental breaches of Contract shall include, but shall not be limited to, the following :

- a) The Contractor uses the advance payment for matters other than the contractual obligations,
- b) the Contractor stops work for 30 days when no stoppage of work is shown on the current Program and the stoppage has not been authorized by the Project Manager;
- c) the Project Manager instructs the Contractor to delay the progress of the Works, and the instruction is not withdrawn within 30 days;
- d) the Employer or the Contractor is made bankrupt or goes into liquidation other than for a reconstruction or amalgamation.
- e) a payment certified by the Project Manager is not paid by the Employer to the Contractor within 90 days of the date of the Project Manager's certificate;
- f) the Project Manager gives Notice that failure to correct a particular Defect is a fundamental breach of Contract and the Contractor fails to correct it within a reasonable period of time determined by the Project Manager;
- g) the Contractor does not maintain a Security, which is required; and
- h) the Contractor has delayed the completion of the Works by the number of days for which the maximum amount of liquidated

damages can be paid, as defined in the SCC.

- i) If the Contractor, in the judgment of the Employer has engaged in corrupt or fraudulent practices in competing for or in executing the Contract, pursuant to GCC 6.1.

42.5 When either party to the Contract gives notice of a breach of Contract to the Project Manager for a cause other than those listed under GCC 42.2 above, the Project Manager shall decide whether the breach is fundamental or not.

42.6 Notwithstanding the above, the Employer may terminate the Contract for convenience.

42.7 If the Contract is terminated, the Contractor shall stop work immediately, make the Site safe and secure, and leave the Site as soon as reasonably possible.

42.8 Payment upon Termination

If the Contract is terminated because of fundamental breach of Contract or for any other fault by the Contractor, the performance security shall be forfeited by the Employer. In such case, amount to complete the remaining works as per the Contract shall be recovered from the Contractor as Government dues.

43. Assignment

43.1 Neither the Employer nor the Contractor shall, without the express prior written consent of the other party which consent shall not be unreasonably withheld, assign to any third party the Contract or any part thereof, or any right, benefit, obligation or interest therein or thereunder, except that the Contractor shall be entitled to assign either absolutely or by way of charge any monies due and payable to it or that may become due and payable to it under the Contract.

I. Claims, Disputes, and Arbitration

44. Contractor's Claims

44.1 If the Contractor considers himself to be entitled to any extension of the Time for Completion and/or any additional payment, under any Clause of these Conditions or otherwise in connection with the Contract, the Contractor shall submit a notice to the Project Manager, describing the event or circumstance giving rise to the claim. The notice shall be given as soon as practicable, and not later than 30 days after the Contractor became aware, or should have become aware, of the event or circumstance.

If the Contractor fails to give notice of a claim within such period of 30 days, the Time for Completion shall not be extended, the Contractor shall not be entitled to additional payment, and the Employer shall be discharged from all liability in connection with the claim. Otherwise, the following provisions of this Subclause shall apply.

The Contractor shall also submit any other notices, which are required by the Contract, and supporting particulars for the claim, all as relevant to such event or circumstance.

The Contractor shall keep such contemporary records as may be

necessary to substantiate any claim, either on the Site or at another location acceptable to the Project Manager. Without admitting the Employer's liability, the Project Manager may, after receiving any notice under this Subclause, monitor the record keeping and/or instruct the Contractor to keep further contemporary records. The Contractor shall permit the Project Manager to inspect all these records, and shall (if instructed) submit copies to the Project Manager.

Within 42 days after the Contractor became aware (or should have become aware) of the event or circumstance giving rise to the claim, or within such other period as may be proposed by the Contractor and approved by the Project Manager, the Contractor shall send to the Project Manager a fully detailed claim, which includes full supporting particulars of the basis of the claim and of the extension of time and/or additional payment claimed. If the event or circumstance giving rise to the claim has a continuing effect,

- (a) this fully detailed claim shall be considered as interim;
- (b) the Contractor shall send further interim claims at monthly intervals, giving the accumulated delay and/or amount claimed, and such further particulars as the Project Manager may reasonably require; and
- (c) the Contractor shall send a final claim within 30 days after the end of the effects resulting from the event or circumstance, or within such other period as may be proposed by the Contractor and approved by the Project Manager.

Within 42 days after receiving a claim or any further particulars supporting a previous claim, or within such other period as may be proposed by the Project Manager and approved by the Contractor, the Project Manager shall respond with approval, or with disapproval and detailed comments. He may also request any necessary further particulars, but shall nevertheless give his response on the principles of the claim within such time.

Each payment certificate shall include such amounts for any claim as have been reasonably substantiated as due under the relevant provision of the Contract. Unless and until the particulars supplied are sufficient to substantiate the whole of the claim, the Contractor shall only be entitled to payment for such part of the claim as he has been able to substantiate.

The Project Manager shall agree with the Contractor or estimate: (i) the extension (if any) of the Time for Completion (before or after its expiry) in accordance with GCC Clause 40, and/or (ii) the additional payment (if any) to which the Contractor is entitled under the Contract.

The requirements of this Subclause are in addition to those of any other Subclause, which may apply to a claim. If the Contractor fails to comply with this or another Subclause in relation to any claim, any extension of time and/or additional payment shall take account of the extent (if any) to which the failure has prevented or prejudiced proper investigation of the claim, unless the claim is excluded under the second paragraph of this Subclause.

In the event that the Contractor and the Employer cannot agree on any matter relating to a claim, either party may refer the matter to the Dispute and Arbitration pursuant to GCC 45 hereof.

45. Disputes and

45.1 The Employer and the Contractor shall attempt to settle amicably by direct negotiation any disagreement or dispute arising between them

Arbitration

under or in connection with the Contract.

- 45.2 Any dispute between the Parties as to matters arising pursuant to this Contract which cannot be settled amicably within thirty (30) days after receipt by one Party of the other Party's request for such amicable settlement may be referred to Arbitration within 30 days after the expiration of amicable settlement period.
- 45.3 In case of arbitration, the arbitration shall be conducted in accordance with the arbitration procedures published by the Nepal Council of Arbitration (NEPCA) at the place given in the SCC.

Section IX - Special Conditions of Contract

The following Special Conditions of Contract (SCC) shall supplement the General Conditions of Contract (GCC). Whenever there is a conflict, the provisions herein shall prevail over those in the GCC. The clause number of the SCC is the corresponding clause number of the GCC.

General Conditions	Ref. GCC	Special Conditions of Contract (SCC)

Definitions	1.0	The Employer is: Koshi Corridor 220kV Transmission Line Project Transmission Directorate Nepal Electricity Authority Kharipati, Bhaktapur, Nepal Telephone: +977 01-6616893, 6616865 Electronic mail address: koshi220kv@nea.org.np The Project Manager is: Project Manager Koshi Corridor 220kV Transmission Line Project Transmission Directorate Nepal Electricity Authority Kharipati, Bhaktapur, Nepal Telephone: +977 01-6616893, 6616865 Electronic mail address: koshi220kv@nea.org.np The Contractor is: [to be inserted] The Contractor's representative is: [to be inserted] Country of Origin: all countries and territories as indicated in Section 5 of the bidding documents, <u>Eligible Countries</u>.
Law and Language	5.0	5.1 The Contract shall be interpreted in accordance with the laws of: Nepal 5.2 The ruling language is: English 5.3 The language for communications is: English
Scope of Facilities	7.3	The Contractor shall ensure the availability of spare parts for the supplied items for a minimum period of five (05) years from the operational acceptance by the Employer. The Contractor shall carry sufficient inventories to ensure an ex-stock supply of consumable spares for the Plant. Other spare parts and components shall be supplied as promptly as possible, but at the most within 6 months of placing the order and opening the letter of credit. In addition, in the event of termination of the production of spare parts, advance notification will be made to the Employer of the pending termination, with sufficient time to permit the Employer to procure the needed requirement. Following such termination, the Contractor will furnish to the extent possible and at no cost to the Employer the blueprints, drawings and specifications of the spare parts, if requested.
Time for Commencement and Completion	8.0	8.1 The Contractor shall commence work on the Facilities from the Effective Date for determining Time of Completion as specified in the Contract Agreement. 8.2 The Time for Completion of the whole of the Facilities shall be Twenty-four (24) months from the Effective Date as described in the Contract Agreement.
Contractor's Responsibilities	9.0	Add the following new Sub-Clauses: GCC 9.9-- Existing Fences Where it is necessary to operate equipment through existing fences, the Contractor shall install suitable temporary gates. The temporary gates shall be constructed of materials and to standards equal to those of the existing fence. Before cutting the fences for the installation of temporary gates, the Contractor shall install adequate braces and additional posts, if necessary, on each

	side of the opening and shall fully anchor the fence so that all wires will maintain their original tension after opening is cut. Except when equipment is passing, such gates shall be kept closed. After completion of the work, the fence shall be restored as nearly as practicable to its original condition. Deviation from the above requirement will be permitted only where the Contractor furnishes advanced written approval from the landowner or landowners for a different method of operation. Where it is necessary for the Contractor to remove or to alter portions of existing fences to permit construction, temporary fence protection shall be provided at all times during construction and upon completion of the construction, the fence shall be rebuilt in its original or relocated position. The cost of all work herein described shall be borne by the Contractor. Should the contractor refuse or neglect to perform any work required by the above provisions within twenty-four hours after notification by the Employer to do so, the Employer reserves the right to perform the work and the cost thereof will be deducted from payment due to the Contractor. GCC 9.10-- Transmission, Telegraph and Telephone Lines: The Contractor shall make all necessary or required provisions concerning any interference with the operation or maintenance of traffic or service of any transmission, telegraph or telephone lines existing on the date of receiving bids, caused by the work of the Contractor under this Contract, all in a manner satisfactory to the owners or operators and to the Employer. The Contractor shall notify the Employers of such facilities of any damage, which is his responsibility and shall promptly settle proper claims. Pending settlement of such claims by the Contractor, an appropriate sum as determined by the Employer may be withheld from payments due to the Contractor until the matter is settled. The cost of providing and maintaining all necessary or required watchmen, signals, guards and temporary structures, of making any necessary repairs, replacements, or similar operations and all or any other costs required by this Sub-Clause shall be borne by the Contractor. GCC 9.11-- The Contractor shall be responsible for selecting and constructing appropriate communication means necessary for the executing of the project at his own expense. If required, the Employer will assist the Contractor in obtaining licences/permits

		from the concerned government agencies. GCC 9.12 -- Gasoline, oil and lubricants for construction equipment and vehicles are available in Nepal and the Contractor will not be permitted to import such products for use on the work. GCC 9.13-- The Contractor shall be responsible for the arrangement of water supply for drinking and construction purposes at his own cost. GCC 9.14 -- The Contractor shall be responsible for the arrangement of electricity supply for construction and any other purposes at his own cost. GCC 9.15-- Operation and maintenance The Contractor shall provide at least one operating and maintenance expert at the site for a continuous period of three (3) months or any extension required thereof because of serious breakdown or any extensions of warranty period, from the commencement of the Defect Liability Period to train the local staff on the operation of various equipment. GCC 9.16-- Commissioning and pre-commissioning The Contractor shall provide sufficient, properly qualified personnel; shall supply and make available all raw materials, utilities, lubricants, chemicals, catalysts, other materials and facilities; and shall perform all work and services of whatsoever nature required to properly carry out Pre-commissioning, Commissioning and Guarantee Test all in accordance with the provisions of the Contract Agreement.
Contract Price	11.1	Supplementing the Clause as After the award of the Contract, the Contractor shall carry out the detail survey of the Substation, design and submit for approval the revised Price Schedule incorporating the actual quantities.
	11.2	The Contract unit price rate will not be adjusted; this is firm price unit rate contract.
Securities	13.0	13.3.1 The Contractor shall deliver the Performance Security of amount as per ITB 40.1, ITB ITB 35.5 (if any others) of Bidding Document and Letter of Commitment for Bank's Undertaking for Line of Credit as per ITB 40.1 to the Employer within fifteen (15) days after receiving the Letter of Acceptance. The Performance Security shall be denominated in the types and proportions of currencies in which the Contract Price is payable.

		13.3.2 The performance security shall be in the form of the Bank Guarantee (Unconditional) attached hereto in Section IX, Contract Forms. The Performance Security shall be issued by Commercial Bank or Financial Institution eligible to issue Bank Guarantee as per prevailing Law in Nepal using Sample Form for the Performance Security included in Section X (Contract Forms), or another form acceptable to the Employer. The performance security issued by any foreign Bank outside Nepal must be counter guaranteed by Commercial Bank or Financial Institution eligible to issue Bank Guarantee as per prevailing Law in Nepal in complete accordance with the specimen provided herein. The performance security as required by the clause 13.3.1 above, shall be valid for period covering entire contract execution period and any extension thereof, defect liability period plus thirty days. 13.3.3. The performance security shall not be reduced on the date of the Operational Acceptance. 13.3.4 Add the following new Sub-Clause: “In case of award of the Contract to a Joint Venture, the performance security shall be submitted in the name of the Joint Venture and not in the name of the Lead Partner or any Partner(s) of the Joint Venture alone”
Taxes and Duties	14.0	Delete this Clause in its entirety and replace it with the following: 14.1 In the country of Origin The prices bid by the Contractor shall include all taxes, duties and other charges imposed outside the Employer's country on the production, manufacture, sale and transport of the Contractor's Equipment, Plant, Materials and Supplies to be used on or furnished under the Contract, and on the services performed under the Contract. 14.2 In Nepal 14.2.1 Unless otherwise specifically declared in the contract documents, the prices bid by the Contractor and its suppliers and subcontractors shall include business taxes and other taxes except VAT and Custom duty that may be levied in accordance with the laws and regulations in force or in effect in Nepal as of 30 days prior to the closing date for submission of tenders in the Employer's country on the Equipment, Plant, Materials and Supplies (permanent, temporary and consumables) acquired for the purpose of the Contract and on the services performed under the Contract. Whatsoever provisions made in the Contract document shall not relieve the Contractor, its suppliers and subcontractors from their responsibility to pay income tax that may be levied in the Employer's country on profits made by the Contractor, its suppliers and subcontractors in respect of the Contract. 14.2.2 The Project is entitled for concessional 1% custom duty and VAT exemption for the import of Plant & Mandatory Spare Parts to be supplied from abroad in Price Schedule No. 1.

		The Contractor has to follow all the procedures to import Plant & Mandatory Spare Parts to be supplied from abroad in Price Schedule No. 1. The Contractor shall pay all the taxes and duties applicable at the point of entry (custom). Employer will refund such amount to the Contractor upon submission of the related original documents. However, Employer will not be responsible for any demurrage charges applicable due to delay in custom clearance. 14.3 The unit bid price quoted in the Price Schedule Nos. 2 & 4 are exclusive of VAT. VAT in each supply/progress bill shall be paid to the Contractor and as per law of Nepal he will be responsible for depositing the same to the concerned Revenue office in Nepal. 14.4 Tax Deduction at Source (TDS) As per the law of Nepal the Employer will deduct TDS at the rate as applicable at the time of execution of the contract from each payment to the Contractor and deposit to the Revenue office. The Contractor shall be provided with all details in this regard promptly. The Contractor shall be responsible for obtaining tax clearance before issuance of Final Acceptance Certificate or before releasing the final 5% retention amount. All firms carrying out works in Nepal are required to be registered at Inland Revenue office. The TDS shall be deducted from the contract amount as per the prevailing rules and regulation (i.e. Income Tax Act and Regulation) of Government of Nepal. 14.5 Staff income tax The Contractor's staff, personnel and laborers, and those of its subcontractors, will be liable to pay personal income taxes in the Employer's country irrespective of local or foreign nationals on income earned including salaries and wages as applicable under the laws and regulations of Nepal. The Contractor shall perform such duties in regard to Tax Deduction at Source (TDS) thereof as may be applicable by such laws and regulations. 14.6 Contractor's Plant, Equipment, Materials and Supplies Notwithstanding the provision of this document, Contractor's Plant and Equipment, including essential tools and spare parts thereof, imported by the contractor for the sole purpose of executing the Contract, and taken out of Nepal upon completion of the Works shall, except for Plant and Mandatory Spare Parts to be supplied from abroad in Price Schedule No.1, be exempt from payment of customs duties and taxes levied in Nepal. However, the Contractor shall deposit the amount or provide a Bank Guarantee to the GoN, Customs Department equal to the amount of customs duties at the prevailing laws, rules and regulations of Nepal for those imported equipment, plant, materials and supplies at the time of import. The amount of the deposit so provided will be refunded in Nepalese Rupees, or the Bank guarantee cancelled by the Employer, after the submission to the Employer of the re-export certificate issued by the Customs Department. If the Contractor disposes of any Contract's Equipment, spare parts, materials or supplies in Nepal, it shall pay all customs duties and taxes applicable on such Items under the laws and regulations of Nepal in force at the time and shall repay to the Employer the amount of any customs duties and taxes which may have been reimbursed to the Contractor by the Employer

		in connection with importation of such items. Contractor shall re-export all the equipment, plant, materials, and supplies within 90(Ninety) days after completion of the project. 4.6 The Contractor shall maintain records satisfactory to the Employer documenting use of all Plant, materials and supplies imported into and/or procured for the performance of the Works. If any of such plant, materials and/or supplies, imported into Nepal or otherwise supplied to the Project at a special or preferential rate of Customs Duties or taxes, are misused or found to be used or appropriated for any purpose other than the Project, the Contractor shall be held fully responsible, and liable to pay customs duties, VAT and other taxes and/or any penalties as may be imposed in accordance with the prevailing laws and regulations of Nepal.
Licenses / Use of Technical Information	15.0	Add the following second paragraph: Under Sub-clause 15.2. The Employer shall however shall have the right to reproduce any or all drawings, documents and other materials furnished to the Employer for the purpose of the Contract and in addition, if required, for operation and maintenance and other contracts of Employer.
Subcontracting	19.0	Add the following paragraph at the end of this sub Clause “The Contactor is not encouraged to add or the delete the list finalized during the contract signing unless special circumstance which is not in the control of the contractor is evidenced. If such situation arise, the qualification requirement of the manufacturer of the major items and sub-contractor of the major civil work, shall be as that stipulated in “Part I, “Evaluation and Qualification Requirement” of the bidding document.
Design and Engineering	20.3.2	Change “fourteen (14) days to “twenty-one (21) days in both paragraphs of this Sub-Clause.
Procurement	21.0	21.3.2 Add the following at the end of this Sub-Clause: The Employer shall in no way be responsible for the condition of road and access. 21.3.4 Add the following at the end of this Sub-Clause:

		"The Contractor shall restore all such facilities, as far as possible, to its original condition at its own expense and to the satisfaction of the Owner of the Facilities." In case of any damage, the Contractor shall restore all such facilities, as far as possible, to its original condition at its own expense and to the satisfaction of the Employer." 21.4 Custom Clearances; Add the following paragraph at the beginning of this Sub-Clause: The Contractor shall familiarize himself with the rules and regulations of Nepal with regard to customs, duties, taxes, importation and clearing of goods and equipment and the like and the Contractor shall follow the required procedures regardless of the relief provided by the Employer. The Employer will provide assistance whenever possible.
Installations	22.0	22.1.1 Add the following at the end of the second paragraph: The checking of any setting-out by the Employer shall not relieve the Contractor of his responsibility for the accuracy thereof. 22.1.3 Add the following Sub Clause: Expatriate personnel engaged for work in Nepal may require work permit issued by the Nepalese Authorities. The Contractor shall be responsible for applying and obtaining such permits. Such applications shall be made in good time so as to enable the completion of the work in accordance with the approved Work Program. The Employer will assist the Contractor to obtain the permit. 22.2.5 Working Hours Normal working hours are: The Contractor shall be responsible for following the normal working hours to specific location and rules.

		22.2.7 Health and Safety (d) The Contractor shall throughout the contract (including the Defect Liability Period): (i) conduct Information, Education and Consultation Communication (IEC) campaigns, at least every other month, addressed to all the Site staff and labor (including all the Contractor's employees, all Sub-Contractors and Employer's and Project Manager's employees, and all truck drivers and crew making deliveries to Site for construction activities) and to the immediate local communities, concerning the risks, dangers and impact, and appropriate avoidance behavior with respect to of Sexually Transmitted Diseases (STD)—or Sexually Transmitted Infections (STI) in general and HIV/AIDS in particular; (ii) provide male or female condoms for all Site staff and labor as appropriate; and (iii) Provide for STI and HIV/AIDS screening, diagnosis, counseling and referral to a dedicated national STI and HIV/AIDS program, (unless otherwise agreed) of all Site staff and labor. The Contractor shall include in the program to be submitted for the execution of the Facilities under Sub clause 18.2 an alleviation program for Site staff and labor and their families in respect of Sexually Transmitted Infections (STI) and Sexually Transmitted Diseases (STD) including HIV/AIDS. The STI, STD and HIV/AIDS alleviation program shall indicate when, how and at what cost the Contractor plans to satisfy the requirements of this Sub clause and the related specification. For each component, the program shall detail the resources to be provided or utilized and any related sub-contracting proposed. The program shall also include provision of a detailed cost estimate with supporting documentation. Payment to the Contractor for the preparation and implementation this program shall not exceed the amount dedicated for this purpose. 22.3.4 Add the Sub-Clause 22.3.4 "Duties on Contractor's Equipment, Plant, Materials and Supplies" Notwithstanding the provision of this document, Contractor's Plant and Equipment, including essential tools and spare parts thereof, imported by the contractor for the sole purpose of executing the Contract, and taken out of Nepal upon completion of the Works shall, except for Plant and Mandatory Spare Parts to be supplied from abroad in Price Schedule No.1, be exempt from payment of customs duties and taxes levied in Nepal. However, the Contractor shall deposit the amount or provide a Bank Guarantee to the GoN,

		Customs Department equal to the amount of customs duties at the prevailing laws, rules and regulations of Nepal for those imported equipment, plant, materials and supplies at the time of import. The amount of the deposit so provided will be refunded in Nepalese Rupees, or the Bank guarantee cancelled by the Employer, after the submission to the Employer of the re-export certificate issued by the Customs Department. If the Contractor disposes of any Contract's Equipment, spare parts, materials or supplies in Nepal, it shall pay all customs duties and taxes applicable on such items under the laws and regulations of Nepal in force at the time and shall repay to the Employer the amount of any customs duties and taxes which may have been reimbursed to the Contractor by the Employer in connection with importation of such items. Contractor shall re-export all the equipment, plant, materials, and supplies within 90(Ninety) days after completion of the project. 22.4 .1 Add the following Sub-Clause Site Regulations and Safety The Contractor shall comply with all the National Legislatures, Environmental Acts, proposed Environmental legislatures and the proposed mitigation measures in preparing proposed site regulations and plan for approval. The Contractor shall take all reasonable steps to protect the environment on and off the Site and avoid damage or nuisance to persons to persons or to property of the public or others resulting from pollution, noise or other causes as a consequence of his method of operation. During the progress of the Contract, the Contractor and his Sub-contractors shall abide at all times by all existing Acts on environmental protection and rules made there under, regulations, notifications bye-laws of the Government of Nepal, and any other law, bye-law, regulations that may be passed or notifications that may be issued in this respect in future. 22.4.2 Add the following Sub - Clause

		Use of Explosives; No blasting or work involving the use of explosives will be permitted in the substation area or adjacent areas under this Contract. 22.6 Add the following at the end of first paragraph: The materials to be removed shall be incinerated or disposed off at places which will not be unsightly or objectionable to the inhabitants of the area following all environmental requirements.
Tests and Inspection	23.0	23.2 Add the following at the end of this Sub-Clause: The Employer and the Project Manager or their designated representatives shall be entitled to attend at his own cost to witness the tests for all the equipments as specified in the Section 6- Employers Requirements (Technical Specifications) at Manufacturer's/Contractor's factory. 23.3 Supplementing Sub Clause 23.3 The Contractor shall intimate the Project Manager the detailed program about the tests and/or inspection and of the place and time thereof at least two (2) weeks in advance in case of domestic supplies & six (6) weeks in advance in case of foreign supplies. 23.4 Supplementing Sub-Clause GC 23.4 The Contractor shall provide the Project Manager with a certified report of the results of any such test and/or inspection within fifteen (15) days after completion of tests" 23.6 Add the following at the end of this Sub-Clause: All costs incurred by the Employer including all travelling and board and lodging expenses by the repetition of the tests or false call for tests shall be borne by the Contractor pursuant to GCC Sub-Clause 23.2. Any delay in delivery due to retest or false call shall not constitute a release of the Contractor

		from his responsibilities for delay.
Completions of Facilities	24.0	24.2 Add the following paragraph at the end of this clause: If Appendix to the Contract Agreement titled "Scope of Works and Supply by the Employer " does not specify the personnel and other necessary materials required for the Pre-commissioning the facilities, the supply and management of same shall be the responsibility of the Contractor. The Contractor is responsible for providing the Pre-commissioning training to the NEA staffs if so requested by NEA and the cost for the same shall be deemed to have been included in the Price Schedule. The maximum number of NEA, Staffs to receive the pre-commissioning training from the contractor shall be 10 (ten). 24.8 Delete this Sub-Clause in its entirety and replace by the following: The issue of the completion certificate does not relieve the Contractor from his responsibilities for the care and custody of the Facilities or the relevant parts thereof together with the risk of loss or damage thereto.
Commissioning and Operational Acceptance	25.0	25.1.2 Add "if so specified in corresponding Appendix (Scope of Works and Supply by the Employer)" at the end of the paragraph. 25.2.2 The Guarantee Test of the Facilities shall be successfully completed within one week from the date of Completion. 25.3.1(e) Add the following new Sub-Clause: Six (6) sets of as built drawings, operating and maintenance manuals in hard copy and USB/Hard drives etc. as per Technical Specifications of the Bidding Documents are furnished.

		25.3.3 Change "seven (7) days" to "twenty one (21) days" 25.3.4 Change "seven (7) days" to "twenty one (21) days"
Completion Time Guarantee	26.0	26.2 Applicable rate for liquidated damages: 0.05 % of the Contract price per each day per delay. Maximum deduction for liquidated damages: ten percent (10%) of the Contract Price. 26.3 No bonus will be given for earlier Completion of the Facilities or part thereof.
Defect Liability	27.0	27.2 Delete first paragraph of the Sub-Clause and replace with the following: The Defect Liability period shall be one (1) year from the date of Operational Acceptance. 27.9 Change "Completion" in line 5 of the Sub Clause to "Operational Acceptance". 27.11 Add this new Sub-Clause as follows: When the Defect Liability Period for the Facilities or any part thereof has expired and the Contractor has fulfilled all his obligations under the Contract for defects in the Facilities, the Employer shall issue within thirty (30) days from the date of expiration to the Contractor a Certificate to that effect.
Transfer of Ownership	31.0	31.1 Add "and upon endorsement of the dispatch documents in favor of the Employer." at the end of this Sub-Clause. 31.4 Add the following at the end of this Sub-Clause: "Provided quantity of any Plant and Equipment specially stipulated in the Contract shall be the property of the Employer whether or not incorporated in the Facilities."
Loss of Damage	33.0	33.1 Add "and defective design, material or workmanship of the Contractor" after "the supply and installation of the Facilities".
Insurance	34.0	34.1 (c) Add "including property of the Employer" after the word "property".
Change in Laws and Regulations	36.0	36.1 Add the following after "Contract." in line 12 in this Sub-Clause: However, these adjustments would be restricted to direct transactions between the Employer and the Contractor and not on procurement of raw materials, intermediary components, etc. by the Contractor.
Force Majeure	37.0	37.6 Replace "either party may terminate." in line 7-9 by "the

		dispute will be resolved in accordance with GC Clause 45." in this Sub-Clause. 37.7 Delete this Sub-Clause in its entirety.
Change in the Facilities	39.0	39.1.2 Interchange the words "Employer" and "Project Manager" in lines 2 and 3 in this Sub-Clause. 39.2.2 Delete this Sub-Clause in its entirety and replace with the following: "Upon instruction from the Project Manager, the Contractor shall prepare the 'Change Proposal' without any cost to the Employer". 39.2.5 Replace "shall withdraw the proposed Change and shall notify the Contractor in writing thereof." at the end of the first paragraph by "and the Contractor shall agree on specific rates for valuation of the Change." in this Sub-Clause. 39.4 Add this new Sub-Clause as follows: The scope of work under the package shall be as per the Section-6 "Employer's Requirement" of Bidding Documents. The quantity variation applicable for the existing scope shall be generally as per the following. a) The Employer reserves the right to increase or decrease the quantity of different items of the specified goods and services to the extent of fifteen percent (15%) of the revised contract price pursuant to the GC Clause 11.1, by way of suitable amendment to the Contract, without any change in unit rate/price and/or other terms and conditions of the Contract. However, the quantities of individual items of goods and services may vary up to any extent.
Extension of Time for Completion	40.0	40.2 Delete "as soon as reasonably practicable circumstance." And replace within 21 days of the identification of the event of such change known to the Contractor.
Suspension	41.0	41.1 Replace "request" by "instruct" in the line 1 of the first Paragraph. 41.5 Add this new Sub-Clause as follows: If the Contractor chooses not to treat prolonged suspension as an omission or termination, the Employer shall, upon request of the Contractor, take over the responsibility for protection, storage, security and insurance of the suspended work and of the plant which has been delivered to the Site and which is affected by suspension and the risk of loss or

		damage thereto shall thereupon pass to the Employer. After receipt of permission or an order to proceed, the Contractor shall after due notice to the Project Manager examine the works and the Plant affected by the suspension. The Contractor shall make good any deterioration or defect in or loss of the Facilities that may have occurred during the suspension. Cost properly incurred by the Contractor, which would not have incurred but for the suspension shall be added to the Contract Price together with profit. The Contractor shall not be entitled for costs incurred in making good any deterioration, defect, or loss caused by faulty workmanship or materials or by the Contractor's failure to take the measures such as protect and secure and insure against any deterioration, loss or damage during suspension.
Disputes and Arbitration	45	45.3 The Place is Kathmandu, Nepal.
Add this new Clause SCC 46 (Supplementing to GCC) <u>Construction of Contract Document</u>		46.1 The Contract will be signed in two (2) originals and the Contractor shall be provided with one signed original and the other will be retained by the Employer. 46.2 The Contractor shall provide free of cost to the Employer all the engineering data, drawing and descriptive materials submitted with the bid, in at least two (2) copies to form a part of the Contract immediately after Notification of Award. 46.3 Subsequent to signing of the Contract, the Contractor at his own cost shall provide the Employer with at least five (5) true copies of Contract Agreement within thirty (30) days after signing of the Contract.

Section X: Contract Forms

This Section contains forms which, once completed, will form part of the Contract. The forms for Performance Security and when required Advance Payment Security shall only be completed by the successful Bidder after contract award.

Letter of Intent

[on letterhead paper of the Employer]

Date:

To: *Name and address of the Contractor*.....

Subject: Issuance of letter of intent to award the contract.....

This is to notify you that, it is our intention to award the contract *[insert date]* for execution of the *[insert name of the contract and identification number, as given in the Contract Data/SCC]* to you as your bid price Nepalese Rupees *[insert amount of contract price in figures and words including taxes]* as corrected and modified in accordance with the Instructions to Bidders is hereby selected as substantially responsive lowest evaluated bid.

Authorized Signature:

Name:

Title:

CC:

[Insert name and address of all other Bidders, who submitted the bid]

[Notes on Letter of Intent

The issuance of Letter of Intent is the information of the selection of the bid of the successful bidder by the Employer and for providing information to other unsuccessful bidders who participated in the bid as regards to the outcome of the procurement process. This standard form of Letter of Intent to Award should be filled in and sent to the successful Bidder only after evaluation and selection of substantially responsible lowest evaluated bid.]

Letter of Acceptance

[on letterhead paper of the Employer]

Date:

To: *Name and address of the Contractor* Subject: *Notification of Award*

This is to notify that your Bid for the Invitation of Bids dated *[Insert date of bid invitation]* for execution of the *[Insert name of the contract and identification number, as given in the Contract BDS/SCC]* for the Contract price of Nepalese Rupees *[insert amount of contract price in figures and words including taxes]*, as corrected in accordance with the Instructions to Bidders is hereby accepted in accordance with the Instruction to Bidders.

You are hereby instructed to contact this office to sign the formal contract agreement within 15 days with Performance Security of **NRs.** in accordance with the Conditions of Contract, using for that purpose the Performance security Form included in Section X (Contract Forms) of this Bidding Document.

Authorized Signature:

Name and Title of Signatory:

Contract Agreement

THIS AGREEMENT made on the [*insert number*] day of [*insert month*], [*insert year*],

BETWEEN

(1) [*name of the employer*], a corporation incorporated under the laws of [*country of the employer*] and having its principal place of business at [*address of the employer*] (hereinafter called “the Employer”), and (2) [*name of the contractor*], a corporation incorporated under the laws of [*country of the contractor*] and having its principal place of business at [*address of the contractor*] (hereinafter called “the Contractor”).

WHEREAS the Employer desires to engage the Contractor to design, manufacture, test, deliver, install, complete and commission certain Facilities, viz. [*list of facilities*] (“the Facilities”) and the Contractor have agreed to such engagement upon and subject to the terms and conditions hereinafter appearing.

NOW IT IS HEREBY AGREED as follows:

Article 1

1.1 Contract Documents (Reference GCC Clause 2)

Contract Documents

The following documents shall constitute the Contract between the Employer and the Contractor, and each shall be read and construed as an integral part of the Contract:

- (a) This Contract Agreement and the Appendixes hereto
- (b) Notification of Award-Letter of Acceptance
- (c) Letter of Bid and Price Schedules submitted by the Contractor
- (d) The Bid Addendum and Clarifications
- (c) Special Conditions of Contract
- (d) General Conditions of Contract
- (f) Employer Requirements
- (g) Other completed Bidding Forms submitted with the Letter of Bid
- (h) Any other documents forming part of the Employer's Requirements
- (i) Any other documents shall be added here

1.2 Order of Precedence (Reference GCC Clause 2)

In the event of any ambiguity or conflict between the Contract Documents listed above, the order of precedence shall be the order in which the Contract Documents are listed in Article 1.1 (Contract Documents) above.

1.3 Definitions (Reference GCC Clause 1)

Capitalized words and phrases used herein shall have the same

meanings as are ascribed to them in the General Conditions.

Article 2**2.1 Contract Price** (Reference GCC Clause 11)**Contract Price
and Terms of
Payment**

The Employer hereby agrees to pay to the Contractor the Contract Price in consideration of the performance by the Contractor of its obligations hereunder. The Contract Price shall be the aggregate of [. . . *amounts of foreign currency in words* . . .], [. . . *amounts in figures*. . .] as specified in Price Schedule No. 5 (Grand Summary), [. . . *amounts of local currency in words* . . .], [. . . *amounts in figures*. . .], or such other sums as may be determined in accordance with the terms and conditions of the Contract.

2.2 Terms of Payment (Reference GCC Clause 12)

The terms and procedures of payment according to which the Employer will reimburse the Contractor are given in the Appendix (Terms and Procedures of Payment) hereto.

Article 3**3.1 Effective Date** (Reference GCC Clause 1)**Effective Date**

The Effective Date upon which the period until the Time for Completion of the Facilities shall be counted from is the date when all of the following conditions have been fulfilled:

- (a) This Contract Agreement has been duly executed for and on behalf of the Employer and the Contractor.
- (b) The Contractor has submitted to the Employer the performance security and the advance payment guarantee
- (c) The Employer has paid the Contractor the advance payment

Each party shall use its best efforts to fulfill the above conditions for which it is responsible as soon as practicable.

- 3.2** If the conditions listed under 3.1 are not fulfilled within two (2) months from the date of this Contract notification because of reasons not attributable to the Contractor, the Parties shall discuss and agree on and the Time for Completion and/or other relevant conditions of the Contract.

The Contractor shall not however, benefit (in reckoning the Time for Completion) on account of its delay in providing the Performance Security or the Bank Guarantee for advance payment beyond the period provided in the

Contract.

**Article 4
Communications**

4.1 The address of the Employer for notice purposes, pursuant to GCC 4.1 is: [*Employer's address*].

4.2 The address of the Contractor for notice purposes, pursuant to GCC 4.1 is: [*Contractor's address*].

**Article 5.
Appendixes**

5.1 The Appendixes listed in the attached List of Appendixes shall be deemed to form an integral part of this Contract Agreement.

5.2 Reference in the Contract to any Appendix shall mean the Appendixes attached hereto, and the Contract shall be read and construed accordingly.

IN WITNESS whereof the parties hereto have caused this Agreement to be executed in accordance with the laws of NEPAL. . . .on the day, month and year indicated above.

Signed by, for and on behalf of the Employer

[*Signature*]

[*Title*]

in the presence of

[*Signature*]

[*Title*]

Signed by, for and on behalf of the Contractor

[*Signature*]

[*Title*]

in the presence of

[*Signature*]

[*Title*]

APPENDIXES

Appendix 1 -	Terms and Procedures of Payment
Appendix 2 -	Price Adjustment
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Appendix 1 - Terms and Procedures of Payment

In accordance with the provisions of GCC Clause 12 (Terms of Payment), the Employer shall pay the Contractor in the following manner and at the following times, based on the Price Breakdown given in the section on Price Schedules. Payments will be made in the currencies quoted by the Bidder unless otherwise agreed between the parties. Applications for payment in respect of part deliveries may be made by the Contractor as work proceeds.

(A) Terms of Payment

Schedule No. 1 - Supply and Delivery of Plant and Equipment Foreign Origin

In respect of above-mentioned price schedule, the following payments shall be made in NPR only by direct payment:

Ten percent (10%) of the total CIP amount in two installments as an advance payment against receipt of invoice and an irrevocable advance payment security for the equivalent amount made out in favor of the Employer. Five (5%) amounts shall be paid against receipt of invoice and irrevocable advance payment security and remaining Five (5%) after mobilization at site by the contractor. The advance payment security may be reduced in proportion to the value of the plant and mandatory spare parts delivered to the site, as evidenced by delivery documents.

Forty percent (40%) of the total or pro rata CIP amount upon Incoterms "CIP," upon delivery to the carrier within forty-five (45) days after receipt of following invoice and documents through direct payment.

- i) Contractor's invoice certified by the Employer showing contract no. goods description, quantity, unit price and total amount.
- ii) Copies of negotiable, clean, on-board bill of lading marked freight prepaid and copies of non-negotiable bill of lading.
- iii) Detailed Packing list identify contents of each package.
- iv) Insurance Policy/Certificate.
- v) Manufacturer's / supplier's warranty certificate.
- vi) Dispatch authorization issued by the employer with the Material Inspection Clearance Certificate.
- vii) Certificate of origin

Twenty percent (20%) of the total or pro rata CIP amount upon Incoterms "CIP," upon delivery of plant and equipment (including mandatory spare parts) to the site and issuance of delivery certificate by the Employer's engineer within forty-five (45) days after receipt of following invoice and documents through direct payment.

Fifteen (15%) of the total or pro rata CIP amount upon Incoterm "CIP," upon erection of equipment at site within 45 days after receipt of invoice as evidenced by the Employer's authorization of the Contractor's application showing contract no. goods description, quantity through direct payment.

Ten percent (10%) of the total or pro rata CIP amount upon the issuance of the Completion Certificate, within 45 days after receipt of invoice.

Five percent (5%) of the total or pro rata CIP amount upon completion of defect liability period, within 45 days after receipt of invoice.

Schedule No. 2 - Plant and Mandatory Spare Parts Supplied from Within the Employer's Country

In respect of plant and mandatory spare parts supplied from within the Employer's country, the following payments shall be made in NPR only by direct payment.

Ten (10%) of the total EXW amount in two installments as an advance payment against receipt of invoice and an irrevocable advance payment security for the equivalent amount made out in favor of the Employer. Five (5%) amounts shall be paid against receipt of invoice and irrevocable advance payment security and remaining Five (5%) after mobilization at site by the contractor. The advance payment security may be reduced in proportion to the value of the plant and mandatory spare parts delivered to the site, as evidenced by delivery documents.

Forty percent (40%) of the total or pro rata CIP amount upon Incoterms "CIP," upon delivery to the carrier within forty-five (45) days after receipt of following invoice and documents through direct payment.

- i) Contractor's invoice certified by the Employer showing contract no. goods description, quantity, unit price and total amount.
- ii) Copies of negotiable, clean, on-board bill of lading marked freight prepaid and copies of non-negotiable bill of lading.
- iii) Detailed Packing list identify contents of each package.
- iv) Insurance Policy/Certificate.
- v) Manufacturer's / supplier's warranty certificate.
- vi) Dispatch authorization issued by the employer with the Material Inspection Clearance Certificate.
- vii) Certificate of origin

Twenty percent (20%) of the total or pro rata EXW amount upon Incoterms "Ex Works," upon delivery of plant and equipment (including mandatory spare parts) to the site and issuance of delivery certificate by the Employer's engineer within forty-five (45) days after receipt of following invoice and documents through direct payment.

Fifteen (15%) of the total or pro rata EXW amount upon Incoterms "Ex Works," upon erection of equipment at site within 45 days after receipt of invoice as evidenced by the Employer's authorization of the Contractor's application showing contract no. goods description, quantity through direct payment.

Ten percent (10%) of the total or pro rata EXW amount upon the issuance of the Completion Certificate, within 45 days after receipt of invoice.

Five percent (5%) of the total or pro rata EXW amount upon completion of defect liability period, within 45 days after receipt of invoice.

Schedule No. 3 - Design Services

The amount of Design Services should be built in the quoted price for Supply and Services.

Schedule No. 4 - Installation and Other Services

In respect of above-mentioned price schedule, the following payments shall be made in **NPR only by direct payment.**

Ten (10%) of the total installation and other services amount in two installments as an advance payment against receipt of invoice and an irrevocable advance payment security for the equivalent amount made out in favor of the Employer. Five (5%) amounts shall be paid against receipt of invoice and irrevocable advance payment security and remaining Five (5%) after mobilization at site by the contractor. The advance payment security may be reduced in proportion to the value of work performed by the Contractor as evidenced by the invoices for Construction, Installation, Testing and Commissioning Services.

Seventy Five percent (75%) of the measured value of work performed by the Contractor, as identified in the said Program of Performance, during the preceding month, as evidenced by the Employer's authorization of the Contractor's application, will be made monthly within 45 days after receipt of invoice.

Ten percent (10%) of the total or pro rata value of installation and other services performed by the Contractor as evidenced by the Employer's authorization of the Contractor's monthly applications, upon issue of the Completion Certificate, within 45 days after receipt of invoice.

Five percent (5%) of the total or pro rata value of installation services performed by the Contractor as evidenced by the Employer's authorization of the Contractor's monthly applications, upon completion of defect liability period, within 45 days after receipt of invoice.

(B) Payment Procedures:

The procedures to be followed in applying for certification and making payments shall be as follows:

The procedures to be followed in applying for certification and making payments are as explained in above respective paras. The Employer shall make payments promptly within forty-five (45) days of submission of an invoice by the Contractor.

Payment of Taxes & duties:

Provisions in SCC 14 shall apply in respect to Taxes & Duties.

Additional Sub-Clause for Submission of Bills for Payment:

- i. All Payments for the works in part or full shall be based upon measurements or otherwise as per the Contract. Immediately after execution of work, the Contractor shall take and record measurements in presence of the authorized representatives of the Employer.
- ii. All Measurements recorded in a Joint Measurement Certificate (JMC) issued by the Employer should be signed with date by the Contractor and the Employer.
- iii. The Value of work executed shall be determined by the Employer.
- iv. The Contractor seeking any payment shall submit the bills with the relevant JMCs and other requisite documents, duly signed by the site representatives of the Employer, to the Employer. The Employer will then verify the bills and approve for release of payment.

Note: No interest shall be paid on delayed payment in terms of GC sub-clause 12.3

Appendix 2 - Price Adjustment

Not Applicable

Appendix 3 - Insurance Requirements

(A) Insurances To Be Taken Out By The Contractor

In accordance with the provisions of GCC Clause 34, the Contractor shall at its expense take out and maintain in effect, or cause to be taken out and maintained in effect, during the performance of the Contract, the insurances set forth below in the sums and with the deductibles and other conditions specified. The contractor shall insure the transmission line towers. The identity of the insurers and the form of the policies shall be subject to the approval of the Employer, such approval not to be unreasonably withheld.

(a) Cargo Insurance

Covering loss or damage occurring, while in transit from the supplier's or manufacturer's works or stores until arrival at the Site, to the Facilities (including spare parts therefore) and to the construction equipment to be provided by the Contractor or its Subcontractors.

Amount [in currency(ies)]	Deductible limits [in currency(ies)]	Parties insured [names]	From [place]	To [place]
110% of total price for plant and equipment	(*)	Contractor	Manufacturer place/cargo warehouse	Site Delivery

(*) Excess 5% of claimed amount subject to minimum of NRs. 20,000 or its equivalent for Normal and NRs. 80,000 or its equivalent for act of God perils and collapse.

(b) Installation All Risks Insurance

Covering physical loss or damage to the Facilities at the Site, occurring prior to Operational Acceptance of the Facilities, with an extended maintenance coverage for the Contractor's liability in respect of any loss or damage occurring during the defect liability period while the Contractor is on the Site for the purpose of performing its obligations during the defect liability period.

Amount [in currency(ies)]	Deductible limits [in currency(ies)]	Parties insured [names]	From [place]	To [place]
110% of total price for plant and equipment	(*)	Contractor	Site Delivery	Final Acceptance

(*) Excess 5% of claimed amount subject to minimum of NRs. 10,000 or its equivalent for Normal and NRs. 30,000 or its equivalent for testing period.

(c) Third Party Liability Insurance

Covering bodily injury or death suffered by third parties (including the Employer's personnel) and loss of or damage to property (including the Employer's property and any parts of the Facilities that have been accepted by the Employer) occurring in connection with the supply and installation of the Facilities.

Amount [in currency(ies)]	Deductible limits [in currency(ies)]	Parties insured [names]	From [place]	To [place]
NRs. 1,000,000 or its equivalent as in (b) above		Contractor's Employee	Commencement of work	Final Acceptance
NRs. 1,000,000 or its equivalent as in (b) above		Third Party Personnel	Commencement of work	Final Acceptance
NRs. 1,000,000 or its equivalent as in (b) above		Employer's Property	Commencement of work	Final Acceptance

(d) Automobile Liability Insurance

Covering use of all vehicles used by the Contractor or its Subcontractors (whether or not owned by them) in connection with the supply and installation of the Facilities. Comprehensive insurance in accordance with statutory requirements.

(e) Workers' Compensation

In accordance with the statutory requirements applicable in any country where the Facilities or any part thereof is executed.

(f) Employer's Liability

In accordance with the statutory requirements applicable in any country where the Facilities or any part thereof is executed.

(B) Types of Insurance to Be Taken Out by the Employer (Not Applicable)

The Employer shall at its expense take out and maintain in effect during the performance of the Contract the following insurance policies.

Details:

Amount [in currency(ies)]	Deductible limits [in currency(ies)]	Parties insured [names]	From [place]	To [place]

Appendix 4 - Time Schedule

4.1 Description of Facilities: Procurement of Plant Design, Supply, Installation, Testing and Commissioning of Second Circuit Stringing of Inaruwa-Basantapur-Baneshwar-Tumlingtar 220 kV Transmission Line, Contract Identification No: KOSHI/NEA/KC-5.

Name of Facilities	Completion Time required by the Employer from the Effective Date	Completion date guaranteed by the bidder from the Effective Date
Procurement of Plant Design, Supply, Installation, Testing and Commissioning of Second Circuit Stringing of Inaruwa-Basantapur-Baneshwar-Tumlingtar 220 kV Transmission Line, Contract Identification No: KOSHI/NEA/KC-5	<i>Twenty Four (24) Months</i>	

- 4.2 The activity (ies) under the Contractor's programme for Project Completion shall be in the form of a master network (MNV) and shall identify the various activities like design, engineering, manufacturing, supply, installation, factory testing, transportation to site, site testing and commissioning, trial operation and Taking Over etc. of the Facilities or specific part thereof (where specific parts are specified in PC). The network shall conform to the above Project Completion Schedule. This master network will be discussed and agreed before Award in line with above, engineering drawing and data submission schedule shall also be discussed and finalized before Award.
- 4.3 The Employer reserves the right to request minor changes in the work schedule at the time of Award of Contract to the successful Bidder.
- 4.4 The successful Bidder shall be required to prepare detailed Network(s) and project implementation plans & programmes and finalize the same with the Employer as per the requirement specified in Technical Specifications, which shall form a part of the Contract. The detailed Network(s) and project implementation plans & programmes shall preferably be preferably prepared in Primavera or in MS Project or in the latest Project Management tool as convenient to Employer.

Appendix 5 - List of Major Items of Plant and Services and List of Approved Subcontractors

A list of major items of plant and services is provided below.

The following Subcontractors and Manufacturers are approved for carrying out the item of the facilities indicated. Where more than one Subcontractor is listed, the Contractor is free to choose between them, but it must notify the Employer of its choice in good time prior to appointing any selected Subcontractor. In accordance with GCC Subclause 19.1, the Contractor is free to submit proposals for Subcontractors for additional items from time to time. No Subcontracts shall be placed with any such Subcontractors for additional items until the Subcontractors have been approved in writing by the Employer and their names have been added to this list of Approved Subcontractors.

Major Items of Plant and Services	Approved Subcontractors and Manufacturers	Nationality

Appendix 6 - Scope of Works and Supply by the Employer

The following personnel, facilities, works, and supplies will be provided or supplied by the Employer, and the provisions of GCC Clauses 10, 21, and 24 shall apply as appropriate.

All personnel, facilities, works, and supplies will be provided by the Employer in good time so as not to delay the performance of the Contractor, in accordance with the approved Time Schedule and Program of Performance pursuant to GCC Subclause 18.2.

Unless otherwise indicated, all personnel, facilities, works, and supplies will be provided free of charge to the Contractor.

Personnel	Charge to Contractor (if any)

Facilities	Charge to Contractor (if any)

Works	Charge to Contractor (if any)

Supplies	Charge to Contractor (if any)

Appendix 7 - List of Documents for Approval or Review

Pursuant to GCC Subclause 20.3.1, the Contractor shall prepare, or cause it's Subcontractor to prepare, and present to the Project Manager in accordance with the requirements of GCC Subclause 18.2 (Program of Performance), the following documents for

(A) Approval

As mentioned in the relevant chapter/Section of the Technical Specifications of the Bidding documents and the following

1. Work Program (Detail Work Schedule)
2. Work Procedure
3. Manufacturers, prior to placing of order
4. Design, calculations and drawings of Plant & Equipments
5. All Civil design and drawings
- 6.....
- 7.....
- 8 Any other documents as desired by the Employer

(B) Review

As mentioned in the relevant chapter/Section of the Technical Specifications of the Bidding documents and the following

1. Designed and calculation procedures for each component forming part of the Plant
2. Operations and maintenance instructions
3. Procedure for Test on Completion
4. Protection calculation / recalculation and setting.
5. Any other documents as desired by the Employer

Note:

Bidder shall furnish the exhaustive list, which shall be discussed and finalized for incorporation into the Contract Agreement.

Appendix 8 - Functional Guarantees

Not Applicable

Performance Security

(On letterhead paper of the Bank)

..... **Bank's Name, and Address of Issuing Branch or Office**

Beneficiary: **[insert Name and Address of Employer]**

Date:

Performance Guarantee No.:

We have been informed that ... **[insert name of the Contractor, which in the case of a joint venture shall be the name of the joint venture]** (hereinafter called "the Contractor") has been notified by you to sign the Contract No. **[insert reference number of the Contract]**, for the execution of **[insert name of contract and brief description of Works]** (hereinafter called "the Contract").

Furthermore, we understand that, according to the conditions of the Contract, a performance guarantee is required.

At the request of the Contractor, we... **[insert name of the Bank]**, hereby irrevocably undertake to pay you any sum or sums not exceeding in total an amount of Nepalese Rupees.....**[insert amount in figures*and amount in words]**.... such sum being payable in Nepalese Rupees, upon receipt by us of your first demand in writing accompanied by a written statement stating that the Contractor is in breach of its obligation(s) under the Contract, without your needing to prove or to show grounds for your demand or the sum specified therein.

This guarantee shall expire, no later than the.....**[insert day]**.Day of**[insert month, year]**, **, and any demand for payment under it must be received by us at this office on or before that date.

This guarantee is subject to the Uniform Rules for Demand Guarantees (URDG), 2010 Revisions, ICC Publication No. 758, except that the supporting statement under Article 15(a) is hereby excluded.

.....
Seal of Bank and Signature(s)

Note:

All italicized text is for guidance on how to prepare this demand guarantee and shall be deleted from the final document.

* The Guarantor shall insert an amount representing the percentage of the Contract Price specified in the Contract in Nepalese Rupees.

** Insert the date thirty days after the date specified for the Defect Liability Period. The Employer should note that in the event of an extension of the time for completion of the Contract, the Employer would need to request an extension of this guarantee from the Guarantor. Such request must be in writing and must be made prior to the expiration date established in the guarantee.

Advance Payment Security

(On letterhead paper of the Bank)

..... **Bank's Name, and Address of Issuing Branch or Office**.....

Beneficiary:**[insert Name and address of employer]**

Date :

Advance Payment Guarantee No.....

We have been informed that **[insert name of the Contractor, which in the case of a joint venture shall be the name of the joint venture]** (hereinafter called "the Contractor") has entered into Contract No.**[insert refrence number of the contract]** dated**[date]**..... with you, for the execution of**[insert name of contract and brief description of Works]** (hereinafter called "the Contract").

Furthermore, we understand that, according to the Conditions of the Contract, an advance payment in the sum Nepalese Rupees **[Insert amount in figures*and in words]** is to be made against an advance payment guarantee.

At the request of the Contractor, we... **[insert name of the Bank]**, hereby irrevocably undertake to pay you any sum or sums not exceeding in total an amount of Nepalese Rupees**[insert amount in figures* and amount in words]** upon receipt by us of your first demand in writing accompanied by a written statement stating that the Contractor is in breach of its obligation under the Contract because the Contractor:

- (a).....Used the advance payment for purposes other than the costs of mobilization in respect of the Works; or
- (b)... Has failed to repay the advance payment when it has become due and payable in accordance with the conditions of the contract, specifying the amount payable by the contractor.

The maximum amount of this guarantee shall be progressively reduced by the amount of the advance payment repaid by the Contractor as indicated in copies of interim statements or payment certificates which shall be presented to us. This guarantee shall expire, at the latest, upon our receipt of a copy of the interim payment certificate indicating that eighty (80) percent of the Contract Price has been certified for payment, or on the**[date]**..... day of ...**[month],[year]**...**, whichever is earlier. Consequently, any demand for payment under this guarantee must be received by us at this office on or before that date.

This guarantee is subject to the Uniform Rules for Demand Guarantees (URDG), 2010 Revisions, ICC Publication No. 758, except that the supporting statement under Article 15(a) is hereby excluded.

.....

Seal of Bank and Signature(s)

Note:

All italicized text is for guidance on how to prepare this demand guarantee and shall be deleted from the final document.

**The Guarantor shall insert an amount representing the amount of the advance payment in Nepalese Rupees of the advance payment as specified in the Contract.*

*** Insert the date Thirty days after the intended completion date. The Employer should note that in the event of an extension of the time for completion of the Contract, the Employer would need to request an extension of this guarantee from the Guarantor. Such request must be in writing and must be made prior to the expiration date established in the guarantee.*

NEPAL ELECTRICITY AUTHORITY

(An Undertaking of Government of Nepal)

TRANSMISSION DIRECTORATE

HIGH VOLTAGE GRID DEVELOPMENT DEPARTMENT



KOSHI CORRIDOR 220kV TRANSMISSION LINE PROJECT

Employer's Requirements

Procurement of Plant Design, Supply, Installation, Testing and Commissioning of Second Circuit Stringing of Inaruwa-Basantapur-Baneshwar-Tumlingtar 220 kV Transmission Line

National Competitive Bidding (NCB)

(Single-Stage Two-Envelope Bidding Procedure)

VOLUME II OF III



Transmission Line

Chapter 1: Project Specification Requirement (PSR)

Chapter 2: General Technical Requirement (GTR)

Chapter 3: Specific Technical Requirement (STR)

Chapter 4: Erection, Stringing, Testing & Commissioning

Chapter 5: Conductor, Ground Wire and Accessories

Chapter 6: Insulators and Insulator's Hardware

Chapter 7: Technical Data Sheet

Chapter 8: Tower Schedule & Drawings



Chapter 1**PROJECT SPECIFIC REQUIREMENTS****1. General Information and Scope**

- 1.1 The primary objective of Nepal Electricity Authority (NEA) is to generate, transmit and distribute adequate, reliable and affordable power by planning, constructing, operating and maintaining all generation, transmission and distribution facilities in Nepal's power system both interconnected and isolated.

The Koshi Corridor 220 kV Transmission Line Project, implemented by the Nepal Electricity Authority (NEA), has completed the construction of a 220 kV Double Circuit transmission line spanning approximately 106 km. The line extends from the 400/220/132/33 kV Inaruwa Substation (Sunsari District) to the 220/132/33 kV Tumlingtar Substation (Sankhuwasabha District), passing through the 220/132/33 kV Basantapur and 220/33 kV Baneshwar Substations of Sankhuwasabha District.

The transmission line has been designed, constructed, and energized at the 220 kV voltage level. Although double circuit towers have been installed, only single circuit stringing has been completed to date. However, the tower structures loading has been designed and engineered to support both single and double circuit stringing.

Additionally, the bays required for the second circuit of transmission line from Inaruwa to Basantapur are already available at both Inaruwa and Basantapur Substations. Likewise, the bay for the second circuit of transmission line from Basantapur to Tumlingtar via Baneshwar is ready at the Basantapur Substation. However, construction of the required bay at the Tumlingtar end has not done.

NEA has now secured funding for the stringing of the second circuit of the 220 kV Double Circuit Inaruwa–Basantapur–Baneshwar–Tumlingtar transmission line. Along with the stringing of ACSR Moose Conductor on second circuit, the scope of work includes stringing with galvanized steel earthwire, installation of insulators, hardware fittings, and other related conductor and galvanized steel earth wire accessories. The key components of the scope for the second circuit stringing of the Inaruwa–Basantapur–Baneshwar–Tumlingtar 220 kV transmission line are outlined below:

- i. Second Circuit Stringing with Quad ACSR Moose conductor on Inaruwa-Basantapur 220kV Transmission line having length is 75.839 km.
- ii. Second Circuit Stringing with Twin ACSR Moose conductor on Basantapur-Baneshwar-Tumlingtar 220kV Transmission line having length is 29.937 km.
- iii. Stringing of Galvanized steel Earth wire at the peak on the second circuit side.

The successful bidder must implement all necessary safety measures to carry out the second circuit stringing work, as the first circuit is already in operation and will be live at the 220kV level and no shutdown will be permitted during the stringing process.

- 1.2 This Specification covers the following scope of works:

- (i) design and supply of Conductor, Insulator, Earth wire, Hardware Fittings and Conductor & Earth wire Accessories,
- (ii) fixing of insulator strings, stringing of conductors and earth wires along with all necessary line accessories,
- (iii) the Stringing of conductor and earth wire from Inaruwa Gantry to Basantapur Gantry for quad section and from Basantapur Gantry to Tumlingtar Gantry for twin section.
- (iv) Destraining of existing first circuit from Bay No. 203 at the Basantapur takeoff gantry of the Inaruwa–Basantapur transmission line section and reconnect it to Bay No. 207,

which has been recently constructed for the Inaruwa line. The price for the same is deemed to be included in the BPS.

(v) testing and commissioning of the erected transmission lines (2nd circuit) and

(vi) Other items not specifically mentioned in this Specification and/or price schedules but are required for the successful commissioning of the transmission line, unless specifically excluded in the Specification.

1.2.1 The successful bidder shall supply necessary jumpers, hardware fittings and accessories to connect the substation side and Transmission line side at the takeoff gantry for Inaruwa, Basantapur and Tumlingtar Substation. The supply and installation of dropper conductor and erection hardware to connect LA and CVT at respective bays at the substations shall also in this scope and the same shall be done by the successful bidder. The price for the same is deemed to be included in the BPS.

1.2.2 The successful bidder shall provide the necessary scaffolding during stringing activities in road (must require at Koshi Highways) areas to ensure the safe passage of transportation vehicles, as well as at locations deemed appropriate by Employer's engineers. The cost of this scaffolding shall be considered included in the quoted rate for stringing works.

1.2.3 The Contractor shall request a shutdown at least one week in advance, specifying the required time and duration. If the requested duration is insufficient, any resulting additional costs shall be borne by the Contractor in accordance with NEA guidelines.

1.2.2. Owner shall provide necessary existing drawings of single circuit transmission lines as required to the Contractor after placement of award, in sequence, suiting the project requirement.

1.2.3 (a) The various items of work are described very briefly in the appropriate Schedule of BPS. The various items of the BPS shall be read in conjunction with the corresponding chapters 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 BPS as well as other necessary operations required to complete the works detailed in these Technical Specifications.

(c) 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.

(d) 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.

(e) 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.

1.3 The bidder shall clearly indicate in their offer, the sources from where they propose to procure Conductor, Insulators, Earthwire, hardware fittings and all type of accessories for conductor and earth wire. The technical description of these items is given in relevant chapter of this Volume of the bidding documents.

1.4 Stringing

a) For transmission line with Bundle Conductor per phase:

In plain or hilly terrain, the stringing shall be done by Tensioner/Puller. The pilot wire which is used to pull the main conductor shall be strung only by Tensioner/Puller or by Drone. Conductor laying by use of workers only shall not be allowed. However, the Bidder having requisite experience has freedom to use 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 employer's site Engineer. Whereas, the pilot wire shall must be

pulled by drone. Unnecessary tree cutting in valleys and other areas shall be prohibited without the consent of employer. The contractor shall deploy appropriate tools / equipment / machinery to ensure that the stringing operation is carried out without causing damage to conductor/earth wire. The conductor / earth wire shall be installed at the prescribed sag-tension as per the stringing charts provided by the employer.

- 1.5 The successful bidder is strictly prohibited from using any part of the foundation or tower members for tying stay wires for any purpose or give any unnecessary load to the tower structure or foundation during stringing operations. Any violation of this condition may result in a deduction of payment equal to the invoiced amount for the entire affected section from the running bill,
- 1.6 As the towers are designed to support double circuit stringing. The successful bidder shall carry out second circuit stringing with due care. Any damage caused to tower members during stringing shall be repaired or replaced by the contractor at no additional cost to the Employer. Employer's decision on whether a member requires repair or replacement will be final and binding. If any damage to tower members is found before starting work, the contractor shall not be held responsible, provided such damage is reported to NEA in writing before commencing any activity on the tower. Additionally, any loose nuts and bolts found during stringing shall be properly tightened by the contractor at no extra cost.
- 1.7 Measurement of line impedance (Positive sequence and Zero sequence) with suitable testing equipment during pre-commissioning test.
- 1.8 Submission of engineering & construction drawings, design basis reports, design calculations, quality assurance plans, testing procedures, operation and maintenance manuals, commissioning procedures, etc.
- 1.9 Obtaining of any consents, licenses and approvals from relevant statutory authorities, other than those obtained by the Employer and required as per law. The scope of Contractor also covers extending necessary assistance wherever logically required to enable Employer to obtain the requisite approval.
- 1.10 Quality assurance of all work related to scope of work of the Contractor.
- 1.11 Submission of schedule of work from zero date to handing over to Employer complete plant and equipment in the form of chart, 'S'-curve; write up etc for Employer's approval. Submission of monthly progress reports, photographs, graphs etc. for engineering, supply, construction and commissioning for all major works with suggestions and plans for making up back log if any for review of Employer. To attend meetings, review, discussion etc. for resolving all issues.
- 1.12 Submission of shipping schedule of equipment and material from country of origin up to receipt at site for off shore supply and ex-works to site for on-shore supply matching with schedule of work for approval of Employer.
- 1.13 Manufacture, fabrication, quality control, shop testing of equipment and material after approval of required technical data and drawings by Employer. To furnish notice to Employer for inspection.
- 1.14 Packing, forwarding, shipment and transportation (including port handling and custom clearance) from the manufacturer's works to site Comprehensive marine/transit-cum-storage-cum-erection insurance coverage of all equipment from Nepal Border / ex-works to project site till the equipment supplied is taken over by Employer. Preservation of all equipment during transportation till testing and commissioning stage.
- 1.15 Hiring of a suitable storing area which shall be approved by the Employer.
- 1.16 Receipt at site, unloading, movement to proper storage, carriage to storage area / interim / final foundation location, security, preservation and conservation of equipment/material at the site.

- 1.17 Supply of all manuals covering installation, stringing and commissioning, performance testing, operation, preservation, and capital maintenance including supply of as-built drawings and services required for satisfactory completion of the project.
- 1.18 Supply of all construction consumables, e.g., welding electrodes, cleaning agents, diesel oil as well as materials required for temporary supports, scaffolding, storage tanks, illumination as necessary.
- 1.19 Deployment of all skilled and unskilled manpower required for installation, stringing, commissioning, testing, etc, supervision of erection, commissioning, testing etc for services to be rendered.
- 1.20 Deployment of all erection tools & tackles adequate number and capacity of cranes, construction machinery, transportation vehicles, and all other implements in adequate number, capacity and size.
- 1.21 Any other tools, tackles and resources required to complete the Contract with required quality and with the schedule.
- 1.22 For detailed scope the stipulation given in each Chapter shall be applicable and governing.

2. Details of Transmission Line

2.1. Routes and Terrain

The Inaruwa–Basantapur–Baneshwar–Tumlingtar 220 kV double-circuit with single-circuit stringing transmission line traverses approximately 20 km across the plain terrain from Inaruwa Substation to Dharan-17 in Sunsari District. The remaining section traverses the undulating hilly terrain of Sunsari, Dhankuta, Tehrathum, and Sankhuwasabha districts, with altitudes ranging from 80 meters to nearly 2,600 meters above mean sea level. The transmission line includes a total of 325 towers, of which only 45 are suspension (DA-type) towers, while the rest are DB, DC, and DD-type angle towers. Bidders are encouraged to visit the transmission line route to acquaint themselves with the terrain conditions and relevant details, particularly the current state of access roads.

2.2. Access to the Line and Right of Way

Right of way of the said transmission line is already secured (15 m either side of the center line of the transmission line) by NEA.

The forest clearance (15 m either side of the center line of the transmission line) of the line has already completed by NEA during the construction of this transmission line and first circuit stringing. However, some vegetation that can violate the electrical clearance requirements may have grown in the interim or missed altogether. The contractor shall be responsible for clearing those vegetations in both private and national/community forests at no additional cost to the employer. Compensation for the private trees, if required, shall be provided by NEA. The Contractor, within one month of the Contract becoming effective, shall carry out a route survey to identify all instances of clearance violations and submit a detailed report including details of span, number and extent of obstacles (trees, structures, ground etc.), and actions needed to maintain minimum clearance. In cases where significant forest clearance in national or community forests was missed or not completed, NEA will carry out the necessary clearing. Such situations will be jointly assessed and decided on-site by NEA and the contractor's representatives.

Further, contractor shall make their own arrangement at their own cost to access the line during the construction time and NEA shall not be responsible for the same. Further, it is duty of the contractor to follow the all the rules and regulations of concerned authority of the Government of Nepal during the time of construction.

- 2.3. The Contractor shall be responsible for the overall co-ordination with internal/external agencies, project management, training of Employer's manpower, loading, unloading,

handling, moving to final destination for successful stringing, installation, testing and commissioning of the Transmission line.

- 2.4. The Contractor shall be responsible to select and verify the route, mode of transportation and make all necessary arrangement with the appropriate authorities for the transportation of the equipment. The dimension of the equipment shall be such that when packed for transportation, it will comply with the requirements of loading and clearance restrictions for the selected route.
- 2.5. The conditions of roads, capacity of bridges, culverts etc. in the route shall also be assessed by the bidders. The scope of any necessary modification/ extension/ improvement to existing road, bridges, culverts etc. shall be included in the scope of the bidder.
- 2.6. The contractor shall arrange all T&P (such as necessary supports, cranes, ladders, platforms etc.) for erection, testing & commissioning of the system at his own cost. Further all consumables, wastages and damages shall be to the account of the contractor.
- 2.7. Contractor shall make his own arrangement at his own cost for the construction water supply along with all further distribution for the same. In any case, Owner shall not be responsible for any delay in works because of non-availability or inadequate availability of water.
- 2.8. Contractor shall make his own arrangement at his own cost for the storage of the materials. In any case, Owner shall not be responsible for non-availability storage area inside the substation boundary. Contractor shall maintain separate register for all certificates of Inspection (CIP) and Material Inspection Clearance Certificates (MICC) issued by NEA. For each issue of CIP/MICC a serial number will be given and it shall be recorded by inspection engineer on CIP clearances/MICC.
- 2.9. The Employer will cover all crop compensation costs within 15 meters of the 30-meter transmission line right-of-way (ROW) on the side where stringing is carried out. However, if the Contractor's workers cause any damages beyond this 15-meter area on private property including access road, the Contractor shall be responsible for the compensation. Additionally, the contractor will mobilize the sufficient gang in the season when there will be no crops in the lands.
- 2.10. Any other items not specifically mentioned in the specification but which are required for Erection, Testing and Commissioning and satisfactory operations of the transmission line are deemed to be included in the scope of the specification and the same shall be supplied and erected by the contractor unless specifically excluded elsewhere.
- 2.11. Permitted Extra consumption of Line material is as follow:

Item	% of permitted extra consumption	Remarks
Conductor and earthwire	2 % of linear span	the permitted extra consumption limit is inclusive of sag, jumpering, damage, droppers & jumpers at substation, loss and wastage etc

Any conductor and earth wire drum which has been opened by the Contractor shall not be taken back by Employer and the unused conductor or earth wire in such drums may be treated as waste permissible within the overall limits specified in table above. The wastage beyond limit has to be supplied by the Contractor at their own cost.

3. PHYSICAL AND OTHER PARAMETERS

Location of the transmission Line– The location of transmission line starts from Tumlingtar substation in Sankhuwasabha district to Inaruwa Substation in Sunsari district. The proposed Transmission line and Substation are located in the Koshi Province at Eastern region of Nepal.

Meteorological data:-

- a) Altitude above sea level: 80m to 2600 m above sea level
- b) Ambient Air Température : 34°C(max)/-5°C(min) with snow loading
- c) Average Humidity (in %): 10-100
- d) The substation locations are lying in the wind speed Zone 4 i.e. 47m/s as per IS 802.

The above specifications are applicable for all the designs.

4. SCHEDULE OF QUANTITIES

The requirement of various items/equipment and civil works are indicated in Schedules of Rates and Prices. All equipment/items and other works for which bill of quantity has been indicated in Schedules of Rates and Prices shall be payable on unit rate basis/quoted rate basis. During actual execution, any variation in such quantities shall be payable as per relevant clauses incorporated in Letter of award.

Wherever the quantities of items/works are not indicated and quantified (i.e. Lump sum or lot items) the bidder is required to estimate the quantity required for entire execution and completion of works and incorporate their price in respective Schedules of Rates and Prices. For module identification, Bidder may refer typical drawings enclosed with the specifications. Any material/works for the modules not specifically mentioned in the description in Schedules of rates and prices, as may be required shall be deemed to be included in the module itself.

The quantities specified in the Schedules of Rates and Prices are only estimates. As soon as practicable, the Contractor shall complete survey, design and investigation works and accordingly revise the quantities and the Schedules of rates and Prices based on the unit/lump sum prices quoted in the Schedules of rates and Prices to complete the Facilities in accordance with the Technical Specifications and submit for Employer's approval. The revised price adjustment due to variation of quantities shall be limited to $\pm 15\%$ of the initial contract amount for the total amount of the respective schedules.

Bidder should include all such items in the bid proposal sheets, which are not specifically mentioned but are essential for the execution of the contract. Item which explicitly may not appear in various schedules and required for successful commissioning of substation and Transmission Line shall be considered included in the bid price and shall be provided at no extra cost to Owner.

5. Supply Schedule

To ensure alignment between the supply of materials/equipment and the construction/installation activities, and to avoid premature deliveries or idle inventory, Contractor shall supply the Conductor based on following schedule.

Item	Requirement Description	Linked to Construction Activity
Conductor	Delivery of conductor to site/yard must match stringing progress	1 st Lot: max 50% Conductor shall be supplied after contract award. 2 nd Lot: remaining Conductor shall be supplied after completion of 30% Stringing work.

The contractor may deliver the materials for each lot in multiple installments.

Payments to the Contractor shall not be released ahead of the scheduled milestones in the event that materials are supplied earlier than the given delivery schedule.

6. EXISTING FENCES

Where it is necessary to operate equipment through existing fences, the Contractor shall install suitable temporary gates. The temporary gates shall be constructed of materials and to standards equal to those of the existing fence. Before cutting the fences for the installation of temporary gates, the Contractor shall install adequate braces and additional posts, if necessary, on each side of the opening and shall fully anchor the fence so that all wires will maintain their original tension after opening is cut. Except when equipment is passing, such gates shall be kept closed. After completion of the work, the fence shall be restored as nearly as practicable to its original condition. Deviation from the above requirement will be permitted only where the Contractor furnishes advanced written approval from the landowner or landowners for a different method of operation. Where it is necessary for the Contractor to remove or to alter portions of existing fences to permit construction, temporary fence protection shall be provided at all times during construction and upon completion of the construction, the fence shall be rebuilt in its original or relocated position. The cost of all work herein described shall be borne by the Contractor. Should the contractor refuse or neglect to perform any work required by the above provisions within 7 days after notification by the Employer to do so, the Employer reserves the right to perform the work and the cost thereof will be deducted from payment due to the Contractor.

7. TRANSMISSION, TELEGRAPH AND TELEPHONE LINES

The Contractor shall make all necessary or required provisions concerning any interference with the operation or maintenance of traffic or service of any transmission, telegraph or telephone lines existing on the date of receiving bids, caused by the work of the Contractor under this Contract, all in a manner satisfactory to the Employers or operators and to the Employer. The Contractor shall notify the Employers of such facilities of any damage, which is his responsibility and shall promptly settle proper claims. Pending settlement of such claims by the Contractor, an appropriate sum as determined by the Employer may be withheld from payments due to the Contractor until the matter is settled. The cost of

providing and maintaining all necessary or required watchmen, signals, guards and temporary structures, of making any necessary repairs, replacements, or similar operations and all or any other costs required by this Sub-Clause shall be borne by the Contractor.

8. PRE-COMMISSIONING AND COMMISSIONING

The Contractor shall provide sufficient, properly qualified personnel; shall supply and make available all raw materials, utilities, lubricants, chemicals, catalysts, other materials and facilities; and shall perform all work and services of whatsoever nature required to properly carry out Pre-commissioning, Commissioning and Guarantee Test all in accordance with the provisions of the Contract Agreement.

9. OTHER RESPONSIBILITIES

- a) The Contractor shall be responsible for selecting and constructing appropriate communication means necessary for the executing of the project at his own expense. If required, the Employer will assist the Contractor in obtaining licenses/permits from the concerned government agencies.
- b) Gasoline, oil and lubricants for construction equipment and vehicles are available in Nepal and the Contractor will not be permitted to import such products for use on the work.
- c) The Contractor shall be responsible for the arrangement of water supply for drinking and construction purposes at his own cost.
- d) The Contractor shall be responsible for the arrangement of electricity supply for construction and any other purposes at his own cost.

10. REQUIRED COMPLETION SCHEDULE

All works under the scope shall be completed within 18 Months from the effective date of the Contract.

11. ORDER OF PRECEDENCE OF DIFFERENT PARTS OF TECHNICAL SPECIFICATION

For the purpose of present scope of work, technical specification shall consist of following parts and they should be read in conjunction with each other.

Chapter 1: Project Specification Requirement (PSR)

Chapter 2: General Technical Requirement (GTR)

Chapter 3: Specific Technical Requirement (STR)

Chapter 4: Stringing, Testing & Commissioning

Chapter 5: Conductor, Ground Wire and Accessories

Chapter 6: Insulators and Insulator's Hardware

Chapter 7: Technical Data Sheet

Chapter 8: Tower Schedule & Drawings

In case of any discrepancy between Chapter 1-PSR, Chapter 2-GTR and other technical specifications on scope of works, Chapter 1-PSR shall prevail over all other chapters. In case of any discrepancy between Chapter 2-GTR and Chapter 2-STR, Chapter 3-STR shall prevail. Similarly, in case of any discrepancy between Chapter 2-GTR, Chapter 3-STR and individual chapters, requirement of individual chapter shall prevail.

CHAPTER 2: GENERAL TECHNICAL REQUIREMENT

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.

1.1. Engineering Data

1.1.1 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 Employer 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 Employer 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.

1.1.2 All engineering data submitted by the Contractor after review by the Employer shall form part of the contract document.

1.2. Climatic & Meteorological Conditions

The transmission line under the scope traverses through undulating landscapes. The variation of altitudes ranges from 65m above MSL to approximately 2,500m above MSL. Therefore, the climate of the project is same along with the altitude. The project area has extremely cold to humid, subtropical climate, warm in winter and hot in summer. The monsoon period of torrential rain typically last from mid-June to mid-September. Almost 80% rainfall occurs during the monsoon period.

All plants and equipment of the transmission line shall be entirely suitable for the climatic and topographic conditions prevailing at site.

Following climatic condition shall be considered for the design of 220 kV transmission line.

S. No.	Description	Unit	Value
1	Maximum Temperature		
a)	Conductor ACSR "MOOSE"	Deg.C	85
b)	Galvanized Steel Ground-wire	Deg.C	53
2 i)	Minimum Temperature	Deg.C	-5
ii)	Max. ambient temperature	Deg.C	45
iii)	Mean annual / every day temperature	Deg.C	32
3	Basic wind speed	m/s	47
4	Maximum monthly Rainfall (Max.)	mm	195 -1000
a)	Rainy months		June-September
b)	Rainy days in a year (days)		NA
5	Average number of thunder storm (days) per annum		30-130
6	Basic Seismic Co-efficient		
	a. Horizontal		0.36 z
	b. Vertical		0.18 z
7	Altitude varying from sea level	m	65m to 2500m above MSL
8	Max. snow days in a month	Nos.	10
9	Max. snow days in a year	mm	15

10	Radial thickness of Ice	mm	10
11	Atmospheric Pollution		Light
12	Pollution Contamination Severity	mm/kV	34.7

Note: The information given in the above table are solely for the general assistance to Bidders. No responsibility for it will be accepted, nor will any claim based on this clause be considered.

The Bidders are advised to survey the sites covered under the Bid to acquaint themselves with site conditions.

1.3. System Particulars

S. No.	Description	Unit	220 kV Line
1	Line Voltage	kV	220
2	Highest System Voltage	kV	245
3	Number of Circuits	Nos.	2
4	No. of Sub-conductors (From Tumlingtar-Basantapur)	Nos.	2
	No. of Sub-conductors (From Basantapur-Inaruwa)	Nos.	4
	Spacing of Sub-conductors	mm	450
5	Frequency	Hz	50
6	Neutral		Effectively Earthed
7	Basic Insulation level*	kV	1050
8	Power Frequency withstand voltage*	kV (rms)	460
9	Short circuit level	KA	50kA for 1 sec
10	Right of way	m	30

1.4. Clearance from Ground, Building, Trees etc.

Clearance from ground, buildings, trees and telephone lines shall be provided in conformity with the Nepal Electricity Rules or Indian standard 5613 Part-2 Section-1 and CBIP Transmission line Manual or the relevant IEC standards as amended up to date.

Clearances for 220 kV Transmission line

S. No.	Name of spanned section	Minimum vertical distance (m)	Remarks
1.	Residential area to ground *	7.5	At maximum operating temperature and Nil Wind
2.	Non-residential area to ground*	7.5	At maximum operating temperature and Nil Wind
3.	Highway	8.84	At maximum operating temperature and Nil Wind
4.	Railway (above track)		At maximum operating temperature and Nil Wind
a)	Electrified (1500 V dc)	15.11	
b)	Electrified (25 KV AC)	18.63	
c)	Non-Electrified	11.89	
5.	Railway (over crane)	3.50	At maximum operating temperature and Nil Wind
6.	River & sea crossing above	To be fixed by	At maximum operating

	maximum flood level	Navigation/Port Authority	temperature and Nil Wind
8.	Electrical Line Crossing	4.58	At maximum operating temperature and Nil Wind
9.	River Crossing/ Lakes		At maximum operating temperature and Nil Wind
(i)	Navigable	To be fixed by Navigation/Port Authority	At maximum operating temperature and Nil Wind
(ii)	Non – Navigable (above HFL)	5.10	
(iii)	Accessible Frozen lakes/ rivers	7.00	
10.	Communication telephone power line & LV line		At maximum operating temperature and Nil Wind
11.	Tree (vertical distance)		At maximum operating temperature and Nil Wind
12.	Houses & buildings		At maximum operating temperature and Nil Wind

* Extra ground clearance allowance shall be made for creep allowance, uneven terrain, possibility for land profile change due to habitation, forestry etc.

Design Data:

Maximum Ambient Temperature: 45 Deg C

Minimum ambient temperature: -5 Deg C

Maximum Temperature of the Conductor: 85 Deg C

Everyday Temperature : 32 Deg c

1.5. Drawings

In addition to those stipulated in clause regarding drawings in GCC/PC, the following also shall apply in respect of Contractor Drawings.

- 1.5.1 All drawings submitted by the Contractor including those submitted at the time of Bid shall be with sufficient detail 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.
- 1.5.2 Each drawing submitted by the Contractor shall be clearly marked with the name of the Employer, the specification/Contract title, the specification/Contract 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.
- 1.5.3 The drawings submitted by the Contractor shall be reviewed by the Employer as far as practicable within 21 days and shall be modified by the Contractor if any modifications and/or corrections are required by the Employer. 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 completion date.
- 1.5.4 The drawings submitted for approval to the Employer shall be of three copies. One print of such drawings shall be returned to the Contractor by the Employer marked "approved/approved with corrections". The contractor shall there upon furnish the

Employer additional prints at least 6 copies as may be required along with one reproducible in original of the drawings after incorporating all corrections.

1.5.5 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 Employer, if so required.

1.5.6 All manufacturing, fabrication and erection/installation/Stringing 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 Employer.

1.5.7 In no case the approval by the Employer 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.

1.5.8 All drawings shall be prepared using software AutoCAD 2007 (version 17.0) 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) in editable format as well as in PDF format shall be submitted to the Employer in pendrives.

A copy of each drawing reviewed will be returned to the Contractor as stipulated herein.

1.5.9 Copies of drawings returned to the Contractor will be in the form of a print with the Employer's marking, or a print made from a microfilm of the marked up drawing.

1.5.10 The following is the general list of the documents and drawings that are to be approved by the Employer.

- a) Work Schedule (Master Network) Plan.
- b) Quality plans for manufacturing and site activities including Quality System.
- c) Sub-vendors approval, etc.
- d) Line material drawings.
- e) Type test report for line materials.
- f) Any other drawings that transpire during the design and execution phase of the project

1.5.12 In order to facilitate approval process, contractor shall submit all drawings and documents to Employer (in 2 sets). Employer shall forward consolidate comments/approval to the contractor. After the incorporation of comments, the contractor shall submit six set of drawings for the final approval.

1.5.13 Any designs/drawings/data sheets submitted by the contractor from time to time shall become the property of the Employer. Under no circumstances, the Contractor shall be allowed to user/offer above designs/drawings/data sheets to any other authority without prior written permission of the Employer.

1.6. Design Improvements

- 1.6.1 The Employer 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.

1.7. 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.

1.8. Design Review Meeting

The contractor will be called upon to attend design review meetings with the Employer during the period of Contract. The contractor shall attend such meetings at his own cost at the Corporate Office of the Employer or at mutually agreed venue as and when required. Such review meeting will be held generally four times in a year or as and when required.

1.9. Quality Assurance, Inspection & Testing

1.9.1 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 Employer 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 equipment.
- (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 Employer.
- (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.

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

1.9.1.1 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 Employer 's inspection of equipment/material.

1.9.1.2 The Employer 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.

1.9.2 Employer's Supervision

1.9.2.1 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.

1.9.2.2 The manufacturing of the product shall be carried out in accordance with the specifications. The scope of the duties of the Employer, pursuant to the contract, will include but not be limited to the following:

- a) Interpretation of all the terms and conditions of these Documents and Specifications.
- b) Review and interpretation of all the Contractor's drawings, engineering data etc.
- c) 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.
- d) Inspect, accept or reject any equipment, material and work under the Contract, in accordance with the Specifications.
- e) Issue certificate of acceptance and/or progressive payment and final payment certificate.
- f) Review and suggest modification and improvement in completion schedules from time to time, and

- g) Supervise the Quality Assurance Programme implementation at all stages of the works.

1.10. Inspection and Tests

1.10.1 Inspection

1.10.1.1 The Employer, his duly authorized representative and/or outside inspection agency acting on behalf of the Employer 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.

1.10.1.2 The Contractor shall give the Employer'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 Employer's inspector. All such inspections shall be to the Contractor's account except for the expenses of the Employer's inspector. The Employer'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 Employer's in writing and he shall forthwith forward to the inspector duly certified copies of test reports / certificates in triplicate.

1.10.1.3 The Employer'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.

1.10.1.4 When the factory tests have been completed at the Contractor's or Sub-Contractor's works, the Employer'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 Employer's inspector, the certificate shall be issued within fifteen (15) days of receipt of the Contractor's Test Certificate by the Employer's Inspector. The completion of these tests or the issue of the certificate shall not bind the Employer's to accept the equipment should it, on further tests after erection, be found not to comply with the Contract.

1.10.1.5 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 Employer'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 Employer's Inspector or to his authorised representative to accomplish testing.

1.10.1.6 The inspection by Employer 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.

1.10.1.7 a) The Contractor shall keep the Employer 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.

b) 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.

1.10.1.8 The Employer 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 Employer's material for satisfying himself that the fabrication is being done in accordance with the provisions of the Specification.

1.10.1.9 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.

1.10.1.10 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 Employer or his authorized representative considers that the defects can be rectified.

1.10.1.11 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 Employer.

1.10.1.12 All gauges and templates necessary to satisfy the Employer shall be supplied by the contractor.

1.10.1.13 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.

1.10.2 Tests

1.10.2.1 The type, acceptance and routine tests and tests during manufacture shall be carried-out on the material and shall mean as follows:

1.10.2.2 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. The Bidder shall indicate his schedule for carrying out these tests.

1.10.2.3 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 purposes of acceptance of that lot.

1.10.2.4 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.

1.10.2.5 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.

1.10.2.6 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 Employer.

1.10.2.7 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 Annexure-A or as mutually agreed to between the Contractor and the Employer in the Quality Assurance Programme.

1.10.2.8 For all type and acceptance tests, the acceptance values shall be the values specified in this Specification or guaranteed by the Bidder, as applicable.

1.10.3 Type-tested items

The Bidders shall offer the type tested following items

- a) ACSR Moose Conductor
- b) Galvanized Steel Earthwire
- c) Antifog Porcelain Insulator
- d) Insulator's Hardware, and accessories for conductor and GSW

The Type Test must have been carried out within 5 years prior to the date of bid opening and type test must have been carried out the recognized

national/international accredited laboratory. If the type test reports are older than 5 years or insufficient, the bidders shall undertake to repeat the same to the satisfaction of the Employer at their own cost. The cost in connection of the visit of the Employer's representative to witness the type test shall also be borne by the Contractor.

1.11. Packing

- 1.11.1 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.
- 1.11.2 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.
- 1.11.3 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.
- 1.11.4 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.
- 1.11.5 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.
- 1.11.6 The packing shall be properly done to avoid losses & damages during transit. Each bundle or package shall be appropriately marked.

1.12. Employer's Environment and Social Policy and its Implementation

1.12.1 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.

Employer'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, the following key principles of Environmental and Social Policy shall be noted by the contractor:

- i) Avoidance of environmentally and socially sensitive areas while planning project activities.
- ii) Minimization of impacts when project activities occur in environmentally and socially sensitive areas.
- iii) Mitigation of any unavoidable adverse impacts arising out of its projects.

1.12.2 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 Employer's projects.
- iii) Involve local people (Workers and labours) affected by transmission line projects as per requirement and suitability. The Contractor shall not employ the child labour in construction.
- 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 mitigatory measures.
- vii) Establish preventive mechanisms to guarantee safety.
- viii) Mitigation measures in case of accidents.
- ix) Avoid unwarranted cutting of trees in forest area.

1.12.3 While constructing the lines through forest stretches the contractor will provide alternate fuel to its employee e.g. working labours/supervisors etc. in order to avoid cutting of forest woods.

1.12.4 Contractor will ensure safety to the wild life, during working/camping near to the National Park/forest. The Contractor shall provide appropriate training in handling the equipment and machinery to the workers and labourers before contraction. All workers employed by the Contractors shall be insured against accident.

1.12.5 Contractor during construction of lines in agricultural fields will ensure minimum damages to the crops, trees, bunds, irrigation etc. The Contractor shall make compensation to the loss of standing crop due to his activities. However, the unavoidable loss of standing crops in the right of the line shall be the responsibility of the Contractor in which case bidders shall assist the employer for the assessment of such loss.

1.12.6 The waste/excess material/debris should be removed from the construction site including agricultural field, forest stretches, river etc. immediately after construction work.

1.12.7 Discharge of cement slurry, garbage and other solid wastes generated by the construction activities and work force should be avoided where possible.

- 1.12.8 The Contractor will have to negotiate with the owner of the property for the use of their premises for the stockpiling of the construction materials even if it is for the short period.
- 1.12.9 Chemical and other hazardous materials should be dumped safely far away from the water bodies.
- 1.12.10 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 trained to the satisfaction of Engineer- in-charge.
- 1.12.11 As far as possible existing path/ kachchi road/approach shall be used for the construction.
- 1.12.12 The Contractor will ensure supply of stone chips/sand from authorized/approved quarry areas.
- 1.12.13 Proper documentation of above, if any.
- 1.12.14 The Initial Environmental Examination (IEE) report of the project is available at the office of the Employer, which shall be referred by the Bidder for further information.

1.13. Codes and Standards

All Equipment, materials, fabrications and tests under these specifications shall conform to the latest applicable standards, manuals and specifications as mentioned in the relevant chapters of Specifications. Any details not specifically covered by these standards and Specifications shall be subject to approval by the Employer.

CHAPTER 3 SPECIFIC TECHNICAL REQUIREMENTS

3.1 SPECIFIC TECHNICAL REQUIREMENTS

The Standard Technical Particulars of the various items are given below and in the relevant schedule/chapters of Specifications. The Bidders are required to comply with the same.

3.2 Line Data:

3.2.1 Electrical System Data

1	Nominal Voltage	kV	220
2	Maximum system voltage	kV	245
3	BIL (Impulse)	kVp	1050
4	Power Frequency withstand voltage (Wet)	kV (rms)	460
5	Minimum Corona Extinction Voltage	kV	154 (Min)
6	RIV at 1 MHz for phase to earth Voltage 154 kV dry	Micro V	1000 (Max)

3.2.2 Service condition

Maximum Ambient	45 degree C
Minimum Ambient	-5 deg C
Maximum Altitude	2,600 m
Basic Wind speed as per IS 802	47 m/s
Isoceraunic level	60 days
Relative humidity (% range)	10-100

3.3 TOWERS AND ACCESSORIES

3.3.1 Clearances

TABLE 3-1

S. No.	Description	Unit	220 kV Line
1	Minimum ground clearances from lowest point	mm	7.5

	of power conductor		
2	Provision for ground undulation and sag error	mm	150
3	Minimum vertical mid-span clearance between power conductor and groundwire in still air	mm	8500
4	Minimum clearance for crossing over Electric Power lines (any voltage level upto 220kV)	mm	4580
5	Minimum clearance for crossing over tele-Communication lines	mm	3050
6	Min Phase-Phase clearance: Horizontal Vertical	mm mm	8400 4900
7	Minimum Highway Crossing	mm	8840

- The minimum ground clearance is at 85 degree C however, extra clearances shall be provided on account of hilly terrain type and to into account of altitude factor during spotting of towers.

3.3.2 Swing angles and minimum clearance from live parts to tower body and cross arms.

i) Single Suspension Insulator string

TABLE 3-2

Swing Angle (Deg)	Min. Electrical Clearance (mm)
	220 kV Line
0	2663
15	2475
30	2288
45	2094
60	-

ii) Double Suspension and Double string

TABLE 3-3

Swing Angle (Deg)	Min. Electrical Clearance (mm)
	220 kV Line

0	2663

iii) Jumper Swings

TABLE 3-4

Swing Angle (Deg)	Min. Electrical Clearance (mm)
	220 kV Line
0	2663
10	2663
20	2094
30	-

In case of a pilot string, the swing angle shall be considered with pilot insulator string as 15 degree.

The arcing gap distance for insulator strings shall be 2600 mm as provided in the insulator chapters.

The bidders may note the subzero service condition and altitude range therefore all the materials shall be guaranteed to perform satisfactorily. The grade of steel for tower materials shall be as per IS 2062 quality grade E250 B or grade E350 for all the steel products. Alternatively, similar grade like J20 as per BSEN 10056 shall also be acceptable.

3.4 CONDUCTOR:

3.4.1 ACSR "MOOSE" (54/3.53 mm ALUMINIUM + 7/3.53 mm STEEL)

TABLE 3-5

S. No	Description	Particulars
1	Conductor	ACSR "MOOSE" 54/3.53 mm Aluminum + 7/3.53 mm steel
2	Standard applicable	IS-398 (part-V)-1996 or ASTM or IEC or equivalent
3	Wire diameter	
	Aluminium	3.53 mm ± 2mm
	Steel	3.53 mm ± 7mm
4	Number of strands per layers	
a)	Steel	
	Steel Core	1
	1 st Steel Layer	6
b)	Aluminium	
	1 st Layer	12
	2 nd Layer	18
	3 rd Layer	24
5	Sectional Area (Approx.)	
	Total conductor	597.00 mm ²
	Total Aluminium	528.5 mm ²
	Cross sectional area of nominal diameter wire (Steel or Aluminium)	9.787 sq. mm
6	Overall diameter	31.77 mm
7	Approximate mass:	
	Overall conductor	2004 kg/km
	Aluminium Wire (per wire)	26.45 kg/km
	Steel Wire (per wire)	76.34 kg/km
8	a. Maximum D.C. resistance of conductor at 20 degrees C,	0.05552 Ω /km
	b. Maximum D.C. resistance of each Aluminum wire at 20 degrees C,	2.921 Ω /km
9	Ultimate Tensile strength	161.20 kN
10	Breaking Load of Wires (min):	
a)	Aluminium (per wire)	
	Before Stranding	1.57 kN or 160kg
	After Stranding	1.49 kN or 152 kg
b)	Steel (per wire)	
	Before Stranding	12.86 kN or 1311 kg
	After Stranding	12.22 kN or 1246 kg
11	Final modulus of elasticity	0.703 x 10 ⁶ kg/cm ²

12	Coefficient of Linear expansion (per °C)	19.35 x 10 ⁻⁶	
13	a. Direction of Lay	Outermost Layer shall be Right hand with inner successive layers having opposite directions to lay.	
	b. Lay Ratio	Maximum	Minimum
	Steel core 6 wire layer	18	16
	Aluminium		
	1 st Layer (12 wire)	14	12
	2 nd Layer (18 wire)	13	11
	3 rd Layer (24 wire)	12	10
14	Zinc coating of steel core		
a)	Number of 1 minute dips	3	
b)	Number of half minute dips	-	
c)	Minimum weight of Zinc Coating	260 g/m ²	
d)	Process of Galvanizing	Hot Dip Galvanization	
e)	Quality of Zinc (min.)	Electrolyte High Grade 99.95%	
15	Joints in strands		
a)	Steel	Not permitted	
b)	Aluminium	No Joints shall be permitted in the Outermost layer. Joints in the individual aluminium wires in intermediate 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 m apart in the complete stranded conductor.	
c)	Method of making joint	Joints shall be made by the cold pressure butt-welding.	
d)	Ultimate tensile strength of joint	14.67 kg/sq. mm	
16	Minimum Number of twists to be withstood in torsion test when tested on a gauge length of 100 times diameter of wire	18 (Before Stranding) 16 (After Stranding)	
17	Minimum Percentage of Elongation during testing for Elongation Test on an original gauge length of 200 mm.	4% (Before stranding) 3.5% (After Stranding)	
18	Chemical composition of high carbon steel wire		
	Element		
a)	Carbon	0.50 to 0.85 %	
b)	Manganese	0.50 to 1.10 %	
c)	Phosphorus	Not more than 0.035 %	
d)	Sulphur	Not more than 0.045 %	
e)	Silicon	0.10 to 0.35 %	

19	Standard Supply length	1500 meter
20	Packing (Wooden Drums)	IS 1778 : 1980 or latest edition

3.5 Galvanized steel Earth-wire

i) 7 / 3.66 mm Galvanised Stranded Steel Earth wire:

TABLE 3-6

1.0	Material & it's purity	Steel
1.1	Chemical composition of high carbon steel wire	
	Element	% Composition
i)	Carbon	Not more than 0.55
ii)	Manganese	0.4 to 0.9
iii)	Phosphorus	Not more than 0.04
iv)	Sulphur	Not more than 0.04
v)	Silicon	0.15 to 0.35
3.	Stranding and wire nominal diameter	7/3.66 mm
4.	Number of strands	
	a) Total	7
	b) Inner Core	1
	c) Outer Core	6
5.	Single wire before stranding (mm)	
a)	Nominal Diameter	3.66
b)	Minimum Diameter	3.64
c)	Maximum Diameter	3.68
d)	Minimum breaking strength	1000 Kg
e)	Minimum tensile strength	95 Kg/sq mm
f)	D.C. resistance at 20 degC	17.15 ohms/Km
6.	Stranded wire	
a)	Length of lay Maximum Minimum	198mm 165mm
b)	Minimum breaking load	6972 Kg or 68.4 KN.
c)	Overall diameter	10.98 mm
d)	Modulus of elasticity	1.933×10^6 Kg/cm ²
e)	Coefficient of linear expansion	11.50×10^{-6} per deg C.
f)	D.C. resistance at 20 degC	2.51 ohms/km
g)	Total sectional area	73.65 mm ²
7.	Minimum Elongation of wire (on 200 mm gauge length) in percentage	
	a) Before Stranding	4
	b) After Stranding	3.5
8.	Zinc Coating on wire	
	a) Minimum Amount of Coating (g/m ²)	

	Before Stranding	275
	After Stranding	238
	b) Minimum Uniformity of Coating	
	Before Stranding	3 Dips of 1 minute and 1 Dip of half min
	After Stranding	2 Dips of 1 minute and 1 dip of half minute
	c) Quality of Zinc	Zn 98 to IS: 209-1966/ Latest revision.
	d) Process of galvanization	Hot Dip
9.	Joints	There shall be no joint in any of the wire constituting the ground wire.
10.	Oiling	The galvanised ground wire shall be dipped in boiled linseed oil.
11.	Standard length	Standard length shall be one specific length of 2000 meters.
12.	Random length	Not less than 70% of the standard length and the total quantity of random lengths shall not be more than 10% of the total qty ordered
13.	Direction of Lay of wire	Right Hand
14.	Approximate Mass of Galvanized Steel Earth Strand (Kg/Km)	583

3.6 POWER CONDUCTOR ACCESSORIES

3.6.1 MID SPAN COMPRESSION JOINT FOR ACSR "MOOSE"

TABLE 3-7

1.	Type	compression	
2.	Material		
	Outer sleeve	Aluminium (Al) /Al - Alloy of purity not less than 99.5%	
	Tapered plug for outer sleeve	Aluminium rod of 99.5% purity	
	Inner sleeve	Extruded tube mild steel hot-dip galvanized	
3.	Brinell hardness of steel sleeve	Shall not exceed 200	
4.	Shape of Cross Section		
	Before Compression	Round	
	After Compression	Hexagonal	
5.	Dimensions and Dimensional Tolerances for Mid Span compression joint for ACSR 'Moose' Conductors	Before Compression	After Compression
a)	Aluminium/ Aluminium Alloy sleeve:		
	Inner dia (mm)	34 ± 0.5	
	Outer dia (mm)	54 ± 1	53 ± 0.5 (Corner to Corner) 46 ± 0.5 (Face to face)
	Length (mm)	735 ± 5	785 ± 5

b)	Steel Sleeve:		
	Inner dia (mm)	11 ± 0.5	
	Outer dia (mm)	21 ± 0.5	20.2 ± 0.5 (Corner to corner) 17.5 ± 0.5 (face to face)
	Length (mm)	250 ± 5	285 ± 5
5.	Minimum Failing Load, (KN)	153.2 KN	
6.	Electrical resistance of the joint after installation	75% of measured resistance of the equivalent length of conductor	
7.	Radio Interference at Phase to ground voltage of 154 kV (rms) dry and frequency 1MHz.	1000 micro volts	
8.	Corona Extinction voltage (KV rms)	154	

3.6.2 REPAIR SLEEVE for ACSR "MOOSE"

TABLE 3-8

1.	Type	Compression type in two parts with provision of seat for sliding of keeper piece.
2.	Application	To be used only for not more than two strands broken in the outer layer.
3.	Material	Aluminium/Al-Alloy (Extruded Tube) of 99.5% purity.
4.	Shape of cross section	
	Before compression	Generally Round
	After compression	Hexagonal
5.	Minimum Failing load	154 kN

6.	Electrical resistance of the Repaired Portion	75% of measured resistance of the equivalent length of the conductor.	
7.	Radio Interference at Phase to ground voltage of 156 kV (rms) dry and frequency 1MHz.	1000 micro volts	
8.	Corona Extinction voltage (KV rms)	154	
9	Dimensions and Dimensional Tolerances	Before Compression	After Compression
	Inner dia (mm)	34 ± 0.5	
	Outer dia (mm)	54 ± 1	53 ± 0.5 (Corner to Corner) 46 ± 0.5 (Face to face)
	Length (mm)	305 ± 5	330 ± 5

3.6.3 ARMOUR RODS:

TABLE 3-9

1.	Type	preformed/formed
2.	Material	Heat treated aluminium alloys as per designation HE-30 specified in IS-733
3.	Minimum ultimate strength (kg/sq. mm.)	35
4.	Conductivity	Not less than 40% of IACS International Annealed copper Standard
5.	Direction of lay	Right hand
6.	Shape of end	Parrot bill
7.	No. of armour rods in each set	Twelve (12)

8.	Radio Interference at phase to ground voltage of 154 KV (rms) dry and frequency 1 MHz	1000 micro volts
9	Corona extinction voltage (kV) (rms)	154
10	Marking	Centre line to be marked with indelible black paint.
11	Dimensions and Dimensional Tolerances	
	Length of each rod(mm)	2540 ± 25
	Diameter of each rod(mm)	9.27 ± 0.1
	Tolerance in length of between complete set (longest and shortest length)	Not more than 13 mm the longest and the shortest rod in a set.

3.6.4 VIBRATION DAMPERS

TABLE 3-10

S. NO.	DESCRIPTION	Specific Technical Particulars
I.	Type	Stockbridge
II.	Material:	
	Clamp	Aluminium alloy
	Messenger Cable	High strength steel wire of strength not less than the strength of steel core of 'Moose' conductor (preferably 135 kg/sq. mm.)
	Weights	Hot dip galvanised mild steel/Cast Iron
III.	Galvanization	
	Spring washers	Electro-galvanised as per IS:1573-1970
	Other ferrous parts	Hot dip galvanized

	Castings	As per BS:729-1961
	Wires	As per IS:4826-1968
	Bolts and Nuts	As per IS:5358-1969
IV.	Slip strength of clamp	(a) Not less than 255 kg when an untested Vibration damper is installed at the recommended bolt torque on the conductor. (b) Not less than 204 kg without retightening the bolts, after conducting the fatigue test.
V.	Maximum permissible Dynamic Strain on Conductor with damper	150 micro strains
VI.	Minimum no. of cycles for fatigue performance.	Ten (10) million
VII.	Amplitude for fatigue test	25 / F, where F is the highest resonant frequency in Hz
VIII.	Radio Interference at phase to ground voltage of 154 kV (rms) dry and frequency 1 MHz	1000 microvolts
IX.	corona extinction voltage (kv rms)	154
X.	Magnetic Power Loss	The damper shall not have a magnetic power loss of more than 1.0 W for current 500A/conductor for 220 kV and 600 A/Conductor for 400 kV and above.

3.6.5 SPACERS/SPACER DAMPERS FOR ACSR "MOOSE"

TABLE 3-11

S. No.	Description	Specific Technical Particulars
1.	Type	Twin Bundle & Quad Bundle
2.	Sub-conductor spacing	450 mm

3.	Arrangement of Sub-Conductor in the Bundle	Horizontal
4.	Galvanization of Spring Washers	Electro-Galvanized
	Other Ferrous Parts	Hot-Dip Galvanization
5.	Elastomer	i) If used, shall have a good mechanical strength, adequate resistance to the effect of ozone, UV radiation, conductor temperature upto 85 degree C and atmospheric contamination under the service conditions. The elastomer shall be electrically conducting. ii) In case of open elastomer clamps, helical/preformed retaining rods shall be used which terminates within the bundle area. The rods shall be meet electrical requirements of spacer assembly with mechanical properties as per Nepal/ Indian/ International Standard.
6.	Clamp Bolt Strength	The clamp bolt shall be capable of withstanding a torque up to 150% of the recommended bolt torque without failure of component parts of the spacer/ spacer damper assembly.
7.	Short Circuit Rating	25 kA
8.	Equivalent Compressive and Tensile Strength Requirement	1500 kg (Compressive) 750 kg (Tensile)
9.	Slip Strength of Clamp (Both for Bolted and Rubber Surfaced type)	i) Not less than 255 kg when an untested spacer/spacers damper is installed at the recommended bolt torque on the "MOOSE" conductor. ii) Not less than 204 kg without retightening

		the bolts, after conducting the fatigue test.
10.	Aeolian Vibrations	Spacer dampers shall be capable to damp out Aeolian vibrations, as well as sub-conductor oscillations within acceptable limits.
11.	Location of spacers	Bundle Spacers shall be designed for 50 meter in-span maximum separation. Rigid Spacers shall not be used except for jumpers. Rigid spacers for jumpers shall meet all the requirements of spacer used on line except its performance for vibration, movements and short – circuit tests.
12.	Allowable Mechanical Movement	
a)	Longitudinal movement parallel to conductor	± 50 mm (minimum)
b)	Vertical movement in a vertical direction at right angle to conductor	± 25 mm (minimum)
c)	Torsional/Angular movement in a vertical plane parallel to conductor	$\pm 5^\circ$ (minimum)
13.	Vibration Requirement	Spacer/Spacer damper shall be capable of withstanding all the external forces, due to wind or otherwise, including sub span oscillations. Spacer damper shall also be capable of damping out the Aeolian vibrations to a dynamic strain level not exceeding 150 micro-strains.
14.	Radio Interference voltage at phase to ground Voltage of 154 kV (rms) dry and frequency 1MHz	1000 micro volts
15.	Corona extinction voltage kV (rms)	154

3.7 EARTHWIRE ACCESSORIES

3.7.1 For 7/3.66 mm:

3.7.1.1 Mid Span Compression Joints

TABLE 3-12

S. No.	For 7/3.66 mm; Galvanized iron steel wire		
1.	Type	For 95 kgf/sq. mm. quality ground wire Compression	
2.	Material	Malleable cast iron/forged steel hot dip galvanised or high strength steel.	
3.	Minimum failing load (kg)	6624	
4.	Electrical resistance of the joint after installation	Shall not exceed 75% of measured resistance of the equivalent length of earthwire.	
5	Dimensions	Before compression	After compression
	Internal dia (mm)	11.5 +/- 1	-----
	External dia (mm)	20 +/- 1	20 +/- 1 (corner to corner) 17.5 +/- 1 (flat to flat)
	Length (mm)	230 +/-5	252 +/- 5

3.7.2SUSPENSION CLAMPS

TABLE 3-13

S. NO.	for 95 kgf/sq. mm, quality groundwire	
1.	Type	Conventional
2.	Material	MCI/Forged steel
3.	Slip strength (kg)	Slip strength not less than 15 kN & not more than 17 kN.
4.	Minimum failing load (Kg)	6972
5.	Galvanization spring washers	Electrogalvanised
6.	Other ferrous parts	Hot-dip galvanised

7.	Electrical resistance of the joint after repair	Shall not exceed 75% of measured resistance of the equivalent length of earthwire.

3.7.3 TENSION CLAMPS

TABLE 3-14

S. NO.	DESCRIPTION	SPECIFIC TECHNICAL PARTICULARS
1.	Type	Compression
2.	Material:	
a)	Body	Forged steel
b)	Bolts & Nuts	Galvanised steel
3.	Minimum failing load (kg)	6624
4.	Minimum slip strength(kg)	6275
5.	Galvanization	
	a) Spring washers	Electro-galvanized
	b) Other ferrous parts	hot-dip galvanized

3.7.4 FLEXIBLE COPPER BONDS

TABLE 3-15

S. NO.	DESCRIPTION	SPECIFIC TECHNICAL PARTICULARS
1.	Material	Tinned Copper
2.	Strand & Wire diameter	37/7/0.417mm
3.	Length	500 mm (approx.)
4.	Equivalent Copper Area (Min.)	35 mm ²
5.	Minimum Slip Strength (kN)	30
6.	Connecting lugs suitable for	16 mm dia hole on both ends One for 12mm dia bolt and other for 16mm dia bolt
7.	HRH MS bolt hot-dip galvanised with nut & lock washer	16mm dia and 40mm long

3.7.5 VIBRATION DAMPERS

TABLE 3-16

S. NO.	DESCRIPTION	SPECIFIC TECHNICAL PARTICULARS
1.	Type	4R stockbridge
2.	Material	
	a) Clamp	Aluminium alloy
	b) Messenger cable	High strength steel strand with strength not less than 135 kg/sq mm
	c) Weights	Hot dip galvanised mild steel/ Cast iron.
3.	Galvanization	
	a) Spring washers	Electro galvanized as per IS:1573-1970
	b) Other ferrous parts	Hot-dip galvanised
	c) Castings	As per BS:729-1961
	d) Wires	As per IS:4826-1968
	e) Bolts & Nuts	As per IS:5358-1969
4.	Maximum permissible dynamic strain on the groundwire with the damper	+/-300 micro strains
5.	Minimum no. of cycles	Ten million for fatigue performance.
6.	Amplitude for fatigue	25/f, where f is the highest test resonant frequency in Hz.

3.8 DETAILS OF LINE MATERIALS:

3.8.1 CONDUCTOR AND EARTHWIRE

3.8.1.1 Conductor and earthwire for 220 kV line for Normal Section

TABLE 3-17

S.no.	Description	Conductor	Earthwire	
1.	Name & Type	ACSR 'MOOSE'	7/3.66mm GS	

		conductor	Earthwire	
2.	Size (mm)	54/3.53 Al + 7/3.53 SI	7/3.66 SI	
3.	Conductor per phase (nos)	2 & 4	NA	
4.	Spacing between conductor of same phase(sub conductor spacing)(mm)	450mm	NA	
5.	Configuration	Vertical (for D/C with 8000 mm min. inter phase spacing)	One continuously to run horizontally on top of the towers and conductors	
6.	Overall Diameter (mm)	31.77	10.98	
7.	Unit mass (kg/km)	2004	583	
8.	Min. UTS (kN)	161.6	68.4	
9.	Ruling Design Span (mtrs)	350	350	

3.9OPGW HARDWARES

3.9.1SUSPENSION CLAMPS

TABLE 3-18

S.no.	Particulars	Specific Technical Particulars
1.	Type	Performed Armour Grip Suspension Clamps
2.	Material for Armour rods	Aluminium Alloy
3.	Slip strength	Not less than 12 kN and not more than 17 kN
4.	Minimum failing load	25 kN

5.	Galvanization (spring washers)	Electro galvanised
6.	Other ferrous parts	Hot dip galvanized

3.9.2 DEAD END ASSEMBLY

TABLE 3-19

S.no.	Particulars	Specific Technical Particulars
1.	Type	Bolted type/ helical preformed type
2.	Material	
	a. Body	Forged steel
	b. Bolts & Nuts	Galvanised steel
3.	Minimum Slip strength	Not less than 0.95 times the OPGW rated tensile strength
4.	Galvanization	
a	spring washers	Electro galvanised
b	Other ferrous parts	Hot dip galvanized

3.9.3 GROUNDING WIRE FOR CLAMPS

TABLE 3-20

S.no.	Particulars	Specific Technical Particulars
1.	Material	All Aluminium / Aluminum Alloy Conductor
2.	Wire diameter	Equivalent size of OPGW
3.	Length	1500mm Long
4.	Connecting lugs suitable for	One for 12mm dia bolt and other for 16mm dia bolt

3.9.4 STRUCTURAL ATTACHMENT CLAMP ASSEMBLIES

No. of Grooves: 2 (One on either side of connecting bolts and suitable for locating OPGW on inside of the tower).

Galvanising:

- a) Spring washers : Electrogalvanised
b) Other ferrous parts : Hot dip Galvanised

3.9.5 VIBRATION DAMPERS

TABLE 3-21

S.no.	Particular	Specific Technical Value
1.	Type of Damper	4R-Stockbridge type
2.	Materials of components	
a	Clamp	Aluminium alloy
b	Messenger cable	High strength Galvanised steel or stainless steel with a minimum strength not less than 135 kg/sq mm.
c	Weights	Hot dip galvanized mild steel/ Cast Iron
3.	Galvanisation	
a	Spring washers	Electrogalvanised as per IS: 1573-1970
b	Other ferrous parts	Hot-dip galvanized
c	Castings	As per BS: 729-1961
d	Wires	As per IS: 4826-1968
e	Bolts & Nuts	As per IS: 5358-1969
4.	Maximum permissible dynamic strain on the groundwire with the damper	+/-150 micro strains
5.	Minimum no. of cycles for fatigue performance	Ten Million
6.	Amplitude for fatigue test	25/f, where f is the highest resonant frequency in Hz

3.9.6 SHIELD WIRE JOINT BOXES

- a) Sturdy, all-water proof units
b) Complete with all necessary hardware to retain, terminate, protect and splice the fibers.

- c) Suitable clamps for fixing to the tower without drilling holes in tower structure.

3.10 INSULATOR DISCS AND STRINGS

3.10.1 DISC INSULATOR UNIT

3.10.1.1 Physical Characteristics

TABLE 3-22

a.	Type	Ball and Socket Type Anti-Fog insulator with Zinc sleeve
b.	Colour	Brown (Porcelain insulator)
c.	Surface	Glazed
d.	Locking device	R type security clip
e.	Diameter (mm)	
	Suspension insulator	255 mm
	Tension insulator	280 mm
	Tension insulator for Long Valleys Crossing Section	305mm
f.	Spacing (mm)	
	i) Suspension insulator	170 mm
	ii) Tension insulator	170 mm
	iii) Tension insulator for Long Valleys Crossing Section	170 mm
g.	Size and designation of pin ball shank (mm)	
	i) Suspension insulator	16/20
	ii) Tension insulator	20
h.	Minimum creepage distance (mm)	
	i) Suspension insulator	430
	ii) Tension insulator	430
i.	Minimum Electro-mechanical strength (KN)	
	a) Suspension insulator(Pilot)	90 KN
	b) Tension insulator	160 KN

	c)Tension insulator for Long Valleys Crossing Section	210 kN

3.10.1.2Electrical characteristics

TABLE 3-23

S.no.	Particular	90 kN Insulator	160 kN Insulator	210kN Insulator
a.	Minimum impulse dry withstand test voltage (+Ve Wave) KV (peak)	110	120	140
b.	Minimum power frequency puncture withstand test voltage KV (rms)	140	140	140
c.	Minimum power frequency one minute withstand voltage			
	Dry-kV (rms)	85	85	100
	Wet-kV (rms)	50	50	55
d.	Minimum visible discharge test voltage KV (rms)	9 kV	18 kV	18kV
e.	Maximum RIV at 10 KV (rms) (in microvolts)	50	50	50

3.10.1.3Complete insulator strings

TABLE 3-24

S.no.	Particular	Suspension	Tension
i)	Number of Insulator discs	-	
a.	Double suspension string	2x14	
b.	Single suspension 'I' pilot string	1 x 14	
c.	Double suspension 'II' pilot string	2x15	
d.	Double tension string		2 x 15
e.	Quad Tension String		4x15
	These numbers of discs are for altitude up to 1000 meter above msl. The no. of required discs		

	shall be increased for altitudes higher than 1,000m as per following:		
	1,000 m – 2,000 m: 2 additional discs 2,000 m – 2,600 m: 3 additional discs		
ii)	Corona extinction voltage KV (rms)	154	154
iii)	RIV at 1 MHZ for complete string i.e, including grading/corona rings, arcing horns, clamps etc., at 154 KV (rms) (in micro-volts)(not exceeding)	1000	1000
iv)	Mechanical failing load (kg)		
v)	Double Suspension	2x90 kN	
	Single Suspension 'I' Pilot	1 x 90 kN	
	Double Tension 'II' Pilot	2x90 kN	
	Double Tension		2 x 160kN
	Quad Tension		4x160 kN
	Double Tension for Long Valleys Crossing Section		2 x 210kN
	Double Tension for Long Valleys Crossing Section		4x210 kN
vi)	Total creepage distance (mm) for altitude up to 1000m above msl	14x 430mm	15 x 430mm
vii)	Maximum length of Double suspension 'II' string from ball hook attachment at hanger to centre line of conductor(approx.)	As per Drg. Enclosed	
viii)	Tension strings from tower attachment point to jumper take off point(approx.) Double Tension		As per Drg. Enclosed
ix)	Maximum voltage across any disc	Not more than 9%	Not more than 10%

3.10.2 INSULATOR STRINGS:

3.10.2.1 Insulator Strings for Normal Section

Table 3-25

Particulars	Twin Moose Double Suspension String	Twin Moose Double Tension String	Quad Moose Double Suspension String	Quad Moose Quad Tension	Single "I" /Double "II" Suspension Pilot Insulator String
1. No. of standard Discs	2x14	2x15	2x14	4x15	1x15 (twin moose) 2x15 (Quad Moose)
2. Size of disc-mm	255 x145	280x170 and 305x170 (for special Towers)	280x170	280x170 and 305x170 (for special Towers)	255 x145 (twin moose)
3. E&M Strength of each string	2x90 kN	2x160 kN and 2x210kN (for special towers)	2x160 kN	4x160 KN and 4x210kN (for special towers)	1x90 kN (twin moose) 2x 90kN (Quad Moose)
4. Ball and socket Designation (mm)	16	20	20	20	16
5. Minimum Creepage distance of each disc (mm)	430	430 and 545mm (for special Towers)	430	430 and 545mm (for special Towers)	430

3.10.2.2 Insulator Strings for Long Valleys Crossing Section

TABLE 3-26

S.no.	Particulars	Specific Technical Particulars
1.	No. of standard insulator Discs	
	For twin moose D/c Transmission line	2x15 (Double Tension)
	For Quad moose D/c Transmission line	4x15 (Quad Tension)
2.	Size of disc-mm	330x170
3.	E&M Strength of each string	210 kN
4.	Ball and socket Designation (mm)	20
5.	Creepage distance of each disc (mm)	545mm
6.	Pollution	Medium polluted IEC 60815

These numbers of discs are for altitude up to 1000 meter above msl. The no. of required discs shall be increased for altitudes higher than 1,000m as per following:

- 1,000 meter -2,000 meter -- 2 additional discs
- 2,000 meter-2,600 meter -- 3 additional discs

3.10.3 INSULATOR HARDWARES

3.10.3.1 For Suspension Clamp

TABLE 3-27

S. No.	Free centre type Suspension clamp	Material	Process of treatment	Reference Standard
1.	Clamp Body/ keeper piece	High strength Al. Alloy 4600 LM-6 OR 6061/65032	Casted or forged & Heat treated	IS:617 OR ASTM-B429
2.	Cotter bolts Hangers Shackles Brackets	Mild Steel	Hot dip galvanised	IS:226-1975/ IS:2062-1992
3.	U Bolts	Stainless Steel or High Strength Al. alloy 6061/6063 or 65032/63400	Forged & Heat treated	AISI 302 OR 304-L, ASTM B429
4.	Preformed Armour Rods	High Strength Al.	Heat	ASTM-B429

	(Min. tensile strength of 35 kg/mm ² .)	alloy type 6061/65032	Treatment during manufacturing	
5.	AGS Clamp	High strength	Cast/forged	IS:617
a)	Supporting House	Corrosion resistant Al. alloy LM6 4600 or 6061/65032	heat treated	ASTM-B429
b)	Al. Insert & retaining strap	High Strength Al. alloy of type 6061/65032	forged & heat treated	ASTM-B429
c)	Elastomer Cushion	Moulded on Al reinforcement		

3.10.3.2 for Tension Clamp

1. Tension Clamp

TABLE 3-28

a	Type	Compression
b	Material	
i.	Outer sleeve	EC Grade Aluminium tube formed by extrusion process.
ii.	Inner sleeve	Galvanised low carbon forged steel.
c	Minimum failing (No deformation)	95% of the breaking load of load conductor.

2. Arcing Horns

TABLE 3-29

a	Type	Loop or ball ended (on tower side)
b	Material	Galvanised mild steel tube/rod hot dip galvanised As per IS-226

3. Grading/Corona Ring

TABLE 3-30

a	Material	High strength heat treated aluminium alloy tube. (6061 /6063/1100 type or 65032/63400 type)	As per ASTM B-429
b	Capacity to withstand load for one minute	150 Kg.	
c	Supporting Brackets and Mounting Bolts	High strength heat treated Al. alloy 6061/6063/1100/65032 /63400 type or Mild steel hot dip galvanised	As per IS:226 OR IS-2062-1992 or ASTM-B 429

4. Other String Hardware

TABLE 3-31

a	Socket ended items	Forged steel/Malleable cast iron hot-dip galvanised.	As per ASTM B-429
b	Sag Adjustment device	High Quality Mild Steel or High Tensile steel, Hot dip galvanized	As per IS:226-1975/ IS:2062-1992
c	Ball ended components U-clevis and chain link	Drop forged steel, Hot dip galvanized	As per IS:2004 -1978
d	Yoke plates	Mild steel hot-dip galvanised	As per IS-226-1975/ IS-2062-1992

5. Security Clips

TABLE 3-32

1	Type	R-type
2	Material	Phosphor bronze or nonmagnetic stainless steel.
3	Rated Strength of fittings	The load carrying hardware should develop minimum strengths as indicated in drawing attached without visual deformation.

3.11 GROUNDING OF TOWERS

- a) Maximum tower footing resistance (ohms) 10
- b) Length of the conductors of counterpoise per leg. 30 metres, 45 m & 60 m respectively (approximately)
- c) Two number of legs for pipe type earthing per tower

3.12.1 The Specific Technical Particulars of the various items shall be furnished by the Bidders in one original and two (2) copies in the prescribed schedules of the Specifications. The Bidder shall also furnish any other information as in their opinion is needed to give full description and details to judge the item(s) offered by them

3.12.2 The data furnished in Specific Technical Particulars should be the minimum or maximum value (whichever is ruling condition 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, whichever is ruling condition, as per the Technical Specification. No preference what so ever shall be given to the bidder offering better/more stringent values than those required as per specification except where stated otherwise.

CHAPTER 4: ERECTION, STRINGING, TESTING & COMMISSIONING

4.1. SCOPE

This chapter covers stringing of conductor, Earthwire, testing and commissioning of the second circuit of transmission lines enumerated in this Specification. The successful bidder shall on its own cost, transport the construction materials for different types line materials such as conductor, Earthwire, Insulators and Hardware fittings and accessories etc. to the work sites by following means of transport i.e. tractors, trucks, Animal drivers cart and or manual labors depending upon site condition.

The above work shall also include the cost of labor, all tools and plants including tension stringing equipment, drone and all other incidental expenses in connection with accomplishing the complete work.

4.2. SPECIFIC TECHNICAL REQUIREMENTS

4.2.1. Transmission Line Route

The route as defined in Chapter 1-PSR clause 2.1 and details tower schedule as given in the chapter-8 of this Technical Specifications.

4.3. STANDARDS

- a. Except where otherwise specified or implied the erection/stringing, testing and commissioning shall conform to the provisions of IS: 5613 (part 2 / Section-2) -1985 (as amended up to date).
- b. The Nepali Standard or Indian Standard or equivalent international standard Specifications mentioned below shall be applicable to the materials and processes used in executing the work.

TABLE 4-1

1.	IS:5613 (Part2-1985/1989)	Code of Practice for Design Installation, and Maintenance of overhead power lines.
	Section - 1:	Design
	Section - 2:	Installation and Maintenance.
2.		Electrical Power technical standards of Nepal.

4.4. COMMUNICATION AND TRANSPORT

The information about the existing communication and transport facilities may be verified from the concerned authorities before submitting his offer.

4.5. MATERIAL HANDLING AND ACCOUNTING

- a. The Contractor shall be responsible for timely delivery of all the required material to the site and its storage etc. In case of loss/damage of the material, the Contractor shall be responsible for making good the shortages/damages within the period specified by the Employer.
- b. The Contractor shall be responsible for safe transportation of conductor, Earth wire, insulators, etc. to the work of site. He shall be responsible for proper distribution of the Conductor and Earth wire drums so that the numbers and lengths of cut pieces are minimum.
- c. No separate charges shall be paid for head loading of materials, tools and tackles. The tenderers shall inspect the line route before submitting their tenders.

4.6. ERECTION LOSSES AND GENERAL STORAGE OF MATERIAL

4.6.1. ERECTION LOSSES

Any loss or damage of materials, public property shall be the responsibility of the contractor.

4.6.2. GENERAL STORAGE OF MATERIAL

The contractor shall have to arrange at least two site store office at convenient place along the transmission line route. They shall also have to arrange appropriate watch and ward over the day and night, water/sanitation etc. Employer shall have the right of exercising inspection of Contractor's stores at any time to ensure no damages to the material.

4.7. ROADS, RIVER, STREAM, POWER AND TELE COMMUNICATION LINE AND RAILWAY CROSSINGS.

- a. The crossings of roads, river, small streams, power and telecommunication lines, and railway tracks falling in the line route shall be carried out with the types of structures and at angles as indicated in the approved profile sheets and tower schedules , ensuring that the minimum clearances at maximum temperature in still wind condition, after taking the effect of conductor creep and slack caused by the broken conductor in the adjoining span are not less than the relevant clearances specified the specification.
- b. The crossings of railway tracks if any, telecommunication lines and erection of lines in the vicinity of aerodromes shall in addition to meet the requirements of the Electricity regulations of Nepal / or the rules laid down by any other concerned agency, Government of Nepal

4.8. CROSSING OF PUBLIC UTILITIES

- a. The Contractor shall be responsible for giving requisite notice to the appropriate authorities and intimate them the date and time when he proposes to carry out erection of the conductors and earth wire along or across power lines or telecommunication lines, public roads, water ways, railways etc. Lowering of the conductors, earth wire etc. of the existing power lines and its restringing and taking all necessary precautions to avoid damage to the existing lines shall be the responsibility of the Contractor. Any guying, temporary reinforcement required for the existing structures shall also be the responsibility of the Contractor.
- b. Where other authorities or public undertakings affected, deem it necessary for the protection of their employees, property, public or for the assistance of traffic to provide flagmen or watchmen, the cost of such provision shall be borne by the Contractor.
- c. Where it is necessary to provide scaffolding over roads, power lines or telecommunication lines this shall be carried out by the Contractor at such times as may be convenient to the requisite Authority and such work shall be deemed to be covered in the rates. Flagmen and approved types of danger or warning notices shall be provided by the Contractor to ensure safety of the public. The time taken to affect the crossing shall be kept to the minimum.

4.9. ERECTION TOOLS AND PLANTS

- d. The Contractor shall provide at his own expenses all necessary erection tools and plants such as surveying instruments, tackles, spanners, wrenches, pumps, timbering, scaffoldings, jacks, winches, ropes and all construction machinery such as tractors, bull dozers, hydraulic compressors and dies, dynamometers, come along clamps, camping requisites, equipment such as tensioner puller, drones, helicopters etc..

4.10. ELECTRIC POWER AND WATER FOR CONSTRUCTION PURPOSES

- a. The Contractor shall make all necessary arrangements and provide all necessary electric power and Water for construction purposes at his own cost. In case the power is available with the Employer, the same shall be supplied at the prevailing tariff rates.
- b. The Employer, at the request of the Contractor shall request the various Organizations or Offices of the Government of Nepal and local bodies to provide the necessary information to the Contractor. The Bidders are requested to familiarize themselves with the government rules & regulations and processes in the acquisition of land.
- c. The Employer shall not be responsible for arranging access roads/right - of - way for transport of material from road side to work sites. If the Contractor has to adopt any such arrangements, he may do so with the consent of the property Employers and any compensation in that respect shall be his responsibility. The Contractor shall take all reasonable steps for preventing damage to crops during execution of the contract work.

4.11. INSULATOR HOISTING

- a. The insulators, string fittings and insulator string assembly drawings shall be supplied by the Contractor. The numbers of insulator units required per string are same as erected in first circuit for the similar spans for suspension as well as tension strings.
- b. Damaged insulators and fittings, if any, shall not be used in the assemblies. All insulators shall be cleaned in a manner that shall not spoil, injure or scratch the surface of the insulator, but in no case, any oils shall be used for the purpose. Before hoisting, the components of the insulator string shall be checked for any damage, crack and missing of security clips etc. Corona control rings in case of 220 kV lines only shall be fitted in an approved manner. The yoke arrangements shall be horizontal for tension and vertical in transverse direction for twin suspension strings. Torque wrench shall be used for fixing

- different components, like suspension clamp for conductor and ground-wire, etc. whenever, recommended by the manufacturer of the same.
- c. The installation of string assemblies shall also include the installation of armour rod sets at suspension locations.
 - d. The compression dead ends and jumper connection in tension assemblies shall be fixed to conductor in accordance with manufacturer's recommendations which shall be furnished by the Contractor.
 - e. Sacking shall be wrapped over the cross arm members of towers to prevent damage to the galvanized surface during hoisting of string assemblies.
 - f. For checking the soundness of the insulators, IR measurement using 10 KV (DC) Megger shall be carried out on insulators.
 - g. Payment for installing insulator assemblies of various types shall be included in the rates quoted in the Schedule of Prices for stringing of conductors.

4.12. HANDLING OF CONDUCTOR AND GROUND WIRE

- a. Before commencement of stringing, the Contractor should verify the stringing chart provided by Employer. Later, the Employer will not be responsible for any short fall bit cutting of conductor and earthwire for any span.
- b. The Contractor shall be entirely responsible for any damage to the towers or conductor's during stringing. While running out the conductors, the care shall be taken that the conductors do not touch and rub against the ground or objects which could cause scratches or damage to the strands. The conductor shall be run out of the drums from the top in order to avoid damage due to chafing. Immediately after running out, the conductor shall be raised at the supports to the levels of the clamp and placed into the running blocks. The groove of the running blocks shall be of such a design that the seat is semi-circular and larger than the diameter of the conductor, ground wire and it does not slip over or rub against the sides. The grooves shall be lined with hard rubber or neoprene to avoid damage to conductor and shall be mounted on properly lubricated bearing.
- c. The running blocks shall be suspended in a manner to suit the design of the cross-arm. All running blocks, especially those at the tensioning end shall be fitted on the cross arms

with jute cloth wrapped over the steel work and under the slings to avoid damage to the slings as well as to the protective surface finish of the steel work. Normally, suspension towers shall not be used even for temporary termination. In case small or medium angle towers are used even for temporary terminations, these shall be well guyed by dead-man anchoring/other anchoring methods and steps be taken by the Contractor to avoid damage. Guying proposal along with necessary calculations shall be submitted by the Contractor to Employer for the approval. Proper T & P shall also be made available to the Employer by the Contractor for checking tensions in the guy wires. The drums shall be provided with a suitable braking device to avoid damages, loose running out and kinking of the conductor. The conductor shall be continuously observed for loose or broken strands or any other damage. When approaching end of a drum length, at least three coils shall be left when the stringing operations are to be stopped. These coils are to be removed carefully, and if another length is required to be run out, a joint shall be made as per the recommendations of the conductor manufacturers.

Alternative procedure for stringing other than that specified may be offered.

- d. Repairs to conductors, if necessary, shall be carried out during the running out operations, with repair sleeves. Repairing of conductor surface shall be done only in case of minor damage, scuff marks etc. keeping in view both electrical and mechanical safety requirements. The final conductor surface shall be clean smooth and shall be without any projections, sharp points, cuts abrasions etc. The repair sleeves provided in the price schedule is firm and hence, no variation in quantities of the repair sleeves. Any further requirement of such due to negligence in stringing work shall be supplied by contractor itself without no any additional cost to Employer.
- e. Conductor splices shall be so made that they do not crack or get damaged in the stringing operation. The Contractor shall use only such equipment/methods during conductor stringing which ensures complete compliance in this regard.
- f. Derricks and scaffolding shall be used where roads, rivers, channels, telecommunication or overhead power lines, railways lines, fences or walls have to be crossed during stringing operations. It shall be seen that normal services are not interrupted or damage caused to property. Shut-down shall be obtained when working at crossing of overhead

- power lines. The Contractor shall be entirely responsible for the proper handling of the conductor, Earth wire and accessories in the field.
- g. Suitable guards/sheaves shall be used to protect the conductor from damage in places where it would otherwise be impossible to save the conductors from coming in contact with objects which may injure the conductors. Guards shall consist of material over which the conductor may slide without injury and shall be subject to the approval of Employer.
 - h. The sequence of running out shall be from top to downwards, i.e. The Earthwire shall be run out first, followed by the conductors in succession. Unbalances of loads on towers shall be avoided as far as possible.
 - i. The proposed 220 kV Transmission lines may run parallel for certain distance with the existing 132 kV, 220 kV, 400 kV lines if any, in particular 33 KV lines and LT lines which may remain energized during the stringing period. As a result, there is a possibility of dangerous voltage build up due to electromagnetic and electrostatic coupling in the pulling wire conductors and ground wires, which although comparatively small during normal operations can be severe during switching operation. It shall be the Contractor's responsibility to take adequate safety precautions to protect his employees and others from this potential danger.
 - j. Proper guying arrangement shall be made by the Contractor during stringing to avoid unbalanced loads on all types of towers. All the expenditure on account of the above work is deemed to be included in the tender and no extra payment shall be made for the same.

4.13. STRINGING OF CONDUCTOR AND GROUND WIRE

- a. Contractor should have at least 2 (Two) set of tension stringing equipment and shall arrange an additional tension stringing equipment at the time of stringing, if required as directed by the employer.
- b. The stringing of the conductor for 220 kV lines shall be done by the control tension method as mentioned in the Chapter-1: Project Specific Requirement (PSR). The equipment shall be capable of maintaining a continuous tension per bundle conductor

such that the sag for each conductor is about twenty percent greater than the sags specified in the stringing sag table. The stringing of conductor for 220/132kV with single conductor shall be done by standard stringing method. Initial sag tension report of stringing chart shall be used during stringing of conductor.

- c. The bidder shall give complete details of the stringing methods he proposes to follow. Prior to stringing the Contractor shall provide the stringing charts for the conductor and earth wire to the stringing gang on which showing the initial and final sags and tension for various temperatures and spans along with equivalent spans in the lines for the approval of the Employer
- d. A controlled stringing method suitable for simultaneous stringing of the sub conductors shall be used. The two/four 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.
- e. Conductor creep is to be compensated by over tensioning the conductor at a temperature as indicated in PSR of this specification lower than the ambient temperature or by using the initial sag and tensions indicated in the tables.
- f. Notwithstanding anything in the specifications, the Employer shall provide stringing charts.
- g. Stringing using drones or helicopters shall be carried out using relevant standards.

4.14. JOINTING

- a. All the joints on the conductor and Earth wire shall be of compression type, in accordance with the recommendations of the manufacturer for which all necessary tools and equipment like compressors, dies, etc. shall have to be arranged by the Contractor. Each part of the joint shall be cleaned by wire brush to make it free of rust or dirt etc. and shall properly be greased with anti-corrosive compound, if required and as recommended by the supplier before the final compression is done with the compressors.
- b. All joints or splices shall be made at least 30 meters away from the structures. No joints or splices shall be made in the spans crossing over power lines, main roads, railways and

rivers. The joints in the tension spans shall be permitted after the approval of the Employer Engineer. Not more than one joint per sub-conductors shall be allowed in one span. The compression type fitting used shall be 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 pressing the joint, the aluminum sleeve shall have all corners rounded; burrs and sharp edges removed and smoothened.

- c. During stringing of conductor, to avoid any damage to the joint, the Contractor shall use a suitable protector with mid span compression joints in case joints are to be passed over pulley blocks /aerial rollers. The size of the groove of the pulley shall be such that the joint along with protector can be passed over it smoothly. The arrangement to be adopted shall be explained by the contractor.

4.15. SAGGING-IN-OPERATION

- a. The conductors and Earth wire shall be pulled up to the desired sag as per the approved stringing chart or sag tables and left in running block for at least one hour after which the sag shall be re-checked and adjusted, if necessary, before transferring the conductors from the running blocks to the suspension clamps. The conductors shall be clamped within 36 hours of sagging in.
- b. The sag shall be checked in the first and the last span of the section in case of sections up to eight spans and in one intermediate span also for sections with more than eight spans. The sag shall also be checked when the conductors have been drawn up and transferred from running blocks to the insulator clamps.
- c. The running blocks, when suspended from the transmission structure for sagging shall be so adjusted that the conductors on running blocks shall be at the same height as the suspension clamp to which it is to be secured.
- d. At sharp vertical downward angles, the sags and tensions shall be checked on both sides of the angles, the conductor and earth wire shall be checked on the running block for equality of tension on both sides. The suspension insulator assemblies shall normally assume vertical positions when the conductor is clamped.

- e. Tensioning and sagging operations shall be carried out in calm weather when rapid changes in temperatures are not likely to occur. In areas where calm weather is not prevalent during working season, the Contractor shall recommend the precautions to be taken during final tensioning and sagging of conductor.

4.16. TENSIONING AND SAGGING OF CONDUCTORS AND GROUNDWIRE

- a. The tensioning and sagging shall be done in accordance with the approved stringing charts before the conductors and earth wire are finally attached to the towers through the earth wire clamps for the ground wire and insulator strings for the conductor. Calibrated Dynamometers shall be employed for measuring tension in the conductor and ground wire. The dynamometers employed shall be periodically checked and calibrated with a standard dynamometer.
- b. Provision for ground undulations, errors in stringing shall be considered at the time of stringing of conductors.
- c. No pre-stressing / over-tensioning of the earth wire shall be done.
- d. The Contractor shall terminate the line conductors and earth wire at the dead-end towers on each end of the line and as mentioned in Chapter-1: PSR. Payment for stringing work shall be made for the actual route length of the line at the unit rates quoted for the stringing of conductors and earth wire in the Schedule of Prices.
- e. The adjustment of conductor sag by means of sag adjustment devices provided in the insulator string or additional insulator shall invariably be not permitted at the time of stringing of the conductors.
- f. The connections of conductors at mid span compression joints shall be checked for electrical efficiency.

4.17. CLIPPING IN

- a. Clipping of the conductors in position shall be done in accordance with the recommendations of the manufacturer. Conductor shall be fitted with the armour rods at suspension point and with vibrations dampers at suspension and tension points.
- b. 4.15.2 The jumpers at the section and angle towers shall be formed to parabolic shape to ensure maximum clearance requirements. Pilot suspension insulator string shall be used, if so desired by the Employer to restrict the jumper swings to the designed values.

- c. Fasteners in all fittings and accessories shall be secured in position. The security clip shall be properly opened and strung into position.

4.18. FIXING OF CONDUCTOR AND EARTHWIRE ACCESSORIES

- a. Vibration dampers and other conductor and earth wire accessories supplied shall be installed by the contractor as per the design requirements and respective manufacturer's instruction. Vibration dampers shall be fitted within 24 hours of the conductor clamping. While installing the conductor and earth wire accessories, the proper care shall be taken to ensure that the surfaces are clean and smooth and no damage shall occur to any part of the accessories.
- b. The Contractor shall ensure that drain holes, if provided, in the weights of the vibration dampers are open. The vibration dampers shall be installed at the intervals indicated by the manufacturer and approval of the Employer. The required number of spacer cars/cycles with meter counters suitable for installing vibration damper shall be arranged by the Contractor.
- c. **Payment:** Rates for installing all the required accessories viz. vibration dampers, spacers shall be included in the rates of stringing of conductor and ground wire.

4.19. REPLACEMENT OF TOWER MEMBERS

If any replacements are to be effected after stringing and tensioning or before handing over, leg members and bracings shall not be removed without reducing the tension on the tower with proper guying or releasing the conductor. If the replacement of cross arms becomes necessary after stringing, the conductor shall be suitably tied to the tower at tension points or transferred to suitable roller pulleys at suspension points.

4.20. FINAL CHECKING, TESTING AND COMMISSIONING

- a. After completion of the works, final checking of the line shall be done by the Contractor to ensure that all the stringing have been done strictly according to the specifications and as approved by the Employer. All the works shall be thoroughly inspected keeping in view of the following main points:
 - I. 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.

- II. All conductor and Earth wire accessories are properly installed.
- III. All other requirements to complete the work like fixing of danger plate, phase plates, number plate, anti-climbing device, Bird guards etc. are properly installed.
- IV. The line insulation is tested by the Contractor by providing his own equipment, manpower etc. to the satisfaction of the Employer.
- V. The line impedance (Zero sequence and positive sequence) is tested by the Contractor by providing his own equipment, manpower etc. to the satisfaction of the Employer.
- VI. The line is tested satisfactorily for commissioning purpose.
- VII. The right-of-way all along the route of line is clear of all obstructions and meets requirements of clause 5.3 of IS: 5613 (Part -2/ Section-2) - 1985.
- VIII. The contractor shall arrange for inspection of the transmission line with the Employer, related authorities and other parties before energizing the line. The contractor shall carry out the, insulation test and megger test on the phase conductor and GW, Those test records shall be submitted to Employer for approval.
- IX. Any defects found as a result of inspection and testing shall be rectified by the Contractor forthwith to the satisfaction of the Employer without any extra charges.
- X. Before taking over of the line by the Employer, the line shall be energized at full working voltage.

4.21. PAYMENTS

- a. Payment for stringing of Conductor and Earthwire shall be done as per BPS. No separate payment shall be made for hoisting of insulators and fitting of all the hardware and accessories which is deemed to be included in the unit rate of stringing.
- b. No claim for idle period resulting from any "force majeure" condition shall be entertained by the Employer.

4.22. ERECTION SCHEDULE

- a. The tenderer shall submit erection/construction schedule(s) covering all phases of work starting from the date of award of contract up to the commissioning of the transmission line, in the form of flow-diagrams showing critical path construction schedule of all phases of work simultaneously or in the form of Bar Chart for all the lines separately.

4.23. PROGRESS REPORT

- a. Tower wise Weekly and monthly Progress Reports of stringing work in triplicate shall be submitted by the Contractor.

4.24. Field Quality Plan

- a. The Field Quality Plan shall be provided by contractor and will be approved by employer. It shall include Description of Activities, Items to be checked, Tests to be done, Reference documents, Testing Agency, Approving Agency, Extent of Completion of work, Counter Check by Employer, Accepting Authority etc. The Employer reserves the right to revise the field quality plan in course of the work.

4.25. PRE-COMMISSIONING PROCEDURES FOR TRANSMISSION LINES

4.25.1. Introduction

Over all procedure, safety rules, Project Technical Requirements, dispatch procedures, switching sequences, observations, passing criteria and documentation of test results have been documented in this report.

The detailed inspection and handing over documents are required to be checked for the entire length of transmission line before energization.

The detailed inspection/test procedures for each activity have been elaborated in separate section of this documentation. The contents of this report are as following:

1. Definition
2. Overall Procedures
3. Safety procedures
4. Inspection

5. Statutory Requirements
6. Handing over
7. Protective system
8. Dispatch procedures
9. Switching procedures
10. Testing
11. Energization
12. De-energization
13. Observations and duration
14. Passing criteria
15. Documentation

4.25.2. Definition

"Main Transmission Lines" means all high pressure cables and overhead lines (not being an essential part of the distribution system of a licensee) transmitting electricity from a generating station to another generating station or a sub-station, together with any step-up and step-down transformers, switch-gear and other works necessary to and used for the control of such cables or overhead lines, and such buildings or part thereof as may be required to accommodate such transformers, switch-gear and other works and the operating staff thereof;

"Power System" means a system under the control of the Government or any other statutory body of Generating Company or other agency and having one or more-

- i) generating station; or
- ii) main transmission lines and sub-stations; or
- iii) generating stations and main transmission lines and substations;

"Load Dispatch Centre" means the Centre so designated where the operation of each of the Regional/Area Electricity Grids constituting the country's power system is coordinated;

"Sub-Station" means a station for transforming or converting electricity for the transmission or distribution thereof and includes transformers, convertors, switch-gear, capacitors,

synchronous condensers, structures cables and other appurtenant equipments and any buildings used for that purpose and the site thereof, a site intended to be used for any such purpose and any buildings used for housing the staff of the sub section;

"Tie-Line" means a line for the transfer of electricity between two power systems together with switchgear and other works necessary to, and used for the control of such line.

4.25.3. Overall Procedure

First it is to be ascertained that the transmission line to be energized is ready for operation and has been properly handed over (released) in writing. This will include all safety aspects, Electrical inspector clearance, clearance from NEA Load Dispatch Centre (LDC), and final inspection, if any.

Instructions for the work and supervision are given by the test leader (nominated by NEA). However, all switching and all operational activities will be executed by the regular operators.

Line charging instructions received, are clearly understood by the Line in charge (from the Contractor side) and doubts, if any, are to be got clarified prior to the energisation of the line.

Once the line is handed over for charging no work shall be permitted without a valid WORKPERMIT.

When the whole system has been energized, including the AC line, it will be kept in this state for 8 hours or more for "soaking" with continuous inspection and monitoring.

4.25.4. Safety Procedures

Energization implies an abrupt and serious change of the working conditions in the plant. In order to avoid serious accidents, thorough information must be imparted to all personnel involved in the construction of transmission line. It should be ensured that due publicity has been made to the public in all the villages/areas along the line route cautioning them against climbing the towers etc. and that the line is proposed to be charged on so and so date. It is also to be confirmed that the AGENCIES involved in the construction activities shall not carry out any job on the said line without a valid WORK PERMIT.

It shall be ensured before charging that all men, material, Tools and plants and any temporary earthing on any part of the entire length of line are removed.

It must be ensured that any power supply / low voltage charging used as anti-theft measure must be disconnected and isolated to avoid accidental connection.

All equipment tests and pre-commissioning tests must have been completed, reterminated (in case cables were isolated for testing purpose) and documented.

The system must be formally declared ready for energization and handed over for operation in writing.

4.25.5. Inspection

Before the line is scheduled to be handed over for the pre-commissioning/energization the same shall be inspected by representatives of Employer, Employer's Engineer and Contractor as follows:

Such an inspection shall include:

- i) Right of way/way leave/electrical clearance
- ii) Tower accessories
- iii) Hardware Fittings
- iv) Insulators
- v) Conductors and Earthwire
- vi) Accessories for conductor and Earthwire
- vii) Aviation Warning Signals (Lights/globules/painting), if any

4.25.6. Right of Way/Way Leave/Electrical Clearance

4.25.6.1. Right of way/Way leave clearance

Ensure that no tree/tree branches are falling within the zone of minimum clearance specified as per FIGURE 4-1.

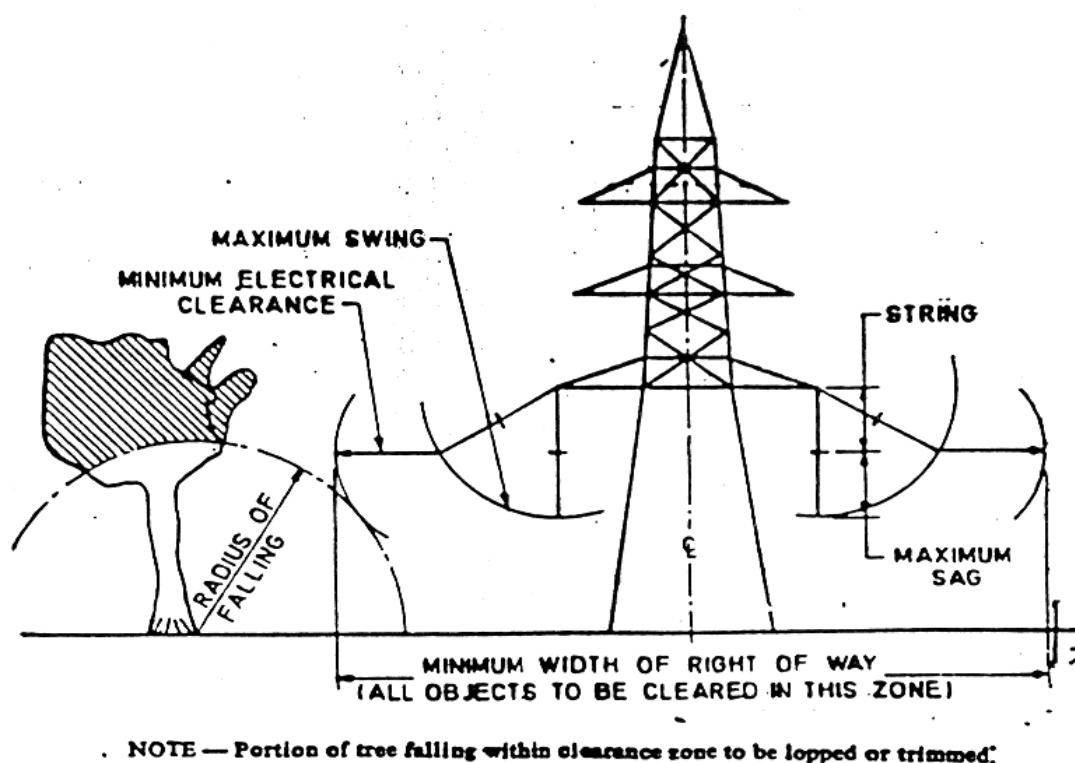


FIGURE 4-1: LINE CLEARANCE (RIGHT OF WA REQUIREMENTS)

Guidelines of forest/environmental rules shall be followed to avoid excessive tree cutting i.e. all the trees should be cut from ROUTE level in the 3 meter corridor below each line Conductor/Earthwires. In the balance corridor, Trees branches are only to be lopped to attain the specified clearance as per TABLE 4-2.

TABLE 4-2: CLEARANCE FOR RIGHT OF WAY

Transmission Voltage in kV	Right of Way (in meters)
220kV	30 meter

4.25.6.2. Electrical Clearance

In case of line crossings, clearance between lowest conductor of line and top conductor of the other line shall be adequate as follows:

(Minimum clearances in mm between lines when crossing each other)

Nominal System Voltage	132 kV	220 kV	400 kV
220 kV	4580	4580	6100

Jumpers in the tension tower are properly intact with conductor and form a parabolic shape in order to achieve adequate clearance from super steel structure.

4.25.6.3. Ground clearance

Normally at the time of construction adequate clearance is provided between lowest conductor and ground, but due to delay in charging/commissioning there are chances of dumping/heaping soil, earth and concrete etc. or staking bricks etc. which may cause reduction in ground clearance. In such cases the stored materials shall be removed.

Ensure that there is no temporary or permanent construction of houses or shades below the line. If the same has been constructed they shall be removed before charging.

The ground profile at the time of commissioning shall be checked with the profile approved at the time of check survey.

Ground clearance of lowest conductors at critical points/where ever the lowest conductor is touching the ground shall be checked in the field from any of the prevalent method and the values of ground clearance at these critical points shall be recorded in the prescribed format.

In case of hilly Terrain and for building clearance, the side clearance from conductors and jumpers at critical points shall also be checked and recorded for all phases of conductor/earthwire towards hill/ building side.

4.25.6.4. Clearance for Telephone line crossings

The minimum clearances between the conductors of the power line and telecommunication lines are specified as follows:

Transmission Voltage in kV	Clearance
220kV	3050 meter

The vertical clearances between conductors and between conductor and earth-wire shall be checked randomly say in any one span of all sections and 10 sections of hilly areas from single line diagram of the towers.

4.25.7. Tower and Tower Accessories

After completion of a transmission line, all the towers shall be thoroughly checked before charging the line. Special attention shall be given to the points as mentioned below:-

Deformed/Buckled/missing/Rusted Members and Nuts and Bolts

It is to be ensured that no members are bent, deformed or rusted due to stringing activities. If any such defects occur, a new member shall be fixed as per instruction of the Employer.

4.25.8. Hardware Fittings

Check the fixing of all security clips (W/R type clips).

Surface condition of corona control rings and distance/alignment between Tower side arcing horn (wherever applicable) and line side arcing horn/corona control ring to be checked as per approved drawings.

Ensure that, no. of insulators per string is lesser by one number as compared to no. of discs in normal string at approach spans to the terminal ends (approx last 1.5 KM).

To restrict the swing of jumpers, the provision of Pilot strings in case of Tension Towers shall be verified from the approved drawings.

4.25.9. Insulators

All the damaged/broken insulator discs shall be replaced.

Unusual deflection in suspension strings if observed shall be rectified.

The insulators shall be cleaned before charging.

IR value of individual disc of at least 5 insulators at random shall be checked by 5/10 kV Megger.

4.25.10. Conductors and Earthwires

4.25.10.1. Surface Condition

Surface of the conductors shall be free from scratches/rubs

Ensure that conductor strands are not cut and opened up. Wherever strands are found cut/damaged/scratched, they must be repaired with repair sleeves/repair protective rods in case the nos. of damaged strands are within specified limits (normally upto 1/6th nos. of strands in the outer layer).

4.25.10.2. Accessories for Conductor and Earthwires

A. Joints

All joints on conductor/earthwires shall be away from the tower at a distance of at least 30 metres or as provided in the Technical specification (TS).

Ensure that no more than one joint in a conductor is provided in one span or provided.

Ensure that no mid span joint is provided in major crossings for main roads, railway crossing and major rivers etc. or provided in TS.

Ensure that all mid span joints on conductors/earthwire and repair sleeves of compression type are free from sharp edges, rust and dust. Wherever grease are specified the same shall be applied in the joints.

B. Clipping

Ensure that conductor is not over tightened in the suspension clamps.

C. Spacers, vibration dampers and copper bonds

Placement and no. of spacers between two sub conductors on each phase shall be verified as per spacer placement chart.

Damaged/missing spacers shall be replaced and loose/displaced spacers shall be tightened/relocated.

Spacing of Vibration dampers from the tower and spacing between damper to damper in case two Vibration Dampers (VD) were provided, shall be verified as per the damper placement chart. All loose/ displaced VD shall be properly tightened/relocated and missing VDs shall be provided.

To be ensured that no copper bond is loose/missing.

D. Jumpers

Verify Electrical clearance of jumpers to tower body as per design. All the jumpers shall be checked properly. In case, jumpers (conductor/earthwire) are found loose, it shall be tightened adequately.

E. Foreign material

Ensure that all foreign materials viz dead bird, fallen tree branches, bird nests etc. on conductors, earthwires, Jumper, insulator string, cross arms are re-moved.

F. Others

It shall be ensured that all temporary/local earthing, guys, T & P (Tools and Plants), foreign material and other loose material which were used during stringing/tower erection have been removed.

In case there is any change in the ground profile before commissioning of line from the approved profile, the extra earth/obstruction/ temporary sheds/any other construction shall be removed.

4.25.11. Aviation Warning / Obstruction Signals (Lights / Globules / Painting)

It shall be ensured that following measures have been taken in the line/ Towers falling within obstruction zone of civil aviation and defense establishments as per their requirement and our specification.

Day markers

Painting of Full/Top portion of Towers with Red/Orange and White Paints.

Globules on earthwires have been provided.

Night markers

It shall be ensured that proper aviation lights at the peak level/at specified heights of towers have been provided along with Solar panels/Battery banks/Control cubicles and other accessories as per specification. The functioning of lights with simulation to be checked/verified.

4.25.12. Statutory Requirement

- a. On the request of the Contractor, Employer will inform concerned authorities and obtain approval, if required for (test) charging of the line. Employer will make public announcement. The Contractor shall also use its site offices to disseminate such notice to the public and its workers.
- b. Before charging of the line shall be inspected jointly by NEA, Engineer and Contractor. The Contractor shall assist NEA to the possible extend, during all kind of test including hot test and the hours of soaking.

4.25.13. Handing Over

The transmission line shall be inspected prior to energization and a formal handing over document to be jointly signed by the representatives of Contractor and NEA. However all contractual taking over has to be resolved separately as per the terms and conditions of the contract. The Handing over shall be limited to the completion of Erection and ready for Energization.

Any outstanding points or remaining activities are to be listed jointly. The remaining activities/outstanding points are classified in the following category:

Details of the SECTIONS:

- A. List of outstanding activities remaining in any part of the line
- B. A list of temporary arrangements introduced.
- C. Check list records properly documented, completed and signed.
- D. Stringing charts (initial and final as applicable) etc. of all towers/line

With the outstanding activities mentioned above are solved or with only minor points without influence on the charging remain (minor issues handing over of the transmission line shall be accepted by the pre-commissioning team. This handing over for energization with or without remaining activities shall be made by the group head to the commissioning in charge in writing.

4.25.14. Protective System

Before energization it must be ascertained that all protective systems for the unit to be energized are operative.

This includes confirmation that the protections have been properly tested and that the tests have been documented.

It also includes verification by inspection or otherwise, if necessary by repetition of trip test, that the protections are actually functionally enabled. This verification serves to prevent that energization takes place of a unit where a protection has been disabled for test or other reason. NEA and Engineer will conduct all the tests required. The Contractor may also witness such tests.

4.25.15. Dispatch Procedures

All operational activities (switching etc.) must be coordinated and communicated with the system dispatcher.

In this respect the general procedures already established by NEA will be followed.

4.25.16. Switching Procedures

For each activity the instructions to the operators and the communications to the dispatchers will be made in writing or by confirmed telephone messages. The switching procedures first to be properly documented step by step and understood by everybody involved in the switching operation prior to the energization. Any clarification required in the procedures must be resolved. The format established by Employer for switching orders and operational data logging shall be followed.

The implication of this is that each and every activity must be listed and described, so that complete information is available for detail investigation, if required in future. The Contractor shall assist NEA in performing activities.

4.25.17. Testing and Measurement Procedures

Followings tests shall be conducted by the Contractor to the satisfaction of the Employer in the presence of Engineer.

Before commissioning of the lines following tests may be carried out.

a. **Insulation Resistance Test**

This test may be carried out with the help of a 10 OR 12 KV megger preferably power driven to ascertain the insulation condition of the line. In case 5 kV megger is used for insulation resistance measurement it shall be ensured that the induced voltage (CVT reading) is LESS than the instrument withstanding capacity otherwise it is likely that the instrument may be damaged.

This Test is to be carried out First prior to the continuity test.

Measurement of Insulation Resistance

One of the most common devices used for testing electrical insulation is the Megger Insulation Tester.

The DC test voltage is generated by a permanent magnet generator. This generator is turned either by hand or by an electric motor. In either case a slip clutch maintains the generator speed at a constant value so long as the slipping speed is exceeded. A constant voltage is important when the insulation under test has a high capacitance. Common generator output voltage are 500, 1000, 2500 and 5000 volts.

Many Meggers have a “guard” terminal as well as “line” and “earth”. The guard terminal is useful shall one wish to exclude part of the insulation under test from the measurement. This is possible since current flowing to the generator via the guard circuit does not pass through the deflecting coil.

Another use of the guard circuit is to shield the “line” lead between the Megger and the apparatus under test. This prevents leakage to ground from the “line” lead which would invalidate the Megger reading.

Insulation resistance is the ratio V_{DC}/I_{DC} . V_{DC} is applied across two conductors separately by the insulation under test.

I_{DC} is the current flowing through/over the insulation. For a healthy and clean insulation the megger reading is in mega-Ohms to infinity. For dirty in, insulation and defective, moist insulation the meggers shows a very low insulation resistance value.

Megger test gives clear indication about the health, cleanliness and dryness of the line/equipment insulation.

5 KV megger or 10 KV megger or 12 KV megger may be used for the Transmission line keeping all safety requirements, Permit to work, clearance from statutory bodies and other conditions prevailing at the Sub-station where charging of the line is being co-ordinated.

b. Conductor Continuity Test

The objective of this test is to verify that each conductor of the overhead line properly connected electrically (the value of electrical resistance of line does not vary abnormally from that of a continuous conductor of the same size and length). The electrical resistance of the conductor shall be measured with a Whetstone bridge or other suitable instrument, if available taking the safety aspects of Equipment as well as testing Engineer.

A simple method of continuity test is illustrated below :

Once the insulation test is completed and the results confirms no short circuit carry the following:

SENDING END	RECEIVING END	RESULTS (OHMS)
CLOSE R-Ph GS	MEGGER R- Ph	ZERO/LOW
OPEN Y – Ph GS	MEGGER Y-Ph	HIGH
OPEN B-Ph GS	MEGGER B-Ph	HIGH
OPEN R-Ph GS	MEGGER R-Ph	HIGH
CLOSE Y – Ph GS	MEGGER Y-Ph	ZERO/LOW
OPEN B-Ph GS	MEGGER B-Ph	HIGH
OPEN R-Ph GS	MEGGER R-Ph	HIGH
OPEN Y–Ph GS	MEGGER Y-Ph	HIGH
CLOSE B-Ph GS	MEGGER B-Ph	ZERO/LOW

(ALL GS OPEN CONDITION) GS means GROUND SWITCH

If the above test results are OK it confirms the continuity of the line.

The continuity Test of the line with proper phase indication or phase marking can be checked by continuity test as described below:

SENDING END	RECEIVING END MEGGER BETWEEN	RESULTS (OHMS)
CONNECT R&Y PHASE B-PHASE& ALL GS OPEN	R PHASE & Y PH Y PHASE & B PH B PHASE & R PH	ZERO OR LOW HIGH HIGH
CONNECT R & B PHASE Y PHASE &ALL GS OPEN	R PHASE & Y PH Y PHASE & B PH B PHASE & R PH	HIGH HIGH ZERO OR LOW
CONNECT Y & B PHASE R-PHASE &ALL GS OPEN	R PHASE & Y PH Y PHASE & B PH B PHASE & R PH	HIGH ZERO OR LOW HIGH

If the test results are OK it confirms that marking of the phases are in order.

c. Phase Sequence

Once the line is charged from one end, without closing the Breaker at the other end the Phase sequence is to be checked from the CVT/PT output by the help of Phase Sequence Meter. In case there are other feeders available Phase sequence is to be RECHECKED by the measurement of secondary voltage of both the Feeders (New line & available charged line). Let the secondary Voltage of CVT/PT is 110 volts (ph to ph) for both the Circuit. In case of correct Phase Sequence the voltage reading shall be as follows:

NEW CIRCUIT	OLD CIRCUIT	VOLTAGE
R-Phase	R-Phase	0
R-Phase	Y-Phase	110
R-Phase	B-Phase	110
Y-Phase	R-Phase	110
Y-Phase	Y-Phase	0
Y-Phase	B-Phase	110
B-Phase	R-Phase	110
B-Phase	Y-Phase	110
B-Phase	B-Phase	0

In case the results are not matching the phase sequence in to be rechecked and reconfirmed before closing the breaker.

4.25.18. Energization

Execution of the energization is simply the last event in the switching sequence, switching of the close control button for the relevant circuit breaker.

4.25.19. De-Energization

Instructions about de-energization will be given only if this is part of the test. Otherwise de-energization will be considered part of regular operation.

4.25.20. Observation and Duration

Visual and audible inspection (look and listen) of the relevant equipment and reading of permanent instrumentation will be made.

The system shall be charged at least for 24 hours. During this time continuous monitoring and inspection will be maintained in control room, auxiliary systems areas and switch yards.

This will include frequent, scheduled inspection of all equipment and reading of all permanent instruments and recorders, and surge arrester counters, especially system parameters as per standard procedures adopted by Employer.

4.25.21. Passing Criteria

Neither insulation breakdown nor protective system actions must occur. No irregular equipment behaviour noise, vibration, high temperature is permitted.

Corona discharges may not be “unreasonable”. Local discharges that may be attributable to sharp points shall be carefully located and recorded. After termination of the energization the equipment shall be closely inspected and the points rounded or covered.

No unscheduled changes of system nor of equipment is permitted during the 24 hour energized condition.

4.25.22. Documentation

Switching and operational activities will be recorded in regular manner in the operator’s log. Likewise all readings of permanent instruments, Copies of this log, notes on special observations from inspections and other measurements will constitute the test records.

CHAPTER - 5

CONDUCTOR, GROUND WIRE AND ACCESSORIES

5.0 INTRODUCTION

This chapter covers the specification and General Technical Particulars of Power Conductor, Galvanised Steel Ground Wire and their accessories for use in Second Circuit Stringing of Inaruwa-Basantapur-Baneshwar-Tumlingtar 220 kV Transmission Line as defined in PSR.

The detailed specification for Power Conductor, Ground Wire and their accessories are given below.

5.1 POWER CONDUCTOR

5.1.1 Scope

This section covers design, manufacture, testing before dispatch, packing, supply and delivery CIP destination, Storage at site of 597 sq.mm ACSR “Moose” Conductor of size 54/ 3.53mm Aluminum + 7/3.53 mm steel. The Conductor shall only be accepted from those manufacturers who have got the valid ISO 9001 or equivalent internationally recognized certification and documentary proof for having such certification shall be submitted with the tender.

6KM additional conductor shall be supplied by the Contractor as a spare quantity. The quantity for same has been included in Price Schedule. Also, The Contractor shall supply the Conductor accessories which may require for wastage at their own cost. Some spare quantities of accessories have been kept in Price schedule which shall be decided during detailed engineering. The unused quantity shall be returned to the Employer in good condition as spare inventory. Missing components or damaged items will not be counted as complete sets or units. Therefore, the Contractor must either supply the missing or damaged items or the corresponding cost will be deducted from the final payment or retention.

5.1.2 Standards

5.1.2.1 The Conductor shall comply in all respects with the IS:398 (latest edition) with all amendments unless otherwise stipulated in this specification or any other equivalent International Standards which ensure equal or higher quality material.

5.1.2.2 The ACSR Conductor shall also conform to the following standards.

TABLE-5.0

S.NO	Indian Standards	Title	International Standards
1	IS:209-1992	Specification for Zinc ingot	BS-3436-1961
2	IS:398-1976	Specification for aluminum conductors for overhead transmission purposes.	
	Part II & V	Aluminum conductors galvanized steel reinforced	IEC-60209-1966 BS-215 (Part-II)1970
3	IS:1608-1995	Mechanical testing of metals Tensile Testing of Steel wire	ISO/R89-1959
4	IS:1755-1983	Method for wrapping test format telic wires	
5	IS:1778-1980	Reels and Drums for Bare conductors	BS-1559-1949
6	IS:1841-1978	E.C. Grade Aluminum rod produced by rolling	
7	IS:2629-1966	Recommended practice for Hot Dip Galvanizing of iron and steel	
8	IS:2633-1986	Method of testing uniformity of coating of zinc coated articles.	
9	IS:4826-1968	Hot Galvanized deep coatings on round steel wires.	ASTM A472-729 BS-443-1969
10	IS:5484-1978	E.C. Grade Aluminum rod produced by continuous casting and rolling.	
11	IS:6745-1972	Methods of determination of mass of zinc-coatingof zinc coated iron and steel articles	BS-443-1969
12	IS:8263-1976	Method of radio-interference tests on high voltage installations.	IEC:60437-1973 NEMA:107-1964

13		Overhead lines – Requirements for greases for aluminium, aluminium alloy and steel bare conductors	IEC 61394: 201
14		Overhead electrical conductors- Formed wire, concentric lay, stranded conductors	IEC 62219: 2002
		Greasing of the conductor	BS EN 50182-2001
15	IS:1885 (Part-32) /1996	Electro-technical vocabulary: Electrical cable	
16		Round wire concentric lay overhead Electrical Stranded Conductor	IEC 61089:1991
17		Aluminum-clad steel wire for electrical Purpose	IS 398:1993
18		Overhead lines-requirements and tests For fittings	IEC 61284:1997/8
19		Zinc coating (hot-dip) on Iron and Steel hardware	ASTM A 153:
20		Concentric Lay Stranded Aluminum-Clad steel conductors	ASTM B416:
21		Concentric lay stranded aluminum conductors, aluminum clad steel reinforced	ASTM B549:
22		Insulator and Conductor Fittings for Overhead Power Lines	BS 3288
		Performance and General Requirements	Part 1 (1993)
		Specifications for a Range of Fittings	Part 2 (1990)
23		Electrical Power technical standards of Nepal	
		Hard-drawn aluminium wire for overhead line conductor	IEC: 60889-1987

		Zinc-coated steel wires for stranded conductors	IEC: 60888-1987.
		Overhead lines - Requirements for greases for aluminium, aluminium alloy and steel bare conductors	IEC 61394:2011

5.1.2.3 Offers conforming to Standards other than IS-398 shall be accompanied by the English version of relevant standards in support of the guaranteed particulars to be furnished as per chapter 2,3 enclosed.

5.1.3 General Technical Requirements

The conductor is to be greased except outer layer. The Technical specifications of greasing are covered in this chapter.

The Specific Technical Requirements are given in chapter-3. The Conductor shall conform to these technical requirements. The Bidder shall furnish guaranteed technical particulars as per chapter 2,3.

- A. The General Technical particulars of the ACSR Moose (excluding the grease) conductor are tabulated below:

TABLE-5.1

S.No	Description	Particulars
1	Conductor	ACSR "MOOSE" 54/3.53 mm Aluminum + 7/3.53 mm steel
2	Standard applicable	IS-398 or ASTM or IEC or equivalent
3	Wire diameter	
	Aluminium	3.53 mm $\pm$ 2mm
	Steel	3.53 mm $\pm$ 7mm
4	Number of strands per layers	
a)	Steel	
	Steel Core	1
	1 st Steel Layer	6
b)	Aluminium	
	1 st Layer	12
	2 nd Layer	18

	3 rd Layer	24
5	Sectional Area (Approx.)	
	Total conductor	597.00 mm ²
	Total Aluminium	528.5 mm ²
	Cross sectional area of nominal diameter wire (Steel or Aluminium)	9.787 sq. mm
6	Overall diameter	31.77 mm
7	Approximate mass:	
	Overall conductor	2004 kg/km (without grease)
	Aluminium Wire (per wire)	26.45 kg/km
	Steel Wire (per wire)	76.34 kg/km
8	a. Maximum D.C. resistance of conductor at 20 degrees C,	0.05552 Ω /km
	b. Maximum D.C. resistance of each Aluminum wire at 20 degrees C,	2.921 Ω /km
9	Ultimate Tensile strength	161.20 kN
10	Breaking Load of Wires (min):	
	a) Aluminium (per wire)	
	Before Stranding	1.57 kN or 160kg
	After Stranding	1.49 kN or 152 kg
	b) Steel (per wire)	
	Before Stranding	12.86 kN or 1311 kg
	After Stranding	12.22 kN or 1246 kg
11	Final modulus of elasticity	0.703 x 10 ⁶ kg/cm ²
12	Coefficient of Linear expansion (per °C)	19.35 x 10 ⁻⁶
13	a. Direction of Lay	Outermost Layer shall be Right hand with inner successive layers having opposite directions to lay.
	b. Lay Ratio	Maximum Minimum

	Steel core 6 wire layer	18	16
	Aluminium		
	1 st Layer (12 wire)	14	12
	2 nd Layer (18 wire)	13	11
	3 rd Layer (24 wire)	12	10
14	Zinc coating of steel core		
a)	Number of 1 minute dips	3	
b)	Number of half minute dips	-	
c)	Minimum weight of Zinc Coating	250 g/m ²	
d)	Process of Galvanizing	Hot Dip Galvanization	
e)	Quality of Zinc (min.)	Electrolyte High Grade 99.95%	
15	Joints in strands		
a)	Steel	Not permitted	
b)	Aluminium	No Joints shall be permitted in the Outermost layer. Joints in the individual aluminium wires in intermediate 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 m apart in the complete stranded conductor.	
c)	Method of making joint	Joints shall be made by the cold pressure butt-welding.	
d)	Ultimate tensile strength of joint	14.67 kg/sq. mm	
16	Minimum Number of twists to be withstood in torsion test when tested on a gauge length of 100 times diameter of wire	18 (Before Stranding) 16 (After Stranding)	
17	Minimum Percentage of Elongation during testing for Elongation Test on an original gauge length of 200 mm.	4% (Before stranding) 3.5% (After Stranding)	

18	Chemical composition of high carbon steel wire	
	Element	
a)	Carbon	0.50 to 0.85 %
b)	Manganese	0.50 to 1.10 %
c)	Phosphorus	Not more than 0.035 %
d)	Sulphur	Not more than 0.045 %
e)	Silicon	0.10 to 0.35 %
19	Standard Supply length	1500 meter
20	Packing (Wooden Drums)	IS 1778 : 1980 or latest edition

- B. For crossings involving longer spans, Aluminium Alloy Conductor Steel Reinforced shall be used in this project. The Aluminium Alloy of Silicon-Magnesium (6201) shall be used. The AACSR Conductor shall generally conform to IS: 398 except where otherwise specified herein.

Aluminium Alloy Strands shall be drawn from Silicon-Magnesium Alloy rods (6201) with appropriate tempering followed by solution treatment. The General Technical particulars of the Aluminium Alloy Conductor Steel Reinforced 'AACSR' Moose (excluding the grease) conductor are tabulated below:

S.No	Description	Unit	Guaranteed Values
1.0.	Raw Materials		
1.1.	Aluminium Alloy		
a.	Silicon	%	0.5-0.9
b.	Magnesium	%	0.6-0.9
c.	Ferrous	%	0.5 (Max)
d.	Copper	%	0.1 (Max)
e.	Manganese	%	0.03 (Max)
f.	Chromium	%	0.03 (Max)
g.	Zinc	%	0.10 (Max)

h.	Boron	%	0.06 (Max)
i.	Other Elements (each)	%	0.03 (Max)
j.	Other elements (total)	%	0.1 (Max)
k.	Aluminium	%	Reminder
1.2.	Steel Wire / Rods		
a.	Carbon	%	0.50 to 0.85
b.	Manganese	%	0.50 to 1.10
c.	Phosphorous	%	Not more than 0.035
d.	Sulphur	%	Not more than 0.045
e.	Silicon	%	0.10 to 0.35 (Max.)
1.3.	Zinc		
a.	Minimum purity of Zinc	%	Electrolyte High Grade 99.95%
2.0.	Aluminum Alloy strands after stranding		
2.1.	Diameter		
a.	Nominal	mm	3.53
b.	Maximum	mm	3.55
c.	Minimum	mm	3.51
2.2.	Minimum breaking load of strand		
a.	Before stranding	kN	3.02
b.	After stranding	kN	2.867
2.3.	Maximum resistance of 1 m length of strand at 20 deg. C	Ω	0.003388
3.0.	Steel strand after stranding		
3.1.	Diameter		
a.	Nominal	mm	3.53
b.	Maximum	mm	3.59
c.	Minimum	mm	3.47
3.2.	Minimum breaking load of strand		
a.	Before stranding	kN	12.86

b.	After stranding	kN	12.22	
3.3.	Galvanising			
a.	Minimum weight of zinc coating per sq.m.	gm	250	
b.	Minimum number of dips that the galvanised strand can withstand in the standard preece test	Nos.	3 dips of one minute	
c.	Min. No. of twists in guage length equal 100 times the dia. of wire which the strand can withstand in the torsion test	Nos.	18 (Before Stranding) 16 (After Stranding)	
d.	Process of Galvanizing		Hot Dip Galvanization	
4.0.	Stranded Conductor			
4.1.	UTS of the conductor		224.64 (Min.)	
4.2.	Lay Ratio		Max	Min
a.	Outer Steel layer	mm	18	16
b.	12 wire Aluminium Alloy layer	mm	14	12
c.	18 wire Aluminium Alloy layer	mm	13	11
d.	24 wire Alumimium Alloy Layer	mm	12	10
4.3.	DC resistance of the conductor at 20°C	Ω/km	0.0624	
4.4.	Minimum corona Extinction Voltage (line to phase) under Dry condition	kV (rms)	156	
4.5.	RIV at 1 MHz at 156 Amp (line to phase) under Dry condition	Micro Volts	Below 1000	
4.6.	Standard length of the conductor	m	1800	
4.7.	Tolerance on Standard length	%	±5	
4.8.	Direction of lay of outer layer		Right Hand	
4.9.	Linear mass of the conductor			

a.	Standard	Kg/k m	1996
b.	Minimum	Kg/k m	1963
c.	Maximum	Kg/k m	2032
4.10.	Sectional Area (Approx.)		
a.	Total	mm ²	597.00
b.	Aluminium	mm ²	528.5
c.	Overall diameter	mm	31.77
d.	Minimum Percentage of Elongation during testing for Elongation Test on an original gauge length of 200 mm.		4% (Before stranding) 3.5% (After Stranding)
5.0.	Joints in strands		
5.1.	Steel		Not permitted
5.2.	Aluminium		No Joints shall be permitted in the Outermost layer. Joints in the individual aluminium wires in intermediate 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 m apart in the complete stranded conductor.
5.3.	Method of making joint		Joints shall be made by the cold pressure butt-welding.
5.4.	Ultimate tensile strength of joint	kg/sq. mm	14.67
6.0.	Packing (Wooden Drums)		IS 1778 : 1980
7.0.	Standard applicable		IS-398 (part-IV)-1996, IS-398 (part-V)-1996 or ASTM or IEC or equivalent

5.1.3.1 Materials & Workmanship

- 5.1.3.1.1 The material offered shall be of best quality and workmanship. The steel cored aluminum strands shall consist of hard drawn aluminum wire manufactured from not less than 99.5% pure electrolytic aluminum rods of E.C. grade and copper content not exceeding 0.04%. They shall have the same properties and characteristics as prescribed in IEC: 60889-1987. The steel wire shall be made from material produced either by the acid or basic open hearth process or by electric furnace process or basic oxygen process. Steel wire drawn from Bessemer process shall not be used. Aluminium Alloy Strands shall be drawn from Silicon-Magnesium Alloy rods (6201) with appropriate tempering followed by solution treatment.
- 5.1.3.1.2 The steel wires shall be evenly and uniformly coated with electrolytic high grade, 99.95% purity zinc complying with the latest issue of IS-209 for zinc. The uniformity of zinc coating and the weight of coating shall be in accordance with Section-3 and shall be tested and determined according to the latest IS-2633 or any other authoritative standard. Chemical composition of high carbon steel wire shall be:

Element	percentage
Carbon	0.50 to 0.85 %
Manganese	0.50 to 1.10 %
Phosphorus	Not more than 0.035 %
Sulphur	Not more than 0.045 %
Silicon	0.10 to 0.35 %

- 5.1.3.1.3 The steel strands shall be hot dip galvanized and shall have a minimum zinc coating of 260 gm/Sq.m. The coating shall be smooth, continuous, and of uniform thickness, free from imperfections and shall withstand minimum three dips after stranding in standard preece test. The steel strands shall be preformed and post formed in order to prevent spreading of strands in the event of cutting of composite core wire. The properties and characteristics of finished strands and individual wires shall be as prescribed in IEC:60888-1987.

5.1.3.2 Conductor Parameters

- 5.1.3.2.1 The Parameters of individual strands and composite steel cored aluminium/ aluminium alloy conductor shall be in accordance with the values given in chapter 3.
- 5.1.3.2.2 Steel core and the inner layers of Aluminum/Aluminium alloy shall be covered with suitable temperature resistant grease during manufacture, but no grease shall be applied to the finished conductor. The Specification of greasing is specified in this clause no. 5.1.3.4 below.
- 5.1.3.2.3 Creep in a conductor is attributed partly due to settlement of strands and partly due to non-elastic elongation of metal when subjected to load. The Bidder shall furnish the amount of creep which will take place in 10, 20, 30, 40 and 50 years along with the supporting calculations. The calculations should be based on everyday temperature of 32 degree C and everyday tension of 25% of UTS of conductor of overhead lines.

5.1.3.3 Tolerances

- 5.1.3.3.1 The tolerances on standard diameter of Aluminum/Aluminium alloy and Steel wires shall be as detailed in specific technical requirements.
- 5.1.3.3.2 The cross-section of any wire shall not depart from circularity by more than an amount corresponding to the tolerance on the standard diameter.
- 5.1.3.3.3 The details of diameters, lay ratios of Aluminium and steel wires shall be in accordance with the chapter-3 "Technical Requirements".

5.1.3.4 Greasing and Surface Conditions

5.1.3.4.1 Greasing

Steel core and the inner layers of Aluminum/Aluminium alloy shall be covered with suitable temperature resistant grease during manufacture, but no grease shall be applied to the finished conductor. Sufficient grease shall be applied to the Steel and inner Aluminium strands to fill the inter-strand spaces (viz. Inner Layer Protection). The completed conductor shall be smooth and free from imperfections, dirt, grit, excessive amounts of drawing oil and other foreign deposits.

The grease used for corrosion protection in the manufacture of ACSR shall have the following requirements satisfying IEC 61394.

- The entire conductor is greased except the outer layer.
- The weight of the grease shall confirm the values given in IEC 61089.
- It shall not flow or deteriorate at temperatures up to 85°C.
- It shall not be inimical to Aluminium or Galvanized Steel.

- e) It shall have good adhesive and cohesive properties and shall retain these qualities after weathering.
- f) It shall not extrude a surplus to the outside of the conductor after erection.
- g) It shall not present any risks to health and shall comply with all the usual health and safety standards.
- h) temperature resistant grease shall have minimum of Lithium soap grease corresponding to Grade II of IS 7623:1993 having minimum drop point not less than 180°C

The greasing process and testing of grease shall be done on the basis of following standard however, the construction features and basic properties of the conductor must not be changed and these are to be as per relevant standard as specified in the specifications.

IEC 61394: 2011	Overhead lines – Requirements for greases for aluminium, aluminium alloy and steel bare conductors
IEC 62219: 2002	Overhead electrical conductors- Formed wire, concentric lay, stranded conductors
BS EN 50182-2001	Conductors for Overhead lines
IS 7623: 1993	Lithium Base Grease for Industrial Purposes

5.1.3.4.2 Surface Conditions

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

each other in such a way as to get out of place and disturb the longitudinal smoothness of the conductor.

5.1.3.5 Joints in Wires

5.1.3.5.1 Aluminum/Aluminum alloy wires

5.1.3.5.1.1 During stranding, no aluminium/ aluminium alloy wire welds shall be made for the purpose of achieving the required conductor length.

5.1.3.5.1.2 No joint shall be permitted in the individual aluminium wires in the outer most layer (24 wires) of the finished Conductor. However, joints in the 18 wire & 12 wires inner layers of the conductor are permitted but these joints shall be made by the cold pressure butt welding and shall be such that no two such joints shall be within 15 meters of each other in the complete stranded conductor.

5.1.3.5.2 Steel wires

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

5.1.3.6 Stranding

5.1.3.6.1 The wires used in construction of the stranded conductor, shall, before stranding, satisfy all requirements of IS-398-1996.

5.1.3.6.2 In all constructions, the successive layers shall be stranded in opposite directions. The wires in each layer shall be evenly and closely stranded round the underlying wire or wires. The outer most layer of wires shall have a right hand lay. The lay ratio of the different layers shall be within the limits given under chapter-3.

5.1.3.7 Packing

5.1.3.7.1 The conductor shall be supplied in non-returnable strong wooden/returnable steel drums provided with lagging of adequate strength constructed to protect the conductor against any damage and displacement during transit, storage and subsequent handling and stringing operations in the field. The drums shall generally conform to IS-1778-1980 and latest version except as otherwise specified hereinafter. The conductor drums shall be adequate to wind one standard length of at least 1500 meters for ACSR 'Moose' conductor.

5.1.3.7.2 The drums shall be suitable for wheel mounting and for letting off the conductor under a minimum controlled tension of the order of 5KN.

- 5.1.3.7.3 The bidders should submit their drawings of the conductor drums along with the bid. After placement of letter of intent the contractor/manufacturer shall submit two copies of fully dimensioned drawing of the drum for employer's approval. After getting approval from the employer, contractor/manufacturer shall submit 6 more copies of the approved drawings for further distribution and field use at Department's end.
- 5.1.3.7.4 All wooden components shall be manufactured out of seasoned soft wood free from defects that may materially weaken the component parts of the drums. Preservative treatment for anti-termite/anti fungus shall be applied to the entire drum with preservatives of a quality which is not harmful to the conductor.
- 5.1.3.7.5 All flanges shall be 2-ply construction with 64 mm thickness, with each ply at right angles to the adjacent ply and nailed together. The nails shall be driven from the inside face flange, punched and then clenched on the outer face. The thickness of each ply shall not vary by more than 3mm from nominal thickness. There shall be at least 3 nails per plank of ply with maximum nail spacing of 75 mm. Where a slot is cut with flange to receive the inner end of the conductor the entrance shall be in line with the periphery of the barrel.
- 5.1.3.7.6 The wooden battens used for making the barrel of the conductor shall be of segmental type. These shall be nailed to the barrel supports with at least two nails. The battens shall be closely butted and shall provide a round barrel with smooth external surface. The edges of the battens shall be rounded or chamfered to avoid damage to the conductor.
- 5.1.3.7.7 Barrel studs shall be used for construction of drums. The flanges shall be holed and the barrel supports slotted to receive them. The barrel studs shall be threaded over a length on either end, sufficient to accommodate washers, spindle plates and nuts for fixing flanges at the required spacing.
- 5.1.3.7.8 Normally, the nuts on the studs shall stand protruded of the flanges. All the nails used on the inner surface of the flanges and the drum barrel shall be countersunk. The ends of the barrel shall generally be flushed with the top of the nuts.
- 5.1.3.7.9 The inner cheek of the flanges and drum barrel surface shall be painted with bitumen based paint.
- 5.1.3.7.10 Before reeling, card board or double corrugated or thick bituminized waterproof bamboo paper shall be secured to the drum barrel and inside of flanges of the drum by means of a suitable commercial adhesive material. The paper should be dried before use. Medium

grade Kraft paper shall be used in between the layers of the conductor. After reeling the conductor the exposed surface of the outer layer of conductor shall be wrapped with thin polythene sheet across the flanges to preserve the conductor from dirt, grit and damage during transportation and handling and also to prevent ingress of rain water during storage/transport.

5.1.3.7.11 A minimum space of 50 mm shall be provided between the inner surface of the external protective lagging and outer layer of the conductor. Outside the protective lagging, there shall be minimum of two binders consisting of hoop iron/galvanized steel wire. Each protective lagging shall have two recesses to accommodate the binders.

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

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

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

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

5.1.3.7.16 Empty metallic Cable drums may be taken back by the contractor after using the cables. Any wooden drums, packaging wooden material shall also be removed from the substation by the contractor in time. Failure to do so in a timely manner the employer will reserve the right to delay the issuance of operational acceptance certificate. Additionally, any costs incurred for handling or storing or managing the unreturned drums will be deducted from the contractor's invoice/retention payment.

5.1.3.8 Labeling and Marking

5.1.3.8.1 The drum number shall be branded or gauged or stenciled into the flange. An arrow shall be marked on the sides of the drum, together with the words "Roll this way". Each drum

shall have the following information provided on the outside of the flange stenciled with indelible ink.

- a) Manufacturer's name and address.
- b) Contract/Specification number.
- c) Size and type of conductor.
- d) Net weight of the conductor.
- e) Gross weight of the conductor and drum.
- f) Tear weight of the Conductor in the Drum
- g) Arrow marking for unwinding
- h) Distance between the outer Layer of the Conductor and the inner surface of lagging
- i) Barrel diameter for three locations and an arrow marking at the location of the measurement.
- j) Length of the conductor.
- k) Position of the conductor end.
- l) Drum and lot number.
- m) Name and address of the consignee.
- n) Month and year of manufacture.
- o) The drum may also be marked with standard specification as per which the conductor is manufactured.

5.1.3.9 Standard Lengths

5.1.3.9.1 The standard length of the conductor shall be at least 1500 meters for 'MOOSE' ACSR. Bidder shall indicate the standard length of the conductor to be offered by them. A tolerance of plus or minus 5% on the standard length offered by the bidder shall be permitted. All lengths outside this limit of tolerance shall be treated as random lengths. The Owner reserves the right to verify the length of the conductor after unreeling.

5.1.3.9.2 Unless otherwise agreed to between the employer and the manufacturer, it shall be permissible to supply not more than 10 percent of the lengths on any one order in random lengths; none of them shall be shorter than one third of the nominal length.

5.1.3.10 Quality Assurance Plan

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

5.1.4 Testing

The Conductor offered shall be type tested duly last 5 years (time period from before final bid submission date). The Bidder needs to furnish Type Test Reports of identical conductor along with the Bid for consideration. In case of non-submission of Type-test reports, Type Test as per the following and as per IS-398 shall be carried out at the reputed standard laboratory (acceptable to Employer).

5.1.4.1 Selection of Test Samples for Type Tests

5.1.4.1.1 The samples shall be taken from a continuous length of conductor and subjected to all the tests specified in clause no. 5.1.4.2.2.

5.1.4.1.2 Selection of Test Samples for Acceptance Tests

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

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

5.1.4.1.2.3 The routine tests shall be same as acceptance test and shall be carried out on each coil before and after standing.

5.1.4.2 Tests

5.1.4.2.1 The following tests shall be carried out as per this specification on a sample/samples of conductor.

5.1.4.2.2 Type Tests (Design test)

- a) Visual examination
- b) Measurement of diameters of individual aluminium/Aluminium alloy and steel wires
- c) Measurement of lay ratio of each layer
- d) Breaking load of "Individual wire" as well as stranded Conductor
- e) Ductility test
- f) Wrapping test
- g) Resistance test on aluminium/Aluminium alloy wires.
- h) DC resistance test on composite conductor
- i) Ultimate Breaking load test on stranded conductor.
- j) Galvanizing test
- k) Surface condition test
- l) Stress Strain test
- m) Breaking load test on welded Aluminium/ Aluminium alloy strands.
- n) Corona test
- o) Radio interference voltage test

5.1.4.2.3 Acceptance tests and Routine tests

- a) Visual and dimensional check on drum.
- b) Visual examination
- c) Measurement of diameters of individual aluminium/ Aluminium alloy and steel wires.
- d) Measurement of lay ratio of each layer
- e) Breaking load of "individual wire"
- f) Ductility test
- g) Wrapping test
- h) Resistance test on aluminium/Aluminium alloy wires.
- i) DC resistance test on composite conductor
- j) Breaking load test on welded Aluminium strands.
- k) Galvanizing test

5.1.4.2.4 Tests during Manufacture

The following tests during manufacture shall be carried out.

- a) Chemical analysis of zinc used for galvanising, as per cl. 5.1.4.16
- b) Chemical analysis of aluminium/Aluminium alloy used for making aluminium/Aluminium alloy strands, as per cl. 5.1.4.15
- c) Chemical analysis of steel used for making steel strands, as per cl. 5.1.4.15

Testing Procedures

5.1.4.3 Visual examination

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

5.1.4.4 Measurement of diameters of individual Aluminium/Aluminium alloy and Steel Wires.

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

5.1.4.5 Measurement of lay-ratios

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

5.1.4.6 Breaking load test

5.1.4.6.1 Breaking load test on stranded conductor.

Circles perpendicular to the axis of the conductor shall be marked at two places on a sample of conductor of minimum 5m length between fixing arrangement suitably fixed on a tensile testing machine. The load shall be increased at a steady rate 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 100% of UTS and held for one minute. The Conductor sample shall not fail during this period. The applied load shall then be increased until the failing load is reached and the value recorded.

5.1.4.6.2 Breaking load test on individual Aluminium/Aluminium alloy and galvanised steel wires.

5.1.4.6.2.1 This test shall be conducted on both Aluminium/Aluminium alloy and galvanised steel wires.

The breaking load of one specimen cut from each of the samples taken shall be determined by means of suitable tensile testing machine. The load shall be applied gradually and the rate of separation of the jaws of the testing machine shall be not less than 25 mm/min. and

not greater than 100 mm./min. The ultimate breaking load of the specimens shall be not less than the values specified in the chapter-3.

5.1.4.7 Ductility Test

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

5.1.4.7.1 Torsion Test

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

5.1.4.7.2 Elongation Test

The elongation of one specimen cut from each of the samples taken shall be determined. The specimen shall be straightened by hand and an original gauge length of 200 mm. shall be marked on the wire. A tensile load shall be applied as described in 5.1.4.6.2.1 and the elongation shall be measured after the fractured ends have been fitted together. If the fracture occurs outside the gauge marks, or within 25 mm. of either mark and the required elongation is not obtained, the test shall be disregarded and another test conducted. When tested before stranding, the elongation shall be not less than 4 percent and when tested after stranding, the elongation shall be not less than 3.5 percent.

5.1.4.8 Wrapping Test

This test shall be conducted on both Aluminium/Aluminium alloy and galvanised steel wires.

5.1.4.8.1 Aluminium/Aluminium alloy wires

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

5.1.4.8.2 Galvanized steel wires

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

5.1.4.9 Resistance Test on Aluminium/Aluminium alloy Wire

5.1.4.9.1 This test shall be conducted on aluminium wires only, conforming to procedure as per IEC:60889. The electrical resistance of one specimen of aluminium wire cut from each of the samples taken shall be measured at ambient temperature. The measured resistance shall be corrected to the value corresponding to 20 degrees C. by means of following formula.

$$R_{20} = R_t \frac{1}{1 + \alpha \times (T - 20)}$$

Where

R_{20} = Resistance corrected at 20 degrees C.

R_T = Resistance measured at T degrees C.

α = Constant mass temperature coefficient of resistance 0.004.

T = Ambient temperature during measurement

This resistance calculated to 20 degrees C. shall be not more than the maximum value specified in chapter-3.

5.1.4.10 Galvanizing Test

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

5.1.4.11 Surface Condition Test

A sample of the finished 'Moose' ACSR for 220 kV system having a minimum length of 5 meters with compression type dead end clamps compressed on both ends in such manner as to permit the conductor to take its normal straight line shape, shall be subjected to a tension of 50 percent of the UTS of the conductor. The surface shall not depart from its cylindrical shape nor shall the strands move relative to each other so as to get out of place or disturb the longitudinal smoothness of conductor. The measured diameter at any place shall be not less than the sum of the minimum specified diameters of the individual aluminium/Aluminium alloy and steel strands as indicated in chapter-3.

5.1.4.12 CORONA TEST

5.1.4.12.1 A sample of the conductor for use in 220 KV overhead transmission line, arranged as a twin horizontal bundle with a sub-conductor spacing of 450 mm. shall be subjected to 50 Hz phase to earth voltage. The stringing height of the bundle shall be such that the minimum clearance to ground is not more than 9.35 m.

5.1.4.12.2 The specimen shall have a corona extinction voltage without corona rings of not less than 154 KV (rms) under dry condition. There shall be no evidence of corona at any point of the sample. The corresponding corona inception voltage shall also be measured. The test should be conducted without Corona Control rings. However, small Corona rings may be used to prevent corona in the end fittings. The voltage should be corrected for standard atmospheric conditions.

5.1.4.13 RADIO INTERFERENCE VOLTAGE TEST

Under dry conditions, the conductor for use in 220 KV line shall be subjected to a 50 HZ ac voltage of 154 KV (rms) line to ground under the conditions specified in clause 4.1.4.12.1, corona test. The test shall be carried out as per the procedure given in IS:8263-1976. The conductor shall have a radio interference levels below 1000 micro volts at 1.0 MHZ.

5.1.4.12 Stress-Strain Test

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

5.1.4.12.2 Test Set-Up

- 5.1.4.12.2.1 The test sample shall be supported in a trough over its full length and the trough adjusted so that the conductor will not be lifted by more than 10mm under tension. This shall be ascertained by actual measurement.
- 5.1.4.12.2.2 The distance between the clamp and the sleeve mouth shall be monitored with callipers during the test to ensure that, after the test, it does not change by more than 1mm + 0.1mm from the value before the test.
- 5.1.4.12.2.3 The conductor strain shall be evaluated from the measured displacements at the two ends of the gauge length of the sample. The gauge reference targets shall be attached to the clamps which lock the steel and aluminium/Aluminium alloy wires together. Target plates may be used with dial gauges or displacement transducers and care shall be taken to position the plates perpendicular to the conductor. Twisting the conductor, lifting it and moving it from side-to-side by the maximum amounts expected during the test should introduce no more than 0.3mm error in the reading.

5.1.4.12.3 Test Loads for Complete Conductor

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

- 5.1.4.12.3.1 1KN load shall be applied initially to straighten the conductor. The load shall be removed after straightening and then the strain gauges are to be set at zero tension.
- 5.1.4.12.3.2 For non-continuous stress-strain data, the strain readings at 1KN intervals at lower tensions and 5 KN intervals above 30% of UTS shall be recorded.
- 5.1.4.12.3.3 The sample shall be reloaded to 30% of UTS and held for 1 hour. Readings are to be noted after 5, 10, 15, 30, 45 and 60 minutes during the hold period. The load shall be released then after the hold period.
- 5.1.4.12.3.4 The sample shall be reloaded to 50% of UTS and held for 1 hour. Readings are to be noted after 5, 10, 15, 30, 45 and 60 minutes during the hold period. The load shall be released then after the hold period.
- 5.1.4.12.3.5 Reloading upto 70% of UTS shall be done and held for 1 hour. Readings are to be noted after 5, 10, 15, 30, 45 and 60 minutes. The load shall be released.
- 5.1.4.12.3.6 Reloading upto 85% of UTS shall be done and held for 1 hour. Readings are to be noted after 5, 10, 15, 30, 45 and 60 minutes and the load shall be released then.

5.1.4.12.3.7 Tension shall be applied again and shall be increased uniformly until the actual breaking strength is reached. Simultaneous readings of tension and elongation shall be recorded upto 90% of UTS at the intervals described under Clause 5.1.4.12.3.6.

5.1.4.12.4 Test Loads for steel core only

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

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

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

5.1.4.12.5 Stress-strain curves

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

5.1.4.13 DC Resistance Test on Composite Conductor

On a conductor sample of minimum 5m length, two contact clamps shall be fixed with a pre-determined bolt torque. The resistance of the sample shall be measured by a Kelvin Double bridge by placing the clamps initially zero meter and subsequently one meter apart. The test shall be repeated at least five times and average value recorded. The value obtained shall be corrected to the value at 20 deg C as per Clause 13.6 of IS: 398 (Part II)-1996. The corrected resistance value at 20 deg C shall conform to the requirements of this specification.

5.1.4.14 Breaking load test on welded Aluminium/aluminium alloy Strands.

Two Aluminium/aluminium alloy wires shall be welded as per the approved quality plan and shall be subjected to tensile load. The breaking strength of the welded joint of the wire shall not be less than the guaranteed breaking strength of individual strands.

5.1.4.15 Chemical Analysis of Aluminium/aluminium alloy and steel

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

5.1.4.16 Chemical Analysis of zinc

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

5.1.4.17 Visual and Dimensional check on Drums

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

5.1.4.18 Rejection and Retest

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

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

5.1.4.19 Checking and Verification of Length of Conductor

5.1.4.19.1 The contractor should arrange for inspection by the representative of the employer specially authorized for this purpose. At least 50% of the total number of drums of conductor subject to minimum of two taken at random should be checked to ascertain the length of conductor adopting the method at clause 5.1.6.6. Arrangements should be made available in the works of the manufacturer for transferring the conductor from one reel to another at the same time measuring the length of the conductor so transferred by means of a meter.

5.1.4.20 Additional Tests

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

5.1.4.21 Testing Expenses

- 5.1.4.21.1 Bidder shall indicate the laboratories in which they propose to conduct the type test.
- 5.1.4.21.2 They shall ensure that adequate facilities are available in the laboratories and the tests can be completed in these laboratories within the time schedule guaranteed by them.
- 5.1.4.21.3 The entire cost of testing for the acceptance and routine tests and tests during manufacture specified herein shall be treated as included in the quoted unit price of the conductor, except for the expenses of the inspector/Employer's representative.
- 5.1.4.21.4 In case of failure in any type test, if repeat type tests are required to be conducted then all the expenses for deputation of Inspector/Employer's representatives shall be included in the quoted price contract price. Also, if on receipt of the contractor/manufacturer's notice of testing, the Employer's representative does not find 'plant' to be ready for testing, the expenses incurred by the Employer, shall be borne by the contractor.

5.1.4.22 Test Reports

- 5.1.4.22.1 Bidders should submit one Copy of type test reports and later on contractor shall be furnish at least four copies along with one original. One copy will be returned duly certified by the Employer/Owner only after which the commercial production of the material shall start.
- 5.1.4.22.2 Record of Routine test reports shall be maintained by the contractor/manufacturer at his works for periodic inspection by the Employer/Owner's representative.
- 5.1.4.22.3 Test certificates of Tests during manufacture shall be maintained by the contractor/manufacturer. These shall be produced for verification as and when desired by the Employer/Owner.

5.1.4.23 Test Facilities

5.1.4.23.1 The following additional test facilities shall be available at the contractor/manufacturer's works:

- a) Calibration of various testing and measuring equipment including tensile testing machine, resistance measurement facilities, burette, thermometer, barometer, etc.
- b) Standard resistance for calibration of resistance bridges.
- c) Finished Conductor shall be checked for length verification and surface finish on separate rewinding machine at reduced speed (variable from 8 to 16 meters per minute). The rewinding facilities shall have appropriate clutch system and be free of vibrations, jerks etc with traverse laying facilities.

5.1.5 Inspection and factory acceptance tests

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

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

5.1.5.3 The contractor will intimate the Employer/Owner about carrying out of the tests at least 15 days in advance of the scheduled date of tests during which the employer will arrange to depute his representative/s to be present at the time of carrying out of the tests. Four (4) copies of the test reports shall be submitted.

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

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

5.1.5.6 At least 50% of the total number of drums subject to minimum of two in any lot put up for inspection shall be selected at random to ascertain the length of conductor by the following method:

"At the works of the manufacturer of the conductor, the conductor shall be transferred from one drum to another at the same time measuring its length with the help of a graduated pulley and Cyclometer. The difference in the average length thus obtained and as declared by the Bidder in the packing list shall be applied to all the drums if the conductor is found short during checking".

5.1.6 Schedule of Deviations/Variations

If the tenderer has any exceptions to any of the clause/s laid down in this specification, these should be clearly stated in the schedule of deviations/variations, otherwise it shall be presumed that the tenderer agrees to the provision/s of this specification and same shall be included in the contract and the contract in case of successful tenderers.

5.2 GALVANISED STRANDED STEEL GROUND WIRE

5.2.1 Scope

This section covers design, manufacture, testing before dispatch, packing, supply and delivery CIP of the high tensile galvanized stranded steel earthwire of size 7/3.66 mm & 7/4.5 mm.

5.2.2 Standards

- 5.2.2.1 The ground wire shall be galvanized steel wire and the base metal shall be produced by open-hearth, electric furnace or basic oxygen process and shall be of such combination that the finished Galvanized steel wire shall have the same properties and characteristics as given in IS 398 unless otherwise specified herein or any other International Standards which ensure equal or higher quality of material. The Earth wire shall only be accepted from those manufacturers who have got the valid ISO 9001 or equivalent internationally recognized certification and documentary proof for having such certification shall be submitted with the tender.
- 5.2.2.2 The galvanized stranded steel earth wires shall comply with IS:2141-1979 and IS: I 2776-I 989 latest versions unless otherwise specified herein or any other International Standards which ensure equal or higher quality of material
- 5.2.2.3 The galvanized stranded steel earth wires shall also conform to the following latest standards. Whenever revised I.S. specifications are available, the same may be followed.

TABLE-5.2

S. No.	Indian Standard	Title
1	IS:209-I 992	Specification for zinc ingot
2	IS: 398	Aluminium conductor steel Reinforced.
3	IS: I608-1995	Mechanical testing of metals tensile testing of steel wire.
4	IS: 1521-1972	Method of tensile testing of steel wire.
5	IS: 1755-1961	Specification for method for wrapping test of wires.
6	IS: 1778-1980	Reels and drums for Bare wire.
7	IS: 2629-1966	Recommended practice for hot dip galvanizing of iron and steel.

8	IS: 2633-1972	Method of testing of uniformity of coating on Zinc coated article.
9	IS: 4826-1968	Galvanized coatings on round steel wires.
10	IS: 6745-1972	Method of determination of weight of Zinc coating on Zinc coated iron and steel articles.
11	IS: 2141-1979	Specification for Galvanized stay strand.
12	IS: 12776-2002	Galvanized strand for earthing.
13	IS: 2363-1965	Glossary in terms relating to wire ropes
14	IS: 6594-1977	Technical supply conditions for steel wire ropes & strand.

5.2.2.4 Offers conforming to standards other than the IS/IEC Specified above shall be accompanied by the English version of relevant standards in support of the guaranteed technical particulars to be furnished as per Section-3.

5.2.3 General Technical Requirements

5.2.3.1 The General Technical requirements are given in chapter-3. The galvanized steel ground wire shall conform to these technical requirements.

5.2.3.1.1 The Bidder shall furnish guaranteed technical particulars in chapter-7.

5.2.3.1.2 The details of the steel wire are tabulated below:

S.no.	Particulars	7/3.66mm Galvanized Steel Ground Wire	7/4.5mm Galvanized Steel Ground Wire
1.	Number of strands		
	Steel core	1	1
	Outer Steel core	6	6
2.	Total Sectional area	73.65 sq. mm	111.33 mm ²
3.	Overall diameter	10.98 mm	13.50 mm
4.	Approximate weight	583 kg/km	882 kg/km
	Maximum	600 kg/km	913 kg/km
	Minimum	562 kg/km	851 kg/km

5.	Minimum ultimate tensile	72.9 kN	106.2 kN
6.	Direction of lay of outer layer	Right Hand	Right Hand
7.	Tensile grade of wire	3	3
8.	D.C. resistance @ 20 °C	2.50 ohms/km	1.66 ohms/km

5.2.3.2 Workmanship

- 5.2.3.2.1** All steel strands shall be smooth, uniform and free from all imperfections such as spills and splits, die marks, scratches, abrasions and kinks after drawing and also after stranding fissures, roughness, grooves, inclusions or other defects which may endanger the performance of the product. The ground wire shall be free from grease, metal particles, dirt etc
- 5.2.3.2.2** The finished material shall have minimum brittleness as it will be subjected to appreciable vibration while in use.
- 5.2.3.2.3** The steel strand shall be hot dip galvanised and shall have a minimum zinc coating of 260 gms/sq.m. and 275 gm sq. m on the uncoated wire surfaces of 7/3.66 mm and 7/4.5 mm respectively. The zinc used for galvanizing shall be electrolytic High Grade Zinc of 99.95% purity. It shall conform to and satisfy all the requirements of IS:209-1992. The zinc coating shall be smooth, continuous, of uniform thickness, free from imperfections and shall withstand three one minute dips after stranding in Standard Preece test. The steel wire rod shall be of the such quality and purity that, when drawn to the size of the strands specified and coated with zinc, the finished strands shall be of uniform quality and have the same properties and characteristics, as specified in relevant Indian Standards Specification.
- 5.2.3.2.4** The steel strands shall be performed and post-formed in order to prevent the spreading of strands in case earth wire is cut. Care shall be taken to avoid damage to galvanization during pre-forming and post-forming operations.
- 5.2.3.2.5** The round wire steel core shall be with a round and uniform galvanization.
- 5.2.3.2.6** To avoid susceptibility towards wet storage stains (with rust), the finished material shall be provided with a protective coating of boiled linseed oil.

5.2.3.3 Joints in Wires

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

5.2.3.4 Tolerances

The manufacturing tolerances to the extent of the following limits only shall be permitted in the diameter of the individual steel strands and lay length of the earth wire.

TABLE-5.3

	<u>Standard</u>	<u>Maximum</u>	<u>Minimum</u>
Diameter 7/3.66	3.66 mm	3.73 mm	3.59 mm
Diameter 7/4.5	4.5 mm	4.58 mm	4.42 mm

5.2.3.5 Materials

- 5.2.3.5.1 The steel wire strands shall be drawn from high carbon steel rods and shall conform to the following requirements as to the chemical composition:

TABLE-5.4

Carbon	Not more than 0.55
Manganese	0.4 to 0.9
Phosphorus	Not more than 0.04
Sulphur	Not more than 0.04
Silicon	0.15 to 0.35

The zinc used for galvanising shall be electrolytic High Grade Zinc of 99.95% purity.

5.2.3.5 Standard Length

- 5.2.3.6.1 The standard length of the earth wire shall be 3000 meters. The tolerance on length shall be +/-5% on the standard length. 30 mm space may be left unwound between outer layer of ground-wire and outer diameter of protective lagging of drum.
- 5.2.3.6.2 Random lengths shall be accepted, provided that no length is less than 70% of the standard length and the total quantity of random lengths shall not be more than 10% of the total quantity ordered. One drum length of earth wire shall be wound on one drum.

5.2.3.7 Quality Assurance Plan

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

5.2.3.8 The contractor will intimate the Employer about carrying out of the tests at least 15 days in advance of the scheduled date of tests during which the Employer will arrange to depute his representative/s to be present at the time of carrying out of the tests. Four (4) copies of the test reports shall be submitted.

5.2.4 Tests

5.2.4.1 The tests on the individual strands constituting the earth wire shall be conducted before stranding by the manufacturer and all the test records shall be made available to the Employer as and when desired. Tests on the sample of the strands after stranding and complete earth wire taken from the earth wire drum shall be conducted in the presence of the Employer or his authorized representative before dispatch of the ground wire.

5.2.4.2 The test pieces from the coils, spools or drum selected for testing shall withstand the following tests.

5.2.4.2.1 Tests on Individual Strands

The Galvanised Steel Earthwire offered shall be type tested duly last 5 years (time period from before final bid submission date). The Bidder needs to furnish Type Test Reports of identical Galvanised Steel Earthwire along with the Bid for consideration. In case of non-submission of Type-test reports, Type Test as per the following and as per IS-398 shall be carried out at the reputed standard laboratory (acceptable to Employer).

5.2.4.2.1.1 Type Tests

TABLE-5.5

a.	Verification of Diameter	
b.	Tensile test	
c.	Torsion test	

d.	Elongation test	As per IS 398, IS 2141 & IS 12776 (latest editions)
e.	Wrapping test	
f.	DC resistance test	
g.	Breaking load test	
h.	Chemical analysis of steel	
I	Galvanizing Test	

5.2.4.2.1.2 Acceptance Tests

The acceptance test shall be same as type tests given in clause 5.2.4.2.1.1

5.2.4.2.2 Tests on Ground Wire

5.2.4.2.2.1 Type Tests

TABLE-5.6

a.	Visual Examination	As per IS 398
b.	UTS Test	As per IS 398
c.	D C Resistance Test	As per IS 398
d.	Lay Length Check	As per IS 398
e.	Verification of length and weight of ground wire.	As per IS 398
f.	Visual and dimensional check on drum	As per IS 398

5.2.4.2.2.2 Acceptance Tests

The acceptance tests shall be the same as type tests.

5.2.4.2.2.3 Routine Tests

- Visual Examination
- Lay Length Check.
- Check for correctness of stranding
- Check that there are no cuts, fins etc. on the strands.
- Check that drums are as per Specification.

5.2.4.2.2.4 Tests during Manufacture

TABLE-5.7

a.	Chemical Analysis of ZINC used for covering	As per cl.5.2.4.4.5 of specification
b.	Chemical analysis of steel	As per cl.5.2.4.4.4 of specification

5.2.4.3 Test Reports

5.2.4.3.1 The tenderer shall submit four (4) copies of certificates of the type and acceptance tests. One copy each of test certificates shall be returned duly certified by the Employer.

5.2.4.3.2 All the routine tests shall be carried out by the manufacturer and record shall be made available to the Employer as and when desired.

5.2.4.3.3 Testing Expenses

5.2.4.3.3.1 The break-up of the testing charges for the type tests specified shall be indicated separately.

5.2.4.3.3.2 Bidders shall indicate the laboratories in which they propose to conduct the type tests. They shall ensure that the tests can be completed in these laboratories within the time schedule guaranteed by them.

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

5.2.4.3.3.4 The entire cost of testing for the acceptance and routine tests specified herein shall be treated as included in the quoted unit price except for the expenses of the inspector/employer's representative.

5.2.4.3.4 Additional tests

5.2.4.3.4.1 The Employer reserves the right of having at his own expense any other test(s) of reasonable nature carried out at contractor's premises, at site or in any other place in addition to the aforesaid type, acceptance and routine tests to satisfy him that the materials comply with the specifications.

5.2.4.4 Procedure for Carrying Out Tests

5.2.4.4.1 Visual Examination

The individual strand and completed ground wire shall be examined visually for good workmanship and general surface finish.

5.2.4.4.2 Chemical Analysis of Material (Steel & Zinc)

Samples taken from steel and Zinc ingots shall be chemically/spectrographically analyzed. The same shall be in conformity with the requirements stated in this specification.

5.2.4.4.3 Tensile Test-Strands

The breaking load of individual strand before and after stranding shall be determined by means of a suitable tensile testing machine. The load shall be applied gradually and the rate of separation of the jaws of the testing machine shall be not less than 25 mm/min. and greater than 100 mm/min. The breaking load shall not be less than guaranteed failing load.

5.2.4.4.4 Elongation Test

The specimen of individual strand before and after stranding (straightened by hand) shall be marked with a gauge length of 200 mm. A tensile load shall be applied gradually and the rate of separation of jaws of the testing machine shall be not less than 25mm/min. and not greater than 100mm/min. The elongation shall be measured after the fractured ends have been fitted together. If the fracture occurs outside the gauge marks, or within 25mm of either marks and the required elongation is not obtained, the test shall be discarded and another test made on fresh sample. The percentage elongation shall conform to the guaranteed elongation limits.

5.2.4.4.5 Torsion Test

The specimen of individual strand before and after stranding shall be gripped at its end in two voices, one of which shall be free to move longitudinally during the test. A small tensile load not exceeding 2% (two percent) of the breaking load of the wire, shall be applied to the sample during testing. The specimen shall be twisted by causing one of the voices to revolve until fracture occurs and the number of twists shall be indicated by a counter or other suitable devices. The rate of twisting shall not exceed 60 rev/min. When tested the number of complete twists before fracture occurs shall be not less than the guaranteed value on a length equal to 100 times the diameter of the wire. In case test sample length is less or more than 100 times the stranded diameter of the wire. The fracture shall show a smooth surface at right angles to the axis of the wire.

5.2.4.4.6 D.C. Resistance Test-Strands

The test shall be carried out as per the relevant standard. The electrical resistance of individual strand shall be measured by a Kelvin double bridge or potentiometer. The value obtained shall be corrected to the value at 20 deg.c. The D.C. resistance value should not exceed the guaranteed d.c. resistance of the wire.

5.2.4.4.7 Ultimate Tensile Strength Test for Ground Wire

Circles perpendicular to the axis of the earth wire shall be marked at two places on a sample of earth wire of minimum 5m length suitably compressed with dead end clamps at either end. The load shall be increased at a steady rate upto 50% of UTS and held for one minute. The circles drawn shall not be distorted due to relative movement of strands. Thereafter, the load shall be increased at steady rate to 100% of UTS and held for one minute. The earth wire sample shall not fail during this period. The applied load shall then be increased until the failing load is reached and the value recorded.

5.2.4.4.8 Dc Resistance Test-Composite Ground Wire

On composite ground wire of minimum five meter length, two contact clamps shall be fixed. The resistance shall be measured by a Kelvin double bridge by placing the clamps initially Zero meter and subsequently one meter apart. The test shall be repeated at each meter length and the value recorded. The value obtained shall be corrected to the value at 20 deg. C. The resistance corrected to 20 deg. C. shall not exceed the guaranteed value.

5.2.4.4.9 Verification of Length and Weight of Ground Wire

Ten percent of the drums offered for inspection shall be checked for the length and weight of the ground wire declared by the contractor/manufacturer. One empty drum will be weighed and groundwire will be rewound on the empty drum and the wound drum will be reweighed. The length of the groundwire will be measured by using a certified measuring counter by appropriate weight and measurement authority. The cost towards unreeling of ground wire drums for verifying the groundwire length and weight shall be to the contractor/manufacturer's account.

5.2.4.4.10 Visual and Dimensional Check On Drums

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

5.2.4.4.11 Lay Length Check

The Lay Length shall be checked to ensure that it conforms to the requirements of this specification.

5.2.4.5 Sample Batch for Type Testing

5.2.4.5.1 The Contractor shall offer material for selection of samples for type testing only after getting Quality Assurance Plan approved by the Employer. The sample shall be manufactured strictly in accordance with the Quality Assurance Plan approved by the Employer.

5.2.4.5.2 The Contractor shall offer at least three drums for selection of sample required for conducting all the type tests.

5.2.4.5.3 The Contractor is required to carry out all the Acceptance tests successfully in the presence of Employer's representative before sample selection.

5.2.4.6 Inspection

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

5.2.4.6.2 The Contractor shall keep the Employer informed in advance of the time of starting and of the progress of manufacture of earth wire in its various stages so that arrangements can be made for inspection.

5.2.4.6.3 No material shall be dispatched from its point of manufacture before it has been satisfactorily inspected and tested, unless the inspection is waived off by the Employer in writing. In the latter case also the earth wire shall be dispatched only after satisfactory testing for all tests specified herein have been completed.

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

5.2.4.7 Test Facilities

5.2.4.7.1 In addition to the test facilities for conducting above tests, the following additional test facilities shall be available at the contractor's works:

- a) Calibration of various testing and measuring equipment including tensile testing machine, resistance measurement facilities, burette, thermometer, barometer etc.
- b) Standard resistance for calibration of resistance bridges.
- c) Finished earth wire shall be checked for length verification and surface finish on separate rewinding machine at reduced speed (variable from 8 to 16 meters per minute). The rewinding facilities shall have appropriate clutch system and be free of vibration, jerks, etc with traverse laying facilities.

5.2.5 REJECTION AND RETEST

5.2.5.1 In case of failure in any type test, the Contractor is either required to manufacture fresh sample lot and repeat all the tests successfully once or repeat that particular type test three times successfully on the sample selected from the already manufactured lot at his own expenses. In case fresh lot is manufactured for testing then the lot already manufactured shall be rejected. The decision of the Employer in this regard shall be final and binding on the Contractor.

5.2.5.2 If the test pieces for tests on strands taken from finished groundwire on a drum selected for such tests fail in the retest, the manufacturer shall test each and every drum and submit them for re-inspection.

5.2.5.3 All rejected material shall be suitably marked and segregated.

5.2.6 PACKING AND MARKING

The ground wire shall be supplied in non-returnable reels or drums of non-perishable or treated wood conforming to IS: 1778-1980 (specification for reels and drums for bare wires), BS-1559 IS-6594-1977 or another authoritative standard. Each drum shall be provided with a label fixed firmly on it bearing the following information.

- a) Contract/purchase order no. & date.
- b) Manufacturer's name and address.
- c) Name and address of consignee.
- d) Size of earthwire.
- e) Drum Number, year of manufacture.
- f) Length of earthwire in meters.
- g) Gross weight of drum with earthwire.

- h) Weight of empty drum with lagging.
- i) Net weight of earthwire.
- j) Arrow marking for unwinding.
- k) Position of the earthwire ends.
- l) Number of turns in the outermost layer.
- m) Distance between outermost layer of earthwire and the inner surface of lagging.
- n) Barrel diameter at three locations and an arrow marking at the location of measurement.

The steel wire shall be packed in the drums in such a way that the drums shall withstand the stresses and rough handling during transit, storing and stringing operations. The steel wire shall be protected from weather with water-proof paper before winding and after winding. There should not be more than one standard length in a drum. Each drum should be provided with a triangular iron collar on either side of the axle hold for easy rolling and to protect the drum from damage during rolling/winding operation. Proper care should be taken to prevent the nails from damaging the steel wire.

5.2.7.0 SCHEDULE OF DEVIATIONS/VARIATIONS

If the tenderer has any exceptions to any of the clause/s laid down in this specification, these should be clearly stated in the schedule of deviations/variations, (technical or commercial), otherwise it shall be presumed that the tenderer agrees to the provision/s of this specification and same shall be included in the purchase order and the contract in case of successful tenderers.

5.3 CONDUCTOR & EARTH WIRE ACCESSORIES

5.3.1 SCOPE

5.3.1.1 This specification covers design, manufacture and testing before dispatch at works, packing, supply and delivery CIP of Accessories for the “Moose-597 sq.mm” ACSR Conductor & AACSR Conductor of size 54/ 3.53+7/3.53 mm, and Galvanized steel Earth wire of size 7/3.66 mm & 7/4.5 mm earth-wire.

5.3.2 The following are the items covered in this Specification:

A) CONDUCTOR ACCESSORIES

- a. Performed Armour Rods
- b. Mid Span Compression joint.
- c. Repair Sleeve
- d. Vibration Damper
- e. Spacer for Quad as well as Twin Conductor
- f. Rigid spacer for jumper for Quad as well as Twin Moose
- g. Bundle Spacer for lines

B) EARTH WIRE ACCESSORIES:

- a) Mid span compression Joints
- b) Vibration Damper
- c) Earth wire Suspension Clamp
- d) Earth wire Tension Clamp
- e) Flexible Copper Bond

5.3.3 STANDARDS

5.3.3.1 The accessories of the “Moose-597 sq.mm” ACSR Conductor and Earth wire shall conform to the following Indian Standards or other equivalent international standards which shall mean latest revisions/Amendment changes adopted and published unless otherwise specified here in as well as to the provisions of this specification.

TABLE-5.8

S. No	Indian Standard	Title
1	IS: 209-1966	Specification for Zinc
2	IS: 398-1996	Specification for Aluminium Conductors for over head Transmission purpose.

	(Part -II)	Aluminium Conductors Galvanized Steel Reinforced for Extra High Voltage (66 KV and above)
3	IS: 1327-1966	Method of determination of weight of the Tin coating on Tin Plate.
4	IS: 1573-1976	Electroplated coating of Zinc on Iron & Steel.
5	IS: 2071-1974	Method of high Voltage testing General definitions and test requirement
6	IS: 2121-1981	Specification for Conductors and earth wire accessories for overhead power lines
	Part - I	Armor Rods, binding wires and tapes for conductors.
	Part - II	Mid span joints and repair sleeves for conductor.
7	IS: 2629-1966	Recommended practice for hot dip galvanizing of Iron and steel.
8	IS: 2633-1972	Methods for testing Uniformity of zinc coating on zinc coated Articles.
9	IS: 3138-1966	Hexagonal bolts and nuts
10	IS: 4218-1967	ISO metric screw threads
11	IS: 4826-1968	Galvanized coating on Round steel wires.
12	IS: 6745-1972	Methods of Determination of weight of zinc coating on zinc coated Iron and Steel Articles.
13	IS: 8263-1966	Methods of Radio Interference Tests on High voltage Insulators.
14	IS: 9708-1993	Specification for stock bridge vibration Dampers for overhead power lines.
15	IS: 2982-1965	Specification for copper conductor in insulated cables & cords.
16	IS: 5358-1969	Specification for Hot-Dip Galvanized Coatings on Fasteners.

17	IS: 8394-1977	Specification for Soldering & welded type terminals ends for conductors and insulated cables.

5.3.3.2 In the event of the supply of accessories conforming to any standard other than Indian standards listed above, the salient features of comparison shall be brought out and furnished along with the bid.

5.3.3.3 The Accessories offered shall be suitable for operation in moderately polluted atmosphere.

5.3.4 MATERIALS/WORKMANSHIP

5.3.4.1 All materials used in the manufacture of the equipments shall be of the first class quality of its kind available and except where modified by this specification, shall comply in all respects with the standards laid down by Bureau of Indian Standards.

5.3.4.2 The material to be used in manufacture shall be selected as the best available for the purpose for which used, considering strength, durability and best engineering practice.

5.3.4.3 All the material to be supplied shall be of recent manufacture, unused and free from defects. All the components of the same design shall be identical and like components shall be interchangeable.

5.3.4.4 WORKMANSHIP AND FINISH

All the equipment shall be of the latest design and conform to the best modern practice adopted in the extra high voltage field. The Bidder shall offer only such equipment as guaranteed by him to be satisfactory and suitable for 220 KV transmission line and will give continued good performance.

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

5.3.4.6 All ferrous parts shall be hot dip galvanized, after all machining has been completed. Nuts may, however, be tapped (Threaded) after galvanizing and the threads oiled. Spring washers shall be electro galvanized. The bolt threads shall be undercut to take care of increase in diameter due to galvanizing. Galvanizing shall be done in accordance with IS: 2629-1966 and satisfy the test mentioned in IS: 2633-1972. Fasteners shall withstand four dips while spring washers shall withstand three dips. Other galvanized materials shall be

guaranteed to withstand at least six dips each lasting one minute under the standard Preece test for galvanizing unless otherwise specified.

5.3.4.7 The zinc coating shall be perfectly adherent, of uniform thickness, smooth, reasonably bright, continuous and free from imperfections such as luster, ash, rust stains, bulky white deposits and blisters etc. The zinc used for galvanizing shall be of grade Zn 99.95 as per IS: 209-1979.

5.3.4.8 The casting shall be free from all internal defects like shrinkage, inclusions, blow holes, cracks or other casting defects and the quality of products shall be uniform throughout.

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

5.3.4.10 No equipment shall have sharp ends or edges, abrasions or projections etc. and shall not cause any damage to the conductor in any way during erection or during continuous operation which would produce high electrical and mechanical stresses in normal working. The design of adjacent metal parts and mating surfaces shall be such as to prevent corrosion of the contact surface and to maintain good electrical contact under all service conditions. All equipments shall have satisfactory corona performance so as to limit the losses and Radio Interference to acceptable level.

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

5.3.4.12 The fasteners shall conform to the requirements of IS: 4218 and IS:6639-1972. All fasteners and clamps shall have corona free locking arrangement to guard against vibration loosening.

5.3.4.13 Welding of aluminium shall be by an inert gas shielded tungsten arc or inert gas shielded metal arc process. Welds shall be clean, sound, smooth uniform, without overlaps properly fused and completely sealed. There shall be no cracks, voids, incomplete penetrations, and incomplete fusions under cutting or inclusions. Porosity shall be minimized so that the mechanical properties of the aluminium alloy are not affected. All welds shall be properly finished as per best engineering practices.

5.3.5 MARKINGS

5.3.5.1 Assembly of each item shall be marked with trade mark of the manufacturer, the manufacturer's catalogue number and year of manufacture. The identifying letters and numerals shall be at least 5 mm high. This shall be cast or die stamped on over or both sides of the assembly. The letters shall be distinct, durable and conspicuous.

5.3.5.2 Die compression areas shall be clearly marked on each accessory. Accessories designed for continuous die compressions shall bear the words "COMPRESS FIRST" near the point of each accessory where the compressions begin. Accessories designed for intermittent die compressions shall bear the identification marks "COMPRESSION ZONE" and "NON-COMPRESSION ZONE" distinctly with arrow mark showing the direction of compression and shall have the ends of each compression zone completely encircled, with Knurled or etched bands. The letters, numerals and other makings on finished accessories shall be distinct and legible.

5.3.6 BID DRAWINGS

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

5.3.6.2 The drawings shall include:

- a) Dimensions and dimensional tolerance.
- b) Material, fabrication details including any weld details and any specified finishes and coatings. Regarding material, designations and reference of standards are to be indicated.
- c) Catalogue No.
- d) Marking
- e) Weight of Assembly
- f) Installation instructions
- g) Design installation torque for bolt or cap screw.
- h) Withstand torque that may be applied to the bolt or cap screw without failure of component parts.
- i) The compression dies number with recommended compression pressure.

j) All other relevant Technical details.

5.3.6.3 Placement charts for vibration dampers.

5.3.6.4 The above drawings shall be submitted with all the details as stated above along with the bid document. After the placement of award, the contractor shall again submit the drawings in four copies to the owner for approval. After owner's approval and successful completion of all type tests 4 more sets of drawings shall be submitted to owner for further distribution and field use at owner's end.

5.3.6.5 **QUALITY ASSURANCE PLAN**

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

5.3.6.6 **SCHEDULE OF DEVIATIONS/VARIATIONS**

If the tenderer has any exceptions to any of the clause/s laid down in this specification, these should be clearly stated in the schedule of deviations/variations, (technical or commercial) otherwise it shall be presumed that the tenderer agrees to the provision/s of this specification and same shall be included in the purchase order and the contract in case of successful tenderers.

5.3.7. **CONDUCTOR ACCESSORIES**

5.3.7.1 **GENERAL**

5.3.7.2 This section details the technical particulars of the accessories for "Moose-597 sq.mm" ACSR Conductor.

5.3.7.3 2.5% extra fasteners and retaining rods shall be provided.

5.3.7.4 The technical particulars are given in chapter-3 of the specification.

5.3.8 **MID SPAN COMPRESSION JOINT**

5.3.8.1 Mid Span Compression Joint shall be used for joining two lengths of conductor. The joint shall have a resistivity less than 75% of the resistivity of equivalent length of conductor.

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

- 5.3.8.2** The joint shall be made of steel and aluminium sleeves for jointing the steel core and aluminium wires respectively. The steel sleeve should not crack or fail during compression. The Brinnel Hardness of steel sleeve shall not exceed 200. The steel sleeve shall be hot dip galvanised. The Joints shall be made of Special Aluminium Alloy for better conductivity / Strength. The aluminium sleeve shall have aluminium of purity not less than 99.5%. Tapered aluminium filler plugs shall also be provided on the line of demarcation between compression and non-compression zone. The dimensions and dimensional tolerances of mid span compression joint shall be as per chapter-3 specific technical requirement of the specification.

5.3.9 REPAIR SLEEVE

- 5.3.9.1** Repair sleeve of compression type shall be used to repair conductor with not more than two strands broken in the outermost layer. The sleeves shall make of Special Aluminium Alloy for better conductivity / Strength and shall have smooth surface. The repair sleeve shall comprise of two pieces with a provision of seat for sliding of the keeper piece. The edges of the seat as well as the keeper piece shall be rounded so that the conductor strands are not damaged during installation. The dimensions and dimensional tolerances of repair sleeve shall be as per Chapter-3 of the specification.

5.3.10 VIBRATION DAMPER

- 5.3.10.1** Vibration dampers of 4R-stockbridge type with four (4) different resonances spread within the specified Aeolian frequency band-width shall be used at suspension and tension points on each conductor in each span to damp out Aeolian vibrations as mentioned hereinafter.
- 5.3.10.2** Alternate damping systems or "Dog bone" dampers offering equivalent or better performance also shall be accepted provided the manufacturer meets the qualifying requirements stipulated in Technical specification. Relevant technical documents to establish the technical suitability of alternate systems shall be furnished by the bidder along with the bid.

- 5.3.10.3 One damper minimum on each side per conductor for suspension points and two dampers minimum on each side per conductor for tension points shall be used for ruling span of 350 meters for 220 kV Transmission Line.
- 5.3.10.4 The clamp of the vibration damper shall be made of high strength aluminium alloy of type LM-6 or equivalent. It shall be capable of supporting the damper and prevent damage or chafing of the conductor during erection or continued operation. The clamp shall have smooth and permanent grip to keep the damper in position on the conductor without damaging the strands or causing premature fatigue failure of the conductor under the clamp. The clamp groove shall be in uniform contact with the conductor over the entire clamping surface except for the rounded edges. The groove of the clamp body and clamp cap shall be smooth, free from projections, grit or other materials which could cause damage to the conductor when the clamp is installed. Clamping bolts shall be provided with self-locking nuts and designed to prevent corrosion of threads or loosening in service.
- 5.3.10.5 The messenger cable shall be made of high strength galvanized steel/stainless steel with a minimum strength of 135 Kg/sq.mm. It shall be of preformed and post formed quality in order to prevent subsequent drop of weight and to maintain consistent flexural stiffness of the cable in service. The number of strands in the messenger cable shall be 19. The messenger cable other than stainless steel shall be hot dip galvanized in accordance with the recommendations of IS-4826-1979 for heavily coated wires.
- 5.3.10.6 The damper mass shall be made of hot dip galvanized mild steel/cast iron. All castings shall be free from defects such as cracks, shrinkages, inclusions and blowholes etc. The surface of the damper masses shall be smooth.
- 5.3.10.7 The damper clamp shall be casted over the messenger cable and offer sufficient and permanent grip on it. The messenger cable shall not slip out of the grip at a load less than the mass pull-off value of the damper. The damper masses shall be fixed to the messenger cable in a suitable manner in order to avoid excessive stress concentration on the messenger cables which shall cause premature fatigue failure of the same. The messenger cable ends shall be suitably and effectively sealed to prevent corrosion.
- 5.3.10.8 The damper assembly shall be electrically conductive to reduce radio interference.

- 5.3.10.9** The vibration damper shall be capable of being installed and removed from energized line by means of hot line techniques. In addition, the clamp shall be capable of being removed and reinstalled on the conductor at the designated torque without shearing or damaging of fasteners.
- 5.3.10.10** The manufacturer must indicate the clamp bolt tightening torque to ensure that the slip strength of the clamp is maintained between 2.5 KN and 5 KN. The clamp when installed on the conductor shall not cause excessive stress concentration on the conductor leading to permanent deformation of the conductor strands and premature fatigue failure in operation.
- 5.3.10.11** The vibration clamps shall not have magnetic power loss more than 1 watt at 500 Amps, 50 Hz alternating current per sub-conductor.
- 5.3.10.12** The vibration analysis of the system, with and without damper and dynamic characteristics of the damper as detailed under Annexure-A, shall have to be submitted by the Bidder along with his bid. The technical particulars for vibration analysis and damping design of the system are as follows:

TABLE-5.9

S.No	Technical Description	Technical Particulars
1.	Configuration:	Double Circuit:
2.	Conductor	Twin ACSR and AACSR 'MOOSE' Conductor bundle per phase in horizontal formation at 450 mm apart and all three phases of each circuit in vertical configuration on each side of tower.
3.	Span length in meters	
i.	Ruling design span	350
ii.	Maximum span	1000 (normal condition)
iii.	Minimum span	-1000 (for large angle tower, broken wire condition)
4.	Tensile load in conductor	As per sag- tension provided

i.	Every day temperature, nil wind (initial condition)	47242 N
ii.	Full design wind pressure at everyday temperature of 32 degree C	95929 N
iii.	Thirty Six (36) per cent Full Design Wind Pressure at Minimum Temperature of -5 degree C.	72684 N
iv.	10mm radial thickness of ice at -5 degree C temperature and nil wind. Ice unit weight is to be considered as 916.8 kg/m ² .	76168 N
v.	Twenty Eight (28) per cent Full Design Wind Pressure and 5 mm of radial thickness of ice at Minimum Temperature of -5 degree C.	77555 N
vi.	75% Full design wind pressure at every day temperature for Tangent towers under broken wire condition.	81834 N
vii.	Nil wind at 85 degree C temperature	35049 N
viii.	Nil Wind at Minimum Temperature of -5 degree C.	61593 N
5.	Armor rods used	Standard preformed armor Rods/AG
6.	Wind velocity/Wind pressure	47 m/sec
7.	Max. permissible dynamic strains	+/- 150 micro strains

Note: All Details regarding normal ruling span and weight span limits shall have to be referred specified in chapter-2,3 of of specification. The bidder shall submit the sag-tension chart with the bid.

5.3.10.13 The damper placement chart for spans ranging from 100 m to 1000 m shall be submitted by the Bidder. Placement charts should be duly supported with relevant technical documents.

5.3.10.14 The damper placement charts shall include the following:

- a) Location of the dampers for various combinations of spans and line tensions clearly indicating the number of dampers to be installed per conductor per span.
- b) Placement distance clearly identifying the extremities between which the distances are to be measured.
- c) Placement recommendation depending upon type of suspension clamps (viz. Free centre type/Armor grip type etc.)
- d) The influence of mid span compression joints, repair sleeves and armor rods (standard and AGS) in the placement of dampers.

5.3.11 BUNDLE SPACERS

General:

Armour grip Bundle spacers shall be used to maintain the spacing of 450 mm between the two sub-conductors of each bundle under all normal working conditions. The spacer shall be designed for maintaining a gap of 450 mm for the twin sub-conductor system as per relevant standard IS 10162.

5.3.11.1 The spacer shall have enough strength so as to restore normal spacing of the sub-conductors after displacement by winds, short-circuit etc without permanent deformation or damage either to conductor or assembly.

5.3.11.2 The materials used in manufacturing spacer shall be corrosion resistant. All ferrous parts of spacer shall be hot-dip galvanized except spring washers which shall be electro-galvanized conforming to the relevant Indian Standards.

5.3.11.3 Spacers offering equivalent or better performance shall also be accepted provided the offer meets the qualifying requirements stipulated in Technical specification.

5.3.11.4 The offer shall include placement charts recommending the number of spacers per phase per span and the sub span lengths to be maintained between the spacers while installing on the twin bundle conductors.

- 5.3.11.4.1 The placement of spacers shall be in such a way that adjacent sub spans are sufficiently detuned and the critical wind velocity of each sub span shall be kept more than 30 km/hr and to avoid clashing of sub-conductors. The placement shall ensure bundle stability under all operating conditions.
- 5.3.11.4.2 The placement chart shall be provided for spans ranging from 100m to 1100m. The number of spacers recommended for a nominal ruling span of 350m shall however be not less than six.
- 5.3.11.4.3 The bidder shall also furnish all the relevant technical documents in support of their placement charts along with the bid.
- 5.3.11.5 Jumpers at tension points shall also be fitted with spacers so as to limit the length of free conductor to 3.65m and to maintain the sub conductor spacing of 450 mm. Bidder shall quote for rigid spacer for jumper. It shall meet all the requirements of spacer used in line except for its vibration performance. Spacers requiring retaining Rods shall not be quoted for jumpers.
- 5.3.11.6 The spacer offered by the Bidder shall satisfy the following requirements:
- 5.3.11.6.1 Spacer shall restore normal spacing of the subconductors after displacement by wind, electromagnetic and the electro-static forces under all operating conditions including the specified short circuit level without permanent deformation / damage either to conductor or to the assembly itself. They shall have uniform grip on the conductors.
- 5.3.11.6.2 For spacer requiring retaining rods, the retaining rods shall be designed for the specified conductor size. The rods shall be made of high strength special aluminium alloy of type 6061 or equivalent aluminium alloy having minimum tensile strength of 35 kg/mm². The ends of retaining rods should be ball ended. The rods shall be heat-treated to achieve specified mechanical properties and give proper resilience and retain the same during service.
- 5.3.11.6.3 Four number of rods shall be applied on each clamps to hold the clamp in position. The minimum diameter of the rods shall be 7.87 +/-0.1 and the length of the rods shall not be less than 1100 mm.
- 5.3.11.6.4 Where elastomer surfaced clamp grooves are used, the elastomer shall be firmly fixed to the clamp. The insert should be forged from aluminium alloy of type 6061 or equivalent

aluminium alloy having minimum tensile strength of 25 kg/mm². The insert shall be duly heat treated and aged to retain its consistent characteristics during service.

- 5.3.11.6.5 Any nut used shall be locked in an approved manner to prevent vibration loosening. The ends of bolts and nuts shall be properly rounded for specified corona performance or suitably shielded.
- 5.3.11.6.6 Clamp with cap shall be designed to prevent its cap from slipping out of position when being tightened.
- 5.3.11.6.7 The clamp grooves shall be in uniform contact with the conductor over the entire clamping surface except for rounded edges. The groove of the clamp body and clamp cap shall be smooth and free of projections, grit or other material which cause damage to the conductor when the clamp is installed.
- 5.3.11.6.8 For the spacer involving bolted clamps, the manufacturer must indicate the clamp bolt tightening torque to ensure that the slip strength of the clamp is maintained between 2.5kN and 5kN. The clamp when installed on the conductor shall not cause excessive stress concentration on the conductor leading to permanent deformation of the conductor strands and premature fatigue failure in operation.
- 5.3.11.6.9 Universal type bolted clamps, covering a range of conductor sizes, will not be permitted.
- 5.3.11.6.10 No rubbing, other than that of the conductor clamp hinges or clamp swing bolts, shall take place between any parts of the spacer. Joint incorporating a flexible medium shall be such that there is no relative slip between them.
- 5.3.11.6.11 The spacer shall be suitably designed to avoid distortion or damage to the conductor or to themselves during service.
- 5.3.11.6.12 Rigid spacers shall be acceptable only for jumpers
- 5.3.11.6.13 The spacer shall not damage or chafe the conductor in any way which might affect its mechanical and fatigue strength or corona performance.
- 5.3.11.6.14 The clamping system shall be designed to compensate for any reduction due to conductor creep.
- 5.3.11.6.15 The spacer assembly shall not have any projections, cuts, abrasions etc., or chattering parts which might cause corona or RIV.
- 5.3.11.6.16 The spacer tube shall be made of aluminium alloy of type 6061 or equivalent aluminium alloy. If fasteners of ferrous material are used, they shall conform to and be galvanized

conforming to relevant Indian Standards. The spacer involving ferrous fasteners shall not have magnetic power loss more than one watt at 600 Amps 50 Hz alternating current per sub conductor.

5.3.11.6.17 Elastomer, if used, shall be resistant to the effects of temperature up to 85 deg.C, ozone, ultraviolet radiation and other atmospheric contaminants likely to be encountered in service. It shall have good fatigue characteristics. The physical properties of the elastomer shall be of approved standard.

5.3.11.6.18 The spacer assembly shall have electrical continuity. The electrical resistance between the sub-conductor across the assembly in case of spacer having elastomer clamp grooves shall be suitably selected by the manufacturers to ensure satisfactory electrical performance and to avoid deterioration of elastomer under all service conditions.

5.3.11.6.19 The spacer assembly shall have complete ease of installation and shall be capable of removal/reinstallation without any damage.

5.3.11.6.20 The spacer assembly shall be capable of being installed and removed from the energised line by means of hot line techniques.

5.3.11.7 Tests

TABLE-5.10

Type tests		
a	Visual examination	As per IS 10162
b	Verification of dimensions	As per IS 10162
c	Movement test	As per IS 10162
d	Clamp slip test	As per IS 10162
e	Resilience test	As per IS 10162
f	Clamp bolt torque test	As per IS 10162
g	Assembly torque test	As per IS 10162
h	Tensile load test	As per IS 10162
i	Compression and pull off test	As per IS 10162
j	Vibration test	As per IS 10162
k	Corona test	As per IS 10162
l	RIV test	As per IS 10162

m	Short-circuit current test	As per IS 10162
n	Magnetic power loss test	As per IS 10162
o	Galvanizing test	As per IS 10162
p	Log decrement test (for spacer dampers only)	As per IS 10162

Acceptance tests: The following tests shall constitute the acceptance tests:

- Visual examination
- Verification of dimensions
- Movement test
- Clamp slip test
- Clamp bolt torque test
- Assembly torque test
- Tensile load test
- Compression and pull off test
- Galvanizing test

Routine test: The following shall constitute the routine tests

- Visual examination
- Verification of dimensions

5.3.12 SPACER DAMPER

5.3.12.1 Suitable spacer dampers for Quad bundle "MOOSE" conductor shall be offered. The spacer damper covered by this specification shall be designed to maintain the bundle spacing of 450mm under all normal operating conditions and to effectively control Aeolian Vibrations as well as sub span oscillations to acceptable limits. The spacer damper shall restore the nominal conductor spacing after release of any external extra ordinary load.

5.3.12.2 The spacer damper shall restore the normal subconductor spacing due to displacement by wind, electromagnetic and electrostatic forces including the specified short circuit level without permanent deformation or damage either to bundle conductors or to spacer damper itself.

- 5.3.12.3 The design offered shall be presented as a system consisting of spacer dampers and their staggering scheme for spans ranging from 100m to 1100m.
- 5.3.12.4 Under the operating conditions specified under clause 5.3.10.12 the spacer damper system shall adequately control Aeolean vibrations throughout the life of the transmission line in order to prevent damage to conductor at suspension clamps, dead end clamps and at the spacer damper clamps.
- 5.3.12.5 The spacer damper system shall also control the sub span oscillations in order to prevent conductor damage due to clashing and due to severe bending stresses at the spacer damper clamps as well as suspension and dead end clamps and to avoid wear to spacer damper components.
- 5.3.12.6 The spacer damper shall consist of a rigid central body called the frame linked to the conductors by two articulated arms terminated by suitable clamping system. The articulations shall be designed to provide elastic damping forces under angular movement of the arms. The dynamic characteristics of the articulations shall be maintained for the whole life of the transmission line.
- 5.3.12.7 The clamping system shall be designed to provide firm but gentle and permanent grip while protecting the conductor against local static or dynamic stresses expected during normal operating conditions. The clamping system shall be designed to compensate for any reduction of conductor diameter due to creep.
- 5.3.12.8 Bolted type clamps shall allow installation without removal of the bolts or the clamps from clamp body. Locking mechanism shall be suitable to prevent bolt loosening. Clamp locking devices using small loose components shall not be accepted.
- 5.3.12.9 Bolts and nuts shall be of mild steel, stainless steel, or high strength aluminium alloy in accordance with the design of the spacer damper.
- 5.3.12.10 Where elastomer surfaced clamps are used the elastomer elements shall be firmly fixed to the clamp. The insert should be forged from aluminium alloy of type 6061 or equivalent aluminium alloy having minimum tensile strength of 25 kg/mm². The elastomer shall be moulded on the insert surface. The insert shall be duly heat treated and aged to retain its consistant characteristics during service. The grain flow of the forged insert shall be in the direction of the maximum tension and compression loads experienced.

- 5.3.12.11 If clamps involving preformed rods are used, these rods shall be designed for specific conductor size. They shall be made of high strength aluminium alloy of type 6061 or equivalent aluminium alloy having a minimum tensile strength of 35 kg/mm². The rods shall be ball ended. The rods shall be heat treated and aged to achieve specified mechanical properties and to retain the same during service.
- 5.3.12.12 The spacer damper body shall be casted/forged from suitable high strength corrosion resistant aluminium alloy. The aluminium alloy shall be chosen in relation with the process used.
- 5.3.12.13 The rubber components like damping elements involved in the design shall be made with rubber compound selected specifically for that particular application. The bidder shall submit a complete list of physical and mechanical properties of the elastomer used. This list shall make reference to all applicable ASTM standards.
- 5.3.12.14 The rubber compounds used shall have good resistance to the effects of temperature upto 85 deg.C and to ultra violet radiation, ozone and other atmospheric contaminants. The rubber shall have good wear and fatigue resistance and shall be electrically semi conductive.
- 5.3.12.15 The spacer damper involving ferrous material shall not have magnetic power loss more than one watt at 600 Amps 50 Hz alternating current per sub conductor.
- 5.3.12.16 The spacer damper assembly shall have electrical continuity. The electrical resistance between the sub-conductors across the assembly in case of spacer damper involving elastomer surfaced clamps shall be suitably selected by the manufacturer to ensure satisfactory electrical performance and avoid deterioration of elastomer under service conditions.
- 5.3.12.17 The spacer damper assembly shall have complete ease of installation and shall be capable of removal/reinstallation without any damage.
- 5.3.12.18 The spacer damper assembly shall be capable of being installed and removed from the energised line by means of hot line techniques.
- 5.3.12.19 The bidder shall recommend the staggering/placement scheme for installation of spacer dampers on the line which shall ensure most satisfactory fatigue performance of the line as specified. The scheme shall indicate the number of spacer dampers per phase per span

and the sub span lengths to be maintained between spacer dampers while installing on the twin bundle conductors.

- 5.3.12.20 The staggering scheme shall be provided for spans ranging from 100 to 1100 m. The number of spacer dampers for a nominal ruling span of 350 m shall be not less than six.
- 5.3.12.21 No sub span shall be greater than 70m and no end sub span shall be longer than 40 m.
- 5.3.12.22 The staggering scheme shall be such that the spacer dampers be unequally distributed along the span to achieve sufficient detuning of adjacent sub spans for oscillations of sub span mode and to ensure bundle stability for wind speeds upto 30 Km/hr.
- 5.3.12.23 The bidder shall furnish all the relevant technical documents in support of the staggering scheme recommended for the spacer damper.

5.4 Earth Wire Accessories

5.4.1 General

- 5.4.1.1 This section details the technical particulars of the accessories for Galvanized Steel Stranded Earth wire as per Section - II of the specification. 2.5% extra fastener shall be supplied

5.4.1.2 Mid Span Compression Joint

Mid Span Compression Joint shall be used for joining two lengths of earth wire. The joint shall be made of mild steel with aluminium encasing. The steel sleeve should not crack or fail during compression. The Brunel Hardness of stainless steel should not exceed 200. The steel sleeve shall be hot dip galvanized. The aluminium sleeve shall have aluminium of purity not less than 99.5%. Filler aluminium sleeve shall also be provided at the both ends. The joints shall not permit slipping off, damage to, or failure of the complete earth wire or any part thereof at a load not less than 95% of the ultimate tensile strength of the earth wire. The joint shall have resistivity less than 75% of resistivity of equivalent length of earth wire. The dimensions and the dimensional tolerances of the joint shall be as per the Section - 3 of the specification.

5.4.2 Vibration Damper

- 5.4.2.1 The bidder shall submit the vibration damper sample analysis with software output thereof. The successful bidder shall submit the detailed analysis methods and placement criteria with damping force and resonance frequency to NEA for approval.

Vibration dampers of 4R-Stockbridge type with four (4) different resonant frequencies spread within the specified Aeolian frequency band-width shall be used for suspension and tension points on earth wire in each span to damp out Aeolian vibrations as mentioned hereinafter.

- 5.4.2.2 Alternate damping systems or "Dogbone" dampers offering equivalent or better performance shall also be acceptable provided the manufacturer meets the qualifying requirements stipulated in Part-I and Part-III. Relevant technical documents to establish the technical suitability of alternate systems shall be furnished by the bidder along with the bid.
- 5.4.2.3 One damper minimum on each side per earth wire at suspension points and two dampers on each side at tension points shall be used for ruling design span of 350 meters.
- 5.4.2.4 The clamp of the vibration damper shall be made of aluminium alloy. It shall be capable of supporting the damper during installation and prevent damage or chafing of the earth wire during erection or continued operation. The clamp shall have smooth and permanent grip to keep the damper in position on the earth wire without damaging the strands or causing premature fatigue failure of the earth wire under the clamp. The clamp groove shall be in uniform contact with the conductor over the entire clamping surface except for the Rounded edges. The groove of the clamp body and clamp cap shall be smooth, free from projections, grit or materials which could cause damage to the earth wire when the clamp is installed. Clamping bolts shall be provided with self locking nuts designed to prevent corrosion of the threads or loosening during service.
- 5.4.2.5 The messenger cable shall be made of high strength galvanized steel/stainless steel with a minimum strength of 135 kg/sq.mm. It shall be of preformed and post formed quality in order to prevent subsequent droop of weights and to maintain consistent flexural stiffness of the cable in service. The number of strands in the messenger cable shall be 19. The messenger cable ends shall be suitably and effectively sealed to prevent corrosion.
- 5.4.2.6 The damper mass shall be made of hot dip galvanized mild steel/cast iron. All castings shall be free from defects such as cracks, shrinkages, inclusions and blow holes etc., The inside and outside surfaces of the damper masses shall be smooth.
- 5.4.2.7 The bidder shall submit the sag-tension chart with the bid.

5.4.2.8 The damper placement chart for spans ranging from 100m to 1100m shall be submitted by the bidder. All the placement charts should be duly supported by relevant technical documents.

5.4.2.9 The damper placement charts shall include the following:

- a) Location of the dampers for various combinations of spans and line tensions clearly indicating number of dampers to be installed per earth wire per span/Earthwire Span.
- b) Placement distances clearly identifying the extremities between which the distances are to be measured.
- c) Placement recommendation depending upon type of suspension clamps (viz, Free centre type/trunnion type etc.)
- d) The influence of mid span compression joints in the placement of dampers.

5.4.3 Flexible Copper Bond

The flexible copper bond shall be circular in cross-section of minimum 34 sq.mm equivalent copper area and not less than 500mm in length. It shall consist of 259 wires of 0.417 mm dia. tinned copper conductor. It shall be laid up as 7 stranded ropes, each of 37 bunched wires. The tinning shall be as per relevant Indian Standard. Two tinned copper connecting lugs shall be press jointed to either ends of the flexible copper cable. One lug shall be suitable for 12 mm. dia. bolt and the other for 16 mm dia. bolt. The complete assembly shall also include one 16 mm dia., 40 mm long HRH MS Bolt hot dip galvanized with nut and lock washer.

5.4.4 Suspension Clamp

5.4.4.1 Standard twisted shackle for earth wire suspension clamp shall be supplied for attaching to the hanger having minimum thickness of 12 mm with a hole of 21.5 mm diameter

5.4.4.2 At all suspension towers, suitable suspension clamps shall be used to support the earth wire of 7/3.66 mm size. The clamps shall be of either free-centre type and shall provide adequate area of support to the earth wire. The groove of the clamp shall be smooth, finished in an uniform circular or oval shape and shall slope downwards in a smooth curve to avoid edge support and hence to reduce the intensity of bending moment on earth wire.

5.4.4.3 There shall be no sharp point in the clamps coming in contact with earth wire. There shall not be any displacement in the configuration of the earth wire strands nor shall the strands be unduly stressed in final assembly during working conditions.

- 5.4.4.4 The clamping piece and the clamp body shall be clamped by at least two U-bolts of size not less than 10 mm diameter having one nut and one 3 mm thick washer on each of its limbs. Suspension clamps shall be provided with inverted type U-bolts. One limb of the U-bolt shall be long enough to accommodate the lug of the flexible copper bond.
- 5.4.4.5 The contractor shall supply all the components of the suspension assembly including shackles, bolts, nuts, washers, split pin etc. The total drop of the suspension assembly from the centre point of the attachment to the centre point of the earth wire shall not exceed 150 mm. The design of the assembly shall be such that the direction of run of the earth wire shall be same as that of the conductor.
- 5.4.4.6 The complete assembly shall be guaranteed for slip strength of not less than 15 kN and not more than 17 kN. The breaking strength of the assembly shall not be less than 25 KN.
- 5.4.5 Tension Clamp**
- 5.4.5.1 At all tension towers suitable compression type tension clamps shall be used to hold 7/3.66 mm Galvanised steel earth wire. Anchor shackle shall be supplied which shall be suitable for attaching the tension clamp to strain plates. The strain plates supplied with the towers will have a minimum thickness of 8 mm with a hole of 21.5 mm diameter.
- 5.4.5.2 The clamps shall have adequate area of bearing surface to ensure positive electrical and mechanical contact and shall not permit any slip to the earth wire under working tension and vibration conditions. The angle of jumper terminal to be mounted should be 30 deg. with respect to the vertical line.
- 5.4.5.3 The clamps shall be made of mild steel with Aluminium encasing. The steel should not crack or fail during compression. The brinell hardness of steel sleeve shall not exceed 200. The steel sleeve shall be hot dip galvanized. The aluminium encasing shall have aluminium of purity not less than 99.5%. Filler aluminium sleeve shall also be provided at the end.
- 5.4.5.4 The complete assembly shall be so designed as to avoid undue bending in any part of the clamp and shall not produce any hindrance to the movements of the clamps in horizontal or vertical directions.
- 5.4.5.5 The slip strength of the assembly shall not be less than 95% of the ultimate strength of the earth wire.

5.4.5.6 The clamps shall be complete with all the components including anchor shackle, bolts, nuts, washers, split pin, jumper arrangement etc.

5.4.6 Tests and Standards

5.4.6.1 Tests

The type, acceptance and routine tests and tests during manufacture shall be carried out on conductor and earth wire accessories, for the purpose of this clause:

5.4.6.2 Type Tests shall mean those tests which are to be carried out to prove the design, process of manufacture and general conformity of the material to this specification/IS. These tests shall be carried out on samples prior to commencement of commercial production against relevant Indian Standards specification. The bidder shall indicate their schedule for carrying out these tests.

5.4.6.3 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.

5.4.6.4 Routine Tests shall mean those tests, which are to be carried out on each item of the material to check requirements which are likely to vary during production.

5.4.6.5 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.

5.4.6.6 The norms and procedure of sampling for these tests will be as per the applicable /standards.

5.4.6.7 For all type and acceptance tests, the acceptance values shall be the values guaranteed by the bidder in the data requirement sheets of this proposal or the acceptance value specified in this specification, whichever is more stringent for that particular test.

5.4.6.8 The contractor will intimate the Employer about carrying out of the tests at least 15 days in advance of the scheduled date of tests during which the Employer will arrange to depute his representative/s to be present at the time of carrying out of the tests. Four (4) copies of the test reports shall be submitted.

5.4.7 Type Tests

5.4.7.1 Mid Span Compression Joint for Conductor and Earth wire

TABLE-5.11

a)	Visual examination	

b)	Dimensional verification	AS per IS: 2121-Part-II & Annexure-A
c)	Galvanizing test	
d)	Electrical Resistance Tests	
e)	Heating cycle test	
f)	Chemical analysis of materials	
g)	Slip strength Test	

Note: - Test mentioned at (e), is not applicable to mid span compression joint for earth wire.

5.4.7.2 Repair Sleeve for Conductor

TABLE-5.12

a)	Visual examination	AS per Annexure-A
b)	Dimensional verification	
c)	Chemical analysis of materials	

5.4.7.3 Flexible Copper Bond

TABLE-5.13

a)	Visual examination	AS per IS: 2121-Part-II & Annexure-A
b)	Dimensional verification	
c)	Slip Strength Test	

5.4.7.4 Vibration Damper for Conductor and Earth wire

TABLE-5.14

a)	Visual examination	
b)	Verification of Dimensions	
c)	Damper efficiency test	
d)	Galvanizing/ electroplating test	
e)	Clamp bolt torque test	
f)	Mass pull off test	
g)	Resonance frequency test	
h)	Chemical analysis of materials.	

i)	Dynamic characteristics Test	As per IS: 9708-1993 and Annexure-A
j)	Vibration Analysis	
k)	Clamp Slip Test	
l)	Fatigue Tests	
m)	Magnetic Power loss Test	

Note: - Test mentioned at (m), is not applicable to dampers for earth wire.

5.4.7.5 Earth wire Suspension Clamp Assembly

TABLE-5.15

a)	Visual examination and Dimensional verification	IS: 2121-1992Part-III and Annexure-A
b)	Galvanizing Test	
c)	Chemical analysis of materials	
d)	Mechanical Strength Test	
e)	Clamp slip strength Vs Torque test for suspension assembly	

5.4.7.6 Earth wire tension clamp assembly

TABLE-5.16

a)	Visual examination and Dimensional verification	IS: 2121-1992 Part-III and Annexure-A
b)	Galvanizing Test	
c)	Chemical analysis of materials	
d)	Mechanical Strength Test (Excluding clamp)	
e)	Slip strength Test on Tension Assembly	
f)	Electrical Resistance Test on Tension Clamp.	

5.4.7.7 Flexible copper bond

TABLE-5.17

a)	Visual examination	IS: 2121-1992 Part-III and Annexure-A
b)	Dimensional verification	
c)	Slip strength test	

5.4.8 Acceptance Tests

5.4.8.1 Mid Span Compression Joint for Conductor and Earth wire- Accessories

TABLE-5.18

a)	Visual examination and Dimensional Verification	IS: 2121-(Part-II)- 1981 and Clause 6.2, 6.3 & 6.7
b)	Galvanizing Test	IS-2121-1992 (Part –III)
c)	Slip strength Test	Annexure-B
d)	Hardness Test	

5.4.8.2 Repair Sleeve for Conductor

TABLE-5.19

a)	Visual examination and Dimensional Verification	IS: 2121-(Part-II)- 1981 Clause 6.2, 6.3

5.4.8.3 Flexible Copper Bond

TABLE-5.20

a)	Visual examination and Dimensional Verification	IS: 2121-(Part-II)- 1981 Clause 6.2, 6.3
b)	Slip Strength Test	Annexure-B

5.4.8.4 Vibration Damper for Conductor and Earth wire

TABLE-5.21

a)	Visual examination and Dimensional Verification	IS: 9708-1993
b)	Galvanizing Test	As per Indian Standard
	i) On damper masses	
	ii) On messenger cable	
c)	Verification of Resonance frequencies	Annexure-B

d)	Clamp Slip Test	
e)	Clamp Bolt Torque Test	
f)	Strength of the Messenger cable	
g)	Mass Pull Off Test	

5.4.8.5 Earth wire Suspension clamp Assembly

TABLE-5.22

a)	Visual examination and Dimensional Verification	IS: 2121-(Part-III)- 1992
b)	Galvanizing Test	As per Indian Standard
c)	Clamp Slip Strength Test	Annexure-B
d)	Mechanical Strength Test on each component	
e)	Chemical Analysis of materials	

5.4.8.6 Earth wire Tension Clamp Assembly

TABLE-5.23

a)	Visual examination and Dimensional Verification	IS: 2121-(Part-III)- 1992
b)	Galvanizing Test	
c)	Hardness Test	
d)	Mechanical Strength Test on each component (Excluding clamp)	Annexure-B
e)	Slip strength Test for Tension clamp	
f)	Chemical Analysis of materials	

5.4.9 Routine Tests

TABLE-5.24

a)	Visual examination and Dimensional Verification	IS: 2121-(Part-II)- 1981 Clause 6.2, 6.3

5.4.10 Test During Manufacture

5.4.10.1 Chemical analysis of zinc used for Galvanizing. Samples taken from the zinc ingots shall be chemically analyzed as per IS: 209-1979.

5.4.10.2 Test on Malleable Castings, Forgings and Fabricated Hardware. The chemical analysis, mechanical and metallographic tests, inclusion rating and magnetic particle inspection for malleable castings, chemical analysis, hardness test, grain size and magnetic particle inspection for forgings and chemical analysis and mechanical tests for fabricated hardware will be based on heat number and heat treatment batch. The details regarding these tests will be as discussed and mutually agreed to by the Contractor and Owner in the quality assurance programme.

5.4.11 Sample Batch For Type Testing

5.4.11.1 The contractor shall offer at least three times the quantity of material required for conducting all the type tests during sample selection for type testing.

5.4.11.2 The contractor is required to conduct all the acceptance tests successfully in presence of the Owner's representative.

5.4.11.3 Sample selection should be done by the Employer's representative.

5.4.12 Testing Expenses

5.4.12.1 Bidder shall indicate the laboratories in which they propose to conduct the type tests, in case of failure of submitting the type test reports performed within last Five years.

5.4.12.2 They shall ensure that the tests can be completed in these laboratories within the time schedule guaranteed by them in the appropriate schedule of this specification.

5.4.12.3 In case of failure in any type test, the bidder whose material has failed is either required to modify the design of the material and successfully complete the type tests in the modified design or to repeat all type tests in the modified design or to repeat all those particular type tests at least three times successfully at his own expenses. The decision of the Owner in this regard shall be final and binding.

5.4.12.4 The entire cost of testing for acceptance and routine tests and test during manufacture specified herein shall be treated as included in the quoted unit price of accessories, except for the Employer's representative.

5.4.13 Additional Tests

5.4.13.1 The Employer reserves the right of having at his own expense any other test(s) of reasonable nature carried out at Contractor's premises, at site, or in any other place in addition to the aforesaid type, acceptance and routine tests to satisfy himself that the materials comply with the specification.

5.4.13.2 The Owner also reserves the right to repeat all type or acceptance tests on samples selected from lots supplied to owner wherever deemed necessary.

5.4.14 Test Reports

5.4.14.1 Copies of type test reports shall be furnished in at least four copies along with one original. One copy shall be returned duly certified by the Owner only after which the commercial production of the concerned material shall start.

5.4.14.2 Copies of acceptance test report shall be furnished in at least four copies. One copy shall be returned, duly certified by the Owner only after which the materials will be dispatched.

5.4.14.3 Record of routine test report shall be maintained by the Contractor at his works for periodic inspection by the Owner's representative.

5.4.14.4 Test certificates/record of tests carried out during manufacture and routine tests shall be maintained by the Contractor. These shall be produced for verification as and when desired by the Employer.

5.4.15 Inspection

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

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

5.4.15.3 Accessories shall not be 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 accessories shall be dispatched only after all tests specified herein have been satisfactorily completed.

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

5.4.16 Packing And Marking

5.4.16.1 All accessories shall be packed in strong, seasoned resistant wooden cases/crates. The gross weight of the packing shall not normally exceed 100 kg to avoid handling problems.

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

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

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

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

5.4.16.6 All the packing cases shall be marked legibly and correctly so as to ensure safe arrival at their destination and to avoid the possibility of goods being lost or wrongly 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.

ANNEXURE-A (TYPE TESTS)

5.4.17 Type Tests: Annexure-A

1) Mid Span Compression Joint for Conductor and Earth wire

a) SLIP STRENGTH TEST

The fitting compressed on conductor/earth wire 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) Flexible Copper Bond

a) Slip Strength Test

On applying a load of 3 KN between the two ends, stranded flexible copper cable shall not come out of the connecting lugs and none of its strands shall be damaged. After the test, the lugs shall be cut open to ascertain that the gripping of cable has not been affected.

3) Vibration Damper for Conductor and Earth wire

a) Dynamic Characteristics Test

The damper shall be mounted with its clamp tightened with torque recommended by the manufacturer on shaker table capable of simulating sinusoidal vibration for Aeolian vibration frequency band of range from 5 to 45 Hz for damper for conductor and 15 to 75 Hz for damper for earth wire. The damper assembly shall be vibrated vertically with a ± 1 mm amplitude from 5 to 15 Hz frequency and beyond 15Hz ± 0.5 mm to determine the following characteristics with the help of suitable recording instruments :

- (i) Force Vs frequency
- (ii) Phase angle Vs frequency
- (iii) Power dissipation Vs frequency

The Force Vs frequency curve shall not show steep peak at resonance frequencies and deep troughs between the resonance frequencies. The resonance frequencies shall be suitably spread within the Aeolian vibration frequency – band between the lower and

upper dangerous frequency limits determined by the vibration analysis of conductor / earth wire without dampers.

Acceptance criteria for vibration damper

- (i) The above dynamic characteristics test on five damper 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 with $0.135f$ to $0.541f$ Kgf/mm limits for “Moose-597 sq.mm” ACSR Conductor, damper and $0.050f$ to 0.3 Kgf/mm limits for earth wire damper where 'f' is frequency in Hz.
- (iv) The above mean phase angle response curve shall be between 25° to 130° and 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 are to be recorded and to be compared with the guaranteed values.

b) Vibration Analysis

The vibration analysis of the conductor/earth wire shall be done with and without damper installed on the span. The vibration analysis shall be done on a digital computer using energy balance approach. The following parameters shall be taken into account for the purpose of analysis;

- (i) The analysis shall be done for single conductor /earth wire without armor rods as per the parameters given in section I & II. The tension shall be taken as 35 KN and 12 KN for conductor and earth wire respectively for a span ranging from 100m to 1100m.
- (ii) The self damping factor and flexural stiffness (EI) for conductor and earth wire shall be calculated on the basis of experimental results. The details of experimental analysis with these data should be furnished. The power dissipation curve obtained from dynamic Characteristic Test shall be used for analysis with damper.
- (iii) Examine the Aeolian vibration level of the conductor/earth wire 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.

- (iv) From vibration analysis of conductor/earth wire without damper, anti-node vibration amplitude and dynamic strain levels at clamped span extremities as well as anti-nodes shall be examined and thus lower and upper dangerous frequency limits between which the Aeolian vibration levels exceed the specified limits shall be determined.
- (v) From vibration analysis of conductor/earth wire with damper/dampers installed at the recommended location, the dynamic strain level at the clamped span extremities, damper attachment point and the anti-nodes on the conductor/earth wire shall be determined. In addition to above damper clamp vibration amplitude and anti-node vibration amplitudes shall also be examined.
- (vi) The dynamic strain levels at damper attachment points, clamped span extremities and anti-nodes shall not exceed the specified limits. The damper clamp vibration amplitude shall not be more than that of the specified fatigue limits.

c) Clamp Slip and Fatigue tests

(i) Test Set up

The clamp slip and fatigue tests shall be conducted on a laboratory set up with a minimum effective span length of 30 m. The conductor/earth wire shall be tensioned at 35 KN/12 KN and shall not be equipped with protective armor rods at any point. Constant tension shall be maintained within the span by means of lever arm arrangement. After the conductor/earth wire has been tensioned, clamps shall be installed to support the conductor/earth wire 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/earth wire. 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 tightening with the manufacturer's specified tightening torque, when subjected to a longitudinal pull of 2.5 KN parallel to the axis of conductor/earth wire for a minimum duration of one minute shall not slip i.e, the permanent displacement between conductor/earth wire and clamp measured after removal of the load shall not exceed 1.0 mm. The load shall be further increased till the clamp starts slipping. The load at which the clamp slips shall not be more than 5 KN.

(iii) Fatigue Test

The vibration damper shall be installed on the test span with the manufacturer's specified tightening torque. It shall be ensured that the damper shall be kept minimum three loops away from the shaker to eliminate stray signals influencing damper movement.

The damper shall then be vibrated at the highest resonant frequency of each damper mass. For dampers involving torsional resonant frequencies tests shall be done at torsional modes also in addition to the highest resonant frequencies at vertical modes. The resonance frequency shall be identified as the frequency at which each damper mass vibrates with the maximum amplitude on itself. The amplitude of vibration of the damper clamp shall be maintained not less than $\pm 25/f$ 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 hereinabove shall be repeated after fatigue test without re-torquing or adjusting the damper clamp and the clamp shall withstand a minimum load equal to 80% of the slip strength for a minimum duration of one minute.

After the above tests, the damper shall be removed from conductor/earth wire and subjected to dynamic characteristics test. There shall not be any major

deterioration in the characteristic of the damper. The damper then shall be cut open and inspected. There shall not be any broken, loose, or damaged part. There shall not be significant deterioration or wear of the damper. The conductor/earth wire under clamp shall also be free from any damage.

For the purpose of acceptance, the following criteria shall be applied:

- a) There shall not be any frequency shift by more than ± 2 Hz at frequencies lower than 15 Hz and ± 3 Hz for frequencies higher than 15 Hz.
- b) The force response curve shall generally lie within guaranteed % variation in reactance after fatigue test in comparison with that before fatigue test by the contractor/manufacturer.
- c) The power dissipation of the damper shall not be less than guaranteed % variation in power dissipation before fatigue test by the contractor/manufacturer. However, it shall not be less than minimum power dissipation which shall be governed by lower limits of reactance and phase angle indicated in the envelope.

4) Magnetic Power Loss Test for Damper/Spacer/Spacer Damper

The sample involving ferrous parts shall be tested in a manner to simulate service conditions for 50 Hz pure sine-wave. The test should be carried out at various currents ranging from 300 amperes to 900 amperes and the magnetic power loss at various currents should be specified in tabulated graphical form. The difference between the power losses without and with sample at room temperature shall be limited to 1 watt for 600 amperes current (rms). The losses shall be determined by averaging the observations obtained from at least four samples.

5) Mechanical strength test of Earth wire Suspension/Tension Clamps

- a) The suspension assembly/tension assembly (excluding tension clamp) shall be subjected to a load equal to 50% of the specified minimum ultimate tensile strength (UTS) which shall be increased at a steady rate to 67% of the minimum UTS specified. This load shall be held for five minutes and then removed. After removal of the load, the components shall not show any visual deformation and it shall be possible to disassemble them by hand. Hand tools may be used to loosen the nuts initially. The assembly shall then be reassembled and loaded to 50% of UTS and the load shall be further increased at a steady rate till the specified minimum UTS is reached and held for one minute. No fracture should occur during this period. The applied load shall then be increased until the failing load is reached and the value recorded.
- 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 7/3.66 Galvanised steel Earth wire 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 earth wire. The clamp slip strength versus torque curve shall be drawn. The clamp slip strength at the recommended tightening torque shall be more than 9 KN but less than 14 KN.
- c) Slip Strength Test of Tension Clamp:
Tension clamps shall be compressed on a 5 m length of 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 earthwire shall be applied & the sample shall be marked in such a way that movement relative to the fitting can easily be detected. Without any subsequent adjustment of the fitting, the load shall be steadily increased to 95% of the specified breaking load and maintained for one minute. There shall be no movement of the 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.

6) Chemical Analysis Test

Chemical analysis of the material used for manufacture of items shall be conducted to check the conformity of the same with technical specification and approved drawing.

7) Corona Extinction Voltage Test (i) Dry

The sample when subjected to power frequency voltage shall have a corona extinction voltage of not less than 156 kV rms line to ground under dry condition. There shall be no evidence of corona on any part of the sample when all possible sources of corona are photographed in a darkened room.

8) Radio Interference Voltage Test (i) Dry

Under the conditions as specified under (8) above, the sample shall have a radio interference voltage level below 1000 microvolts at one MHz when subjected to 50 Hz AC Voltage of 156 kV rms line to ground under dry condition. The test procedure shall be in accordance with IS: 8263-1976.

ANNEXURE-B (ACCEPTANCE TESTS)

5.4.18 Acceptance Tests- Annexure-B

1) Mid Span Compression Joint for Conductor and Earth wire

a) Hardness Test

The Brine hardness at various points on the steel sleeve of conductor core and of the earth wire compression joint and tension clamp shall be measured.

2) Flexible Copper Bond

a) Slip Strength Test

Same as Clause 2(a) of Annexure A

3) Vibration Damper for Conductor and Earth wire

a) Verification of Resonance Frequencies

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

b) Clamp Slip Test

Same as Clause 3 (c) (ii) of Annexure-A.

c) Clamp Bolt Torque Test

The clamp shall be attached to a section of the conductor / 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 3 (c) (i), Annexure-A.

d) Strength of the Messenger Cable

The messenger cable shall be fixed in a suitable tensile testing machine and the tensile load shall be gradually applied until yield point is reached. The load shall be not less than the value guaranteed by the bidder.

e) Mass Pull Off Test

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

4) Spacer/Spacer Damper

a. Test Set up

The test set up for the tests described hereunder is as per clause 3 (c) (i) Annexure-A

b. Movement Test

The spacer/spacer damper assembly shall be capable of the following movements without damaging the conductor, assuming one conductor is fixed and the other moving:

i.	Longitudinal movement parallel to the conductor	± 50 mm
ii.	Vertical movement in a vertical direction at right angle to the conductor.	± 25 mm
iii.	Torsional movement/angular movement in a vertical plane parallel to the conductor	± 5 deg.

c. Compressive and Tensile Test

The spacer/spacer damper assembly shall withstand ultimate compressive load of 15 kN (1500 kg) and tensile load of 7.5 kN (750 kg) applied between sub-conductor bundle and held for one minute without failure. Line distance between clamps shall be recorded during each of the compression and tension test. Measurement shall be recorded at (i) no load (ii) with load (iii) after release of load. The center line distance under load shall be within ± 100 mm of the nominal design spacing. After release of load it shall be possible to retain the clamps at their original position using only slight hand pressure. There shall be no deformation or damage to the spacer assembly which would impair its function of maintaining the normal spacing.

d. Clamp Slip Test

Same as clause 4 (b) of Annexure-A.

e. Clamp Bolt Torque Test

The spacer/spacer damper assembly shall be attached to conductor. A torque of 150 percent of the manufacturer's specified tightening torque shall be applied to the clamp bolts or cap screws. There shall be no failure of the component parts.

f. Assembly Torque Test

The spacer/spacer damper assembly shall be installed on conductor. The same shall not rotate on either clamp on applying a torque of 0.04 kN (4kg) in clockwise or anti-clockwise direction.

g. Hardness test for elastomer

The shore hardness at different points on the elastomer surface of cushion grip clamp shall be measured by shore hardness meter. They shall be lie between 65 to 80.

h. UTS of Retaining Rods

The ultimate tensile strength of the retaining rods shall be measured. The value shall not be less than 35 kg/mm².

CHAPTER - 6

INSULATORS AND INSULATOR'S HARDWARE

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CHAPTER - 6

INSULATORS AND INSULATOR'S HARDWARE

6.1 INSULATOR

6.1.1 SCOPE

- a) This section covers design; manufacture, stage testing, inspection, testing before dispatch, packing, supply and delivery of insulators specified here-in-under of 90 kN, 160 kN EM and 210kN (for special towers) strength Porcelain Disc insulators for Twin and Quad ACSR "MOOSE" conductors.
- b) Contractor shall supply the Insulators and Hardware Fittings which may require for wastage at their own cost. Some spare quantity of insulators and Hardware fittings have been kept in Price schedule which shall be decided during detailed engineering. The unused Insulators and Hardware Fittings shall be returned to the Employer in good condition as spare inventory. Missing components or damaged Insulators will not be counted as complete sets or units. Therefore, the Contractor must either supply the missing or damaged items or the corresponding cost will be deducted from the final payment or retention.
- c) For 220 kV Double Circuit Transmission line anti-fog type Disc Insulators of Electro-mechanical strength of 90 kN, 160 kN and 210kN (for special towers) shall be used for suspension towers and angle/tension towers in following insulator strings formation along with all necessary hardware fittings:
 - i. 2 x 90 kN Double suspension string for Twin "MOOSE" conductor (2x14): for altitude up to 1000 meter for suspension type of tower
 - ii. 2 x 160 kN Double tension string for Twin "MOOSE" conductor (2x15): for altitude up to 1000 meter for tension type of tower
 - iii. 2 x 160 kN Double suspension string for Quad "MOOSE" conductor (2x14): for altitude up to 1000 meter

- iv. 4x 160 kN Quad tension string for Quad "MOOSE" conductor (4x15): for altitude up to 1000 meter
- v. 1x90kN Single suspension "Pilot" insulator strings for Twin "MOOSE" conductor (1x15): for large angle type towers
- vi. 2x90kN Single suspension "Pilot" insulator strings for Quad "MOOSE" conductor (2x15): for large angle type towers.
- vii. For special towers, 2x 210kN insulator Double tension string for Twin "MOOSE" conductor (2x15): for altitude up to 1000 meter for tension type of tower
- viii. For Special Towers, 4 x 160 kN Quad tension string for Quad "MOOSE" conductor (4x15): for altitude up to 1000 meter

d) These numbers of discs are for altitude up to 1000 meter. The no. of required discs shall be increased for altitudes higher than 1,000m as per following:

Altitude range	Increased no. of discs
1,000 meter -2,000 meter	2
2,000 meter-2,600 meter	3

6.1.2 STANDARDS

The insulator strings and its components shall conform to the following Nepali standards (if any) / Indian standards or equivalent International Standards which shall mean to latest revision, with amendments/changes adopted and published, unless specifically stated otherwise in the specification.

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

TABLE-6.0

S.No	Indian Standards	Title	International

			standard
1	IS: 209-1992	Specification for Zinc Ingot	BS: 3436-1986
2	IS: 385	Specification for phosphor Bronze rods and Bars, sheet strip and wire	BS: 2870
3	IS: 406-1964	Method for chemical Analysis of slab zinc (Spelter)	
4	IS: 731-1971	Specification for Porcelain insulators for Over-head power lines with a nominal voltage greater than 1000 V	BS: 137-1982(I & II) IEC: 60383- (Part-I)-1993 (Part-II)-1992
5	IS: 1367-1980	Technical supply conditions for threaded steel fasteners.	
6	IS: 1570-1961	Specification for wrought steels for general engineering purposes	
	(Part-I)	Steel specified by tensile and/or yield properties	
7	IS: 1573-1986	Specification for Electroplated coatings of zinc on iron and steel.	
8	IS: 2004-1991	Specification for Carbon steel forgings for general engineering purposes	
9	IS: 2016-	Specification for Plain Washers	
10	IS: 2070-1962	Method of Impulse Voltage Testing	
11	IS 2071-1974	Code for Method of high voltage testing Techniques	IEC 60-1-1989
	Part – I	General definitions and test requirements	

	Part – II	Test Procedure	
	Part - III	Measuring devices	
12	IS: 2107-1977	Specification for white heart malleable iron castings.	
13	IS: 2108-1977	Specification for black heart malleable iron castings.	
14	IS: 2121-1981	Specification for Conductors and earth wire accessories for overhead power lines	
	Part-I	Armor Rods, binding wires and tapes for conductors.	
	Part-II	Mid span joints and repair sleeves for conductor.	
15	IS: 2486	Specification for Metal Fittings of insulators for overhead power lines with nominal voltage greater than 1000V	
	Part-I – 1993	General requirements and tests	BS: 3288-1979
	Part-II - 1989	Dimensional requirements	IEC: 120-1984, BS 3288-Part-2-1990
	Part-III - 1974	Locking Devices	IEC: 372-1984
	Part-IV 1981	Tests for Locking Device	
16	IS: 2629-1985	Recommended practice for hot dip galvanizing of iron and steel.	ISO-1461(E)
17	IS: 2633-1986	Method for testing of uniformity of coating of zinc coated articles.	
18	IS: 3138- 1966	Hexagonal bolts and nuts	ISO/R947and ISO/R272

19	IS: 3188-1980	Code for Characteristics of String Insulator Units	IEC: 60305-1978
20	IS: 4218-1976	ISO metric screw threads.	ISO/R 68-1969, R-26-1963, R262-1969, R965-1969.
21	IS: 4759-1996	Specification for Hot dip zinc coating on structural steel and other allied products.	
22	IS: 5358-1969	Specification for Hot dips Galvanized coatings on fasteners.	
23	IS 6603	Stainless steel bars and flats	
24	IS 6745-1972	Methods for Determination of mass of zinc coated iron and steel articles	BS: 433-1969 ISO 1460-1973
25	IS: 8263-1976	Methods of Radio Interference test on High Voltage insulators	IEC: 437-1973 NEMA PUBLICATION NO.107/1964 CISPR
26	IS: 8269-1976	Methods for switching impulse test on High Voltage insulators.	IEC: 506-1975
27		Thermal mechanical performance test and mechanical performance test on string insulator units.	IEC: 575-1977
28		Salt Fog Pollution Voltage withstand test.	IEC: 507-1991
29		Residual Strength of String	IEC: 797-1984

6.1.3

TECHNICAL DESCRIPTION

		Insulator units of Glass or Ceramic Material for overhead lines after mechanical Damage of the Dielectric	
30		Guide for the selection of insulators in respect of polluted conditions.	IEC: 815-1986
31	IS 10136 - 1982	Code of practice for selection of Disc Insulator fittings for Highest system voltage of 72.5 kV and above.	
32	IS 13305 - 1992	Permissible Limits of Visual Defects for Insulator Porcelains for Electrical Circuits	

L DESCRIPTION

6.1.3.1 Details of Disc Insulators

The Insulator of the strings shall consist of standard discs for a three phase, 50 Hz, effectively earthed 220 KV Transmission systems in a lightly polluted atmosphere.

- The discs shall be ball and socket (B&S) type.
- The discs shall be Anti-Fog type with Zinc sleeve.
- Bidder shall quote for electro porcelain disc insulators in accordance with the clause 6.0 (Scope).
- The size of disc insulator, minimum creepage distance, the number to be used in different types of strings, their electromechanical strength and mechanical strength of insulator strings along with hardware fittings shall be as in Table below:

Table-6.1

Particulars of Insulators and Insulator Strings

Particulars	Twin Moose Double	Twin Moose	Quad Moose	Quad Moose	Single "I" /Double "II"

	Suspension String	Double Tension String	Double Suspension String	Quad Tension	Suspension Pilot Insulator String
1. No. of standard Discs	2x14	2x15	2x14	4x15	1x15 (twin moose) 2x15 (Quad Moose)
2. Size of disc-mm	255 x145	280x170 and 305x170 (for special Towers)	280x170	280x170 and 305x170 (for special Towers)	255 x145 (twin moose)
3. E&M Strength of each string	2x90 kN	2x160 kN and 2x210kN (for special towers)	2x160 kN	4x160 KN and 4x210kN (for special towers)	1x90 kN (twin moose) 2x 90kN (Quad Moose)
4. Ball and socket Designation (mm)	16	20	20	20	16
5. Minimum Creepage distance of each disc (mm)	430	430 and 545mm (for special Towers)	430	430 and 545mm (for special Towers)	430

These numbers of discs are for altitude up to 1000 meter. The no. of required discs shall be increased for altitudes higher than 1,000m as per following:

Altitude range	Increased no. of discs
1,000 meter -2,000 meter	2
2,000 meter-2,600 meter	3

6.1.3.2 Dimensions of Insulator Discs

It shall be ensured that the dimensions of the disc insulators are within the limits specified below:

Table-6.2

S.No.	Description	Standard	Maximum	Minimum
	Insulator Disc with EM Strength 90 kN Disc			
a)	Diameter of disc (mm)	255	262	248
b)	Ball to Ball spacing between discs (mm)	145	149	141
	Insulator Disc with EM Strength 160 kN Disc			
a)	Diameter of disc (mm)	280	288	272
b)	Ball to Ball spacing between discs (mm)	170	175	165
	Insulator Disc with EM Strength 210 kN Disc			
a)	Diameter of disc (mm)	305	318	292
b)	Ball to Ball spacing between discs (mm)	170	175	165

6.1.4 Bid Drawings

- a) The bidder shall furnish full description and illustration of the material offered.
- b) The Bidder shall furnish along with the bid the outline drawing of each insulator unit including a cross-sectional view of the insulator shell. The drawing shall include but not be limited to the following information:
 - (i) Shell diameter and ball to ball spacing with manufacturing tolerances.
 - (ii) Minimum creepage distance with positive tolerance.
 - (iii) Eccentricity of the disc
 - Axial run out
 - Radial run out
 - (iv) Unit mechanical and electrical characteristics.
 - (v) Size and weight of ball and socket parts.
 - (vi) Weight of unit insulator disc.

- (vii) Materials for the disc, cap and pin and standard to which conforming.
 - (viii) Identification mark.
 - (ix) Manufacturer's catalogue number.
 - (x) Brief installation instructions.
 - (xi) Relevant technical details of significance.
 - (xii) Galvanization Process, weight of zinc and no. and duration of dips.
- c) Drawings for complete Insulator strings may be furnished with following information.
- (i) Dimensional drawings for different insulator strings.
 - (ii) Electro-Mechanical Strength
 - (iii) No. of insulator disc units in each string.
 - (iv) Weight of insulator discs, Hardware sets and total weight of insulator strings.
 - (v) Tolerance if any.
- d) After placement of the award, the contractor shall submit fully dimensioned insulator drawings containing all the details as given in Clause No.6.3.1 and 6.3.2 above, in three (3) copies to Employer for approval. After getting approval from Employer and successful completion of all the type tests, the contractor shall submit six (6) more copies of the same drawing to the Employer for further distribution and field use at Employer's end.
- e) After placement of award the Contractor shall also submit fully dimensioned insulator crate drawing of different types of insulators.

6.1.5 GENERAL TECHNICAL REQUIREMENTS

6.1.5.1 Porcelain

The porcelain used in the manufacture of the shells shall be Brown, nonporous of high dielectric, mechanical and thermal strength, free from internal stresses, blisters, laminations, voids, foreign matter, imperfections or other defects which might render it in any way unsuitable for insulator shells. Porcelain shall remain unaffected by climatic conditions, ozone, acid, alkalis, zinc or dust. The manufacturing shall be by the wet process and impervious character obtained by thorough vitrification.

Porcelain Glaze

Surfaces to come in contact with cement shall be made rough by sanding. All other exposed surfaces shall be glazed with ceramic materials having the same temperature coefficient of expansion as that of the insulator shell. The thickness of the glaze shall be uniform throughout and the color of the glaze shall be brown. The glaze shall have a good visible lusture, smooth on surface and be subject to satisfactory performance under extreme tropical climatic weather conditions and prevent ageing of the porcelain. The glaze shall remain under compression on the porcelain body throughout the working temperature range.

6.1.5.2 Metal Parts**a) Cap and Ball Pins**

Ball pins shall be made with drop forged steel and caps with malleable cast iron. They shall be in one single piece and duly hot dip galvanized. They shall not contain parts or pieces joined together, welded, shrink fitted or by any other process from more than one piece of material. The pins shall be of high tensile steel, drop forged and heat treated. The caps shall be cast with good quality black heart malleable, cast iron/spherical graphite iron/drop forged steel and annealed. Galvanizing shall be by the hot dip process with a heavy coating of zinc of very high purity. The Bidder shall specify the grade, composition and mechanical properties of steel used for caps and pins.

b) Security Clips

The R type security clips shall be made of good quality phosphor bronze confirming to IS 7814:1975 or stainless steel confirming to IS 6603:1972.

6.1.5.3 Filler Material

Cement to be used as a filler material shall be quick setting, fast curing Portland cement. It shall not cause fracture by expansion or loosening by contraction. Cement shall not react chemically with metal parts in contact with it and its thickness shall be as small and as uniform as possible. Proper care shall be taken to correctly centre and locate individual parts during cementing.

6.1.5.4 Material Design and Workmanship

a) General

- All raw materials to be used in the manufacture of these insulators shall be subject to strict raw material quality control and to stage testing/ quality control during manufacturing stage to ensure the quality of the final end product. Manufacturing shall conform to the best engineering practices adopted in the field of extra high voltage transmission. Bidders shall therefore offer insulators as are guaranteed by them for satisfactory performance on 220 KV Transmission Lines.
- The design, manufacturing process and material control at various stages shall be such as to give maximum working load, highest mobility, best resistance to corrosion, good finish, elimination of sharp edges and corners to limit corona and radio interference voltages.

b) Insulator Shell

The design of the insulator shells shall be such that stresses due to expansion and contraction in any part of the insulator shall not lead to deterioration. Shells shall be dried under controlled conditions of humidity and temperature.

c) Metal Parts

- The pin and cap shall be designed to transmit the mechanical stresses to the shell by compression and develop uniform mechanical strength in the insulator. The cap shall be circular with the inner and outer surfaces concentric and of such design that it will not yield or distort under loaded conditions. The head portion of the pin ball shall be suitably designed so that when the insulator is under tension, the stresses are uniformly distributed over the pinhole portion of the shell. The pin ball shall move freely in the ball socket either during assembly of a string or during erection of a string or when a string is placed in position.
- Metal caps shall be free from cracks, seams, shrinks, air holes, blow holes and rough edges. All metal surfaces shall be perfectly smooth with no projecting parts or irregularities which may cause corona. All load bearing surfaces shall be smooth

and uniform so as to distribute the loading stresses uniformly. Pins shall not show any microscopically visible cracks, inclusions and voids.

d) Galvanizing

- e)** 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 minimum grade Zn 99.5 as per IS: 209. The zinc coating shall be uniform, smoothly adherent, reasonably bright, continuous and free from impurities such as flux, ash, rust stains, bulky white deposits and blisters. Before ball pins are 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. The galvanized metal parts shall be guaranteed to withstand at least six successive dips each lasting one minute duration under the standard preece test.

f) Cementing

The insulator design shall be such that the insulating medium shall not directly engage with the hard metal. The surfaces of porcelain and the metal parts shall be coated with resilient paint to offset the effect of difference in thermal expansions of these materials.

6.1.5.5 Security Clips (Locking Devices)

- 6.1.5.5.1** Socket fitting shall be provided with R-shaped security clip in accordance with IS: 2486 (Parts III & IV) to provide positive locking against unintentional disengagement of socket from ball of the insulator. The security clip shall be humped to maintain the clip in the locked position and shall have prongs spread to prevent complete withdrawal from the socket. The clip end shall not project outside the recess of socket when the clip is in locked position. The locking device should be resilient, corrosion resistant and of suitable mechanical strength. There shall be no risk of the locking device being displaced accidentally or being rotated when in position. Under no circumstances shall the locking device allow separation of insulator units of strings. The locking device shall be effective at the lowest temperature likely to be encountered in service.

6.1.5.5.2 The hole for the security clip and length are designed to make the eye of the security clip protrude at least 5 mm. The hole for the security clip shall be on the side of the socket opposite to the socket opening. The hole for the clip shall be countersunk. The clip eye shall be of such design that the same may be engaged by a hotline clip puller to provide for disengagement under energized conditions.

6.1.5.5.3 The free ends of the security clip are bent outwards and one of the legs has a hump.

6.1.5.5.4 The force required to pull the clip to its unlocked position shall not be less than 50 N or more than 500 N.

6.1.5.5.5 The security clip shall be made of stainless steel of type AISI 302 or 304 or phosphor bronze as per IS: 7814.

6.1.5.5.6 The dimension of Security clip shall confirm to the Fig. 2 of IS 2486-Part-3 : 1974.

6.1.5.6 Ball and Socket Designation

The dimensions of the balls and sockets for 90 kN discs and 160 kN discs shall be 16 mm and 20 mm designation, respectively in accordance with the standard dimensions stated in IS: 2486 (Part II).

a) Interchangeability:

The insulators inclusive of the ball and socket fitting shall be of standard design suitable for use with hardware fittings of any make conforming to relevant Indian standards.

6.1.5.7 Corona and Radio Interference (RI) Performance

All surfaces shall be clean, even, smooth, without cuts, abrasions or projections. No part shall be subjected to excessive localized pressure. The metal parts and Porcelain shall not produce any noise generating corona under all operating conditions.

6.1.5.8 Suitability for Live Line Maintenance

The insulators shall be compatible for use with hot line or live line maintenance techniques so that usual hot line operations can be carried out with ease, speed and safety.

a) Methods And Periodicity Of Maintenance

Bidders shall indicate the methods generally adopted in routine hot and cold line maintenance of EHV lines for similar disc insulators supplied by them. Bidders shall also indicate the recommended periodicity of such maintenance.

6.1.5.9 Freedom from Defects

Insulators shall have none of the following defects:

- a. Ball pin shake
- b. Cementing defects near the pin like small blow holes, small hair cracks, lumps, etc.,
- c. Sand fall defects on the surface of the insulator.

6.1.5.10 Insulator Strings**a) Type and Rating**

- b) The insulator strings shall be formed with standard disc insulators described in this specification for use on three phase, 220 KV, 50 Hz effectively earthed systems in a Lightly polluted atmosphere. Suspension insulator strings for use with suspension/tangent towers are to be fitted with disc insulator units of 90 kN and 160 kN EM strength rating for Twin Moose Double Suspension & Suspension Pilot String and Quad Moose Double Suspension String, respectively while Twin Moose Double tension and Quad Moose Quad Tension insulator strings for use with anchor/ tension towers are to be fitted with disc insulator units of 160 KN EM strength rating.

c) String Size

- d) The size of the disc insulator, the number to be used in different types of strings, their electromechanical strength with minimum nominal creepage distance shall be in accordance with Cl.No.6.1.3.1
- e) Insulator units after assembly shall be concentric and coaxial within limits as permitted by Indian Standards.
- f) The string design shall be such that when units are coupled together, there should not be contact between the shell of one unit and metal of the next adjacent unit. The design of the ribs shall be such that the security clips of the insulator can be engaged and disengaged easily with the hot stick without damaging the shell ribs.

6.1.6 TESTS

The following tests shall be carried out on the insulator string and disc insulators.

6.1.6.1 Type Tests

The insulator string and disc insulators offered shall be type tested duly last 5 years (time period from before final bid submission date). The Bidder needs to furnish Type Test Reports of identical insulator string and disc insulators along with the Bid for consideration. In case of non-submission of Type-test reports, Type Test as per the following and as per IS-398 shall be carried out at the reputed standard laboratory (acceptable to Employer).

These shall mean those tests which are to be carried out to prove the design, process of manufacture and general conformity of the material and product with the intent of this specification. These tests shall be conducted on a representative number of samples prior to commencement of commercial production. The Contractor shall indicate his schedule for carrying out these tests.

6.1.6.2 Acceptance Tests

These shall mean those tests which are to be carried out on samples taken from each lot offered for pre-dispatch inspection for the purpose of acceptance of the lot as per the approved Sampling plan.

6.1.6.3 Routine Tests

These tests shall mean those tests, which are to be carried out on each insulator to check the requirements which are likely to vary during production.

6.1.6.4 Stage Tests during Manufacture

Stage tests during manufacture shall mean those tests which are to be carried out during the process of manufacture and end inspection by the Contractor to ensure the quality control such that the end product is of the desired quality conforming to the intent of this specification.

6.1.6.5 Test Values

For all type and acceptance tests, the acceptance values shall be the values guaranteed by the bidder in the Guaranteed Technical Particulars or the acceptance values specified in this specification or the relevant standard whichever is more stringent for that particular test.

6.1.6.6 Test Procedures and Sampling Norms

The norms and procedures of sampling for the above tests shall be as per the relevant Indian Standard or other internationally accepted standards. This will be discussed and mutually agreed to between the Contractor and the Employer before placement of order. The standards and norms according to which these tests are to be carried out are listed against each test. Where a particular test is a specific requirement of this specification, the norms and procedures of the same shall be as per Clause 6.1.18 or as mutually agreed to between the Contractor and the Employer in the Quality Assurance Program (QAP).

6.1.6.7 The following type tests shall be conducted on the disc Insulator units.

TABLE-6.3

1	Verification of dimensions	IS: 13305-1992
2	Dry lightning Impulse withstand voltage test	
3	Wet power frequency withstand voltage test	AS PER IEC: 60383-1-1993
4	Electromechanical failing load test	
5	Thermal Mechanical Performance test	
6	Verification of the displacements	
7	Verification of the locking system	
8	Temperature cycle test	AS PER IEC: 60383-1-1993
9	Puncture withstand test	
10	Porosity test	
11	Galvanizing test	IS: 731
12	Visual examination test	

13	Wet power frequency voltage flashover test	BS: 137
14	Visible discharge test	IS: 731-1971
15	RIV test (dry)	IEC: 437-1973
16	Metallurgical test	IS: 2108 & IS: 2004
17	Residual strength test	As per clause no. 6.1.18.15
18	Steep wave front test	As per clause no. 6.1.18.13
19	Mechanical Performance test	As per IEC: 575-1977

6.1.6.7.1 The Thermal mechanical performance test and steep wave front test shall be repeated once for every supply of 25,000 nos. insulators. The samples shall be drawn randomly from any offered acceptance lot.

6.1.6.8 Acceptance Tests (On Disc Insulator Units)

TABLE-6.4

1	Verification of dimensions	IS: 13305
2	Verification of the displacements	As per IEC 60383-1-1993
3	Verification of the locking system	
4	Temperature cycle test	
5	Electromechanical failing load test	
6	Porosity test	
7	Galvanizing test	IS: 731
8	Visual examination test	
9	Residual strength test	As per cl.no.6.1.18.15
10	Metallurgical test	IS: 2108 & IS: 2004
11	Mechanical Performance test	As per IEC: 60575- 1977

6.1.6.9 Routine Tests (Disc Insulator Units)

TABLE-6.5

1	Visual Inspection test	As per IEC 60383-1 1993.
2	Mechanical test	
3	Electrical test	

6.1.6.10 The following Type Tests shall be conducted on complete insulator strings with hardware fittings.

TABLE-6.6

1	Wet power frequency voltage test	As per IEC: 383-2: 1992
2	Lightning impulse voltage test	
3	Wet switching impulse voltage test	
4	Visual Examination	IS: 731
5	Voltage distribution test	As per Clause no. 6.1.18.8
6	RIV test	As per Clause no. 6.1.18.10
7	Mechanical strength test	As per Clause no. 6.1.18.1
8	Dynamic/Vibration test	As per Clause no. 6.1.18.9
9	Corona Extinction voltage test	As per Clause no. 6.1.18.11
10	Pollution withstand voltage test	As per Clause no. 6.1.18.12

6.1.6.11 All the type tests given under clause 6.1.6.7 & 6.1.6.10 shall be conducted on Twin Moose Double suspension, Quad Moose Double Suspension, Twin Moose Double Tension and Quad Moose Quad Tension insulator string along with hardware fittings. All the above tests except at SI No. 8 under clause 6.1.6.10 shall also be conducted on Single and Double suspension pilot insulator strings along with hardware fittings.

6.1.6.12 Tests during Manufacture (Stage Tests)

On all components as applicable

TABLE-6.7

a.	Chemical analysis of Zinc used for galvanizing	As per Clause no. 6.1.18.2
b.	Chemical analysis, mechanical and metallographic test and magnetic particle inspection for malleable castings	As per Clause no. 6.1.18.4

c.	Chemical analysis, hardness test and magnetic particle inspection for forgings	As per Clause no. 6.1.18.3
d.	Hydraulic internal Pressure on shell	As per Clause no. 6.1.18.6
e.	Crack detection test for metal parts	As per Clause no. 6.1.18.7

6.1.7 ADDITIONAL TESTS

6.1.7.1. The Employer reserves the right for carrying out any other tests of a reasonable nature at the works of the Contractor/ laboratory / research institute in addition to the above mentioned type, acceptance and routine tests at the cost of the Employer to satisfy that the material complies with the intent of this specification.

6.1.7.2. For 220 KV insulator strings, the Contractor is required to produce type test reports to the satisfaction of the Employer.

6.1.7.3. Repeat E&M strength test.

E&M test on 20 nos. of samples for every lot of 10,000 nos. received at site shall be conducted preferably at independent laboratory. Test charges have to be borne by the Contractor and shall be included in quoted Ex-works price. In case of failure, it will be repeated on double nos. of samples and if it again fails, the whole lot should be rejected and shall be replaced by the Contractor. The samples have to be taken at random after segregating insulators damaged in transportation or otherwise.

6.1.7.4. The Employer 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 Contractor's premises or at any other test Centre. In case of evidence of non-compliance, it shall be binding on the part of the Contractor to prove the compliance of the items to the Technical Specifications by repeat test or correction of deficiencies or replacement of defective items, all without any extra cost to the Employer.

6.1.8 TEST CHARGES AND TEST SCHEDULE

a) Type Tests

All the materials offered shall be fully type tested as per this specification and the Bidder shall furnish type test reports along with the offer. These tests must not have been conducted earlier than five years. The Employer reserves the right to demand repetition of some or all the type tests in the presence of Employer's representative. For this purpose, the Bidder may quote unit rates for carrying out each type test. These prices shall be taken into consideration for bid evaluation. For any change in the design/type offered against this specification, Employer reserves the right to demand repetition of tests without any extra cost. Bidder shall indicate unit type test charges for all the tests covered under Clause 6.1.6.7 & 6.1.6.10 separately, in the relevant schedule. Charges for each type test shall be separately indicated. Test charges indicated by the bidder shall be inclusive of repeat type tests envisaged in cl. No. 6.1.6.7.1

- In case of any failure during testing on complete insulator string, the test shall be repeated at the Contractor's cost.
- In case of failure of any type test, the Contractor is either required to modify the design of the material and successfully carryout all the type tests as has been detailed out in Clause 6.1.6.7 & 6.1.6.10 of this specification or to repeat that Particular type test at least three times successfully at his own expenses. The decision of the Employer in this regard shall be final and binding.
- Bidder shall indicate the laboratories in which they propose to conduct the type tests. They shall ensure that the tests can be completed in these laboratories within the time schedule guaranteed by him in the appropriate schedule.
- The entire cost of testing for acceptance and routine tests and tests during manufacture specified herein shall be treated as included in the quoted unit price of disc insulators except for the expenses of the Inspector/Employer's representative. All acceptance tests as stipulated herein shall be carried out by the Contractor in the presence of Employer's representative. The record of

routine tests, as and when desired by the Employer shall be furnished by the contractor.

- In case of failure in any type test, if repeat tests are required to be conducted, then all the expenses for deputation of inspector/Employer's representative shall be deducted from the contract price. Also if on receipt of Contractor's notice of testing, the Employer's representative does not find 'plant' to be ready for testing the expenses incurred by the Employer for re-deputation shall be deducted from the contract price.
- Immediately after finalization of the program of type/acceptance testing, the Contractor shall give sufficient advance intimation to the Employer, to enable him to depute his representative for witnessing the tests.

6.1.9 SAMPLE BATCH FOR TYPE TESTING

6.1.9.1. The Contractor shall offer material for sample selection for type testing only after getting Quality Assurance Program (QAP) approved by the Employer. The Contractor 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 Program (QAP) approved by the Employer.

6.1.9.2. Before sample selection for type testing, the Contractor shall be required to conduct all the acceptance tests successfully in presence of Employer's representative.

6.1.10 SCHEDULE OF TESTING

The Bidder has to indicate the schedule of following activities in their bids:

- a) Submission of drawing for approval
- b) Submission of Quality Assurance Program for approval
- c) Offering of material for sample selection for type testing.
- d) Type testing.

6.1.11 INSPECTION

- 6.1.11.1. The Employer and his representatives shall at all times be entitled to have access to the works and to all places of manufacturer, where the insulators are manufactured and the Contractor shall afford all facilities for unrestricted inspection of the works, inspection of materials, inspection of manufacturing process of insulators and for conducting necessary tests as specified herein.
- 6.1.11.2. The Contractor shall keep the Employer informed in advance of the time of starting and of the progress of manufacture of insulators in its various stages so that arrangements could be made for inspection.
- 6.1.11.3. No material shall be dispatched from its point of manufacture unless the material has been satisfactorily inspected and tested.
- 6.1.11.4. The acceptance of any quantity of insulators shall in no way relieve the Contractor of his responsibility for meeting all the requirements of this specification and shall not prevent subsequent rejection if such insulators are later found to be defective.
- 6.1.11.5. The material for final inspection shall be offered by the Contractor only under packed condition as detailed earlier in the specification. The Employer shall select sample at random from the packed lot for carrying out acceptance tests. Insulators shall normally be offered for inspection in lots not exceeding 5,000 nos. The lot should be homogeneous, and should contain insulators manufactured in the span of not more than 3-4 consecutive weeks.

6.1.12 IDENTIFICATION MARKING

- 6.1.12.1. Each disc insulator unit shall be legibly and indelibly marked with the trade mark of the manufacturer, the year of manufacture, the guaranteed combined mechanical and electrical strength in Kilo-Newton abbreviated by 'KN' to facilitate easy identification and proper use.
- 6.1.12.2. The marking shall be on porcelain. The marking on the insulator shall be printed and not impressed and the same shall be applied before firing.
- 6.1.12.3. One 10mm thick ring or 20mm thick spot of suitable quality of paint shall be marked on the cap of each insulator of particular strength for easy identification of the type of

insulator. The paint shall not have any deteriorating effect on the insulator performance. Following codes shall be used as identification mark.

6.1.12.4. For 90 KN disc: Black

For 160 KN disc: Red

6.1.13 QUALITY ASSURANCE PLAN (QAP)

6.1.13.1. The Bidder shall invariably furnish the following information along with his offer, Information shall be separately given for individual type of equipment offered.

- a) Statement giving list of important raw materials, names of sub-contractors for the raw material, list of standards according to which the raw material are tested, list of tests normally carried out on raw material in presence of Bidder's representative and copies of test certificates.
- b) Information and copies of test certificates as in (a) above in respect of bought out items.
- c) List of manufacturing facilities available.
- d) Level of automation achieved and list of areas where manual processing exists.
- e) List of areas in manufacturing process, where stage inspections are normally carried out for quality control and details of such tests and inspections.
- f) Special features provided in the hardware to make it maintenance free.
- g) List of testing equipment available with the Bidder or its proposed manufacturer for final testing of insulators specified and test plant limitation, if any, vis-a-vis the type, special, acceptance and routine tests specified in the relevant standards. These limitations shall be very clearly brought out in schedule of deviations from specified test requirements.

6.1.13.2. The Contractor shall within 30 days of placement of order, submit the following information to the Employer.

- a) List of raw material as well as bought out accessories and the name of the raw material as well as bought out accessories with the names of sub-Contractors selected from those furnished along with the offer.
- b) Type test certificates of the raw material and bought out accessories.
- c) Quality Assurance Plan (QAP) with customer holds points for Employer's inspection. The QAP and Employer's hold points shall be discussed between the Employer and the Contractor before the QAP is finalized.

6.1.13.3. The Contractor shall submit the routine test certificates of bought out items and raw material at the time of routine testing of insulators.

6.1.14 TEST REPORTS

6.1.14.1. Six copies of type test reports shall be furnished to the Employer within 15 days of conducting the tests. One copy will be returned duly certified by the Employer to the Contractor within three weeks there afterwards and on receipt of the same Contractor shall commence with the commercial production of the concerned material.

6.1.14.2. Six copies of acceptance test reports shall be furnished to the Employer. One copy will be returned, duly certified by the Employer and only thereafter shall the materials be dispatched.

6.1.14.3. All records of routine test reports shall be maintained by the Contractor at his works for periodic inspection by the Employer.

6.1.14.4. All test reports of tests conducted during manufacture shall be maintained by the Contractor. These shall be produced for verification as and when requested for by the Employer.

6.1.15 COORDINATION FOR TESTING

The contractor and its designated manufacturer shall take full responsibility for supply and testing of insulator discs with the required hardware fittings and shall have to also guarantee the test values and overall satisfactory performance of disc insulators with the hardware fittings.

6.1.16 PACKING AND FORWARDING

- 6.1.16.1. All insulators shall be packed in strong seasoned wooden crates. The gross weight of the crates along with insulators shall not normally exceed 50 Kg to avoid handling problem.
- 6.1.16.2. The packing shall be of sufficient strength to withstand rough handling during transit, storage at site and subsequent handling in the field.
- 6.1.16.3. Suitable cushioning, protective padding, or dunnage or spacer shall be provided to prevent damage to or deformation during transit and handling.
- 6.1.16.4. All packing cases shall be marked legibly and correctly so as to ensure their safe arrival at their destination and to avoid the possibility of goods being lost or wrongly dispatched on account of faulty packing or faulty or illegible markings. Each wooden case/crate shall have all the markings stenciled on it in indelible ink. All galvanized components shall be given a protective coating against formation of white rust.

6.1.17 QUANTITY AND DELIVERY REQUIREMENTS

The schedule of requirements and the desired delivery is set out in the bidding document. The quantities given in the schedule are provisional and the exact qty shall be finalized after detailed survey.

6.1.18 TEST DETAILS**6.1.18.1. Mechanical Strength Test**

The complete insulator string along with its hardware fittings without arcing horn and suspension assembly / dead end assembly shall be subjected to a load equal to 50% of the specified minimum ultimate tensile strength (UTS) which shall be increased at a steady rate to 67% of the minimum UTS specified. The load shall be held for five minutes and then removed. After removal of the load, the string components shall not show any visual deformation and it shall be possible to disassemble them by hand. Hand tools may be used to remove cotter pins and loosen the nuts initially. The string shall then be reassembled and loaded to 50% of UTS and the load shall be further increased at a steady rate to the specified minimum UTS and held for one minute. No

fracture should occur during this period. The applied load shall then be increased until the failing load is reached and the value recorded.

6.1.18.2. Chemical Analysis of Zinc Used For Galvanizing

Samples taken from the zinc ingot shall be chemically analyzed as per IS: 209. The purity of zinc shall not be less than 99.5 %.

6.1.18.3. Tests for Forgings

The chemical analysis, hardness test, 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 Employer in the Quality Assurance Programme.

6.1.18.4. 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 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 Employer in the Quality Assurance Programme.

6.1.18.5. Eccentricity Test

The insulator shall be vertically mounted on a fixture using dummy pin and socket. A vertical scale with horizontal slider shall be used for the axial run out. The pointer shall be positioned in contact with the bottom of the outermost petticoat of the disc. The disc insulators shall be rotated with reference to the fixture and the slider shall be allowed to move up and down on the scale but always maintaining contact with the bottom of the outermost petticoat. After one full rotation of the disc the maximum and minimum position the slider has reached on the scale can be found out. Difference between the above two readings shall satisfy the guaranteed value for axial run out. Similarly using a horizontal scale with vertical slider the radial run out shall be measured. The slider shall be positioned on the scale to establish contact with the circumference of the disc insulator and disc insulator rotated on its fixture always maintaining the contact. After

one full rotation of the disc the maximum and minimum position of the slider reached on the scale are found out. The difference between the above readings shall satisfy the guaranteed value for radial run out.

6.1.18.6. Hydraulic Internal Pressure Test on Shells

The test shall be carried out on 100% shells before assembly. The details regarding test will be as discussed and mutually agreed to by the Contractor and Employer in the Quality Assurance Programme.

6.1.18.7. Crack Detection Test

Crack detection test shall be carried out on each ball pin before assembly of disc unit. The manufacturer shall maintain complete record of having conducted such tests on each and every piece of ball pin. The bidder shall furnish full details of the equipment available with him for crack test and also indicate the test procedure in detail.

6.1.18.8. Voltage Distribution Test

The voltage across each insulator unit shall be measured by sphere gap method. The result obtained shall be converted into percentage. The voltage across any disc shall not exceed 13% for suspension insulator strings and 14% for tension insulator strings.

6.1.18.9. Dynamic/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 conductor tensioned at 43 KN shall be secured with clamps. The system shall be suitable to maintain constant tension on conductor throughout the duration of the test. Vibration dampers shall not be used on the test span. The conductor shall be vertically vibrated at one of the resonance frequencies of the insulators string (more than 10 Hz) by means of vibration inducing equipment. The peak to peak displacement in mm of vibration at the antinode point nearest to the string shall be measured and the same shall not be less

than $1000/f^{1.8}$ where f is the frequency of vibration in cycles/sec. The insulator string shall be vibrated for not less than 10 million cycles without any failure. After the test the disc insulators shall be examined for looseness of pins and cap or any crack in the cement. The hardware shall be examined for looseness for fatigue failure and mechanical strength test. There shall be no deterioration of properties of hardware components and disc insulators after the vibration test. The disc insulators shall be subjected to the following tests as per relevant standards:

TABLE-6.8**Tests: Percentage of discs to be tested.**

a	Temperature cycle test followed by mechanical performance test	60
b	Puncture test	40

6.1.18.10. RIV Test (Dry)

Under the conditions as specified under clause 6.1.18.11 below the insulator string along with complete hardware fittings shall have a radio interference voltage level below 1000 microvolts at one (1) MHz when subjected to 50 Hz AC voltage of 154 KV(rms) line to ground under dry conditions. The test procedure shall be in accordance with IS: 8263-1976/IEC:437, or its latest revision thereof.

6.1.18.11. Corona Extinction Voltage Test

The complete insulator string when subjected to power frequency voltage shall have a corona extinction voltage of not less than 154 KV rms line to ground under dry conditions. There shall be no evidence of corona on any part of the samples when all sources of corona are photographed in a darkened room. The atmospheric conditions during testing shall be recorded and the test results shall be accordingly corrected to standard atmospheric conditions with suitable correction factor as stipulated in IEC: 383.

6.1.18.12. Pollution Withstand Voltage Test

The test shall be carried out in accordance with the clean fog test method (solid layer method) prescribed in Section 4 of IEC: 60507-1991. Test procedure is as follows:-

The test object is first contaminated by dipping in contaminant solution, which is composed of salt (NaCl), non-soluble material (Kaolin) and water. Non-soluble deposit density (NSDD) and salt deposit density are 0.1 mg/sq.cm and 0.03 mg/sq.cm, respectively. After having been contaminated and dried, the test object is installed in the fog chamber. The specified constant test voltage as per IEC-60507 is applied to the test object and then artificial steam fog is generated. The applied voltage is maintained for 60 minutes or until flash over occurs within 60 minutes. The above procedure is repeated at least three (3) times on renewed contaminated test object.

6.1.18.13. Steep Wave Front Test

The following test shall be performed on 10 insulator units selected at random from the lot offered for selection for Type test.

- a) Each insulator unit shall be subjected to five successive positive and negative flashovers with a wave having minimum effective rate of rise of 2500 kV per microsecond.
- b) Each unit shall then be subjected to three dry power frequency voltage flashovers. Acceptance Criteria an insulator shall be deemed to have met the requirement of this test if having been successfully subjected to the ten impulse flashovers, the arithmetic mean of the three subsequent dry power frequency voltage flashover values equals or exceeds 95% of the rated dry power frequency flashover voltage. An insulator shall be deemed to have failed to meet the requirement of above testing if
 - (i) It has not flashed over when the oscillogram or peak voltage indicator shows a marked reduction in voltage.
 - or
 - (ii) Any one of the subsequent three dry power frequency voltage flashover values is less than 80% of the value specified. Failure of any one unit either in the steep front of wave or subsequent low frequency voltage test shall be cause for testing on double number of units.

6.1.18.14. Thermal Mechanical Performance Test

Thermal Mechanical Performance Test shall be performed in accordance with IEC 60383-1-1993 clause 20 with the following modifications:

- (i) The applied mechanical load during this test shall be 70 % of the rated electromechanical or mechanical value.
- (ii) The acceptance criteria shall be
 - a) X greater than or equal to $R+3S$
 where X is Mean value of the individual mechanical failing load.
 R is the Rated electro-mechanical/mechanical failing load.
 S is the Standard deviation
 - b) The minimum sample size shall be taken as 20 for disc insulator units.
 - c) The individual electromechanical failing load shall be at least equal to the rated value. Also puncture shall not occur before the ultimate fracture.

6.1.18.15. Residual Strength Test

The above test shall be performed as per clauses 4.4 and 4.5 of IEC-797 preceded by the temperature cycle test. The sample size shall be 25 and the evaluation of the results and acceptance criteria shall be as per clause no. 4.6 of IEC : 60797.

6.1.18.16. Electromechanical Failing Load Test

This test shall be performed in accordance with clause 18 of IEC-383 with the following acceptance criteria:

- a) X greater than or equal $R+3S$ where
 X Mean value of the electro-mechanical failing load.
 R Rated electromechanical failing load
 S Standard deviation
- b) The minimum sample size shall be taken as 20 for disc insulator units. However, for larger lot size, IEC-591 shall be applicable.
- c) The individual electro-mechanical failing load shall be at least equal to the rated value. Also electrical puncture shall not occur before the ultimate fracture.

6.2 INSULATOR HARDWARE FITTINGS**6.2.1 SCOPE**

6.2.1.1. This section covers design, manufacture, stage testing, inspection and testing before dispatch, packing, supply and delivery CIP (free at destination site/store) of hardware fittings, specified herein under for their satisfactory operation on 220 KV transmission lines.

6.2.1.2. The following are the materials covered in this specification:

TABLE-6.9**Hardware Fittings for Insulators**

S.No.	Particulars	220 kV
1	Twin moose Double Suspension "II" Insulator String (2x90kN)	2 x 14 Nos
2	Quad Moose Double suspension string (2x160kN)	2 x 14 Nos
3	Single Suspension pilot Insulator String for Twin Moose Conductor (1x90kN)	1x15 Nos
4	Double Suspension pilot Insulator String for Quad Moose Conductor (2x90kN)	2 x 15 Nos
5	Twin Moose Double Tension Insulator String, 2 x 160kN for normal Towers 2 x 210kN for special Towers	2 x 15 Nos.
6	Quad Moose Quad Tension Insulator String, 4 x 160kN for normal Towers 4 x 210kN for special Towers	4 x 15 Nos

These numbers of discs are for altitude up to 1000 meter. The no. of required discs shall be increased for altitudes higher than 1,000m as per following:

Altitude range	Increased no. of discs
1,000 meter -2,000 meter	2
2,000 meter-2,600 meter	3

- 6.2.1.3.** For Twin Moose Section, Single suspension "pilot" insulator string disc insulator unit of 1x90 kN EM strength shall be used and for Quad Moose Section, Double suspension "pilot" insulator string disc insulator unit of 2x90 kN EM strength shall be used.
- 6.2.1.4.** For Twin Moose Double Tension and Quad Moose Quad Tension Insulator String, disc insulator units of 160 KN EM strength shall be used.
- 6.2.1.5.** For Special Towers, Twin Moose Double Tension and Quad Moose Quad Tension Insulator String, disc insulator units of 210kN EM strength shall be used.

6.2.2 STANDARDS

- 6.2.2.1** The design, identification, manufacture and performance testing of the equipment shall comply with the latest editions and amendments of the relevant Indian Standards or International Standards. The tenderer shall clearly indicate in his tender the reference standards to which the design, manufacture and performance testing of the material offered shall comply.
- 6.2.2.2** Some of the applicable Standards, along with internationally recognized standards to which these generally correspond are as given below.

TABLE-6.10

S.No.	Indian Standards (IS)	TITLE	International & Internationally recognized standard
1	IS 209-1966	Specification for Zinc	BS: 3436-1986
2	IS 2071-1974	Method of high voltage testing, general definitions and test requirement	BS: 137-1982 (I & II) IEC: 60274-1968 IEC: 60383-1993 (Part I&II)
	part-I 1974	General definitions and test requirements.	
	part-II part-III	Test Procedure Measuring devices.	
3	IS 731-1974	Porcelain insulators for overhead	IEC 60383 -1993 (Part I&II)

		power lines with a nominal voltage greater than 1000 V	
4	IS: 2121-1981	Specification for Conductors and earth wire accessories for overhead power lines.	
	Part-I	Armor Rods, binding wires and tapes for conductors.	
	Part-II	Mid span joints and repair sleeves for conductor.	
5	IS: 2486	Specification for insulator fittings for overhead power lines with a nominal voltage greater than 1000V.	
	Part-I: 1971	General requirements and Tests	BS: 3288-1979
	Part-II: 1974	Dimensional requirements	IEC: 60120-1984
	Part-III: 1975	Locking Devices.	IEC: 60372-1984
6	IS: 2629-1985	Recommended practice for hot dip galvanizing of iron and steel.	
7	IS: 2633-1986	Method for testing of uniformity of coating of zinc coated articles.	
8	IS: 3138-1966	Hexagonal bolts and nuts.	ISO/R947 and ISO/R272
9	IS: 3188-1980	Dimensions for disc insulators.	IEC: 305-1978
10	IS: 4218-1976	ISO metric screw threads.	ISO/R 68-1969, R-26-1963, R262-1969, R 965-1969.
11	IS: 6745-1972	Determination of weight of zinc coating on zinc coated iron and steel articles.	BS: 433-1969 ISO:1460(E)
12	IS: 8263-1976	Methods of RI test on HV	IEC: 60437-1973 NEMA

		insulators.	PUBLICATION NO.107/1964 CISPR
13	IS: 8269-1976	Methods for switching impulse test on HV insulators.	IEC: 60506-1975
14		Thermal mechanical performance test and mechanical performance test on string insulator units. Sampling rules	IEC: 60575 IEC: 591-1978
15	IS: 6639-1972	Hexagonal bolts for steel structures.	ISO/R272-1968
16		Ozone test on Elastomer.	ASTM-D1171
17	IS: 406	Methods of Chemical Analysis of Slab zinc.	

6.2.3 DETAILS OF HARDWARE FITTINGS

6.2.3.1 The hardware fittings shall be as per the specification. Hardware fittings shall be suitable for single/double suspension insulator strings and single/double tension insulator strings. Each hardware fitting shall be supplied complete in all respects and shall include all components indicated in the specification.

6.2.3.2 Particulars of Insulators and Insulator Strings

TABLE-6.11

Particulars of Insulators and Insulator Strings

Particulars	Twin Moose Double Suspension String	Twin Moose Double Tension String	Quad Moose Double Suspension String	Quad Moose Quad Tension	Single "I" /Double "II" Suspension Pilot Insulator String
1.No. of standard Discs	2x14	2x15	2x14	4x15	1x15 (twin moose) 2x15 (Quad Moose)

2. Size of disc-mm	255 x145	280x170 and 305x170 (for special Towers)	280x170	280x170 and 305x170 (for special Towers)	255 x145 (twin moose)
3. E&M Strength of each string	2x90 kN	2x160 kN and 2x210kN (for special towers)	2x160 kN	4x160 kN and 4x210kN (for special towers)	1x90 kN (twin moose) 2x 90kN (Quad Moose)
4. Ball and socket Designation (mm)	16	20	20	20	16
5. Minimum Creepage distance of each disc (mm)	430	430 and 545mm (for special Towers)	430	430 and 545mm (for special Towers)	430

6.2.4 BID DRAWINGS

A list of specification drawings in respect of the hardware fittings of this specification are indicated in drawing's section 6 These specification drawings are attached herewith for information and guidance of the Bidder only. The drawings to be furnished by the Bidder shall be as per his own design and manufacturing and shall be distinct and separate from these specification drawings.

- The tenderer shall furnish full description and illustration of materials offered.
- Dimensioned drawings of the complete insulator strings and their component parts showing clearly the following arrangements shall be furnished. Weight, material and fabrication details of all the components should be included in the drawings.
 - a) Attachment to the hanger or strain plate.
 - b) Suspension or dead end assembly.
 - c) Arcing horn attachment to the string as specified in this specification.
 - d) Yoke plates.

- e) Hardware fittings of ball and socket type for interconnecting units to the top and bottom yoke plates.
- f) Links with suitable fittings.
- g) Any other.
- After placement of award, the contractor shall submit fully dimensioned drawings including all the components in three (3) copies to the Employer for approval. After getting approval from the Employer and successful completion of all the type tests, the contractor shall submit 6 more copies of the same drawings to the Employer for further distribution and field use at Employer's end.
- Material specifications, details of applicable standards and heat treatment details shall also be furnished.
- The details of manufacturing process also shall be furnished along with the component drawings.
- The details of trade mark to be provided on the components shall also be furnished.

6.2.5 GENERAL TECHNICAL REQUIREMENTS

6.2.5.1 General

This section details out the technical specification of the hardware fittings for 220 KV insulator strings suitable for Twin and Quad ACSR “MOOSE” – 597 mm² conductor.

6.2.5.2 Details of Hardware Fittings

The hardware fittings shall be as per specification. Each set of hardware fittings shall be supplied complete in all respects and shall include following hardware parts:

- a) Suitable yoke plate for double suspension, double tension and Quad Tension strings complying with the specification given here-in-after.
- b) Suitable arcing horn as specified in clause here-in-after.
- c) Suspension clamp and tension i.e., dead-end clamp and armor rods to suit conductor sizes.

- d) Other fittings necessary, for making the string assemblies complete such as ball hook, hanger, eye links, ball-clevis, socket-clevis, clevis-eye, clevis-clevis, clevis-tongue, chain link and anchor shackles etc.
- e) 2.5% extra fasteners and aluminium filler plugs.

6.2.5.3 Important Design Features

6.2.5.3.1 The insulator strings along with hardware fittings shall be used by attachment to tower in the following manner:

a) Suspension strings

The Twin Moose Double suspension Insulator string shall consist of 2x 14 nos. discs of 90 KN EM strength and Quad Moose Double suspension string shall consist of 2 x 14 nos. discs of 160 KN EM strength for 220 kV Transmission Line. Each set of hardware fittings shall be supplied for attaching to hanger/anchor shackle fixed to the tower.

b) Tension strings

Twin Moose Double tension string shall consist of 2x15 nos. discs of 160 KN EM strength and Quad Moose Quad Tension String shall consist of 4 x 15 nos. discs of 160 KN EM strength for 220 kV Line. Suitable anchor shackles shall be designed to accommodate the tower strain plates. For Special Towers, Twin Moose Double Tension and Quad Moose Quad Tension Insulator String, disc insulator units of 210kN EM strength shall be used instead of 160kN.

c) Pilot Insulator String

The Twin Moose Single suspension "I" Pilot Insulator string to be used for large angle towers, shall consist of 1x 15 nos. discs of 90 KN EM strength and Quad Moose Double suspension "II" Pilot Insulator string to be used for large angle towers, shall consist of 2 x 15 nos. discs of 90 KN EM strength for 220 kV Transmission Line. Each set of hardware fittings shall be supplied for attaching to hanger/anchor shackle fixed to the tower.

- d) These numbers of discs are for altitude up to 1000 meter. The no. of required discs shall be increased for altitudes higher than 1,000m as per following:**

Altitude range	additional no. of discs
1,000 meter -2,000 meter	2
2,000 meter-2,600 meter	3

- 6.2.5.3.2** Tolerance on overall length of the hardware fittings/complete insulator strings shall be + 2% and on individual components + 3%.

6.2.6 INTERCHANGEABILITY

The hardware together with ball and socket fittings shall be of standard design so that these hardware are interchangeable with each other and suitable for use with disc insulators of any make conforming to relevant Indian/International standard.

6.2.7 BALL AND SOCKET FITTINGS

- 6.2.7.1** The dimensions of the ball and socket shall be of designation 16 mm for 90 kN & 20 mm for 160 KN respectively for suspension string assembly and tension string assembly in accordance with standard dimensions stated in IS: 2486 (Part-II)/IEC:120.

6.2.7.2 Ball Fittings

Ball fittings shall be made of class IV steel as per IS: 2004 -1978 or steel of equivalent grade forged in one piece. They shall be normalized to achieve the minimum breaking strength. 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.

6.2.7.3 Socket Fittings

- Socket fittings shall be made of class IV steel as per IS: 2004-1978 or steel of equivalent grade and shall be forged in one piece. They shall be normalized to achieve the minimum breaking strength.
- Socket ends, before galvanizing shall be of uniform contour. The bearing surface of socket ends shall be uniform about the entire circumference without depressions

or high spots. The internal contours of socket ends shall be symmetrical with axis of the fittings as per relevant standards. The axis of the bearing surfaces of socket ends shall be co-axial with the axis of the fittings. There shall be no noticeable tilting of the bearing surfaces with the axis of the fittings.

6.2.8 DIMENSIONS AND TOLERANCES

- The dimensions and tolerances of pin balls and socket ends shall conform to IS: 2486 Part-II/IEC120 and shall be checked by the gauge therein after galvanizing.
- 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.
- The bearing surfaces of balls and machined sockets, before galvanizing, shall not have surface roughness more than 250 micro inches.
- 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.

6.2.9 SECURITY CLIPS AND SPLIT PINS

The security clip shall be made of stainless steel as per AISI 302 or 304-L or phosphor bronze as per IS: 7814-1985.

- Socket fittings shall be provided with R-shaped security clip in accordance with IS: 2486 (Parts III & IV) to provide positive locking against unintentional disengagement of socket from the ball of the insulator. The security clip shall be humped to maintain the clip in the locked position and shall have both prongs spread to prevent complete withdrawal from the socket. The clip end shall not project outside the recess of socket when the clip is in locked position.
- 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.

- Split pins shall be used with cotter bolts.
- The force required to pull the clip to its unlocked position shall not be less than 50 N or more than 500 N.

6.2.10 CORONA AND RI PERFORMANCE

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

6.2.11 ARCING HORN

The arcing horn shall be either ball ended rod type or tubular type. The design of the arcing horn shall be such that effective operation under actual field conditions is ensured. The design of arcing horn shall be such that the negative tolerance in the insulator string may not infringe the requirement of minimum arcing distance. The minimum arcing distance between arcing horn and corona control rings/grading ring shall be 3050 mm. The minimum arcing distance shall be as indicated in the drawings.

6.2.12 Yoke Plates/Link Plates

- The yoke plates/link plate shall be made of mild steel or high tensile steel, hot dip galvanized.
- The strength of yoke plate shall be adequate to withstand the minimum ultimate tensile strength. The plates shall be either triangular or rectangular in shape. The design of yoke plate shall take into consideration the most unfavorable loading conditions likely to be experienced as a result of dimensional tolerance for disc insulators as well as components of hardware fittings within the specified range. The plates shall have suitable holes for fixing arcing horn. All corners and edges shall be rounded with a radius of about 3 mm.
- Holes shall be cylindrical, clean cut and perpendicular to the plane of the material. The periphery of the holes shall be free from burrs. Design calculation i.e. for bearing and tensile strength for deciding dimensions of yoke plate shall be

furnished by the contractor. The holes provided for bolts in the yoke plate should satisfy shear edge condition as per clause no. 8.10 of IS: 800-1984.

6.2.13 CORONA CONTROL RINGS/GRADING RING

- 6.2.13.1** The corona control rings/grading rings shall be made of high strength heat treated aluminium alloy tube. The brackets for supporting the rings and mounting bolts shall be of high strength aluminium alloy or hot dip galvanized mild steel. The welded joint should be of the mechanical strength at least 20 KN (2,000 Kg.).
- 6.2.13.2** The corona control rings/grading ring having suitable design as detailed hereunder shall be provided on the line side of all the string hardware fittings.
- 6.2.13.3** The design and shape of the corona control rings/grading ring shall be such that it will reduce the voltage across the line side insulator unit, adjacent to the conductor of an insulator string, to a value less than 22 kV to prevent visual corona from forming on metal parts of the insulators and shall minimize the Radio Interference Voltage (RIV) from complete insulator and hardware assemblies when operated at a voltage 10% higher than the rated service voltage.
- 6.2.13.4** The corona control ring shall have a minimum wall thickness of 2.5mm and tube diameter between 55-60mm. The brackets shall not be welded to the pipe but shall be fixed by means of bolts and nuts on a small attachment or a plate welded to the pipe. The welded portion of the corona control ring/grading ring shall be grinded before buffing.
- 6.2.13.5** The corona control ring/grading ring should have a brushed satin finish and not a bright glossy surface to pass electrical requirement for smoothness. No blemish should be seen or felt when rubbing a hand over the metal.

6.2.14 SAG ADJUSTMENT DEVICE

- 6.2.14.1** The sag adjustment device shall be of high quality mild steel or high tensile steel and hot dip galvanised.
- 6.2.14.2** The sag adjustment device to be provided with the double tension fitting shall be of the three plate type. The sag adjustment device 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. The ultimate tensile strength shall be 161.78 KN (16,500 Kg.).

6.2.14.3 The maximum length of sag adjustment device from the connecting part of the rest of the hardware fittings shall be 520 mm. The details of maximum and minimum adjustment shall be clearly indicated in the drawing submitted with tender. The adjustment of 150 mm shall be possible with the sag adjustment device. The step of adjustment shall not be more than 15 mm.

6.2.15 SUSPENSION ASSEMBLY

- The suspension assembly for 220 kV line shall be suitable for Twin and Quad ACSR “MOOSE 597 mm²” conductor.
- The suspension assembly shall include either free centre type suspension clamp along with a set of standard formed armor rods or one armor grip suspension clamp. For pilot insulator string only free centre type suspension clamp shall be used.
- The suspension clamp along with standard formed armor 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.
- The suspension clamp along with standard formed armor rods set shall have a slip strength not less than 8% of UTS and not to be more than 15% of UTS of conductor as per IS 2486 part-I - 1993.
- The suspension assembly shall be smooth without any cuts, grooves, abrasions, projections, ridges or excrescences which might damage the conductor.
- In case, the magnetic power loss of the suspension assembly obtained during type testing of the same exceeds the value guaranteed by the tenderer in his tender, the material shall be rejected outright.

6.2.16 FREE CENTRE TYPE SUSPENSION CLAMP

- The clamp body and keeper pieces shall be of high strength corrosion resistant and heat treated cast/forged aluminium alloy. The components such as cotter bolts, hangers, shackles, brackets and U-bolts etc., shall be of galvanized mild steel, drop forged steel or high strength aluminium alloy.
- The body of free centre type suspension clamp shall be smoothly rounded and curved into a bell mouth at the ends. The lip edges shall have rounded head. There shall be at least two U-bolts for tightening of clamp-body and keeper pieces together.

6.2.17 Preformed Armor Rods set

- The Pre-formed armor rods shall be made of high strength special aluminium alloy of type 6061 or equivalent duly heat treated during manufacturing process. The finished rod shall have a minimum tensile strength of 35 Kg/Sq.mm.
- The AGS formed Armor rod set suitable for ASCR “MOOSE – 597 mm²” (220 kV line) conductor (line) conductor shall be used to minimize the stress developed in the conductor due to different static and dynamic loads because of vibration due to wind, slipping of conductor from the suspension clamp as a result of unbalanced conductor tension in adjacent spans and broken wire conditions. It shall also withstand power arcs, chafing and abrasion from suspension clamp and localized heating effect due to magnetic power loss from Suspension clamp as well as (I²R) resistance losses of the conductor.
- The formed armor rod set shall have right hand lay and the inside diameter of the helix shall be less than the outside diameter of the conductor to grip the same tightly. The surface of the armor rod when fitted on the conductor shall be smooth and free from projections, cuts and abrasions etc.
- The pitch length of the rods shall be determined by the Bidder but shall be less than that of the outer layer of ASCR “MOOSE – 597 mm²” for 220 kV line conductor and the same shall be accurately controlled to maintain uniformity and consistently reproducible characteristic wholly independent of the skill of linemen.

- The length and diameter of each rod shall be 2540mm + 25 mm and 9.27 mm $\pm$ 0.1 mm respectively. The tolerance in length of the rods in completed set should be within 13 mm between the longest and shortest rod. The ends of armor rod shall be parrot billed.
- The number of armor rods in each set shall be 13. Each rod shall be marked in the middle with paint for easy application on the line.
- The armor 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).

6.2.18 ARMOR GRIP SUSPENSION CLAMP

- The armor grip suspension clamp shall comprise of retaining strap, support housing, elastomer inserts with aluminium reinforcements and AGS formed rod set.
- The armor grip suspension clamp shall be so manufactured that it shall minimize the static and dynamic stress developed in the conductor under various loading conditions as well as during wind induced conductor vibrations. It shall allow slipping of the conductor under unbalanced conductor tension in adjacent spans and broken wire conditions. It shall also withstand power arcs and have required level of Corona/RIV performance. The AGS preformed rods shall be as detailed in clause 6.18.13 above except for the following:
 - a) The length of the formed rods shall be such that it shall ensure sufficient slipping strength as detailed in cl. 6.18.11 and shall not introduce unfavorable stress on the conductor under all operating conditions.
 - b) Elastomer cushion shall be resistant to the effects of temperature up to + 75 deg C, ozone, ultraviolet radiations and other atmospheric contaminants likely to be encountered in service. The physical properties of the elastomer shall be of approved standard. It shall be electrically shielded by a cage of AGS formed rod set. The elastomer cushion shall be so designed that the curvature of the AGS rod shall follow the contour of the neoprene insert and shall not leave any gap between the two when installed.

- The tenderer may clearly indicate remedial measures to overcome the problem of external erosion if any arising from galvanic interaction between the graphite loaded rubber and the aluminium strands.

6.2.19 DEAD END ASSEMBLY

- The dead end Assembly shall be suitable for Twin and Quad ACSR "MOOSE – 597 mm²" conductor and made of specially aluminum alloy for better conductivity and strength.
- The dead end assembly shall be of compression type with provision for compressing jumper terminal at one end. The angle of jumper terminal to be mounted should be 30 deg. with respect to the vertical line. The area of bearing surface on all the connections shall be sufficient to ensure positive electrical and mechanical contact and avoid local heating due to I²R losses. The resistance of the clamp when compressed on the conductor shall not be more than 75% of the resistance of equivalent length of conductor.
- The assembly shall not permit slipping of, damage to or failure of the complete conductor or any part thereof at a load less than 95% of the minimum UTS of the conductor.
- The mechanical efficiency of the clamp shall not be affected by method of erection involving the use of 'come-along' or similar clamps before, during or after assembly and erection of tension clamps itself.
- The outer sleeve shall be made out of E.C. grade aluminium of purity not less than 99.5%.
- Dimensional tolerance of the cross section of aluminium shall be as per IS/Standards:

6.2.20 COMPRESSION MARKING

Die compression length shall be clearly marked on each dead end assembly designed for continuous die compressions and shall bear the words 'COMPRESS FIRST' suitably

inscribed near the point on each assembly where the compression begins. It shall bear identification marks 'COMPRESSION ZONE' and 'NON-COMPRESSION ZONE' distinctly with arrow marks showing the direction of compressions and knurling marks showing the end of the zones. Tapered aluminium filler plugs shall also be provided at the line of demarcation between compression and non-compression zone. The letters, number and other markings on the finished clamp shall be distinct and legible.

6.2.21 FASTENERS

- All fasteners shall conform to IS: 6639-1972. All fasteners shall be hot dip galvanized. All bolts and nuts shall have hexagonal heads, the heads being forged out of solid truly concentric, and square with the shank, which must be perfectly straight. All bolts and nuts shall be galvanized as per IS-1367-(Part 13)/IS-2629.
- Fully threaded bolt shall not be used. The length of the bolt shall be such that the threaded portion shall not extend into the place of contact of the component parts.
- Flat washers and spring washers shall be provided wherever necessary and shall be of positive lock type. Thickness of washers shall conform to IS: 2016. Spring washers shall be electro galvanized.
- To obviate bending stress in bolt, it shall not connect aggregate thickness more than three times its diameter.
- All bolts shall be threaded to take the full depth of the nuts and threaded enough to permit the firm gripping of the component parts but not further. It shall be ensured that the threaded portion of the bolt protrudes not less than 3 mm and not more than 8 mm when fully tightened. All nuts shall fit and tight to the point where shank of the bolt connects to the head.
- Bolts may have either rolled or cut threads. Nuts may be threaded after galvanizing to ensure clean threads but bolts shall not be threaded or rethreaded after galvanizing. Nut threads shall be tapped oversize to closely fit those of the

galvanized bolt, with no unnecessary looseness but free enough to permit the nut to be turned freely with fingers over the entire threaded length.

- 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 bolt for 5.6 grades 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.
- Nuts should be double chamfered as per the requirement of IS: 1363- PartIII-1984. It should be ensured by the manufacturer that nuts should not be over tapped beyond 0.4mm oversize on effective diameter for size up to M16.
- The bidder shall furnish bolt schedules giving thickness of components connected, the nut and the washer and the length of shank and the threaded portion of bolts, size of holes and any other special details of this nature.
- To ensure effective in-process Quality Control it is essential that the manufacturer should have all the testing facilities for tests like weight of zinc coating, shear strength, other testing facilities etc, in house. The manufacturer should also have proper quality assurance system which should be in line with the requirements of this specification and IS-14000 Services Quality System Standard.
- Fasteners of grade higher than 8.8 are not to be used and minimum grade for bolt shall be 5.6.

6.2.22 FORGED COMPONENTS

Forged components other than those covered in the clauses mentioned herein above shall be made out of class IV steel as per IS: 2004 or equivalent. The components shall be hot dip galvanized. The items shall be normalized to achieve the required tensile properties. The forged components shall not have sharp corners and edges so as to affect corona and RIV performance.

6.2.23 MATERIALS

The materials of the various components shall be as specified in clauses mentioned hereinabove/Section-II. However, components made of alternative materials giving equivalent or better performance shall also be considered. The contractor shall indicate the material proposed to be used for each and every component of hardware fittings stating clearly the class, grade or alloy designation of the material and the reference standards. However the critical dimensions of components shall not be changed in relation to selection of different material.

6.2.24 OTHER MISCELLANEOUS PARTS

Socket ended, ball ended items and all shackles and links shall be made by drop forging process from suitable steel as per IS: 2004-1978 or equivalent. These parts shall be hot dip galvanized after proper machining.

6.2.25 GALVANIZING

- All ferrous parts shall be hot dip galvanized in accordance with IS: 2629 and shall satisfy the tests mentioned in IS: 2633. No material shall be galvanized until all shop operations have been completed except that the nuts may be threaded and oiled after galvanizing. Minimum weight of zinc coating shall be 300 g/sq.m. for fasteners and 610 g/sq.m. for all other hot dip galvanized articles.
- Fasteners shall withstand four dips while spring washers shall withstand three dips each of one minute duration in the Standard Preece test. Other galvanized material shall withstand minimum six dips each of one minute duration in the standard Preece test.
- The zinc coating shall be perfectly adherent, of uniform thickness, smooth, reasonably bright, continuous and free from imperfections such as flux, ash, rust stains, bulky white deposits and blisters.
- The zinc used for galvanizing shall be of minimum grade 99.95% as per IS: 209.

6.2.26 WORKMANSHIP

- All the equipment shall conform to the best modern practices adopted in the Extra High Voltage field. The Bidder shall offer only such equipment as guaranteed by

him to be satisfactory and suitable for 220 kV transmission lines and will give continued good performance.

- The manufacturing process and quality control of all the materials shall be such as to give maximum possible working load, highest mobility, elimination of sharp edges and corners to limit corona and radio-interference, best resistance to corrosion and a good finish.
- Castings shall be uniform without sharp edges or corners, free from all defects like shrinkage, inclusion, blow holes, cracks etc. Pressure die casting shall not be used for casting of components with thickness more than 5 mm.
- Forgings shall be uniform in quality and condition, without sharp edges or corners, free from cracks, flakes or seams, laps, slag, silvers, scabs, rolled-in scale and fissures.
- All current carrying parts shall be so designed and manufactured that contact resistance is reduced to minimum.
- No item shall have sharp ends or edges, abrasions or projections and cause any damage to the conductor in any way during erection or during continuous operation which would produce high electrical and mechanical stresses in normal working. The design of adjacent metal parts and mating surfaces shall be such as to prevent damage of the contact surface and to maintain good electrical contact under service conditions.
- All fasteners shall have suitable corona free locking arrangement and shall not loosen under vibration conditions.
- Welding of aluminium shall be by inert gas shielded tungsten arc or inert gas shielded metal arc process. Welds shall be clean, sound, smooth uniform without overlaps, properly fused and completely sealed. There shall be no cracks, voids, incomplete penetration, incomplete fusions, undercutting or inclusions. Porosity shall be minimized so that mechanical properties of the aluminium alloys are not affected. All welds shall be properly finished as per good engineering practices.

6.2.27 EQUIPMENT MARKING

Each component of hardware shall be marked with the trade mark of the manufacturer. Marks shall be forged or stamped with a steel die before galvanizing. The marks shall be distinct, durable, and conspicuous.

6.2.28 HOT LINE MAINTENANCE

- The equipment offered shall be suitable for hot line maintenance.
- To release the tension in insulator strings, specially designed tools may be necessary. The tenderers shall clearly indicate in their tender the type of tools to be used and shall make sure that fittings and/or yoke plates accommodate these tools. Tenderers shall also indicate the periodicity of maintenance.

6.2.29 TESTS

The following type, acceptance, routine tests and stage tests during manufacture shall be carried out on the hardware fittings.

1. Type Tests

These are those tests which are to be carried out to prove the design, process of manufacture and general conformity of the material in accordance with these specifications. These tests shall be carried out on samples prior to commencement of commercial production against this specification.

2. Acceptance Tests

These are those tests which are to be carried out during inspection prior to dispatch for the purpose of acceptance of that lot.

3. Routine Tests

These are those tests which are to be carried out on each hardware fitting to check the requirements which are likely to vary during production.

4. Stage Tests

Stage tests during manufacture shall mean those tests which are to be carried out during the process of manufacture and end inspection by the Contractor to ensure the desired quality of the end product.

5. Testing Values

For all type and acceptance tests, the acceptance values shall be those values guaranteed by the Contractor in the Guaranteed Technical Particulars or the acceptance values specified in the relevant standard whichever is more stringent for that particular test. The norms and procedures of sampling for these tests will be as per the Quality Assurance Programme to be mutually agreed to by the Contractor and the Employer. The standards and norms to which these tests will be carried out are listed against them. Where a particular test is a specific requirement of this specification, the norms and procedures of these shall be as specified in Clause 6.25 of this specification or as mutually agreed to between the Contractor and the Employer in the Quality Assurance Program.

6.2.30 TYPE TESTS

The following type tests shall be conducted on fittings of each type as indicated in the enclosed drawings. Type tests shall be made on fittings that have passed the routine tests.

6.2.30.1. Type Tests on complete Insulator string along with Hardware fittings.

TABLE-6.12

1	Wet power frequency voltage test	as per IEC: 383-2: -1992
2	Lightning impulse voltage test	
3	Wet switching impulse voltage test	
4	Visual Examination	IS: 731
5	Voltage distribution test	As per Clause no. 6.2.41.2
6	RIV test	As per Clause no. 6.2.41.4
7	Mechanical strength test	As per Clause no. 6.2.41.5
8	Dynamic/Vibration test	As per Clause no. 6.2.41.16
9	Corona Extinction voltage test	As per Clause no. 6.2.41.3
10	Pollution withstand voltage test	As per IEC: 60507-1991

Note:

- i. All the type tests given under clause 6.19 shall be conducted on Twin Moose Double suspension, Quad Moose Double Suspension, Twin Moose Double Tension and Quad Moose Quad Tension insulator string along with hardware fittings.
- ii. All the above tests except at SI No. 8 shall also be conducted on Single and Double suspension pilot insulator strings along with hardware fittings.

6.2.30.2. On Suspension Hardware fitting only

TABLE-6.13

A	Shore hardness test of elastomer cushion for AG suspension clamp	As per Clause no. 6.2.41.10
B	Bend test for armor rod set	IS: 2121 (Part-I)
C	Resilience test for armor rods set	
D	Conductivity test for armor rods set	
E	Clamp slip strength versus torque test for suspension clamp	As per Clause no. 6.2.41.15
F	Magnetic power loss test	As per Clause no. 6.2.41.6
G	Mechanical strength test	As per Clause no. 6.2.41.5 & Clause no. 6.2.41.9
H	Mechanical strength test of welded joint	As per Clause no. 6.2.41.8
I	Test on locking devices for ball and socket coupling	IEC-372(2)- 1976
J	Mechanical strength test of each component	As per Clause no. 6.2.41.7
K	Verification of dimensions	IS: 2486(Part-I)
L	Galvanizing/Electroplating	As per Clause no. 6.2.41.11
M	Visual Examination	IS: 2486(Part-I)
N	Ozone test on elastomer	As per Clause no. 6.2.41.17

6.2.30.3. On Tension Hardware Fittings only**TABLE-6.14**

a.	Slip strength test for dead end assembly	IS: 2486 (Part-I)
b.	Electrical resistance test for dead end assembly	
c.	Heating cycle test for dead end assembly	
d.	Mechanical strength tests	As per Clause no. 6.2.41.5 & Clause no. 6.2.41.9
e.	Verification of dimensions	IS: 2486 (Part-I)
f.	Galvanizing/Electroplating	As per Clause no. 6.2.41.11
g.	Visual examination	IS: 2486 (Part-I)

6.2.30.4. Tests on Corona/Grading Rings

- a. Mechanical Test : As per Cl. 6.25.18
- b. Electrical Test : As per Cl. 6.25.19

Assembly Test	As per Clause no. 6.2.41.1

6.2.31 ACCEPTANCE TESTS**6.2.31.1. On both Suspension and Tension hardware fittings for 220 kV lines****TABLE-6.15**

a.	Visual examination	IS: 2486 (Part-I)
b.	Verification of dimensions	IS: 2486 (Part-I)
c.	Galvanizing / Electroplating test	As per Clause no. 6.2.41.11
d.	Mechanical strength test of welded joint	As per Clause no. 6.2.41.8
e.	Test on locking devices for ball and socket coupling	IEC: 372(2) 1976
f.	Mechanical strength test of each component	As per Clause no. 6.2.41.7

	(excluding arcing horn.)	
g.	Mechanical strength test on arcing horn.	BS 3288 (Part-I) 1979
h.	Assembly Test	As per Clause no. 6.2.41.1

6.2.31.2. On Suspension Hardware Fittings only**TABLE-6.16**

a.	Shore hardness test of elastomer cushion for AG suspension clamp	As per Clause no. 6.2.41.10
b.	Bend test for armor rod set	IS: 2121(PART-I)
c.	Resilience test for armor rods set	
d.	Conductivity test for armor rods set	
e.	Clamp slip strength versus torque test for suspension clamp	As per Clause no. 6.2.41.15
f.	Assembly Test	As per Clause no. 6.2.41.1

6.2.31.3. On Tension Hardware Fittings Only**TABLE-6.17**

a.	Slip strength test for dead-end assembly	IS: 2486(Part-I)
b.	Assembly Test	As per Clause no. 6.2.41.1

6.2.32 ROUTINE TESTS**TABLE-6.18**

a.	Visual Inspection	IS: 2486(Part-I)
b.	Proof Load Test	As per Clause no. 6.2.41.12

Tests during Manufacture

On all components as applicable

TABLE-6.19

a.	Chemical analysis of Zinc used for galvanizing	As per Clause no. 6.2.41.13
b.	Chemical analysis, hardness tests, grain size, inclusion rating and magnetic particle inspection for forgings/ castings	As per Clause no. 6.2.41.14
c.	Chemical analysis, and proof load test for fabricated hardware	As per Clause no. 6.2.41.12 & As per Clause no. 6.2.41.14

6.2.33 TEST CHARGES AND TEST SCHEDULE

a) Type Tests

All the equipments offered shall be fully type tested as per the relevant standards and the Bidder shall furnish four sets of type test reports along with the offer. These tests must not have been conducted earlier than five years. The Employer reserves the right to demand repetition of some or all the type tests in the presence of Employer's representative. For this purpose the Bidder may quote unit rates for carrying out each type test. These prices shall be taken into consideration for bid evaluation. For any change in the design/type already type tested and the design/type offered against this specification the Employer reserves the right to demand, repetition of tests without any extra cost.

- b) For type tests which involve the tests on the complete insulator string with hardware fittings, the contractor shall arrange the necessary number of sets of hardware fittings at the place of testing free of cost.
- c) In case of failure of the complete string in any type test, the contractor shall get the test repeated at his cost.
- d) In case of failure in any type test, the contractor is either required to modify the design of the material and successfully carryout all the type tests as has been detailed out in Clause 6.2.30 of this specification or to repeat that particular

type test at least three times successfully at his own expenses. The decision of the Employer in this regard shall be final and binding.

- e) Bidder shall indicate the laboratories in which it is proposed to conduct the type tests. Bidder shall also ensure that the tests can be completed in these laboratories within the time schedule guaranteed by him in the appropriate schedule.
- f) The entire cost of testing for acceptance and routine tests and tests during manufacture specified herein shall be treated as included in the quoted unit price of hardware fittings, except for the expenses of the Inspector/Employer's representative. All acceptance tests shall be carried out by the Contractor in the presence of Employer's representative.
- g) In case of failure in any type test, if repeat tests are required to be conducted, then all the expenses for deputation of Inspector/Employer's representative shall be deducted from the contract price. Also if on receipt of the Contractor's notice of testing, the Employer's representative does not find 'plant' to be ready for testing, the expenses incurred by the Employer for re-deputation shall be deducted from contract price.
- h) Immediately after finalization of the programme of type/acceptance/routine testing, the Contractor shall give sufficient advance intimation to the Employer, to enable him to depute his representative for witnessing the tests.

6.2.34 SAMPLE BATCH FOR TYPE TESTING

- a) The Contractor shall offer material for sample selection for type testing only after getting Quality assurance Programme approved by the Employer. The Contractor shall offer at least three times the quantity of materials required for conducting all the type tests for sample selection. The sample for type testing will be manufactured strictly in accordance with the Quality Assurance Programme approved by the Employer.
- b) Before sample selection, the Contractor shall be required to conduct all the acceptance tests successfully in the presence of Employer's representative.

6.2.35 INSPECTION

- 6.2.35.1. The Employer shall have access at all times to the works and all other places of manufacture, where the hardware fittings and its components are being manufactured and the Contractor shall provide all facilities for unrestricted inspection of the Contractor's works, raw materials, manufacture of all the accessories and for conducting necessary tests as detailed herein.
- 6.2.35.2. The Contractor shall keep the Employer informed in advance of the time of starting and of the progress of manufacture of accessories in its various stages so that arrangements could be made for inspection.
- 6.2.35.3. No material shall be dispatched from its point of manufacture unless the material has been satisfactorily inspected and tested.
- 6.2.35.4. The acceptance of any quantity of accessories shall in no way relieve the Contractor of his responsibility for meeting all the requirements of this specification and shall not prevent subsequent rejection if such hardware fittings are later found to be defective.
- 6.2.35.5. The material for final inspection shall be offered by the contractor only under packed condition. The engineer shall select sample at random from the packed lot for carrying out acceptance tests.

6.2.36 QUALITY ASSURANCE PLAN

- 6.2.36.1. The Bidder shall invariably furnish the following information along with his offer. Information shall be separately given for individual type of equipment offered.
- a) Statement giving list of important raw materials, names of sub-Contractors for the raw material, list of standards according to which the raw material are tested, list of tests normally carried out on raw material in presence of Bidder's representative, copies of test certificates.
 - b) Information and copies of test certificates as in (a) above in respect of bought out items.
 - c) List of manufacturing facilities available.
 - d) Level of automation achieved and list of areas where manual processing exists.

- e) List of areas in manufacturing process, where stage inspections are normally carried out for quality control and details of such tests and inspections.
- f) Special features provided in the hardware to make it maintenance free.
- g) List of testing equipment available with the Bidder for final testing of hardware specified and test plant limitation, if any, vis-a-vis the type, special, acceptance and routine tests specified in the relevant standards. These limitations shall be very clearly brought out in schedule of deviations from specified test requirements.

6.2.36.2. The Contractor shall within 30 days of placement of order submit the following information to the Employer.

- a) List of raw material as well as bought out accessories and the name of the raw material as well as bought out accessories and the names of sub-Contractors selected from those furnished along with the offer.
- b) Type test certificates of the raw material and bought out accessories.
- c) Quality Assurance Plan (QAP) with customer holds points for Employer's inspection. The QAP and Employer's hold points shall be discussed between the Employer and the Contractor before the QAP is finalized.
- d) The Contractor shall submit the routine test certificates of bought out items and raw material at the time of routine testing of the fully assembled hardware.

6.2.37 DOCUMENTATION

6.2.37.1 The Bidder shall furnish along with the bid the dimensional drawings of all types of hardware fittings.

- a) These drawings shall include the following information.
- b) Dimensions.
- c) Tolérance on dimensions.
- d) Material designation used for different components with reference to standards.
- e) Fabrication details such as welds, finishes and coatings.

6.2.37.2 Catalogue or part numbers for each component and the total assembly with bill of materials.

- a) Identification marking.

- b) Weight of individual components and total assembled weight.

6.2.37.3 The assembly drawings shall include the following:

- a) Brief installation instructions.
- b) Design installation torque for the bolt or cap screw.
- c) Withstand torque that can be applied to the bolt or cap screw without failure of components or parts thereof.
- d) Compression die number with recommended compression pressure.
- e) Relevant technical details of significance.

6.2.38 TEST REPORTS

- a) Six copies of type test reports shall be furnished to the Employer within 15days of conducting the tests. One copy will be returned duly certified by the Employer to the Contractor within three weeks thereafter wards and on receipt of the same Contractor shall commence with the commercial production of the concerned material.
- b) Six copies of acceptance test reports shall be furnished to the Employer. One copy will be returned, duly certified by the Employer and only thereafter shall the materials be dispatched.
- c) All records of routine test reports shall be maintained by the Contractor at his works for periodic inspection by the Employer.
- d) All test reports of tests conducted during manufacture shall be maintained by the Contractor. These shall be produced for verification as and when requested for by the Employer.

6.2.2.5 The contractor shall take full responsibility for supply and testing of hardware fittings with insulator discs and shall have to also guarantee the test values and overall satisfactory performance of disc insulators with the hardware fittings.

6.2.39 PACKING AND FORWARDING

6.2.39.1 All hardware fittings shall be packed in suitably sized strong and weather resistant wooden cases/crates. The gross weight of the packing shall not normally exceed 50 Kg. to avoid handling problems.

- 6.2.39.2 Suitable cushioning, protective padding, or spacer shall be provided to prevent damage to or deformation of the hardware's during transit and handling.
- 6.2.39.3 All identical items shall be dispatched to destination duly assembled and packed. Bolts, nuts, washers, cotter pins, security clips and split pins etc. shall be packed duly installed and assembled with the respective parts and suitable measures shall be taken to prevent their transit loss.
- 6.2.39.4 Each component part shall be legibly and indelibly marked with the trade mark of the manufacturer and year of manufacture.
- 6.2.39.5 All packing cases shall be marked legibly and correctly so as to ensure their safe arrival at their destination and to avoid the possibility of goods being lost or wrongly dispatched on account of faulty or illegible markings. Each wooden case/crate shall have all the markings stenciled on it in indelible ink.
- 6.2.39.6 The packing shall be of sufficient strength to withstand rough handling during transit (Sea, Rail and Road) storage at site and subsequent handling in the field.

6.2.40 QUANTITY AND DELIVERY REQUIREMENTS

- a) This is set out separately in Bidding Document.
- b) The scope of supply shall include a supply of 2.5 % extra quantity of bolts, nuts, washers, split pins, cotter pins and such other small loose items free of cost.

6.2.41 DETAILS OF TESTS

6.2.41.1 Assembly Test

This test shall be carried out to ensure that cotter pins, bolts, clamps etc., fit freely and properly.

6.2.41.2 Voltage Distribution Test

The voltage across each insulator unit shall be measured by using either sphere gap or high impedance voltmeter. The result obtained shall be converted into percentage. The voltage across any disc shall not exceed the following values: 13% for suspension insulator strings and 14% for tension insulator strings.

6.2.41.3 Corona Extinction Voltage Test

The complete insulator string when subjected to power frequency voltage shall have a corona extinction voltage of not less than 154kV rms line to ground under dry conditions. There shall be no evidence of corona on any part of the samples when all sources of corona are photographed in a darkened room. The atmospheric conditions during testing shall be recorded and the test results shall be accordingly corrected to standard atmospheric conditions with suitable correction factor as stipulated in IEC: 383.

6.2.41.4 RIV Test (Dry)

Under the conditions as specified under clause 6.2.41.3 above the insulator string along with complete hardware fittings shall have a radio interference voltage level below 1000 microvolts at one (1) MHz when subjected to 50 Hz AC voltage of 154 KV (rms) line to ground under dry conditions. The test procedure shall be in accordance with IS: 8263-1976/IEC: 437, or its latest revision thereof.

6.2.41.5 Mechanical Strength Test

The complete insulator string along with its hardware fittings without arcing horn and suspension assembly / dead end assembly shall be subjected to a load equal to 50% of the specified minimum ultimate tensile strength (UTS) which shall be increased at a steady rate to 67% of the minimum UTS specified. The load shall be held for five minutes and then removed. After removal of the load, the string components shall not show any visual deformation and it shall be possible to disassemble them by hand. Hand tools may be used to remove cotter pins and loosen the nuts initially. The strings shall then be reassembled and loaded to 50% of UTS and the load shall be further increased at a steady rate to the specified minimum UTS and held for one minute. No fracture should occur during this period. The applied load shall then be increased until the failing load is reached and the value recorded.

6.2.41.6 Magnetic Power Loss Test for Suspension Assembly

One hollow aluminium tube of 29 mm diameter shall be placed. An alternating current of 50 Hz over the range of 300 to 700 amps. shall be passed through the tube. The reading of the wattmeter with and without suspension assembly shall be recorded. Not less than 3 suspension assemblies shall be tested. The average power loss for

suspension assembly shall be plotted for each value of current. The value of the loss corresponding to 500 amp. shall be read off from the graph.

6.2.41.7 Mechanical Strength Test of Each Component

Each component shall be subjected to a load equal to the specified minimum ultimate tensile strength (UTS) which shall be increased at a steady rate to 67% of the minimum UTS specified. The load shall be held for five minutes and then removed. The component shall then again be loaded to 50% to UTS and the load shall be further increased at a steady rate till the specified UTS and held for one minute. No fracture should occur. The applied load shall then be increased until the failing load is reached and the value recorded.

6.2.41.8 Mechanical Strength Test of Welded Joint

The welded portion of each component shall be subjected to a load of 2000 Kgs. for one minute. Thereafter, it shall be subjected to die-penetration /ultrasonic test. There shall not be any crack at the welded portion.

6.2.41.9 Mechanical Strength Test for Suspension/Tension Hardware Fittings

The complete string (without insulators) excluding arcing horn, and suspension or dead end assembly shall be subjected to a load equal to 50% of the specified minimum ultimate tensile strength (UTS) which shall be increased at a steady rate up 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 then be reassembled and loaded to 50% of UTS and the load shall be further increased at a steady rate till the specified minimum UTS is reached and held for one minute. No fracture should occur during this period. The applied load shall then be increased until the failing load is reached and the value recorded. This test shall be carried out for every 300 sets.

6.2.41.10 Shore Hardness Test

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

6.2.41.11 Galvanizing/Electroplating Test

The test shall be carried out as per clause no. 5.9 of IS: 2486 (Part-I)-1971 except that both uniformity of zinc coating and standard Preece test shall be carried out and the results obtained shall satisfy the requirements of this specification.

6.2.41.12 Proof Load Test

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

6.2.41.13 Chemical Analysis of Zinc

For the chemical analysis of the zinc used for galvanizing, samples taken from zinc ingot shall be chemically analyzed as per IS: 209-1966. The purity of the zinc shall not be less than 99.95%.

6.2.41.14 Tests For Forging/Casting and Fabricated Hardware

The chemical analysis, hardness test, grain size inclusion rating and magnetic particle inspection for forging, casting and chemical analysis and proof load test for fabricated hardware 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 in the Quality Assurance Plan.

6.2.41.15 Clamp Slip Strength Vs Torque Test for Suspension Clamp

The suspension clamp shall be vertically suspended by means of a flexible attachment. A suitable length of ACSR "MOOSE – 597 mm²" 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 8% of UTS of conductor and less than 15% of UTS of Conductor as per IS 2486 –Part-I – 1993.

6.2.41.16 Dynamic/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 conductor tensioned at 3500 Kg shall be secured with clamps. The system shall be suitable to maintain constant tension on conductor throughout the duration of the test. Vibration dampers shall not be used on the test span. The conductor shall be vertically vibrated at one of the resonance frequencies of the insulators string (more than 10 Hz) by means of vibration inducing equipment. The peak to peak displacement in mm of vibration at the anti-node point nearest to the string shall be measured and the same shall not be less than $1000/f^{1.8}$ where f is the frequency of vibration in cycles/sec. The insulator string shall be vibrated for not less than 10 million cycles without any failure. After the test the disc insulators shall be examined for looseness of pins and cap or any crack in the cement. The hardware for looseness shall be examined for fatigue failure and mechanical strength test. There shall be no deterioration of properties of hardware components and disc insulators after the vibration test. The disc insulators shall be subjected to the following tests as per relevant standards:

TABLE-6.20

S.NO	Tests	Percentage of discs to be tested.
a.	Temperature cycle test followed by mechanical performance test	60
b.	Puncture test	40

6.2.41.17 Ozone Test on Elastomer

This test shall be performed in accordance with ASTM D-1171 by the ozone chamber exposure method (method B). The test duration shall be 500 hours and the ozone concentration 50 PPHM. At the test completion, there shall be no visible crack under a 2 x magnification.

6.2.41.18 Mechanical test for Grading/Corona rings

The fittings should be rigidly supported. A load of 150 kg shall be applied and maintained for one minute in the plane of the fitting. The fitting should not fail.

6.2.41.19 Electrical test for Grading/Corona ring

The electrical control fitting shall be designed to ensure that when incorporated in the insulator string, the specified electrical performance of the string is achieved. There shall be no visible discharge at the specified test voltage when tested with complete string.

6.2.41.20 Additional Tests

- a) The Employer reserves the right of having at his own expenses any other test(s) of reasonable nature carried out at Contractor's premises, at site, or in any other place in addition to the aforesaid type, acceptance and routine tests to satisfy that material comply with the specifications.
- b) The Employer 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 Contractor's premises or at any other test centre. In case of any failure, it shall be binding on the part of the Contractor to replace that particular lot completely, without any extra cost to the Employer.

Chapter 7- Technical Data Sheet

(TO BE FILLED IN AND SIGNED BY THE TENDERER)

SN	Description	TECHNICAL DATA SHEET	
I	CONDUCTOR	597 sq.mm ACSR Moose (Al 54/3.53mm + St. 7/3.53 mm)	
1	Maker's Name, Address & Country. :		
a	Aluminum/Aluminium Alloy :		
b	Galvanised Steel wire		
c	Complete conductor		
	CONDUCTOR		
3	Size & Code		
4	IS/International Standards applicable		
5	Wire diameter in mm		
a	Aluminium/Aluminium Alloy		
b	Steel Wire		
6	Number of strands :		
	1st layer of Steel		
	2nd layer of Steel		
	3rd layer of Aluminium/Aluminium Alloy		
	4th layer of Aluminium/Aluminium Alloy		
	5th layer of Aluminium/Aluminium Alloy		
7	Total Sectional Area of complete conductor in mm ² :		
	Total Sectional Area of Aluminium in mm ² :		
8	Overall diameter of complete conductor in mm :		
9	Weight in kg :		
10	Calculated D.C. resistance at 20 degrees C, maximum.		
11	Continuous current rating at 85 degree C (Enclose supporting calculations)		
12	Corona extinction voltage, kV		
13	Radio interference voltage		
14	Ultimate tensile strength, kN		
15	Final modulus of elasticity		
16	Co-efficient of Linear expansion		
17	Lay-Ratio	Maximum	Minimum
	Steel Core (6 Wire layer)		
	Aluminium		
	1st layer		
	2nd layer		
	3rd layer		
	STRANDS		
18	Technical particulars of Aluminum/Aluminium Alloy and Steel strands	Aluminium	Steel
a	Diameter (mm)		
	Standard		
	Maximum		
	Minimum		
b	Cross-sectional area of nominal diameter wire (sqmm):		
c	Weight in Kg./Km.		
d	Minimum breaking load in Kg/KN		
	Before stranding		
	After stranding		
e	Minimum ultimate tensile stress of strand (kg/sq. mm)		
f	Co-efficient of linear expansion		
19	D.C. Resistance at 20 degrees C in ohms/Km		
20	Zinc coating of steel wire in gms/m ²		
a	Number of 1 minute dips.		



SN	Description	TECHNICAL DATA SHEET	
	Number of 1/2 minute dips.		
b	Minimum weight of Zinc Coating		
c	Process of Galvanizing		
d	Quality of Zinc		
		597 sq.mm ACSR Moose (Al 54/3.53mm + St. 7/3.53 mm)	
21	Joints in strands		
a	Steel		
b	Aluminium		
c	Method of making joint		
d	Ultimate tensile strength of joint		
22	Maximum single length of conductor which can be manufactured in km		
23	Standard length of each piece in Km		
24	a) Tolerance if any on standard lengths		
	b) Details of random lengths :		
25	No. of standard length in one reel		
26	Type of Drums and IS applicable		
27	Dimensions of the Drum in cm. (Drawing shall be enclosed).		
28	Weight of the Drum in kg		
29	with conductor		
30	empty Drum with lagging		
31	Details of marking on conductor drum		
32	Whether the drums are suitable for use with tension stringing equipment.		
33	Standard according to which the conductor will be manufactured and tested		
a	Certification Mark if any :		
b	Test certificate enclosed : Yes/No		
34	Chemical composition of high carbon steel wire		
35	Initial & Final sag and Tension charts Furnished		
36	Stress/Strain data corresponding to different tensions, temperatures and time furnished.		
37	Curves/tables of creep compensation corresponding to different tensions temperatures furnished		
38	Other details if any :		
	III Galvanised Steel Earth wire	G.S. Earthwire (7/3.66mm)	
1	Maker's Name, address and country :		
a	Steel wires/rods :		
b	Zinc :		
c	Galvanised stranded Steel wire :		
2	a.Stranding and wire diameter (mm)		
	b. No. of strands Steel Core (No.) outer steel layer (No.)		
	c.Weight of complete (kg/km) :		
3	Single wire before stranding		
	a) Diameter of wire (mm) :		
	b) Tolerance if any (+/-%) :		
	c) Minimum elongation in 200 mm length (mm):		
	d) Minimum breaking strength (kg):		
	e) Minimum tensile strength (kg/sqmm):		
	f) D.C. resistance at 20 degC (ohms/km):		
4	Stranded wire		



SN	Description	TECHNICAL DATA SHEET
	a) Length of lay	
	Maximum (mm) :	
	Minimum (mm) :	
	b) Minimum breaking load (kg or KN):	
	c) Overall diameter (mm) :	
	d) Minimum breaking load (kg or KN) :	
	e) Overall diameter (mm) :	
	f) Modulus of elasticity (kg/sq mm) :	
	i) Initial :	
	ii) Final :	
	g) Coefficient of linear expansion (per degC)	
	h) D.C. resistance at 20 degC (ohms/km) :	
	i) Total sectional area (sq.mm) :	
	j) Overall weight (kg/Km) :	
5	Direction of lay of outer layer :	
6	Zinc coating	
	a) Number of one minute dips (No.) :	
	b) Number of half minute dips (No.) :	
	c) Quality of Zinc :	
	d) Weight of coating on wire (gm/sq.m) :	
	e) Process of galvanising :	
7	Joints :	
8	Oiling :	
9	Standard length (m) :	
10	Tolerance if any on standard length (+/- %)	
11	Standard length of earth wire in each drum (m)	
12	No. of standard lengths in each drum	
13	(a) Random lengths (m) :	
	(b) No. of random lengths (No) :	
14	Standard weight of drum (kg) :	
15	Type of drum and IS/IEC applicable :	
16	Dimensions of the drum in cm. (Drawing shall be enclosed):	
17	Weight of the Drum	
	- with earth wire (kg.) :	
	- empty drum with lagging (kg.) :	
18	Type of drum and IS applicable :	
19	Dimensions of the drum in cm. (Drawing shall be enclosed) :	
20	Details of marking on earth wire drum :	
21	Drums suitable for tension stringing :	
22	Standards according to which the earth wire will be :	
	a) Manufactured	
	b) Tested	
	c) Types of tests	
23	Chemical composition :	
24	Other details if any	
IV.	CONDUCTOR ACCESSORIES	597 sq.mm ACSR Moose (Al 54/3.53mm + St. 7/3.53 mm)
	A. MID SPAN COMPRESSION JOINTS	
1	Maker's name and country	
2	Type	
3	Suitable for (Conductor size) (mm)	
4	Materials of joint with reference of ISS to which it conforms	
	a) Aluminium sleeve	
5	Shape of cross-section	
	a) Before compression	



SN	Description	TECHNICAL DATA SHEET
	b) After compression	
6	Outside diameter of sleeves	
	a) Before compression	
	i) Aluminium (mm)	
	b) After compression	
	Aluminium	
	i) Corner to corner (mm)	
	ii) Surface to surface (mm)	
7	Inside diameter of sleeves	
	a) Before compression	
	i) Aluminium (mm)	
8	Length of sleeves	
	a) Before compression	
	i) Aluminium (mm)	
	b) After compression	
	i) Aluminium (mm)	
9	Weight of sleeve in	
	i) Aluminium (kg.)	
10	Breaking strength of the mid span joint as percentage of ultimate tensile strength of conductor (%)	
11	Conductivity of the compression joint expressed as percentage of the conductivity of equivalent length of the conductor(%)	
12	Whether compression and non-compression joints marked on the sleeves.	
13	Slip strength of mid span compression joints expressed as % of UTS of conductors.	
14	Details of die set required for making joint.	
15	Type of greece and capacity of Hydraulic compressor for making joints.	
16	Suitable for passing through the sleeve of stringing block.	
17	Reference of manufacturers' drawing and catalogue no.	
18	Reference of ISS or any other international standard to which the midspan joints conform, if any	
19	Certification Mark (ISI/BS/or Any other International Standard)	
20	Packing details	
	B. REPAIR SLEEVE	
1	Maker's name and country	
2	Type	
3	Suitable for Conductor size (mm)	
4	Shape of cross-section	
	a) Before compression	
	b) After compression	
5	Inside diameter of sleeves (mm)	
	Before compression	
6	Outside diameter of sleeve	
	a) Before compression (mm)	
	b) After compression	
	i) Corner to corner	
	ii) Surface to surface	
7	Length of sleeve	
	a) Before compression (mm)	
	b) After compression (mm)	
8	Weight of sleeve	

SN	Description	TECHNICAL DATA SHEET
9	Conductivity of the repair sleeve expressed as percentage of the equivalent length of Bare conductor (%)	
10	Material and standard to which conforming	
11	Breaking strength as % of UTS of conductor	
12	Resistance as percentage of measured resistance of equivalent length of conductor	
13	Details of die set for making joint	
14	Capacity of compressor for making joint	
15	Whether suitable to pass through stringing blocks when installed on conductor during tension stringing if not state the protective device needed to make it suitable.	
16	Certification mark (ISI/BS/Any International Institution.	
17	Reference of ISS or any other international standard specification to which the repair sleeves shall conform, if any	
18	Reference of drawing and catalogue no. etc.	
19	Packing details,	
	C. VIBRATION DAMPERS	
1	Maker's name & Country	
2	Type	
3	Suitable for conductor size (mm)	
4	Total weight of each damper (kg)	
5	Dimension of balancing weights (mm)	
6	Weight of each balancing weight (kg)	
7	Tolerance in balancing weights (+/-%)	
8	Messenger cable	
	(a) Stranding and wire diameter	
	(b) UTS of each strand	
	(c) Ultimate bending strength	
9	Slipping strength of cable w.r.t. each balancing weight	
10	Natural frequency of the damper (hz)	
	(a) First resonance	
	(b) Second resonance	
	(c) Third resonance	
	(d) Fourth resonance	
11	The number of damper required per span (suspension/tension)	
	(a) Span lengths (mtrs) 100 250 390 400 440 1100	
	(b) Nos. of dampers (nos.)	
12	Position of fixing damper on the conductor from the clamp mouth	
	(a) At tension points	
	i) First damper (mm)	
	ii) Second damper, (mm)	
	iii) Third damper (mm)	
	(b) At suspension points	
	i) First damper (mm)	
	ii) Second damper, (mm)	
	iii) Third damper (mm)	
13	Clamping torque (kg m)	
14	Minimum fatigue strength in no. of cycles at +/-1 mm amplitude at	
	(a) Resonant frequency of line conductor	
	(b) Highest resonant frequency of vibration damper	
15	Clamp slipping strength of vibration damper (kg)	
	(a) Before fatigue test	



SN	Description	TECHNICAL DATA SHEET
	(b) After undergoing fatigue test without re-torquing the bolts.	
16	(a) Diagram showing power dissipated by the damper in watts for various vibration frequencies & amplitudes (watts)	
	(b) Diagram showing the vibration energy for conductor bundle for various frequencies under varied winds and spans	
17	Magnetic power loss per damper at 600 amp. 50 Hz AC current (watts)	
18	Material and standards to which conforming	
	a) Clamp b) Messenger cable c) Damper weight	
19	Quantity of zinc and standard to which conforming	
20	Galvanization	
	(a) method of galvanization	
	i) Spring washers	
	ii) Other spare parts	
	(b) no. of dips	
	i) One minute	
	ii) Half minute	
	(c) minimum weight of zinc coating (g/sq. m)	
	i) Casting	
	ii) Wires	
21	Certification Mark (ISI/BS/or any other International Standard)	
22	Packing details	
	i) Marking	
	ii) Standard to which conforming	
	D. SPACERS	
1	Makers's name & Country	
2	Type	
3	Suitable for conductor size (mm)	
4	weight of the bundle spacer (kg)	
5	Spacing between sub-conductor	
	(a) Along the run of line (mm)	
	(b) At suspension insulator- string (mm)	
	(c) At tension insulator strings (mm)	
	(d) At jumpers (mm)	
6	Distance between support clamp and first spacer (mm)	
	(a) At tension position (mm)	
	(b) At suspension position (mm)	
7	Longitudinal distance between spacers	
	(a) Span (m.) 100 250 390 400 440 1100	
	(b) Maximum (m.)	
	(c) Minimum (m.)	
8	No. of spacers per span (nos.)	
	(a) Span length	
	(b) Nos.	
9	Maximum distance between adjacent spacers of each phase for jumper connection	
10	Deflection of spacers	
	(i) Under normal full load current (mm)	
	(ii) Under fault conditions (mm)	
11	Ultimate strength of the spacer under (mm)	
	(i) Compressive load (kg)	
	(ii) Tensile load	



SN	Description	TECHNICAL DATA SHEET
12	Movement which can be applied to the spacers	
	(i) Longitudinal parallel to the conductor (mm)	
	(ii) Vertical in a vertical direction at right angle to the conductor(mm)	
	(iii)Torsional (angular) in a vertical plane parallel to the conductor (degrees)	
13	Magnetic power loss per spacer (watts) at 600 amps. 50 Hz AC current	
14	Corona performance of the spacer	
	(a) Visible corona voltage line to earth (kV)	
	i) Dry condition	
	Inception (kV rms)	
	Extinction (kV rms)	
	ii) Wet condition	
	Inception (kV rms)	
	Extinction (kV rms)	
	(b) Corona power loss per spacer at rated voltage (watts)	
	i) Dry condition (watts)	
	ii) Wet condition (watts)	
15	Radio Interference voltage performance of the spacer at 305 kV (rms) phase to ground	
	i) Dry condition (micro volts)	
	ii) Wet condition at corona extinction voltage(micro volts)	
16	Damping performance of the spacer	
	(i) If vibration test satisfactory	
	(ii) If damping test satisfactory	
17	Clamp slipping strength of spacer clamp	
	(a) Before vibration test when tightened at specified torque (kg)	
	(b) After under-going the vibration test	
	(i) Without retorquing the clamp of the assembly (kg)	
	(ii)With retorquing the clamp of the assembly (kg)	
18	Minimum fatigue strength of spacer and no. of cycles for specified amplitudes and frequencies under following conditions	
	i) For longitudinal vibration (kg/Hz)	
	ii) For vertical vibration (kg/Hz)	
	iii) For subspan oscillation (kg/Hz)	
19	Material & Standard to which conforming	
20	Quality of Aluminium Alloy	
21	Galvanisation	
	a) Method of galvanisation	
	i) Spring Washers	
	ii) any other spare parts	
	b) Quality of Zinc and standard to which conforming	
22	Short circuit Rating (kA)	
23	Equivalent compressive and tensile strength of 40KA short circuit current (kg)	
24	Shore hardness of the Elastomer(if applicable)	
25	Electrical resistance of elastomer (ohms)	
26	Electrical resistance between two sub-conductor across the assembly (ohm)	
27	Maximum conductor temperature which can be with stood by the elastomer (deg. C.)	
28	Certification Mark	
29	Packing details	
	i) Marking	



SN	Description	TECHNICAL DATA SHEET
	ii) Standard to which conforming.	
	E. SPACER DAMPERS	
1	Makers's name & address	
2	Type	
3	Suitable for (conductor size) (mention drg. and catalogue nos. also) (mm)	
4	Total weight of each spacer damper (kg)	
5	Spacing between subconductor (mm)	
	(i) Along run of line (mm)	
	(ii) At suspension insulators string (mm)	
	(iii) At tension insulator string (mm)	
6	Distance between support clamp and first spacer	
	(i) At tension position (mm)	
	(ii) At suspension position (mm)	
7	Minimum no. of spacer dampers per span (nos.)	
	} 250 m	
	} 390 m	
	} 400 m	
	} 450 m	
8	Maximum distance between adjacent spacers of each phase along run of line (mtrs.)	
9	(i) Under normal full load current (mm)	
	(ii) Under fault conditions (mm)	
10	Ultimate strength of the spacer damper (mm)	
	(i) Compressive load (kg)	
	(ii) Tensile load (kg)	
11	Movement which can be applied to the spacer damper	
	(i) Longitudinal parallel to conductor (mm)	
	(ii) Vertical (mm)	
	(iii) Torsional (degrees)	
12	Magnetic power loss per spacer (watts) damper at 600 amps. 50 cycles/ sec. AC current	
13	Corona performance of the spacer damper of 50 Hz	
	(a) Corona inception and extinction voltage line to earth (kV)	
	i) Dry condition	
	ii) Wet condition	
	(b) Corona power loss per spacer damper in watts at rated voltage (watts)	
	i) Dry condition	
	ii) Wet condition	
14	Radio Interference voltage performance of the spacer damper at 305 kV (rms) phase to ground	
	i) Dry condition	
	ii) Wet condition	
15	(a) Diagram showing power dissipated by the damper in watts for various vibration frequencies and amplitude (watts)	
	(b) Diagram showing vibration energy per conductor bundle for various frequencies under varied winds and spans	
16	Minimum fatigue strength of spacer damper in nos. of cycles for specified amplitudes and frequencies under following conditions	
	i) For longitudinal vibration (kg/Hz)	
	ii) For vertical vibration (kg/Hz)	



SN	Description	TECHNICAL DATA SHEET
	iii) For subspan oscillation (kg/Hz)	
17	Clamp slipping strength of spacer damper clamp	
	(a) Before vibration test when tightened at specified torque	
	(b) After the vibration test	
	(i) Without retorquing the bolts and cap screws (kg)	
	(ii) With retorquing the bolts and cap screws (kg)	
18	Natural frequency of the spacer damper	
	(a) Upper frequency (Hz)	
	(b) Lower frequency (Hz)	
19	Material & Standard to which conforming	
20	Quality of Aluminium Alloy	
21	Galvanisation	
	a) Method of galvanisation	
	i) Spring Washers	
	ii) any other spare parts	
	b) Quality of Zinc and standard to which conforming	
22	Short circuit Rating (KA)	
23	Equivalent compressive and tensile strength of 40KA short circuit current (kg)	
24	Electrical resistance of elastomer (ohms)	
25	Electrical resistance between two sub-conductors across the assembly (ohm)	
26	Maximum conductor temperature which can be withstood by the elastomer (deg. C.)	
27	Log decrement value for 4 to 6 times the conductor diameter	
28	Certification Mark (ISI/BS/or any other International Standard)	
29	Packing details	
	i) Standard to which conforming.	
	V. GALVANISED STEEL EARTH WIRE ACCESSORIES	
	A. SUSPENSION ASSEMBLY	
1	Manufacturer's name & address	
2	Type	
3	Material	
4	Drawing no. (give complete details and dimension including no. of components)	
5	Reference of Indian Standard specification to which conform	
6	Minimum slip strength with respect to earth wire	
7	Minimum ultimate breaking strength	
8	Galvanising	
	(a) Spring washers	
	(b) Other ferrous parts	
	(c) weight of zinc (g/sq. m)	
	(d) no. of dips	
	i) one minute	
	ii) half minute	
	(e) Quality of zinc and standard to which conforming	
9	Fixing arrangement of clamp on the ground wire / OPGW	
10	Whether the limb of the U-bolt has been long enough to accommodate the leg of the flexible copper bond (Y/N)	
11	Total drop of the suspension assembly from the centre point of the attachment to the centre point of the ground wire (mm)	



SN	Description	TECHNICAL DATA SHEET
12	Certification Mark (ISI/BS/Any other International Standard)	
13	Total weight of assembly (kg)	
14	Method of manufacture adopted e.g. forging or casting	
15	Packing details	
16	Other details, if any	
	B. TENSION ASSEMBLY	
1	Manufacturer's name & address	
2	Type	
3	Material	
	(a) Body	
	(b) Bolts and nuts	
4	Drawing no. (give complete details and dimension and no. of components)	
5	Reference of Indian Standard specification / IEC to which conforms	
6	Minimum slip strength	
7	Minimum ultimate breaking strength	
8	Brinell hardness of steel	
9	Galvanising	
	(a) Spring washers	
	(b) Other ferrous parts	
	(c) weight of zinc (g/sq. m)	
	(d) no. of dips	
	i) one minute	
	ii) half minute	
	(e) Quality of zinc and standard to which conforming	
10	Total weight of complete assembly (kg)	
11	Breaking strength of tension clamp as % of breaking load of ground wire	
12	Resistivity as % of equivalent length of ground wire	
13	Whether lugs along with necessary nuts and bolts for jumper connections will be supplied (Y/N)	
14	Angle of Jumper terminal with the vertical plate (degree)	
15	Whether the bolt holding the jumper is sufficiently long and will be provided with washers, nuts and locking nuts etc., for fixing one lug of the flexible copper bond (Y/N0)	
16	Certification Mark (ISI/BS/or Any other International Standard)	
17	Packing details	
18	Other details, if any	
	C. VIBRATION DAMPERS	
1	Maker's name & Country	
2	Type	
3	Suitable for earth wire of size (mm)	
4	Material with reference of ISS to which it conforms	
	(a) Clamp	
	(b) Messenger cable	
	(c) Weight	
5	Reference of manufacturer's drawing and catalogue no. etc.	
6	Total weight of each damper (kg)	
7	Dimensions of balancing weights (mm)	
8	Length of each balancing weight (mm)	
9	Weight of each balancing weight (kg)	
10	Tolerance in balancing weights (+%)	



SN	Description	TECHNICAL DATA SHEET
11	Messenger cable	
	(a) Stranding and wire diameter (mm)	
	(b) Ultimate tensile strength (kg)	
	(c) Ultimate bending strength (kg m)	
12	Slipping strength of stranded messenger cable with respect to balancing weight (kg)	
13	(a) Diagram showing power dissipated by the damper in watts for various vibration frequencies & amplitudes (watts)	
	(b) Diagram showing the vibration energy for various frequencies under varied winds and spans	
14	Natural frequency of the damper	
	(a) Ist (Hz)	
	(b) IInd (Hz)	
	(c) IIIrd (Hz)	
	(d) IVth (Hz)	
15	The number of dampers required per span for various span length	
	(a) Span lengths (mtrs) 250m 390m 400m 440m 1100m	
	(b) Nos. of dampers	
	i) Suspension span	
	ii) Tension span	
16	Position of fixing damper on the earth wire from the clamp mouth	
	(a) At tension points	
	i) First damper (mm)	
	ii) Second damper (mm)	
	iii) Third damper (mm)	
	(b) At suspension points	
	i) First damper (mm)	
	ii) Second damper, (mm)	
	iii) Third damper (mm)	
17	Clamping torque (kg m)	
18	Maximum possible dynamic strain on the earth wire with recommended number of dampers	
19	Minimum fatigue strength at amplitude of +/- 0.5 mm in nos. of cycles at	
	(a) Resonant frequency of Earth wire	
	(b) Highest frequency of vibration dampers	
20	Clamp slipping strength of vibration damper	
	(a) Before fatigue test	
	(b) After fatigue test for 10 million cycles	
21	Weight of zinc coating in (gms/m ²)	
	(a) Spring washers	
	(b) Bolts and nuts	
	(c) Weights	
	(d) Clamp	
	(e) Messenger cable	
22	No. of dips of 1 minute duration which the damper withstands under 'Preece Test'	
	(a) Spring washers	
	(b) Bolts and nuts	
	(c) Weights	
	(d) Clamp	
	(e) Messenger cable	
23	Packing details	

SN	Description	TECHNICAL DATA SHEET
24	Certificate Marks (ISI/BS/or Any other International Standard)	
	D) MIDSPAN COMPRESSION JOINT	
1	Maker's name & address	
2	Type	
3	Inside diameter of sleeve before compression	
4	Outside dimension of sleeve	
	a) Before compression (mm)	
	b) After compression (mm)	
	i. Corner to corner (mm)	
	ii. Surface to surface (mm)	
5	Length of sleeve	
	a) Before compression (mm)	
	b) After compression (mm)	
6	Weight of sleeve (kg)	
7	Slipping strength of mid span (%)	
	joint, expressed as a percentage of	
	Ultimate tensile strength	
8	Resistance of the compressed	
	Unit expressed as a percentage	
	of the Resistance of equivalent	
	length of bare earth wire	
9	Material of sleeves	
	a) Material	
	b) Standard to which conform	
	c) Whether annealed properly	
	d) Brinell Hardness of material	
10	Galvanization	
	a) Process	
	b) Weight of zinc (g/sq. m)	
	c) No. of dips	
	i) one minute	
	ii) half minute	
	d) Quality of zinc and standard to which conforming	
11	Whether compression and non compression joints marked on the sleeve (Y/N)	
12	Breaking strength of Mid span joint as of the breaking load of ground wire %	
13	Details of die set for making joint	
14	Whether suitable to pass through stringing block when installed on ground wire during tension stringing if not state the protective device needed to make it suitable.	
15	Capacity of Hydraulic compressor for making joint	
16	Certification mark (ISI/BS/Any international Institution	
17	Drum no. and details and no. of components	
18	Packing details	
	E) FLEXIBLE COPPER BONDS	
1	Maker's name & address	
2	Governing Standard	
3	Material & Standard	
4	No. of Strands	
5	Length	
6	Weight	
7	Slipping strength of lugs provided on either end of earthing bond without any damage to earthing bond	
8	Certification mark (ISI/BS/Any international Institution	



SN	Description	TECHNICAL DATA SHEET		
9	Packing details (No. of bonding pices per package and gross weight)			
	E. FLEXIBLE COPPER BONDS			
	Flexible Copper Bonds (Bonding Pieces)			
1	Maker's name and address			
2	Governing standard			
	Material and standard to which conforming			
	No. of strands and wire diameter.			
	Length(mm)			
	Resistance (ohms)			
	Weight (kg)			
	Slip strength of lugs provided on either end of earthing bond without any damage to earthing bond (kg)			
	Certification mark (ISI/BS/ Any International Institution).			
	Packing details (No. of bonding pieces per package and gross weight).			
	VIII. INSULATOR DISCS AND COMPLETE STRINGS			
	I. SINGLE DISC INSULATOR	90kN	160kN	210kN
1	Type of insulator			
2	Maker's name,address and country			
3	Material and Governing standard			
4	Detailed dimensional drawing indicating tolerances for each type of insulator disc enclosed (YES/NO)			
5	Dimensions (Indicate tolerances also)			
	a) Diameter (mm)			
	i) Suspension			
	ii) Tension			
	b) Spacing (mm)			
	i) Suspension			
	ii) Tension			
	c) Creepage distance (mm)			
	i) Suspension			
	ii) Tension			
6	Pin-ball-shank diameter (mm)			
	a) Suspension insulator			
	b) Tension insulator			
7	Colour			
	a) Suspension			
	b) Tension			
8	Electromechanical strength (KN)			
	a) Suspension			
	b) Tension			
9	Mechanical breaking strength (KN)			
	a) Suspension			
	b) Tension			
10	Power frequency one-minute withstand voltage -KV (rms)			
	a) Dry			
	i) Suspension			
	ii) Tension			
	b) Wet			
	i) Suspension			
	ii) Tension			
11	Impulse 1.2x50 microsecond withstand voltage -KV (peak)			
	a) +ve Wave			



SN	Description	TECHNICAL DATA SHEET		
	i) Suspension			
	ii) Tension			
	b) -ve Wave KV (peak)			
	i) Suspension			
	ii) Tension			
12	Power frequency flashover voltage -KV (rms)			
	a) Dry			
	i) Suspension			
	ii) Tension			
	b) Wet KV (rms)			
	i) Suspension			
	ii) Tension			
13	Impulse 1.2x50 microsecond flashover voltage KV (peak)			
	a) +ve Wave			
	i) Suspension			
	ii) Tension			
	b) -ve Wave			
	i) Suspension			
	ii) Tension			
14	Power frequency puncture voltage KV (rms)			
	a) Suspension			
	b) Tension			
	(ii) Corona extinction voltage KV (rms)			
	a) Suspension			
	b) Tension			
15	RIV at 10 KV (rms)			
	a) Suspension (microvolts)			
	b) Tension (microvolts)			
16	Weight of the Insulator disc (kg)			
	a) Suspension			
	b) Tension			
17	Locking device			
	a) Type			
	i) Suspension			
	ii) Tension			
	b) Material			
	i) Suspension			
	ii) Tension			
	c) Standard to which conforming			
18	Socket and ball ended component			
	a) Standard to which conforming			
	b) Material and Standard to which conforming			
	c) Galvanising process			
	d) Quality of zinc and Standard to which conforming			
	e) Weight of zinc (g/m^2)			
	f) Number of one-minute dips			
19	Packing details (No. of disc insulators of each type per package and gross weight)			
20	Certification mark (BIS/BS/Any National Institution)			
	II. INSULATOR STRINGS	For Altitude upto 3000m above msl		
1	No. of insulator discs			
	a) Single suspension 'I' Pilot Insulator String			
	b) Double suspension 'II' Pilot Insulator String			
	c) Double Suspension Insulator String			
	d) Double Tension Insulator String			
2	Electromechanical (E.M.) Strength - KN			



SN	Description	TECHNICAL DATA SHEET
	a) Single suspension 'I' Pilot Insulator String	
	b) Double suspension 'II' Pilot Insulator String	
	c) Double Suspension Insulator String	
	d) Double Tension Insulator String	
	e) Double Tension Insulator String for special towers	
3	Power frequency one minute withstand voltage KV (rms)	
	Dry/Wet	
	i) Suspension Insulator String	
	a) Double Suspension	
	ii) Tension Insulator String	
	a) Double Tension	
	b) Double Tension (for special Towers)	
	iii) Pilot Suspension Insulator String	
	a) Single suspension 'I' Pilot Insulator String	
	b) Double suspension 'II' Pilot Insulator String	
4	Power frequency flashover voltage KV (rms) Dry/Wet	
	i) Suspension Insulator String	
	a) Double Suspension	
	ii) Tension Insulator String	
	a) Double Tension	
	b) Double Tension (for special Towers)	
	iii) Pilot Suspension Insulator String	
	a) Single suspension 'I' Pilot Insulator String	
	b) Double suspension 'II' Pilot Insulator String	
5	Impulse withstand voltage (dry) KV (peak)	
	Positive wave	
	i) Suspension Insulator String	
	a) Double Suspension	
	ii) Tension Insulator String	
	a) Double Tension	
	b) Double Tension (for special Towers)	
	iii) Pilot Suspension Insulator String	
	a) Single suspension 'I' Pilot Insulator String	
	b) Double suspension 'II' Pilot Insulator String	
	Negative wave	
	i) Suspension Insulator String	
	a) Double Suspension	
	ii) Tension Insulator String	
	a) Double Tension	
	b) Double Tension (for special Towers)	
	iii) Pilot Suspension Insulator String	
	a) Single suspension 'I' Pilot Insulator String	
	b) Double suspension 'II' Pilot Insulator String	
6	Impulse flashover voltage (dry)	
	Positive wave - KV (peak)	
	i) Suspension Insulator String	
	a) Double Suspension	
	ii) Tension Insulator String	
	a) Double Tension	
	b) Double Tension (for special Towers)	
	iii) Pilot Suspension Insulator String	
	a) Single suspension 'I' Pilot Insulator String	
	b) Double suspension 'II' Pilot Insulator String	



SN	Description	TECHNICAL DATA SHEET
	b) Double suspension 'II' Pilot Insulator String	
	Negative wave - KV (peak)	
	i) Suspension Insulator String	
	a) Double Suspension	
	ii) Tension Insulator String	
	a) Double Tension	
	b) Double Tension (for special Towers)	
	iii) Pilot Suspension Insulator String	
	a) Single suspension 'I' Pilot Insulator String	
	b) Double suspension 'II' Pilot Insulator String	
7	Corona extinction voltage - KV (rms)	
	a) Dry/Wet - KV (rms)	
	i) Suspension Insulator String	
	a) Double Suspension	
	ii) Tension Insulator String	
	a) Double Tension	
	b) Double Tension (for special Towers)	
	iii) Pilot Suspension Insulator String	
	a) Single suspension 'I' Pilot Insulator String	
	b) Double suspension 'II' Pilot Insulator String	
8	Maximum RIV for complete string i.e. including arcing horns, clamps etc. at 154 KV (rms) (in microvolt)	
	i) Suspension Insulator String	
	a) Double Suspension	
	ii) Tension Insulator String	
	a) Double Tension	
	b) Double Tension (for special Towers)	
	iii) Pilot Suspension Insulator String	
	a) Single suspension 'I' Pilot Insulator String	
	b) Double suspension 'II' Pilot Insulator String	
9	Creepage distance of complete string	
	i) Suspension Insulator String	
	a) Double Suspension	
	ii) Tension Insulator String	
	a) Double Tension	
	b) Double Tension (for special Towers)	
	iii) Pilot Suspension Insulator String	
	a) Single suspension 'I' Pilot Insulator String	
	b) Double suspension 'II' Pilot Insulator String	
10	Detailed Dimensional drawing for insulator strings with tolerances attached for:	
	i) Suspension Insulator String (YES/NO)	
	a) Double Suspension	
	ii) Tension Insulator String (YES/NO)	
	a) Double Tension	
	b) Double Tension (for special Towers)	
	iii) Pilot Suspension Insulator String (YES/NO)	
	a) Single suspension 'I' Pilot Insulator String	
	b) Double suspension 'II' Pilot Insulator String	
11	Weight (kg.)	
	i) Suspension Insulator String	
	a) Double Suspension	
	ii) Tension Insulator String	
	a) Double Tension	

SN	Description	TECHNICAL DATA SHEET
	b) Double Tension (for special Towers)	
	iii) Pilot Suspension Insulator String	
	a) Single suspension 'I' Pilot Insulator String	
	b) Double suspension 'II' Pilot Insulator String	
12	Maximum percentage of line to earth voltage across insulator discs of insulator string (of n numbers of discs) for double(II) suspension, Double tension, Double Tension for Special Towers.	
	a) 1st insulator disc from line side	
	b) 2nd insulator disc from line side	
	c) (n-1)th insulator disc from line side	
	d) nth insulator disc from line side.	
13	Mechanical strength of complete insulator string alongwith hardware fittings.	
	i) Suspension Insulator String	
	a) Double Suspension 'II'	
	ii) Tension Insulator String	
	a) Double Tension	
	b) Double Tension (for special Towers)	
	iii) Pilot Suspension Insulator String	
	a) Single suspension 'I' Pilot Insulator String	
	b) Double suspension 'II' Pilot Insulator String	
14	Whether end user certificate in support of performance attached. (YES/NO)	
15	Certification Mark (BIS/BS/Any National Institution)	
IX	HARDWARE FITTINGS	
	A. DOUBLE SUSPENSION CLAMP ASSEMBLY	
1	Type	
2	Manufacturer's Name, address and country	
3	Suitable for (Conductor size)	
4	Governing standard	
5	Detailed dimensioned drawings of each component showing tolerances, material and the standard to which conforming enclosed. YES/NO	
6	Weight of suspension clamp (kg.)	
	a) Body	
	b) Supporting and clamping components	
	c) Total	
7	Galvanization and standard to which conforming.	
	a) Spring washers	
	b) Other ferrous parts	
	c) Weight of zinc g/m ²	
	d) Number of one-minute dips	
	e) Quality of zinc and standard to which conforming	
8	Minimum failing load (No deformation) (kg.) & (KN)	
9	Slip strength at recommended tightening torque (KN)	
10	Whether clamp torque Vs slip curve enclosed YES/NO	
11	Magnetic power loss at:	
	a) 500 amps Watts	
12	Whether a graph showing relation between power losses in watts against current in amperes is enclosed YES/NO	
13	Formed armour rod set	
	a) Type	



SN	Description	TECHNICAL DATA SHEET
	b) Manufacturer's name, address and country	
	c) Suitable for (Conductor size)	
	d) No. of rods per set (No.)	
	e) Direction of lay	
	f) Overall length after fitting on conductor (mm)	
	g) Actual length of each rod along its helix (mm)	
	h) Diameter of each rod (mm)	
	i) Tolerance in	
	i) Diameter of each rod (+/- mm)	
	ii) Length of each rod (+/- mm)	
	iii) Difference of length between the longest and shortest rod in a set (+/- mm)	
	j) Type of aluminium alloy used for manufacture of Formed armour rod set and standard to which	
	k) UTS of each rod (kg/mm ²)	
14	Elastomer for AGS clamps	
	a) Supplier	
	b) Type	
	c) Moulded on insert YES/NO	
	d) Shore hardness	
	e) Temp. range for which designed (deg.C)	
15	Particulars of insert	
	a) Type of aluminium alloy used for manufacturing of insert and standard to which conforming.	
	b) Manufacturing process	
16	Packing details (No. of suspension clamp/formed armour rod set/elastomer etc. per package and gross weight of each package)	
17	Whether end user certificate in support of performance enclosed YES/NO	
18	Certification mark (BIS/BS/Any National Institution).	
	B. TENSION (DOUBLE) CLAMP ASSEMBLY (FOR NORMAL AS WELL AS SPECIAL TOWERS)	For Normal Tower
1	Type	
2	Manufacturer's name address and country	
3	Suitable for (conductor size)	
4	Governing standard	
5	Detailed dimensioned drawings of each component showing tolerances, material and standard to which conforming enclosed YES/NO	
6	Materials composition and standard to which	
	a) Outer sleeve	
	b) Inner sleeve	
7	Slip strength (KN)	
8	Minimum failing load (KN) (No deformation)	
9	Shape of cross section	
	a) Before compression (mm)	
	i) Aluminium	
	ii) Steel	
	b) After compression	
	i) Aluminium	
	ii) Steel	
10	Dimensions of sleeve (mm)	
	a) Before compression (mm)	
	i) Aluminium sleeve	
	ii) Steel sleeve	
	b) After compression (mm)	



SN	Description	TECHNICAL DATA SHEET
	i) Aluminium sleeve	
	ii) Steel sleeve	
11	Length of sleeve	
	a) Before compression (mm)	
	i) Aluminium sleeve	
	ii) Steel sleeve	
	b) After compression (mm)	
	i) Aluminium sleeve	
	ii) Steel sleeve	
12	Galvanisation	
	a) Process	
	b) Weight of zinc (g/sq.m)	
	c) No. of dips	
	i) 1 minute	
	ii) 1/2 minute	
	d) Quality of zinc and standard to which conforming.	
13	Whether compression and non-compression (YES/NO) zones marked on the sleeves	
14	Electrical resistance of tension clamp as a % of equivalent length of conductor.	
15	Details of dies and hydraulic compressor required for compressing sleeves of tension clamp.	
16	Packing details (Nos. of tension clamp assembly per package and gross weight)	
17	Whether end user certificate in support of YES/NO performance enclosed	
18	Certification mark (BIS/BS/Any National Institution)	
	III. OTHER HARDWARE FITTINGS	
1	Manufacturer's name, address and country.	
2	Material, composition, mechanical strength and standard to which conforming.	
	a) Anchor shackle	
	b) Chain link	
	c) Yoke plate	
	d) Arcing horn	
	e) Split pin	
	f) Socket clevis	
	g) Ball clevis	
	h) Clevis-Clevis	
	i) Clevis eye	
	j) Ball hook	
	k) Socket eye horn holder type	
	l) Ball eye	
	m) Twisted shackle	
3	Galvanisation and Standard to which conforming.	
	a) Spring washers	
	b) Other ferrous parts	
	c) Weight of zinc g/sq.m	
	d) No. of one minute dips	
	e) No. of 1/2 minute dips.	
4	Quality of zinc and standard to which conforming.	
5	Detailed dimensioned drawing of each fitting showing tolerances, weight, strength etc. enclosed (YES/NO)	
6	Whether components are interchangeable. (YES/NO)	
7	Packing details of each fitting per package and gross weight	

SN	Description	TECHNICAL DATA SHEET
8	Whether end user certificate in support of performance enclosed YES/NO	
9	Certification mark (BIS/BS/Any National institution.)	



Chapter 8- Tower Schedule & Drawings

LIST OF DRAWINGS/ DOCUMENTS

S. No.	TITLE	NO OF SHEETS
1.	INARUWA-BASANTAPUR-BANESHWAR-TUMLINGTAR TRANSMISSION LINE TOWER SCHEDULE	8
2.	90kN & 160kN DISC INSULATOR UNIT BALL & SOCKET ANTIFOG TYPE	2
3.	220KV DOUBLE SUSPENSION HARDWARE FITTINGS SUITABLE FOR QUAD ACSR MOOSE CONDUCTOR	1
4.	220KV SINGLE SUSPENSION "PILOT" HARDWARE FITTINGS SUITABLE FOR TWIN ACSR MOOSE CONDUCTOR	1
5.	220KV DOUBLE TENSION HARDWARE FITTINGS SUITABLE FOR TWIN ACSR MOOSE CONDUCTOR	1
6.	220KV QUAD TENSION HARDWARE FITTINGS SUITABLE FOR QUAD ACSR MOOSE CONDUCTOR	1
7.	220KV DOUBLE SUSPENSION HARDWARE FITTINGS SUITABLE FOR TWIN ACSR MOOSE CONDUCTOR	1
8.	220KV DOUBLE SUSPENSION "PILOT" HARDWARE FITTINGS SUITABLE FOR QUAD ACSR MOOSE CONDUCTOR	1
9.	CROSS SECTIONAL DRAWING OF ACSR MOOSE CONDUCTOR	1
10.	INARUWA SUBSTATION LAYOUT	1
11.	BASANTAPUR SUBSTATION LAYOUT	1
12.	TUMLINGTAR SUBSTATION LAYOUT	1



TOWER SCHEDULE FOR FOR 220KV TWIN LINE TUMLINGTAR TO BANESHAWAR TRANSMISSION LINE
Rev: R11, Dt. 01.02.2022
For 29.854 Kms

Sr No	Provisional Number	Structure Type	Actual Leg extn (Anti Clock wise)				Tower	Height of Leg Extn.				Raise chimney LEG-A	Raise chimney LEG-B	Raise chimney LEG-C	Raise chimney LEG-D	45N_WGS-44 UTM Easting	45N_WGS-44 UTM Northing	45N_WGS-44 UTM Elevation	Bottom Conductor Height	Line Angle (deg)	SPANS					Section Length(m)	Cumulative Distance (km)	Major Crossings	Structure Number	Insulator Type	SUSPENSION TOWER	TOWER TYPE	Remarks	Name of VOC	Ward No	Type of Land	Name of Land owner	Foundation Type & Class	Required Area in SQM
			Leg-A	Leg-B	Leg-C	Leg-D		Leg-A	Leg-B	Leg-C	Leg-D																												
50	AP21/4	50	DCT+0BE	OBE	0	0	4.5	6	DCT-BB	6	6	10.5	12	0.5	0	0.5	0	532780.7	3013081	1435.23	16.55	LT 25° 28' 26"	368	16740.676	PUCCA ROAD AP21/4	50	TEN.	NO	DCT		Mamling	5	private land		NDS/DFR	25X25			
51	AP21/5	51	DDT+6BE	6BE	0	-3	3	7.5	DDT-NT	6	3	9	13.5	1	0	0	2	532906.1	3012985	1436.38	22.55	RT 39° 58' 35"	158	16898.452	AP21/5	51	TEN.	NO	DDT	CP up +1m	Mamling	6	private land		NDS/DFR	27X27			
52	AP21/6	52	DCT+0BE	OBE	4.5	1.5	3	7.5	DCT-BB	10.5	7.5	9	13.5	0	0	0.5	2	532941.1	3012830	1483.36	16.55	LT 22° 49' 42"	159	17057.868	LT LINE, PUCCA ROAD AP21/6	52	TEN.	NO	DCT	CP up +3m	Mamling	6	private land		NDS/DFR	27X27			
53	AP22	53	DDT+0BE	OBE	0	-3	3	4.5	DDT-BB	6	3	9	10.5	1	0.5	0	0.5	533001.2	3012746	1501.76	16.55	RT 35° 27' 50"	103	17161.259	LT LINE AP22	53	TEN.	NO	DDT	CP up +0.5m	Mamling	6	private land		NDS/DFR	25X25			
54	AP23	54	DCT+0BE	OBE	0	-1.5	3	4.5	DCT-BB	6	4.5	9	10.5	0.5	0	0	0.5	533001.5	3012475	1537.49	16.55	LT 20° 1' 9"	271	17432.355	PUCCA ROAD AP23	54	TEN.	NO	DCT	CP up +0.5m	Mamling	6	private land		NDS/DFR	25X25			
55	AP23/1	55	DDT+0BE	OBE	-1.5	-3	3	7.5	DDT-BB	4.5	3	9	13.5	1	0.5	0.5	0	533127.3	3012130	1557.05	16.55	RT 45° 2' 25"	367	17798.922	AP23/1	55	TEN.	NO	DDT	CP up +3m	Mamling	6	private land		NDS/DFR	27X27			
56	AP23/2	56	DDT+0BE	OBE	-3	-1.5	1.5	3	DDT-BB	3	4.5	7.5	9	0.5	0	0.5	0.5	533051.1	3011967	1617.64	16.55	LT 54° 47' 44"	181	180.592	LT LINE, PUCCA ROAD AP23/2	56	TEN.	NO	DDT		Mamling	7	private land		NDS/DFR	25X25			
57	AP23/3	57	DCT+0BE	OBE	3	0	0	1.5	DCT-BB	9	6	6	7.5	0	0	0	0.5	533233.2	3011649	1701.64	16.55	RT 28° 49' 54"	366	18345.66	PUCCA ROAD(4NOS) AP23/3	57	TEN.	NO	DCT		Mamling	7	private land		NDS/DFR	27X27			
58	AP24	58	DCT+0BE	OBE	1.5	-1.5	-1.5	1.5	DCT-BB	7.5	4.5	4.5	7.5	0	0	0.5	0.5	533237.1	3011431	1762.52	16.55	LT 26° 8' 24"	218	18564.1	LT LINE, PUCCA ROAD(2NOS) AP24	58	TEN.	NO	DCT		Mamling	7	private land		NDS/DFR	27X27			
59	AP24/1	59	DBT+0BE	OBE	0	-1.5	0	6	DBT-BB	6	4.5	6	12	0.5	0.5	1	0.5	533403.7	3011105	1846.59	16.55	RT 1° 56' 27"	365	18929.421	WATER WAY, PUCCA ROAD AP24/1	59	TEN.	NO	DBT		Mamling	7	private land		NDS/DFR	23X23			
60	AP24/2	60	DBT+0BE	OBE	1.5	-3	6	6	DBT-BB	7.5	3	12	12	0	0	0	0	533487.1	3010928	1894.63	16.55	LT 1° 52' 35"	196	19125.398	PUCCA ROAD, 11KV AP24/2	60	TEN.	NO	DBT	CP up +0.5m	Mamling	7	private land		NDS/DFR	23X23			
61	AP24/3	61	DCT+0BE	OBE	4.5	1.5	1.5	7.5	DCT-BB	10.5	7.5	7.5	13.5	0.5	0	0	0.5	533589.2	3010729	1966.83	16.55	RT 22° 14' 46"	224	19349.62	AP24/3	61	TEN.	NO	DCT	CP up +1m	Mamling	8	private land		NDS/DFR	23X23			
62	AP25	62	DBT+0BE	OBE	4.5	1.5	-3	-1.5	DBT-BB	10.5	7.5	3	4.5	0	0.5	0	0.5	533607	3010518	1993.91	16.55	LT 14° 4' 35"	211	19560.683	PUCCA ROAD AP25	62	TEN.	NO	DBT		Mamling	8	private land		NDS/DFR	23X23			
63	AP25/1	63	DCT+0BE	OBE	-1.5	-3	1.5	4.5	DCT-BB	4.5	3	7.5	10.5	1	0.5	0	0	533696.7	3010256	2029.29	16.55	LT 23° 8' 11"	277	19837.585	PUCCA ROAD AP25/1	63	TEN.	NO	DCT		Mamling	8	private land		NDS/DFR	25X25			
64	AP25/2	64	DBT+3BE	3BE	0	0	4.5	10.5	DBT-NT	3	3	7.5	13.5	0	0	0	1	533873.6	3010060	2041.06	19.55	RT 0° 4' 16"	264	20101.702	PUCCA ROAD AP25/2	64	TEN.	NO	DBT	Step Benching at Leg A & B	Tamaphok	7	private land		NDS/DFR	28X28			
65	AP26	65	DCT+0BE	OBE	3	1.5	7.5	3	DCT-BB	9	7.5	13.5	9	1	0.5	0	0.5	534011.2	3009907	2088.87	16.55	RT 19° 36' 34"	206	20307.443	AP26	65	TEN.	NO	DCT		Tamaphok	7	private land		NDS/DFR	25X25			
66	AP26/1	66	DBT+0BE	OBE	1.5	0	1.5	6	DBT-BB	7.5	6	7.5	12	1	0	0	0	534184.2	3009487	2122.008	16.55	LT 14° 27' 39"	455	20762.222	EP, MAIN ROAD AP26/1	66	TEN.	NO	DBT	CP up +1m	Tamaphok	7	private land		NDS/DFR	23X23			
67	AP27	67	DBT+0BE	OBE	-3	0	4.5	1.5	DBT-BB	3	6	10.5	7.5	0.5	0	0	0	534291.3	3009343	2142.59	16.55	LT 7° 41' 11"	179	20941.022	MAIN ROAD, LT LINE AP27	67	TEN.	NO	DBT		Tamaphok	7	private land		NDS/DFR	25X25			
68	AP27/1	68	DBT+0BE	OBE	-3	0	6	6	DBT-BB	3	6	12	12	0.5	0	1	0.5	534523.4	3009107	2120.62	16.55	LT 13° 2' 23"	331	21271.979	11KV LINE, PUCCA ROAD, 33KV AP27/1	68	TEN.	NO	DBT		Tamaphok	7	private land		NDS/DFR	23X23			
69	AP27/2	69	DDT+0BE	OBE	-3	-1.5	7.5	6	DDT-BB	3	4.5	13.5	12	0.5	0	3	0	534796.4	3008934	2091.2	16.55	RT 30° 36' 36"	324	21595.55	KANCHI ROAD, LT LINE AP27/2	69	TEN.	NO	DDT		Tamaphok	8	private land		NDS/DFR	27X27			
70	AP27/3	70	DBT+0BE	OBE	3	1.5	4.5	6	DBT-BB	9	7.5	10.5	12	0	0	0.5	0	535009.6	3008514	2141.51	16.55	RT 3° 14' 35"	471	22066.215	LT LINE, KANCHI ROAD(2NOS) AP27/3	70	TEN.	NO	DBT	CP up +3m	Tamaphok	8	private land		NDS/DFR	25X25			
71	AP28	71	DBT+6BE	6BE	-3	-3	1.5	3	DBT-NT	3	3	7.5	9	0	0	0	0	535108.5	3008289	2164.94	22.55	LT 3° 21' 19"	246	22312.179	PUCCA ROAD AP28	71	TEN.	NO	DBT		Tamaphok	8	private land		NDS/DFR	25X25			
72	AP28/1	72	DCT+0BE	OBE	0	-3	0	1.5	DCT-BB	6	3	6	7.5	0	1	0	0	535171.1	3008166	2168.419	16.55	LT 15° 22' 9"	138	22449.792	ROAD AP28/1	72	TEN.	NO	DCT	CP up +0.5m	Tamaphok	8	private land		NDS/DFR	27X27			
73	AP28/1A	73	DBT+0BE	OBE	0	0	1.5	3	DBT-BB	6	6	7.5	9	0	0	1	0	535482.1	3007826	2190.3	16.55	RT 7° 32' 58"	461	22910.893	LT LINE, 11 KV, ROAD AP28/1A	73	TEN.	NO	DBT		Tamaphok	9	Forest		NDS/DFR	23X23			
74	AP28/1B	74	DBT+0BE	OBE	3	-1.5	3	3	DBT-BB	9	4.5	9	9	0.5	0	0	0.5	535699.1	3007515	2271.84	16.55	LT 12° 19' 49"	379	23290.338	AP28/1B	74	TEN.	NO	DBT	CP Down -0.5m	Tamaphok	9	Forest		NDS/DFR	23X23			
75	AP28/2	75	DDT+0BE	OBE	1.5	4.5	6	6																															

TOWER SCHEDULE FOR FOR 220KV TWIN LINE TUMLINGTAR TO BANESHAWAR TRANSMISSION LINE																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																												
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Sr No	Provisional Number	Structure Type	TOWERS																Line Angle (deg)	SPANS					Section Length(m)	Cumulative Distance (km)	Major Crossings	Structure Number	Insulator Type	SUSPENSION TOWER	TOWER TYPE	Remarks	Name of VDC	Ward No	Type of Land	Name of Land owner	Foundation Type & Class	Required Area in SQM																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																						
			Actual Leg extn (Anti Clock wise)				Attachme nt level	Height of Leg Extn.				Raise chimney LEG-A	Raise chimney LEG-B	Raise chimney LEG-C	Raise chimney LEG-D	45N_WGS-84 UTM Easting	45N_WGS-84 UTM Northing	45N_WGS-84 UTM Elevation		Bottom Conductor Height																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																								
			Leg-A	Leg-B	Leg-C	Leg-D		Leg-A	Leg-B	Leg-C	Leg-D																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																	

*NOTE Bottom conductors heights are excluding muff. Height 0.5mtr



TOWER SCHEDULE FOR 220KV QUAD LINE INARUWA TO BASANTPUR TRANSMISSION LINE Rev: R9 ; Dt. 31.05.22																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
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Sr No	TOWERS			TOWERS												Line Angle (deg)	SPANS						Mejor Crossings	Structure Number	Insulator Type	SUPER-SUSPENSION TOWER	TOWER TYPE	Remarks	Name of VDC	Ward No	Type of Land	Name of Land owner	Foundation Type & Class	Required Area in SQM																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
	Location No	Provisional Number	Structure Type	Actual Leg extn				Attachment level	Height of Leg Extn.				Leg-A	Leg-B	Leg-C		Leg-D	Leg-A	Leg-B	Leg-C	Leg-D	Leg-A													Leg-B	Leg-C	Leg-D	Actual Span (m)	Wind Span (m)	Weight Span (m) Cold	Weight Span (m) Hot	Equivalent Span (m)	Section Length(m)	Cumulative Distance (km)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																											
1	GANTRY BAY	1	Gantry_bay	---	---	---	---	Gan-NT	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---</

Chapter 8 – Tower Schedule and Drawings

TOWER SCHEDULE FOR FOR 220KV QUAD LINE INARUWA TO BASANTPUR TRANSMISSION LINE
Rev: R9 : Dt. 31.05.22

For 75.803 Kms

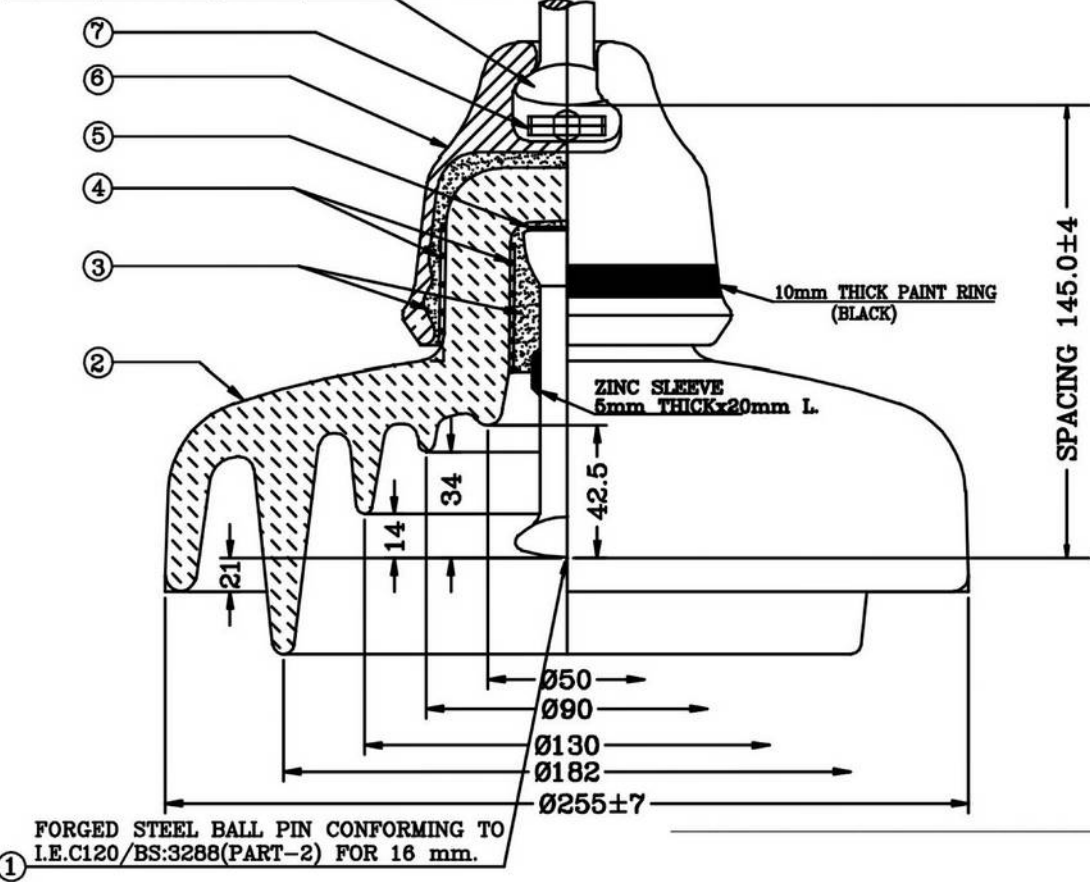
Sr No	Location No	Provisional Number	Structure Type	Actual Leg extn				Attachment level		TOWERS Height of Leg Extn.				Raise Chimney Leg-A	Raise Chimney Leg-B	Raise Chimney Leg-C	Raise Chimney Leg-D	45N WGS-84 UTM Easting	45N WGS-84 UTM Northing	45N WGS-84 UTM Elevation	Bottom Conductor Height	Line Angle (deg)	SPANS					Section Length(m)	Cumulative Distance (km)	Mejor Crossings	Structure Number	Insulator Type	SUSPENSION TOWER	TOWER TYPE	Remarks	Name of VDC	Ward No	Type of Land	Name of Land owner	Foundation Type & Class	Required Area in SQM
				Leg-A	Leg-B	Leg-C	Leg-D	Tower	Leg-A	Leg-B	Leg-C	Leg-D	Actual Span (m)										Wind Span (m)	Weight Span (m) Cold	Weight Span (m) Hot	Equivalent Span (m)															
112	AP52/C	104	DDQ+0BE	0BE	4.5	6	0	-1.5	DDQ-BB	10.5	12	6	4.5	0.5	1	0	0	531973.44	2972672.58	1095.11	16.8	RT 55° 39' 50"	420	364	149	359	420	37418	Road AP52/C	104	TEN.	NO	DOQ		Vedetar	Private		NDS	31X31		
113	AP52/B	105	DCQ+9BE	9BE	-3	-4.5	4.5	4.5	DCQ-NT	6	4.5	13.5	13.5	0	0.5	3	3	531723.889	2972539.987	1178.92	25.8	LT 23° 12' 7"	283	297	117	210	283	37700	AP52/B	105	TEN.	NO	DCQ		Vedetar	Forest		NDS/DFR	34X34		
114	AP52/A	106	DBQ+0BE	0BE	4.5	-1.5	1.5	6	DBQ-BB	10.5	4.5	7.5	12	0	0	0	1	531552.179	2972326.539	1297.45	16.8	LT 12° 11' 16"	274	385	1116	693	465	37974	AP52/A	106	TEN.	NO	DBQ	CP UP : +3	Vedetar	Forest		NDS/DFR	30X30		
115	AP53/0	107	DDQ+9BE	9BE	-1.5	-4.5	-4.5	0	DDQ-NT	7.5	4.5	4.5	9	0	0	0.5	0	531343.906	2971911.124	1356.33	25.8	LT 34° 10' 17"	465	574	553	533	465	38439	AP53/0	107	TEN.	NO	DDQ		Vedetar	Forest		NDS/DFR	31X31		
116	AP53/A	108	DCQ+9BE	9BE	4.5	4.5	-4.5	-4.5	DCQ-NT	13.5	13.5	4.5	4.5	2.5	5	0	0.5	531406.032	2971442.011	1409.996	25.8	RT 21° 40' 33"	473	665	1438	1282	473	38912	AP53/A	108	TEN.	NO	DCQ	CP DOWN : -2.5	Ghopa	Forest		NDS/DFR	30X30		
117	AP54/0	109	DDQ+0BE	0BE	1.5	3	-1.5	-3	DDQ-BB	7.5	9	4.5	3	0	0.5	0.5	0	531253.297	2970835.381	1215	16.8	RT 39° 3' 47"	626	598	242	289	626	39538	AP54/0	109	TEN.	NO	DDQ		Ghopa	Forest		NDS	31X31		
118	AP54/H	110	DDQ+3BE	3BE	4.5	4.5	1.5	0	DDQ-NT	7.5	7.5	4.5	3	0	0.5	0	0	530819.757	2970510.992	1137.46	19.8	RT 34° 50' 39"	541	389	606	391	541	40079	AP54/H	110	TEN.	NO	DDQ	CP UP : +1.5	Ghopa	Forest		NDS	33X33		
119	AP54/G	111	DBQ+0BE	0BE	1.5	4.5	1.5	-3	DBQ-BB	7.5	10.5	7.5	3	1	0.5	0	0	530584.898	2970502.951	1102.4	16.8	LT 5° 51' 33"	235	249	-92	101	235	40314	AP54/G	111	TEN.	NO	DBQ		Ghopa	Forest		NDS	28.5X28.5		
120	AP54/F-1	112	DBQ+0BE	0BE	4.5	4.5	-3	-3	DBQ-BB	10.5	10.5	3	3	0	1	0	0	530325.203	2970467.285	1087.33	16.8	RT 12° 54' 44"	262	207	1014	437	262	40576	AP54/F-1	112	TEN.	NO	DBQ		Ghopa	Forest		NDS	28.5X28.5		
121	AP54/E	113	DCQ+6BE	6BE	1.5	7.5	0	-3	DCQ-NT	7.5	13.5	6	3	0	0.5	0.5	0	530180.775	2970480.155	1033.93	22.8	LT 28° 44' 57"	145	200	60	275	145	40721	AP54/E	113	TEN.	NO	DCQ	CP UP : +1.5	Ghopa	Forest		NDS	30X30		
122	AP54/D	114	DDQ+0BE	0BE	-1.5	6	4.5	-3	DDQ-BB	4.5	12	10.5	3	0	0	1	0	529961.084	2970383.914	969.9	16.8	RT 43° 56' 34"	240	254	965	529	240	40961	AP54/D	114	TEN.	NO	DDQ		Ghopa	Forest		NDS	31X31		
123	AP54/C	115	DDQ+0BE	0BE	7.5	7.5	7.5	-3	DDQ-BB	13.5	13.5	13.5	3	1	2	1	0	529750.281	2970461.833	833.14	16.8	LT 45° 34' 23"	225	248	-290	26	225	41186	AP54/C	115	TEN.	NO	DDQ	CP UP : +3	Ghopa	Forest		NDS	31X31		
124	AP54/B	116	DBQ+9BE	9BE	-3	3	4.5	-4.5	DBQ-NT	6	12	13.5	4.5	0	0	1.5	0	529550.776	2970367.582	749.06	25.8	RT 7° 57' 16"	221	336	-510	-23	221	41407	AP54/B	116	TEN.	NO	DBQ		Ghopa	Forest		NDS	34X34		
125	AP54/A	117	DDQ+0BE	0BE	-1.5	7.5	4.5	-1.5	DDQ-BB	4.5	13.5	10.5	4.5	0	0	0.5	0	529134.589	2970237.693	736.255	16.8	RT 3° 26' 20"	436	639	196	256	436	41843	AP54/A	117	TEN.	NO	DDQ		Ghopa	Forest		NDS	34X34		
126	AP55	118	DDQ+0BE	0BE	1.5	0	3	1.5	DDQ-BB	7.5	6	9	7.5	0	0	0	0	528327.637	2970038.084	876.16	16.8	LT 4° 58' 9"	831	673	924	914	831	42674	AP55	118	TEN.	NO	DDQ		Ghopa	Forest		NDS	34X34		
127	AP55/I	119	DDQ+9BE	9BE	0	-4.5	4.5	4.5	DDQ-NT	9	4.5	13.5	13.5	1	0	0.5	0	527851.339	2969875.353	888.9	25.8	LT 30° 34' 51"	503	415	114	250	503	43177	AP55/I	119	TEN.	NO	DDQ		Ghopa	7	Private	NDS	36X36		
128	AP55/H	120	DBQ+6BE	6BE	0	0	6	7.5	DBQ-NT	6	6	12	13.5	1	0	0.5	0	527642.048	2969630.79	943.49	22.8	RT 9° 21' 47"	322	418	917	742	322	43499	AP55/H	120	TEN.	NO	DBQ		Ghopa	7	Private	NDS/DFR	34X34		
129	AP55/G	121	DCQ+0BE	0BE	-1.5	4.5	7.5	7.5	DCQ-BB	4.5	10.5	13.5	13.5	0	0	1.5	2	527251.015	2969301.734	921.93	16.8	RT 22° 41' 47"	511	384	1246	755	511	44010	AP55/G	121	TEN.	NO	DCQ	CP UP : +1.5	Ghopa	Forest		NDS/DFR	28.5X28.5		
130	AP55/F	122	DBQ+0BE	0BE	-3	3	4.5	3	DBQ-BB	3	9	10.5	9	0.5	0.5	0.5	0.5	527018.273	2969228.867	837.29	16.8	LT 2° 30' 6"	244	377	-195	223	244	44254	AP55/F	122	TEN.	NO	DBQ		Ghopa	Forest		NDS/DFR	28.5X28.5		
131	AP55/E	123	DCQ+0BE	0BE	-3	-1.5	4.5	1.5	DCQ-BB	3	4.5	10.5	7.5	0	0	0	0	526559.009	2969062.742	749.78	16.8	RT 18° 23' 4"	488	431	70	154	488	44742	AP55/E	123	TEN.	NO	DCQ		Ghopa	8	Private	NDS/DFR	28.5X28.5		
132	AP55/D	124	DCQ+0BE	0BE	-1.5	3	3	1.5	DCQ-BB	4.5	9	9	7.5	0	0	0.5	0	526194.156	2969053.178	744.62	16.8	LT 25° 40' 18"	365	336	223	270	365	45107	AP55/D	124	TEN.	NO	DCQ		Ghopa	8	Private	NDS/DFR	28.5X28.5		
133	AP55/C	125	DCQ+0BE	0BE	7.5	6	-3	0	DCQ-BB	13.5	12	3	6	0.5	0.5	0.5	0	525921.177	2968913.047	753.5	16.8	RT 25° 25' 51"	307	286	859	579	307	45414	AP55/C	125	TEN.	NO	DCQ		Ghopa	8	Forest	NDS/DFR	28.5X28.5		
134	AP55/B	126	DDQ+0BE	0BE	1.5	1.5	4.5	3	DDQ-BB	7.5	7.5	10.5	9	0	0	0	0.5	525658.6	2968905.059	706.33	16.8	LT 32° 54' 54"	263	204	357	161	263	45677	AP55/B	126	TEN.	NO	DDQ		Ghopa	8	Forest	NDS/DFR	31X31		
135	AP55B-1	127	DBQ+6BE	6BE	-3	-3	7.5	7.5	DBQ-NT	3	3	13.5	13.5	0	0	0	2	525543.953	29																						



TOWER SCHEDULE FOR FOR 220KV QUAD LINE INARUWA TO BASANTPUR TRANSMISSION LINE Rev: R9 ; Dt. 31.05.22 For 75.803 Kms																																									
Sl No	Location No	Provisional Number	Structure Type	Actual Leg extn				Attachment level	TOWERS Height of Leg Extn.				Raise Chimney Leg-A	Raise Chimney Leg-B	Raise Chimney Leg-C	Raise Chimney Leg-D	45N_WGS-84 UTM Easting	45N_WGS-84 UTM Northing	45N_WGS-84 UTM Elevation	Bottom Conductor Height	Line Angle (deg)	SPANS					Section Length(m)	Cumulative Distance (km)	Mejor Crossings	Structure Number	Insulator Type	SUSPENSION TOWER	TOWER TYPE	Remarks	Name of VDC	Ward No	Type of Land	Name of Land owner	Foundation Type & Class	Required Area in SQM	
				Leg-A	Leg-B	Leg-C	Leg-D		Leg-A	Leg-B	Leg-C	Leg-D										Actual Span (m)	Wind Span (m)	Weight Span (m) Cold	Weight Span (m) Hot	Equivalent Span (m)															
224	AP65	74	DBQ+3BE	3BE	0	0	0	0	DBQ-NT	3	3	3	3	0	0	0	0	512625.852	2945466.994	85.919	19.8	LT 5° 48' 15"	238	289	322	307			73919	WATER WAY AP65 TRACK	74	TEN.	NO	DBQ		Dumraha	8	Paddy land		WET	27.5X27.5
225	65-1	75	DAQ+6BE	6BE	0	0	0	0	DAQ-NT	6	6	6	6	0	0	0	0	512545.969	2945137.206	86.678	22.5		339	344	364	357			74259	65-1	75	SUS.	YES	DAQ		Dumraha	8	Paddy land		WET	20X20
226	65-2	76	DAQ+6BE	6BE	0	0	0	0	DAQ-NT	6	6	6	6	0	0	0	0	512463.809	2944798.019	86.282	22.5		349	352	382	371	359	1797	74608	65-2	76	SUS.	YES	DAQ		Dumraha	8	Paddy land		WET	20X20
227	65-3	77	DAQ+3BE	3BE	0	0	0	0	DAQ-NT	3	3	3	3	0	0	0	0	512380.152	2944452.652	84.78	19.5		355	353	347	350			74963	11KV LINE , 33KV LINE	77	SUS.	YES	DAQ		Dumraha	8	Paddy land		WET	19X19
228	65-4	78	DAQ+0BE	0BE	0	0	0	0	DAQ-BB	6	6	6	6	0	0	0	0	512297.99	2944113.455	84.134	16.5		349	376	300	329			75312	65-4 ROAD, RIVER, TRACK	78	SUS.	YES	DAQ		Dumraha	8	Paddy land		WET	18X18
229	AP66	79	DDQ+6BE	6BE	0	0	0	0	DDQ-NT	6	6	6	6	0	0	0	0	512202.882	2943720.813	83.321	22.8	LT 07° 01' 20"	404	245	386	338			75716	AP66	79	TEN.	NO	DDQ	0° Line deviation to be maintained at Line side	Bhokraha	7	Paddy land		WET	19X19
																					87					87	87														
230	INARUWA S/S GANTRY	80	Gantry_bay	Gantry_bay	--	--	--	--	Gan-NT	--	--	--	--	0	0	0	0	512192.876	2943634.255	82.951	21.5			44	-46	-17			75803	INARUWA S/S GANTRY	80	TEN.	NO	GANTRY		Bhokraha	7	Paddy land		WET	31X31
																						75803						75803													



SOCKET PORTION CONFORMING TO
I.E.C:120/BS:3288 (PART-2) FOR 16mm ALT. B



* S.G.I. GRADE 450/10 I.S:- SPECIFICATION : 1865
* BALL PIN GRADE EN 8D I.S. SPECIFICATION: BS:970
* UNTOLERANCED DIMENSIONS INDICATED ARE FOR REFERENCE
PURPOSE ONLY & NOT FOR INSPECTION.

7	'R' TYPE SECURITY CLIP	1	STAINLESS STEEL	-
6	SOCKET CAP	1	S.G.I.	HOT DIP GALVANIZED
5.	CUSHION	1	CUSHION	-
4.	GROG.	-	PORCELAIN.	-
3	CEMENT	-	CEMENT	RAPID HARDENING HIGH STRENGTH PORTLAND CEMENT
2	INSULATOR SHELL	1	ELECTRO PORCELAIN	BROWN GLAZED
1	BALL PIN	1	FORGED STEEL	HOT DIP GALVANIZED



TECHNICAL PARTICULARS

1. GENERAL
- TYPE OF INSULATOR. BALL AND SOCKET TYPE ANTI FOG DISC INSULATOR(TYPE-B)
- SIZE & DESIGNATION OF BALL & SOCKET. :- 16 mm.ALT-'B' AS PER I.S: 2486(PART-II)
- APPROX. NET WEIGHT OF SOCKET CAP. :- 1.05 KG.±0.1KG.
- APPROX. NET WEIGHT OF BALL PIN. :- 0.250 KG.±0.025
2. DIEMENSIONS:-
- PORCELAIN DISC INSULATOR DIA. :- 255 mm
- TOLERANCE OF DIA. :- ±7 mm
- UNIT SPACING. :- 145 mm
- TOLERANCE OF SPACING. :- ±4 mm.
- CREEPAGE DISTANCE(MIN) :- 430 mm
- TOLERANCE ON CREEPAGE DISTANCE :- +20 mm - 0
- PROTECTED CREEPAGE DISTANCE. :- 216 mm.
3. COLOUR OF GLAZE OF THE FINISHED PORCELAIN INSULATOR :- BROWN.
4. MECHANICAL VALUES:-
- ELECTRO- MECHANICAL STRENGTH. :- 90 kN
5. ELECTRICAL VALUES:-
- POWER FREQUENCY FLASHOVER VOLTAGE. DRY. :- 90 kV.(RMS)
- WET :- 55 kV (RMS)
- IMPULSE FLASHOVER VOLTAGE. 1.2 X 50 µS. POSITIVE :- 120 kV (PEAK)
- NEGATIVE :- 115 kV (PEAK)
- POWER FREQUENCY WITHSTAND TEST VOLTAGE. DRY. :- 85 kV. (RMS.)
- WET. :- 50 kV. (RMS.)
- IMPULSE WITHSTAND TEST VOLTAGE. 1.2 X 50 µS. POSITIVE :- 110 kV (PEAK)
- NEGATIVE :- 110 kV (PEAK)
- STEEPNESS OF IMPULSE VOLTAGE WHICH THE DISC INSULATOR WITHSTAND IN STEEP WAVE FRONT TEST.2500kV/µSEC
6. POWER FREQUENCY PUNCTURE VOLTAGE. :- 140 kV. RMS.
7. MIN. VISIBLE DISCHARGE VOLTAGE. :- 9 KV.(RMS)
8. MAX R.I.V. AT 1 MHz AND 10 kV (RMS.) :- 50 µV
9. NET WEIGHT OF INSULATOR UNIT. (APPROX.) :- 7.0 KG.
10. STANDARD SPECIFICATION TO WHICH INSULATOR WILL CONFORM. :- I.S:731, I.S:13305,I.E.C:383.
11.
12. ALL FERROUS PARTS SHALL BE HOT DIP GALVANIZED AS PER I.S:2629 & I.S:2633 (6 DIPS x 1 MINUTE DURATION FOR EACH DIP)
13. ECCENTRICITY OF DISC:- (REF. CL. NO. 21-2 OF IEC:60383-1 OF 1993)
- MAX. RADIAL RUNOUT. :- 7.65mm.
- MAX. AXIAL RUNOUT. :- 10.2 mm.
14. MASS OF ZINC COATING :- 610 gm/m²
15. ZINC PURITY FOR GALVANIZING. :-99.95%
16. PURITY OF ZINC USED FOR ZINC SLEEVES(Min) :-99.8%
17. ZINC SLEEVE EXPOSED LENGTH /THICKNESS (Min). :-10mm/5mm

FOR TENDER PURPOSE ONLY

NEPAL ELECTRICITY AUTHORITY

PROJECT : KOSHI CORRIDOR 220kV TRANSMISSION LINE PROJECT

TRANSMISSION LINE: KOSHI CORRIDOR 220kV TRANSMISSION LINE

TITLE : 90 KN ANTI FOG DISC INSULATOR (WITH ZINC SLEEVE)

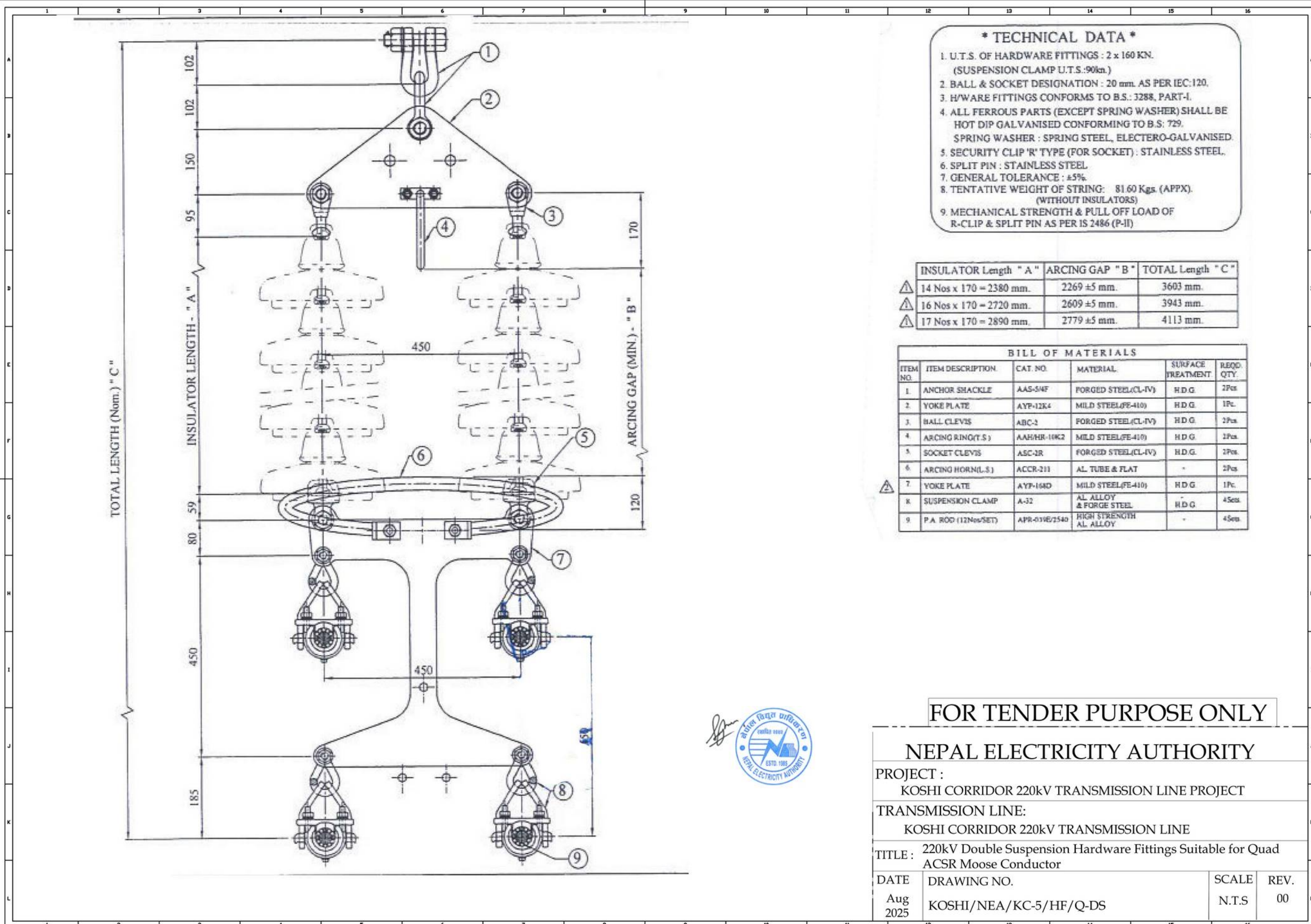
DATE Aug 2025

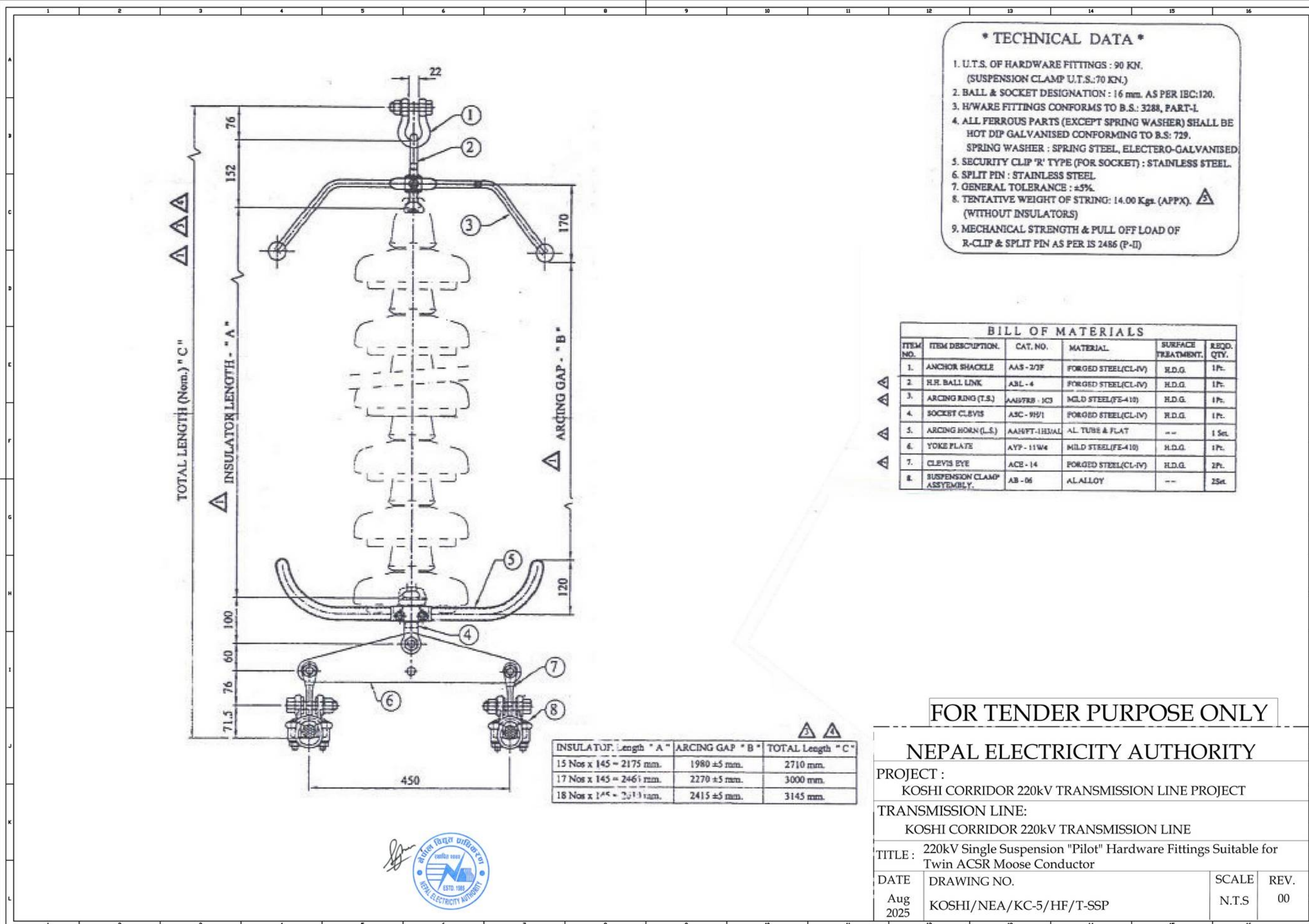
DRAWING NO. KOSHI/NEA/KC-5/IN/90

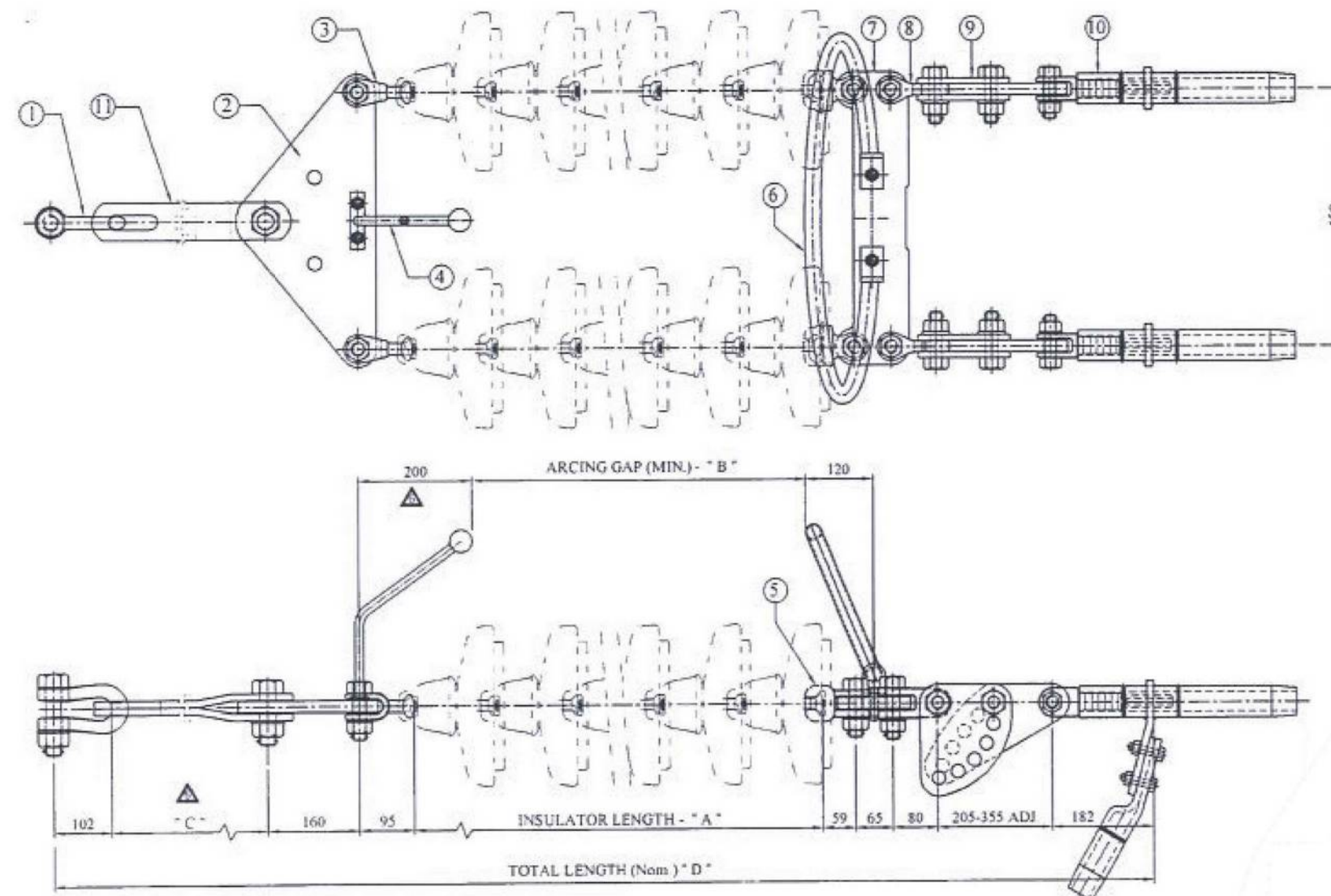
SCALE N.T.S

REV. 00

7	'R' TYPE SECURITY CLIP	1	STAINLESS STEEL	—
6.	CUSHION	1	CUSHION	
5	SOCKET CAP	1	S.G.I. *	HOT DIP GALVANIZED
4.	GROG.	—	PORCELAIN.	—
3	CEMENT	—	CEMENT	RAPID HARDENING HIGH STRENGTH PORTLAND CEMENT
2	INSULATOR SHELL	1	ELECTRO PORCELAIN	BROWN GLAZED
1	BALL PIN	1	FORGED STEEL *	HOT DIP GALVANIZED







* TECHNICAL DATA *

- 1 U.T.S. OF HARDWARE FITTINGS: 2 x 160 KN
(TENSION CLAMP U.T.S. 95% OF CONDUCTOR'S U.T.S.)
- 2 BALL & SOCKET DESIGNATION: 20 mm. AS PER IEC 120
- 3 HARDWARE FITTINGS CONFORMS TO B.S. 3218, PART-1
- 4 ALL FERROUS PARTS (EXCEPT SPRING WASHER) SHALL BE
HOT DIP GALVANISED CONFORMING TO B.S. 729
SPRING WASHER: SPRING STEEL, ELECTRO-GALVANISED
- 5 SECURITY CLIP 'R' TYPE (FOR SOCKET) STAINLESS STEEL
- 6 SPLIT PIN: STAINLESS STEEL
- 7 GENERAL TOLERANCE: $\pm 5\%$
- 8 TENTATIVE WEIGHT OF STRING HARDWARE AS PER CHART
(WITHOUT INSULATORS)
- 9 MECHANICAL STRENGTH & PULL OFF LOAD OF
R-CLIP & SPLIT PIN AS PER IS 2486 (P-II)



BILL OF MATERIALS					
ITEM NO	ITEM DESCRIPTION	CAT. NO	MATERIAL	SURFACE TREATMENT	REQD QTY.
1	ANCHOR SHACKLE	AAS-5/4F	FORGED STEEL (CL-IV)	H.D.G.	1Pcs
2	YOKE PLATE	AYP-12V3	MILD STEEL (FE-410)	H.D.G.	1Pc
3	BALL CLEVIS	ABC-2	FORGE STEEL (CL-IV)	H.D.G.	2Pcs
4	ARCING RING (TS)	AAH/HRB-9N3	MILD STEEL (FE-410)	H.D.G.	1Pc
5	SOCKET CLEVIS	ASC-2R	FORGED STEEL (CL-IV)	H.D.G.	2Pcs
6	ARCING RING (S)	ACCR-211	AL TUBE & FLAT	-	1Pc
7	YOKE PLATE	AYP-175C	MILD STEEL (FE-410)	H.D.G.	1Pc
8	CLEVIS EYE	ACE-76T	FORGED STEEL (CL-IV)	H.D.G.	2Pcs
9	SAG ADJ. PLATE	ASA-1E	MILD STEEL (FE-410)	H.D.G.	2Sets
10	TENSION CLAMP ASSY	AD/C-001D	AL TUBE, AL EXTRUDE & FORGE STEEL	-	2Sets
11	EXTENSION LINK	Details in Chan	MILD STEEL (FE-410)	H.D.G.	1Set

INSULATOR LENGTH "A"	ARCING GAP "B"	TOWER NAME	EXT. LINK Length "C"	CAT NO	TOTAL LENGTH "D"	H/Ware Weight Excluding Insulat	
15 Nos x 170 = 2550 mm	2416 $\pm$ 5 mm	DCT	702	AEL-1047	4200 - 4350 mm	65.33 Kgs	
			402	AEL-1048	3900 - 4050 mm	61.63 Kgs	
	2416 $\pm$ 5 mm	DDT	502	AEL-1049	4000 - 4150 mm	62.95 Kgs	
			302	AEL-1050	3800 - 3950 mm	60.63 Kgs	
	** WITHOUT EX. LINK TENSION STRING					3600 - 3750 mm	52.93 Kgs
	17 Nos x 170 = 2890 mm	2756 $\pm$ 5 mm	DCT	702	AEL-1047	4580 - 4690 mm	AS ABOVE
402				AEL-1048	4280 - 4390 mm		
2756 $\pm$ 5 mm		DDT	502	AEL-1049	4380 - 4490 mm		
			302	AEL-1050	4180 - 4290 mm		
** WITHOUT EX. LINK TENSION STRING					3940 - 4090 mm		
18 Nos x 170 = 3060 mm		2926 $\pm$ 5 mm	DCT	702	AEL-1047	4760 - 4860 mm	AS ABOVE
	402			AEL-1048	4460 - 4560 mm		
	2926 $\pm$ 5 mm	DDT	502	AEL-1049	4560 - 4660 mm		
			302	AEL-1050	4360 - 4460 mm		
	** WITHOUT EX. LINK TENSION STRING					4110 - 4260 mm	

FOR TENDER PURPOSE ONLY

NEPAL ELECTRICITY AUTHORITY

PROJECT :

KOSHI CORRIDOR 220kV TRANSMISSION LINE PROJECT

TRANSMISSION LINE:

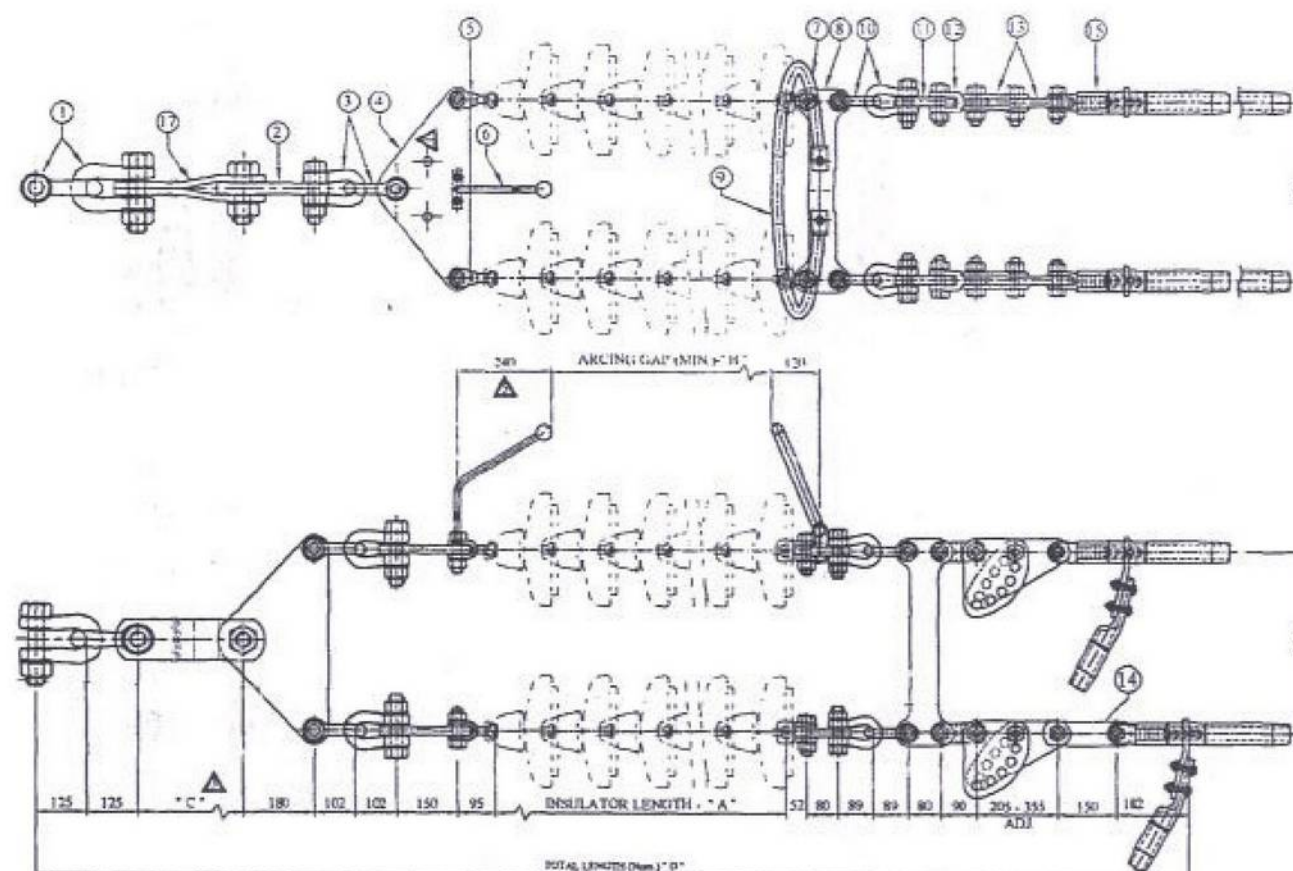
KOSHI CORRIDOR 220kV TRANSMISSION LINE

TITLE : 220kV Double Tension Hardware Fittings Suitable for Twin ACSR
Moose ConductorDATE
Aug
2025

DRAWING NO.

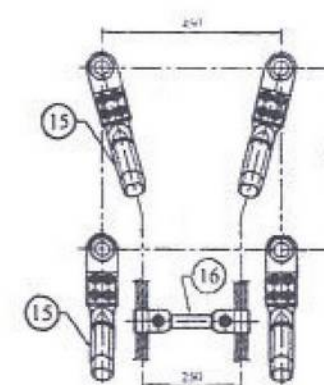
KOSHI/NEA/KC-5/HF/T-DT

SCALE
N.T.SREV.
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* TECHNICAL DATA *

1. U.T.S. OF HARDWARE FITTINGS : 4 x 160 KN.
(TENSION CLAMP U.T.S. : 95% OF RELEVANT CONDUCTOR U.T.S.)
2. BALL & SOCKET DESIGNATION : 20 mm. AS PER IS:120.
3. HARDWARE FITTINGS CONFORMS TO B.S. : 3288, PART-1.
4. ALL FERROUS PARTS (EXCEPT SPRING WASHER) SHALL BE HOT DIP GALVANISED CONFORMING TO B.S. : 729.
SPRING WASHER : SPRING STEEL, ELECTRO-GALVANISED
5. SECURITY CLIP 'R' TYPE (FOR SOCKET) : STAINLESS STEEL.
6. SPLIT PIN : STAINLESS STEEL
7. GENERAL TOLERANCE : $\pm 5\%$
8. TENTATIVE WEIGHT OF STRING HARDWARE : AS PER CHART.
9. MECHANICAL STRENGTH & PULL OFF LOAD OF R-CLIP & SPLIT PIN AS PER IS 2486 (P-II)



CONDUCTOR SPACING

BILL OF MATERIALS					
ITEM NO.	ITEM DESCRIPTION.	CAT. NO.	MATERIAL	SURFACE TREATMENT.	REQD. QTY.
1.	ANCHOR SHACKLE	AAS-13F	FORGED STEEL (CL-IV)	H.D.G.	2Pcs.
2.	YOKE PLATE (T.S.)	AYP-10Q17	MILD STEEL (FE-410)	H.D.G.	1Pc.
3.	ANCHOR SHACKLE (Int.T.S.)	AAS-5/F	FORGED STEEL (CL-IV)	H.D.G.	4Pcs.
4.	YOKE PLATE (INTER-T.S.)	AYP-12K4	MILD STEEL (FE-410)	H.D.G.	2Pcs.
5.	BALL CLEVIS	ABC-2	FORGED STEEL (CL-IV)	H.D.G.	4Pcs.
6.	ARCING HORN (T.S.)	AAHVRB-PRJ	MILD STEEL (FE-410)	H.D.G.	1Pc.
7.	SOCKET CLEVIS	ASC-2R	FORGE STEEL (CL-IV)	H.D.G.	4Pcs.
8.	YOKE PLATE (INTER-L.S.)	AYP-354B	MILD STEEL (FE-410)	H.D.G.	2Pcs.
9.	ARCING HORN (L.S.)	ACCR-211	AL. TUBE	-	1Pc.
10.	ANCHOR SHACKLE (Int.L.S.)	AAS-1601	FORGE STEEL (CL-IV)	H.D.G.	8Pcs.
11.	YOKE PLATE (L.S.)	AYP-354C1	MILD STEEL (FE-410)	H.D.G.	2Pcs.
12.	CLEVIS EYE	ACE-90 (Ø14/Ø12)	FORGE STEEL (CL-IV)	H.D.G.	4Pcs.
13.	SAG ADJ. PLATE	ASA-1E	MILD STEEL (FE-410)	H.D.G.	4Sets.
14.	EXTENSION LINK	AEL-296A	MILD STEEL (FE-410)	H.D.G.	1Set.
15.	TENSION CLAMP ASSY.	ADP-0001D	AL. TUBE, AL. EXTRUD & FORGE STEEL (CL-II)	-	4Sets.
16.	RIGID SPACER	ARQS-001/250S	AL. ALLOY (A-4)	-	1Set.
17.	EXTENSION LINK	Details in Chart	MILD STEEL (FE-410)	H.D.G.	1Set.

INSULATOR LENGTH "A"	ARCING GAP "B"	TOWER NAME	EXT. LINK Length "C"	CAT. NO.	TOTAL LENGTH "D"	Hardware Weight Excluding Spacers
12 Nos x 170 = 2040 mm.	2300 ± 5 mm.	DOQ	330	AEL-1056	4796 - 4966 mm.	180.50 Kgs.
17 Nos x 170 = 2890 mm.	2700 ± 5 mm.	DOQ	330	AEL-1056	5136 - 5280 mm.	As Above
18 Nos x 170 = 3060 mm.	2870 ± 5 mm.	DOQ	330	AEL-1056	5306 - 5430 mm.	As Above
					4956 - 5106 mm.	

FOR TENDER PURPOSE ONLY

NEPAL ELECTRICITY AUTHORITY

PROJECT :

KOSHI CORRIDOR 220kV TRANSMISSION LINE PROJECT

TRANSMISSION LINE:

KOSHI CORRIDOR 220kV TRANSMISSION LINE

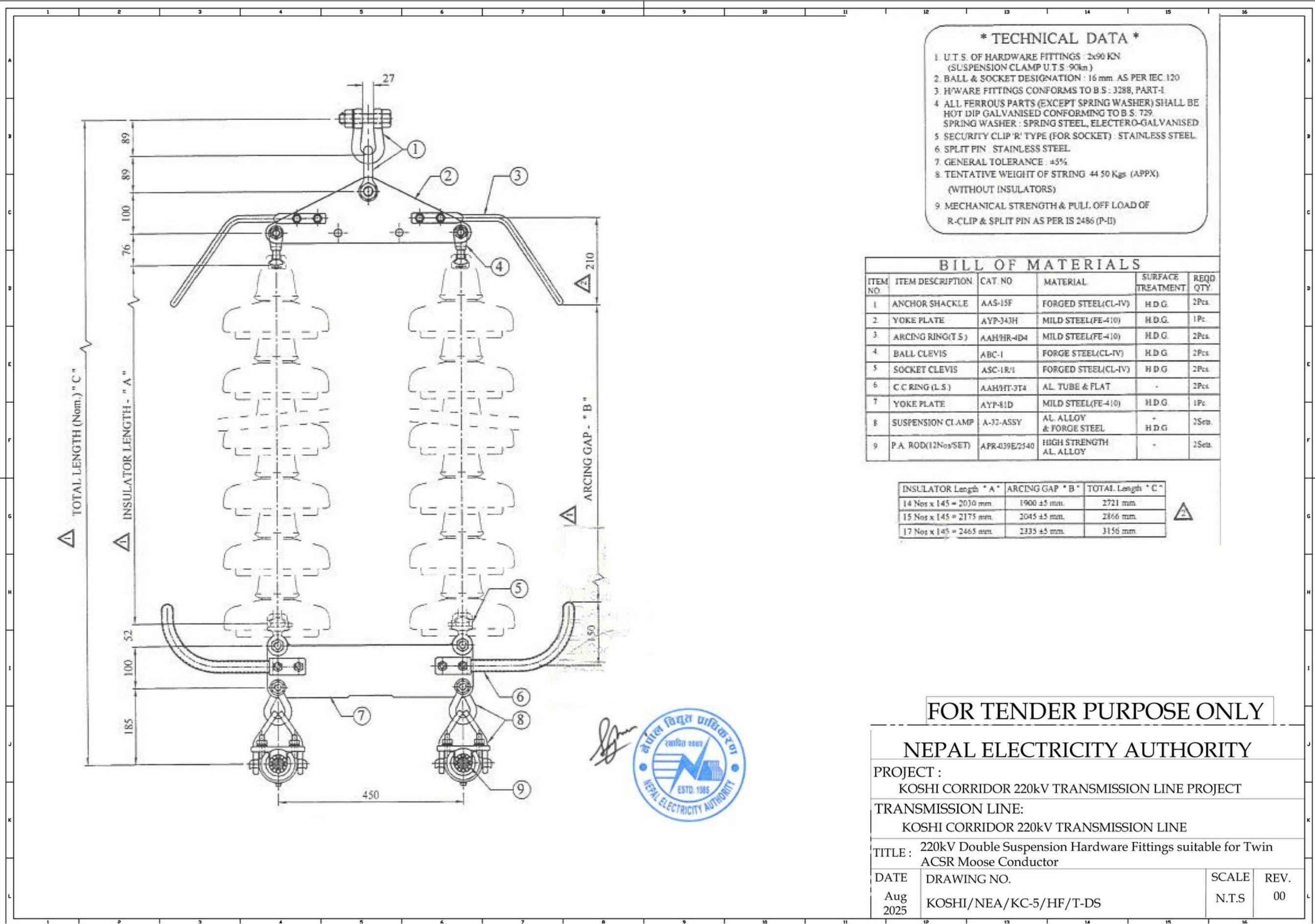
TITLE : 220kV Quad Tension Hardware Fittings Suitable for Quad ACSR Moose Conductor

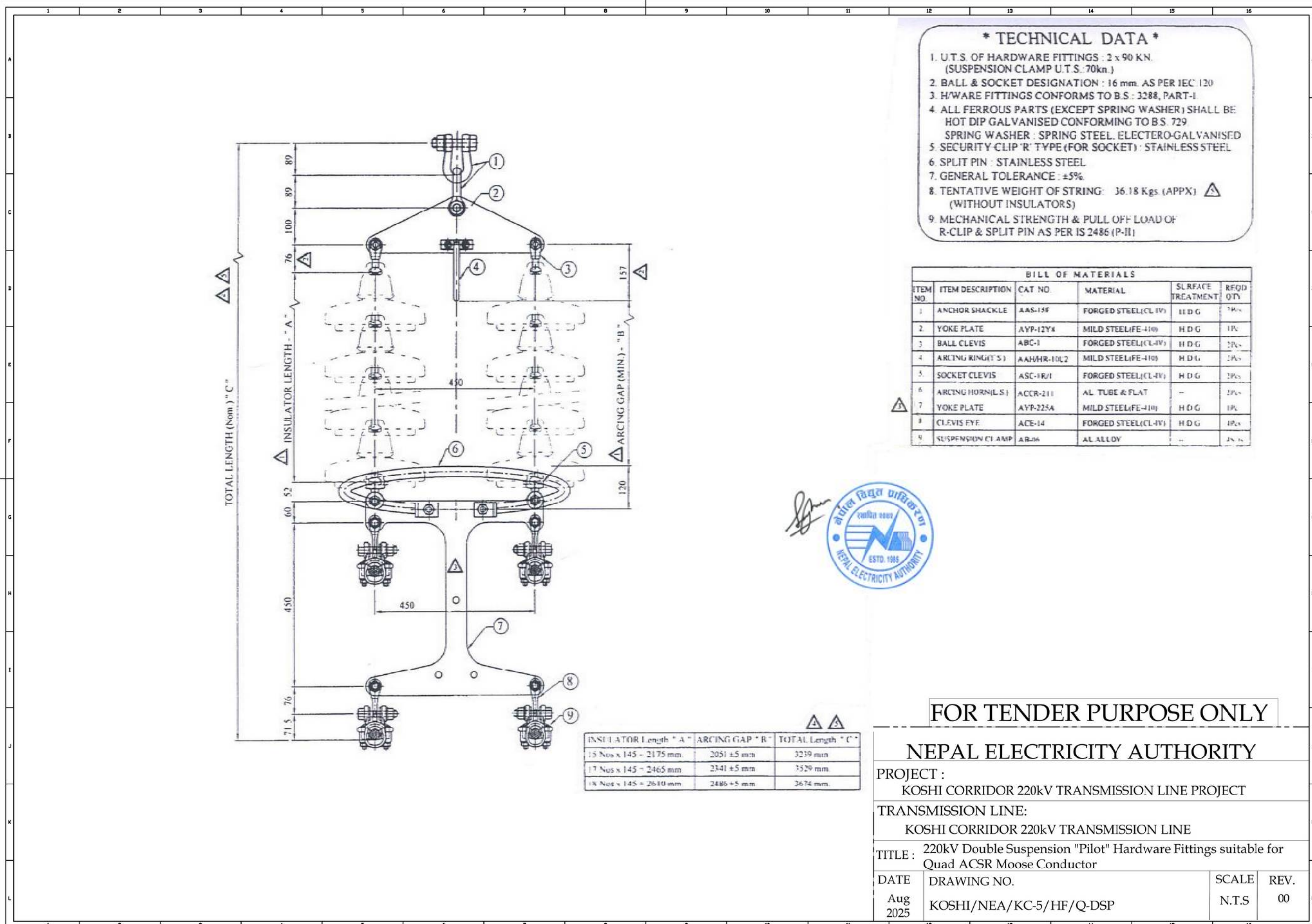
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2025

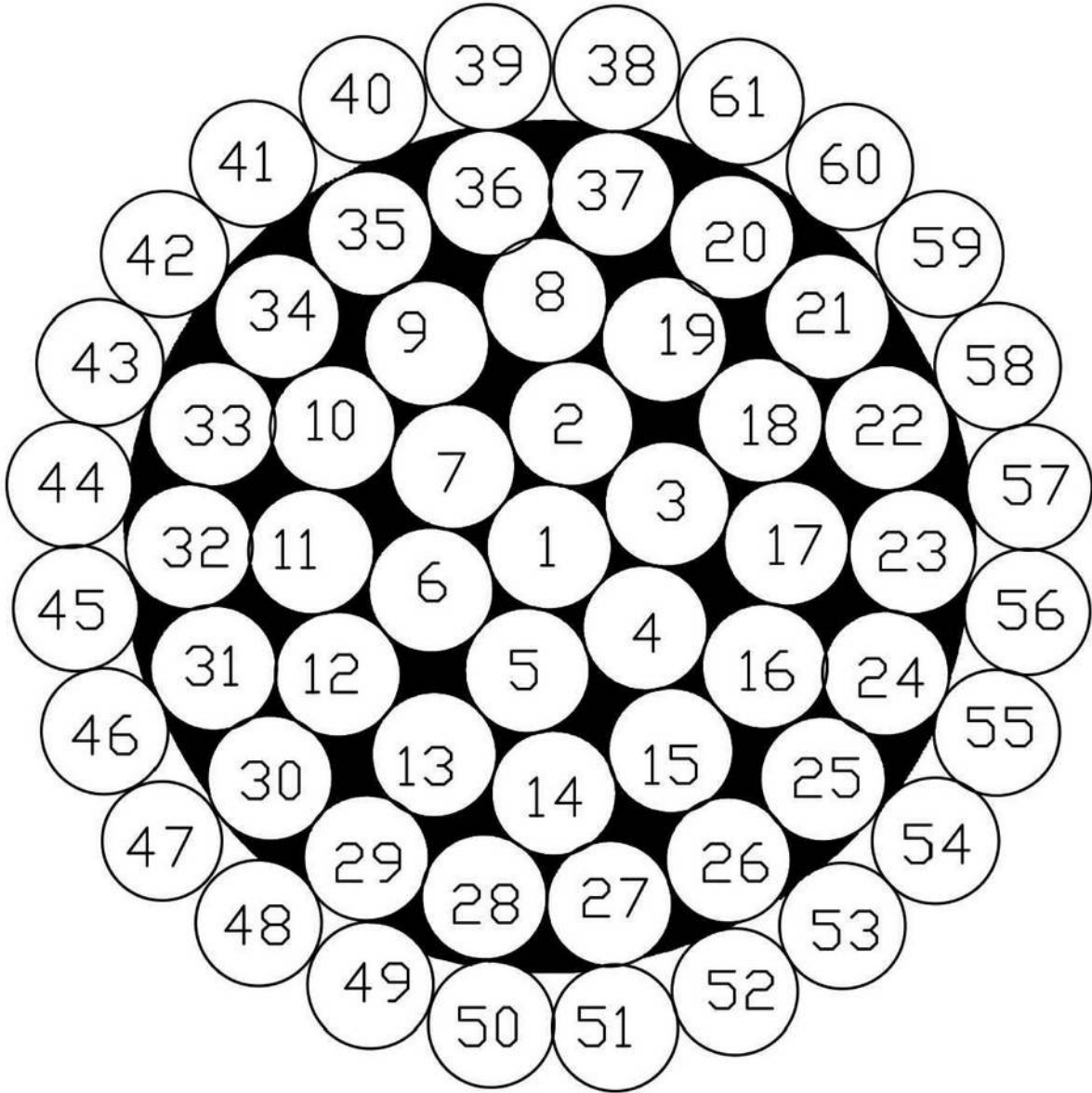
DRAWING NO.

KOSHI/NEA/KC-5/HF/Q-QT

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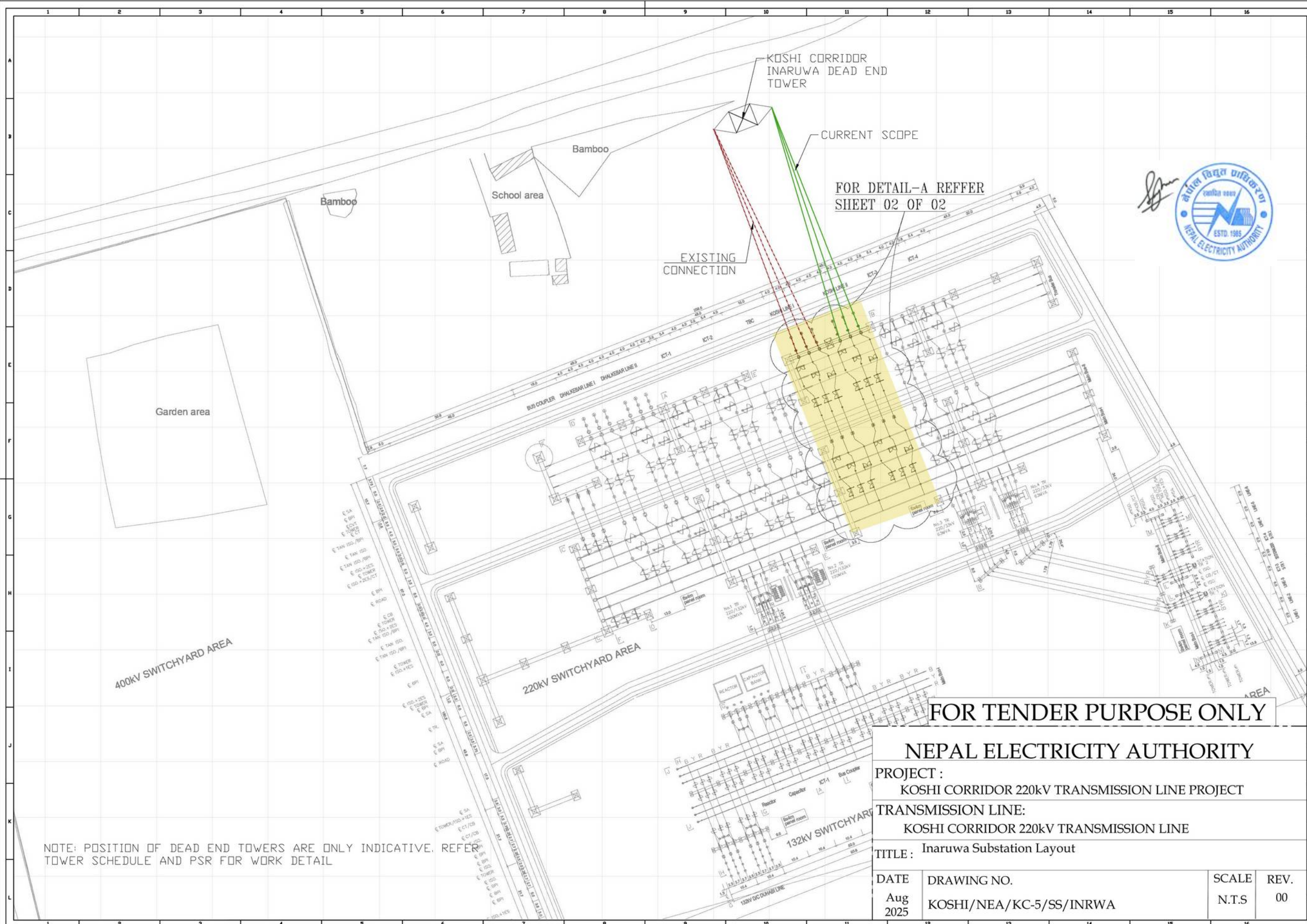


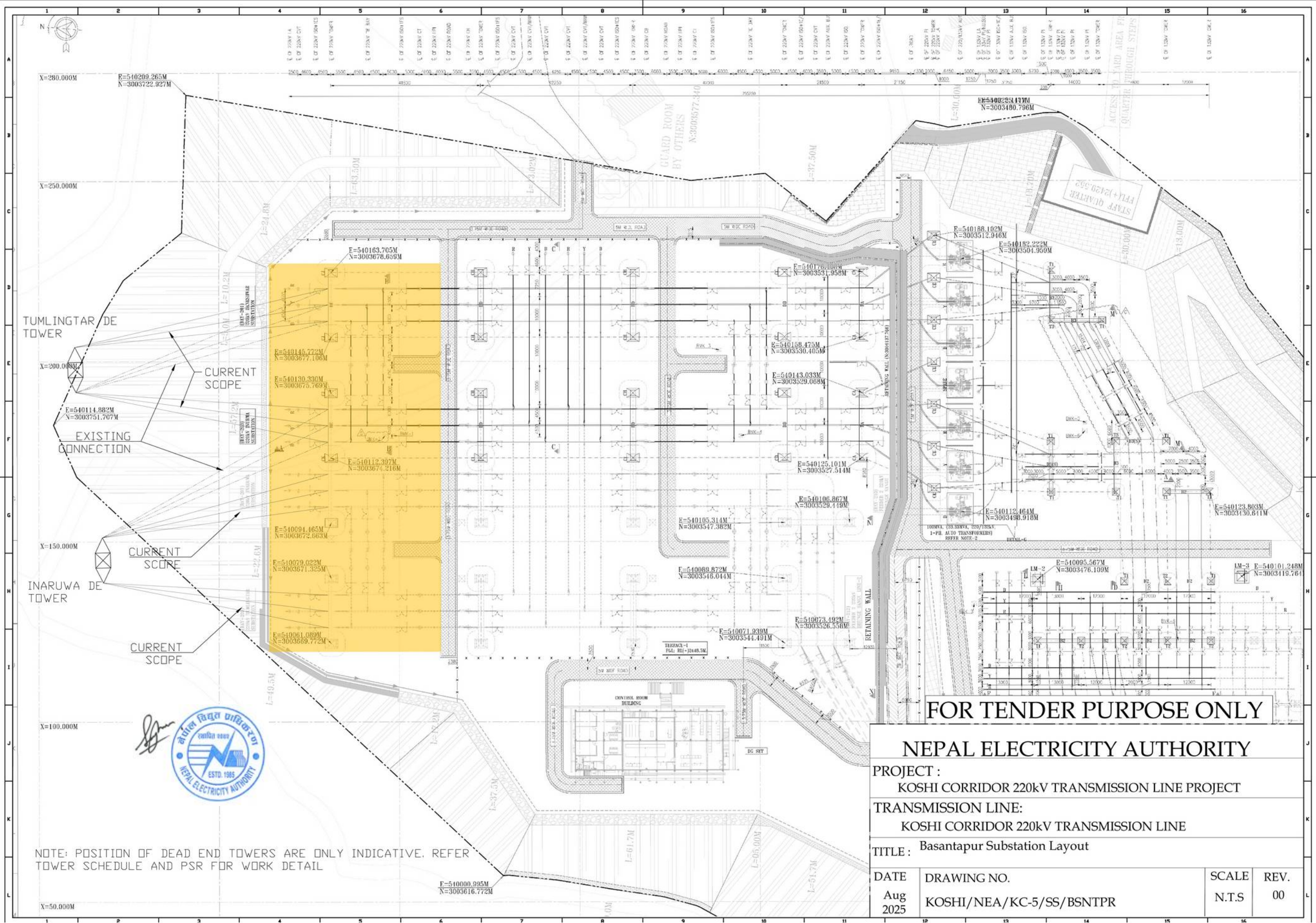


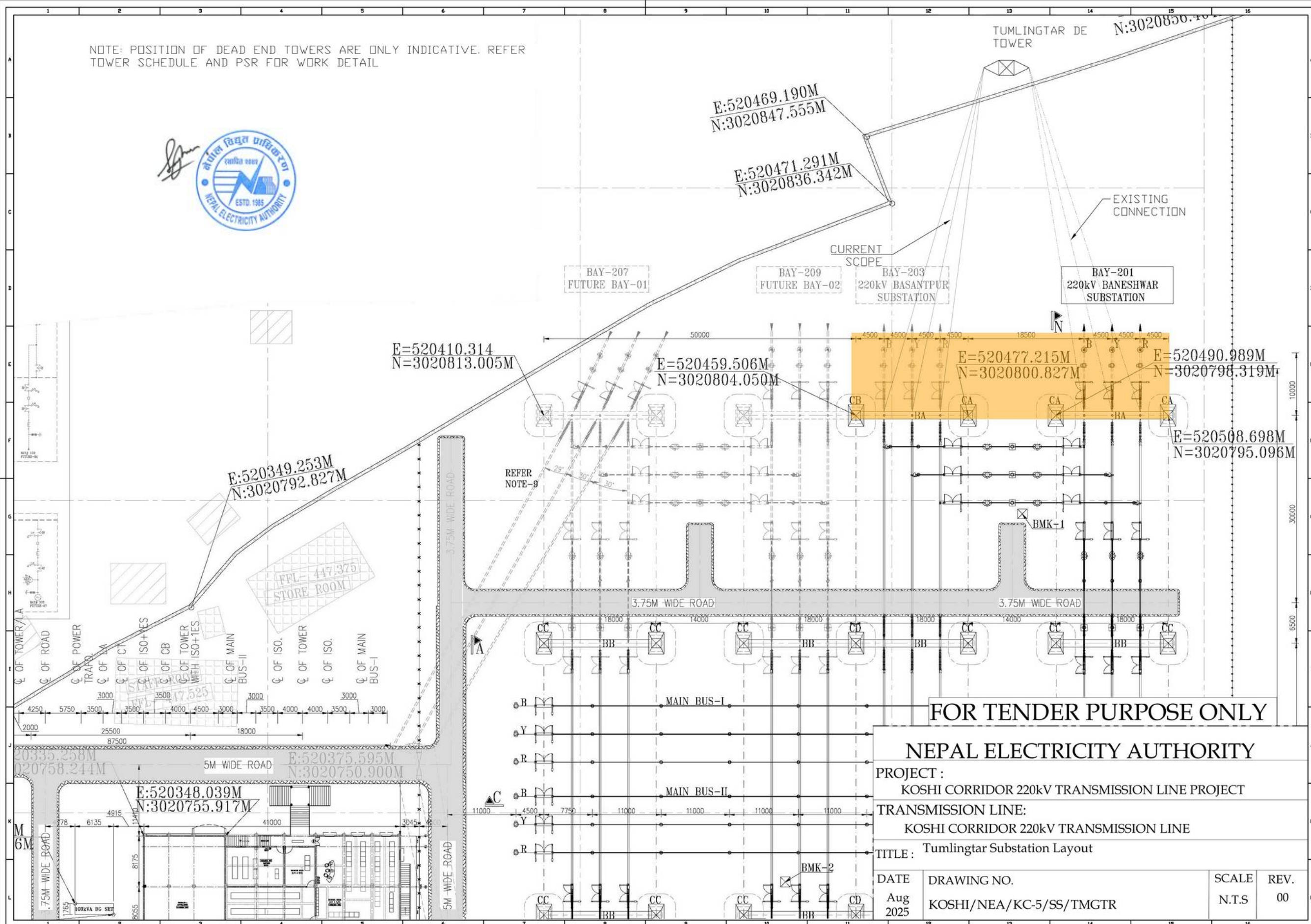
Cross Sectional View Of AACSR MOOSE Conductor (54+7/3.53 mm)
Aluminium Alloy Conductor Steel Reinforced
(Inner Layer Greased)

FOR TENDER PURPOSE ONLY

NEPAL ELECTRICITY AUTHORITY			
PROJECT : KOSHI CORRIDOR 220kV TRANSMISSION LINE PROJECT			
TRANSMISSION LINE: KOSHI CORRIDOR 220kV TRANSMISSION LINE			
TITLE : Cross Sectional drawing of ACSR Moose Conductor			
DATE Aug 2025	DRAWING NO. KOSHI/NEA/KC-5/ACSR/CSD	SCALE N.T.S	REV. 00







NEPAL ELECTRICITY AUTHORITY

(An Undertaking of Government of Nepal)

TRANSMISSION DIRECTORATE

HIGH VOLTAGE GRID DEVELOPMENT DEPARTMENT



KOSHI CORRIDOR 220kV TRANSMISSION LINE PROJECT

Bill of Quantities

Procurement of Plant Design, Supply, Installation, Testing and Commissioning of Second Circuit Stringing of Inaruwa-Basantapur-Baneshwar-Tumlingtar 220 kV Transmission Line

National Competitive Bidding (NCB)

(Single-Stage Two-Envelope Bidding Procedure)

VOLUME III OF III, Price Bid



NEPAL ELECTRICITY AUTHORITY
TRANSMISSION DIRECTORATE
High Voltage Grid Development Department
Koshi Corridor 220 kV Transmission Line Project

IFB No.- KOSHI/NEA/KC-5: Procurement of Plant Design, Supply, Installation, Testing and Commissioning of Second Circuit Stringing of Inaruwa-Basantapur-Baneshwar-Tumlingtar 220 kV Transmission Line

(Bill of Quantities)

Price Schedule No 5: Grand Summary

Schedule No.	Particulars	Currency (NPR)	Remarks
1	Price Schedule 1: Supply and Delivery of Plant and Equipment Foreign Origin	-	
2	Price Schedule 2: Supply and Delivery of Plant and Equipment Nepal Origin	-	
3	Price Schedule No.3:Design Services	Included	
4	Price Schedule No.4: Transportation of Material from Border/EXW to site, Installation and Commissioning Services		
4.1	Price Schedule No.4.1: Transportation of Material from Border/ EXW to Site including insurance, clearing, and forwarding	-	
4.2	Price Schedule No.4.2: Installation and Commissioning Services	-	
5	Grand Total excluding Custom duty and VAT	-	

NEPAL ELECTRICITY AUTHORITY
TRANSMISSION DIRECTORATE
High Voltage Grid Development Department
Koshi Corridor 220 kV Transmission Line Project

IFB No.- KOSHI/NEA/KC-5: Procurement of Plant Design, Supply, Installation, Testing and Commissioning of Second Circuit
Stringing of Inaruwa-Basantapur-Baneshwar-Tumlingtar 220 kV Transmission Line

(Bill of Quantity)

Price Schedule 1: Supply and Delivery of Plant and Equipment Foreign Origin

Item No.	Item description	Unit	Quantity	Unit Rate (NRs)	Amount (NRs)	Remarks
(1)	(2)	(3)	(4)	(5)	(6) = (4)x(5)	(7)
1.0	Design, manufacture and Supply of Conductor & Earthwire Line Materials as per specifications					
a	ACSR MOOSE Conductor	Km	1,117.48			
b	GS Earth Wire 7/3.66 mm Size	Km	107.89			
2.0	Design, manufacture and Supply of Standard Disc Insulators					
a.	90 KN Disc Insulators	Nos.	6,320			
b	160 kN Disc Insulator	Nos.	98,235			
3.0	Design, manufacture and Supply of Insulator 's Hardwares fitting for Quad Moose with all attachment assemblies and arcing horns all complete					
a	Double suspension Pilot Insulators String complete with hardwares, PA rods etc. (suitable for 2x15 nos. 90 KN insulators)	sets	135			
b	Double suspension strings complete with hardwares, PA rods etc. for Quad Moose (suitable for 2x14 nos. 160 KN insulators.	sets	138			
c	Quad Tension strings complete with hardware fittings for Quad Moose (suitable for 4x15 nos. 160 KN insulators.	sets	566			
d	Quad Tension strings complete with hardware fittings for Quad Moose (suitable for 4x17 nos. 160 KN insulators.	sets	208			
e	Quad Tension strings complete with hardware fittings for Quad Moose (suitable for 4x18 nos. 160 KN insulators.	sets	345			
4.0	Design, manufacture and Supply of Insulator 's Hardwares fitting for Twin Moose with all attachment assemblies and arcing horns all complete					
a	Single suspension Pilot Insulators String complete with hardwares, PA rods etc. (suitable for 1x15 nos. 90 KN insulators)	sets	112			
b	Double tension strings complete with hardware fittings (suitable for 2x15 nos. 160 KN insulators.	sets	165			
c	Double tension strings complete with hardware fittings (suitable for 2x17 nos. 160 KN insulators.	sets	235			



NEPAL ELECTRICITY AUTHORITY
TRANSMISSION DIRECTORATE
High Voltage Grid Development Department
Koshi Corridor 220 kV Transmission Line Project

IFB No.- KOSHI/NEA/KC-5: Procurement of Plant Design, Supply, Installation, Testing and Commissioning of Second Circuit
Stringing of Inaruwa-Basantapur-Baneshwar-Tumlingtar 220 kV Transmission Line

(Bill of Quantity)

Price Schedule 1: Supply and Delivery of Plant and Equipment Foreign Origin

Item No.	Item description	Unit	Quantity	Unit Rate (NRs)	Amount (NRs)	Remarks
(1)	(2)	(3)	(4)	(5)	(6) = (4)x(5)	(7)
d	Double tension strings complete with hardware fittings (suitable for 2x18 nos. 160 KN insulators.	sets	225			
5.0	Conductor & Earthwire's Accessories for Quad Moose Conductor					
a	Bundle spacer cum damper for line, suitable for Quad ACSR Moose Conductor	Nos.	4,900			
b	Rigid Spacer for jumper for Quad ACSR Moose Conductor	Nos.	1,700			
c	Mid Span Compression Joint for Quad ACSR Moose Conductor	Nos.	325			
d	Repair Sleeve for Quad ACSR Moose Conductor	Nos.	20			
6.0	Conductor & Earthwire's Accessories for Twin Moose Conductor					
a	Vibration Damper for ACSR Moose Conductor	Nos.	2,500			
b	Bundle spacer for line, suitable for Twin ACSR Moose Conductor	Nos.	1,635			
c	Rigid Spacer for jumper for Twin ACSR Moose Conductor	Nos.	936			
d	Mid Span Compression Joint for Twin ACSR Moose Conductor	Nos.	52			
e	Repair Sleeve for Twin ACSR Moose Conductor	Nos.	10			
7.0	Accessories for Earthwire Conductor					
a	Flexible Copper Bond for 7/3.66 mm GS Earthwire	Nos.	612			
b	Vibration Damper for 7/3.66 mm GS Earthwire	Nos.	1,196			
c	Mid Span Compression Joint for 7/3.66 mm GS Earthwire	Nos.	35			
d	Tension Clamp for 7/3.66 mm GS Earthwire	Sets	595			
e	Suspension Clamp for 7/3.66 mm GS Earthwire	Sets	50			
f	Repair Sleeve for 7/3.66 mm GS Earthwire	Nos.	50			
	TOTAL					

NEPAL ELECTRICITY AUTHORITY
TRANSMISSION DIRECTORATE
High Voltage Grid Development Department
Koshi Corridor 220 kV Transmission Line Project

IFB No.- KOSHI/NEA/KC-5: Procurement of Plant Design, Supply, Installation, Testing and Commissioning of Second Circuit Stringing of Inaruwa-Basantapur-Baneshwar-Tumlingtar 220 kV Transmission Line

(Bill of Quantity)

Price Schedule 2: Supply and Delivery of Plant and Equipment Nepal Origin

Item No.	Item description	Unit	Quantity	Unit Rate (NRs)	Amount (NRs)	Remarks
(1)	(2)	(3)	(4)	(5)	(6) = (4)x(5)	(7)
1.0	Design, manufacture and Supply of Conductor & Earthwire Line Materials as per specifications					
a	ACSR MOOSE Conductor	Km	1,117.48			
b	GS Earth Wire 7/3.66 mm Size	Km	107.89			
2.0	Design, manufacture and Supply of Standard Disc Insulators					
a.	90 KN Disc Insulators	Nos.	6,320			
b	160 kN Disc Insulator	Nos.	98,235			
3.0	Design, manufacture and Supply of Insulator 's Hardwares fitting for Quad Moose with all attachment assemblies and arcing horns all complete					
a	Double suspension Pilot Insulators String complete with hardwares, PA rods etc. (suitable for 2x15 nos. 90 KN insulators)	sets	135			
b	Double suspension strings complete with hardwares, PA rods etc. for Quad Moose (suitable for 2x14 nos. 160 KN insulators.	sets	138			
c	Quad Tension strings complete with hardware fittings for Quad Moose (suitable for 4x15 nos. 160 KN insulators.	sets	566			
d	Quad Tension strings complete with hardware fittings for Quad Moose (suitable for 4x17 nos. 160 KN insulators.	sets	208			
e	Quad Tension strings complete with hardware fittings for Quad Moose (suitable for 4x18 nos. 160 KN insulators.	sets	345			
4.0	Design, manufacture and Supply of Insulator 's Hardwares fitting for Twin Moose with all attachment assemblies and arcing horns all complete					
a	Single suspension Pilot Insulators String complete with hardwares, PA rods etc. (suitable for 1x15 nos. 90 KN insulators)	sets	112			
b	Double tension strings complete with hardware fittings (suitable for 2x15 nos. 160 KN insulators.	sets	165			

NEPAL ELECTRICITY AUTHORITY
TRANSMISSION DIRECTORATE
High Voltage Grid Development Department
Koshi Corridor 220 kV Transmission Line Project

IFB No.- KOSHI/NEA/KC-5: Procurement of Plant Design, Supply, Installation, Testing and Commissioning of Second Circuit Stringing of Inaruwa-Basantapur-Baneshwar-Tumlingtar 220 kV Transmission Line

(Bill of Quantity)

Price Schedule 2: Supply and Delivery of Plant and Equipment Nepal Origin

Item No.	Item description	Unit	Quantity	Unit Rate (NRs)	Amount (NRs)	Remarks
(1)	(2)	(3)	(4)	(5)	(6) = (4)x(5)	(7)
c	Double tension strings complete with hardware fittings (suitable for 2x17 nos. 160 KN insulators.	sets	235			
d	Double tension strings complete with hardware fittings (suitable for 2x18 nos. 160 KN insulators.	sets	225			
5.0	Conductor & Earthwire's Accessories for Quad Moose Conductor					
a	Bundle spacer cum damper for line, suitable for Quad ACSR Moose Conductor	Nos.	4,900			
b	Rigid Spacer for jumper for Quad ACSR Moose Conductor	Nos.	1,700			
c	Mid Span Compression Joint for Quad ACSR Moose Conductor	Nos.	325			
d	Repair Sleeve for Quad ACSR Moose Conductor	Nos.	20			
6.0	Conductor & Earthwire's Accessories for Twin Moose Conductor					
a	Vibration Damper for ACSR Moose Conductor	Nos.	2,500			
b	Bundle spacer for line, suitable for Twin ACSR Moose Conductor	Nos.	1,635			
c	Rigid Spacer for jumper for Twin ACSR Moose Conductor	Nos.	936			
d	Mid Span Compression Joint for Twin ACSR Moose Conductor	Nos.	52			
e	Repair Sleeve for Twin ACSR Moose Conductor	Nos.	10			
7.0	Accessories for Earthwire Conductor					
a	Flexible Copper Bond for 7/3.66 mm GS Earthwire	Nos.	612			
b	Vibration Damper for 7/3.66 mm GS Earthwire	Nos.	1,196			
c	Mid Span Compression Joint for 7/3.66 mm GS Earthwire	Nos.	35			
d	Tension Clamp for 7/3.66 mm GS Earthwire	Sets	595			
e	Suspension Clamp for 7/3.66 mm GS Earthwire	Sets	50			
f	Repair Sleeve for 7/3.66 mm GS Earthwire	Nos.	50			
	TOTAL					

NEPAL ELECTRICITY AUTHORITY
TRANSMISSION DIRECTORATE
High Voltage Grid Development Department
Koshi Corridor 220 kV Transmission Line Project

IFB No.- KOSHI/NEA/KC-5: Procurement of Plant Design, Supply, Installation, Testing and Commissioning of Second Circuit Stringing of Inaruwa-Basantapur-Baneshwar-Tumlingtar 220 kV Transmission Line

(Bill of Quantity)

Price Schedule 3: Design Services

Item No.	Item description	Unit	Quantity	Unit Rate (NRs)	Amount (NRs)	Remarks
(1)	(2)	(3)	(4)	(5)	(6) = (4)x(5)	(7)
The Scope of the Contract covers the detail design as well. The price of the design is deemed to have been covered in the prices of the other schedules.						

NEPAL ELECTRICITY AUTHORITY
TRANSMISSION DIRECTORATE
High Voltage Grid Development Department
Koshi Corridor 220 kV Transmission Line Project

IFB No.- KOSHI/NEA/KC-5: Procurement of Plant Design, Supply, Installation, Testing and Commissioning of Second Circuit Stringing of Inaruwa-Basantapur-Baneshwar-Tumlingtar 220 kV Transmission Line

(Bill of Quantity)

Price Schedule No.4: Transportation of Material from Border/EXW to site, Installation and Commissioning Services

4.1 Transportation of Material from Border/EXW to site including insurance, clearing, and forwarding

Item No.	Item description	Unit	Quantity	Unit Rate (NRs)	Amount (NRs)	Remarks
(1)	(2)	(3)	(4)	(5)	(6) = (4)x(5)	(7)
1.0	Design, manufacture and Supply of Conductor & Earthwire Line Materials as per specifications					
a	ACSR MOOSE Conductor	Km	1,117.48			
b	GS Earth Wire 7/3.66 mm Size	Km	107.89			
2.0	Design, manufacture and Supply of Standard Disc Insulators					
a	90 KN Disc Insulators	Nos.	6,320			
b	160 kN Disc Insulator	Nos.	98,235			
3.0	Design, manufacture and Supply of Insulator 's Hardwares fitting for Quad Moose with all attachment assemblies and arcing horns all complete					
a	Double suspension Pilot Insulators String complete with hardwares, PA rods etc. (suitable for 2x15 nos. 90 KN insulators)	sets	135			
b	Double suspension strings complete with hardwares, PA rods etc. for Quad Moose (suitable for 2x14 nos. 160 KN insulators.	sets	138			
c	Quad Tension strings complete with hardware fittings for Quad Moose (suitable for 4x15 nos. 160 KN insulators.	sets	566			
d	Quad Tension strings complete with hardware fittings for Quad Moose (suitable for 4x17 nos. 160 KN insulators.	sets	208			
e	Quad Tension strings complete with hardware fittings for Quad Moose (suitable for 4x18 nos. 160 KN insulators.	sets	345			
4.0	Design, manufacture and Supply of Insulator 's Hardwares fitting for Twin Moose with all attachment assemblies and arcing horns all complete					
a	Single suspension Pilot Insulators String complete with hardwares, PA rods etc. (suitable for 1x15 nos. 90 KN insulators)	sets	112			

NEPAL ELECTRICITY AUTHORITY
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High Voltage Grid Development Department
Koshi Corridor 220 kV Transmission Line Project

IFB No.- KOSHI/NEA/KC-5: Procurement of Plant Design, Supply, Installation, Testing and Commissioning of Second Circuit
Stringing of Inaruwa-Basantapur-Baneshwar-Tumlingtar 220 kV Transmission Line

(Bill of Quantity)

Price Schedule No.4: Transportation of Material from Border/EXW to site, Installation and Commissioning Services

4.1 Transportation of Material from Border/EXW to site including insurance, clearing, and forwarding

Item No.	Item description	Unit	Quantity	Unit Rate (NRs)	Amount (NRs)	Remarks
(1)	(2)	(3)	(4)	(5)	(6) = (4)x(5)	(7)
b	Double tension strings complete with hardware fittings (suitable for 2x15 nos. 160 KN insulators.	sets	165			
c	Double tension strings complete with hardware fittings (suitable for 2x17 nos. 160 KN insulators.	sets	235			
d	Double tension strings complete with hardware fittings (suitable for 2x18 nos. 160 KN insulators.	sets	225			
5.0	Conductor & Earthwire's Accessories for Quad Moose Conductor					
a	Bundle spacer cum damper for line, suitable for Quad ACSR Moose Conductor	Nos.	4,900			
b	Rigid Spacer for jumper for Quad ACSR Moose Conductor	Nos.	1,700			
c	Mid Span Compression Joint for Quad ACSR Moose Conductor	Nos.	325			
d	Repair Sleeve for Quad ACSR Moose Conductor	Nos.	20			
6.0	Conductor & Earthwire's Accessories for Twin Moose Conductor					
a	Vibration Damper for ACSR Moose Conductor	Nos.	2,500			
b	Bundle spacer for line, suitable for Twin ACSR Moose Conductor	Nos.	1,635			
c	Rigid Spacer for jumper for Twin ACSR Moose Conductor	Nos.	936			
d	Mid Span Compression Joint for Twin ACSR Moose Conductor	Nos.	52			
e	Repair Sleeve for Twin ACSR Moose Conductor	Nos.	10			
7.0	Accessories for Earthwire Conductor					
a	Flexible Copper Bond for 7/3.66 mm GS Earthwire	Nos.	612			
b	Vibration Damper for 7/3.66 mm GS Earthwire	Nos.	1,196			
c	Mid Span Compression Joint for 7/3.66 mm GS Earthwire	Nos.	35			
d	Tension Clamp for 7/3.66 mm GS Earthwire	Sets	595			
e	Suspension Clamp for 7/3.66 mm GS Earthwire	Sets	50			
f	Repair Sleeve for 7/3.66 mm GS Earthwire	Nos.	50			
TOTAL						

NEPAL ELECTRICITY AUTHORITY
TRANSMISSION DIRECTORATE
High Voltage Grid Development Department
Koshi Corridor 220 kV Transmission Line Project

IFB No.- KOSHI/NEA/KC-5: Procurement of Plant Design, Supply and Installation of Second Circuit Stringing of Inaruwa-Basantapur-Baneshwar-Tumlingtar 220 kV Transmission Line

(Bill of Quantity)

Price Schedule No.4: Transportation of Material from Border/EXW to site, Installation and Commissioning Services

4.2 Installation and Commissioning Services

Item No.	Item description	Unit	Qty	Unit Rate(NRs)	Amount (NRs)	Remarks
(1)	(2)	(3)	(4)	(5)	(6) = (4)x(5)	(7)
1	Stringing of Conductor including Installation of Insulator complete with arcing horns and necessary hardwares, fixing of conductor accessories (220 kV Single ckt stringing)					
a	Single circuit with ACSR Quad Moose conductor	Ckt km	75.839			
a	Single circuit with ACSR Twin Moose conductor	Ckt km	29.937			
2	Stringing of Earthwire including Installation of all hardware complete and earthwire					
a	G.S. Earth wire 7/3.66 mm (Line Length Km)	Km	105.776			
	TOTAL					

SECTION-VI

Bill of Quantities

Notes for Unit Rate Contracts :

Objectives

The objectives of the Bill of Quantities are

- (a) to provide sufficient information on the quantities of Works to be performed to enable Bids to be prepared efficiently and accurately; and
- (b) when a Contract has been entered into, to provide a priced Bill of Quantities for use in the periodic valuation of Works executed.

In order to attain these objectives, Works should be itemized in the Bill of Quantities in sufficient detail to distinguish between the different classes of Works, or between Works of the same nature carried out in different locations or in other circumstances which may give rise to different considerations of cost. Consistent with these requirements, the layout and content of the Bill of Quantities should be as simple and brief as possible.

Content

The Bill of Quantities should be divided generally into the following sections:

- (a) Preamble;
- (b) Work Items (grouped into parts);
- (c) Day works Schedule;
- d) Provisional Sums; and
- (d) Summary.

Preamble

The Preamble should indicate the inclusiveness of the unit prices, and should state the methods of measurement which have been adopted in the preparation of the Bill of Quantities and which are to be used for the measurement of any part of the works.

Work Items

The items in the Bill of Quantities should be grouped into sections to distinguish between those parts of the Works which by nature, location, access, timing, or any other special characteristics may give rise to different methods of construction, or phasing of the Works, or considerations of cost. General items common to all parts of the works may be grouped as a separate section in the Bill of Quantities.

Day work Schedule

A Day work Schedule should be included only if the probability of unforeseen work, outside the items included in the Bill of Quantities, is high. To facilitate checking by the Employer of the realism of rates quoted by the Bidders, the Day work Schedule should normally comprise the following:

- (a) A list of the various classes of labor, materials, and Constructional Plant for which basic day work rates or prices are to be inserted by the Bidder, together with a statement of the conditions under which the Contractor will be paid for work executed on a day work basis.
- (b) Nominal quantities for each item of Day work, to be priced by each Bidder at Day work rates as bid. The rate to be entered by the Bidder against each basic Day work item should include the Contractor's profit, overheads, supervision, and other charges.

Provisional Sums

A general provision for physical contingencies (quantity overruns) may be made by including a provisional sum in the Summary Bill of Quantities. Similarly, a contingency allowance for possible price increases should be provided as a provisional sum in the Summary Bill of Quantities. The inclusion of such provisional sums often facilitates budgetary approval by avoiding the need to request periodic supplementary approvals as the future need arises. Where such provisional sums or contingency allowances are used, the Contract Data should state the manner in which they will be used, and under whose authority (usually the Project Manager's).

Summary

The Summary should contain a tabulation of the separate parts of the Bill of Quantities carried forward, with provisional sums for Day work, for physical (quantity) contingencies, and for price contingencies (upward price adjustment) where applicable.

These Notes for Preparing Specifications are intended only as information for the Employer or the person drafting the Bidding documents. They should not be included in the final documents.

Bill of Quantities

1 Provisional Sum						
Procument Item Details						
SL. No	Item Description	Unit	Quantity	Unit Rate(NPR)	Amount(NPR)	
1	PS	Lot	0.0	0.0	0.00	
2 Construction work						
Procument Item Details						
SL. No	Item Description	Unit	Quantity	Bidder's Rate (NPR)	Bidder's Rate (in words)	Total Amount (NPR)
1	Summary of Price Schedule 5 for Procurement of Plant Design, Supply, Installation, Testing and Commissioning of Second Circuit Stringing of Inaruwa-Basantapur-Baneshwar-Tumlingtar 220 kV Transmission Line (Bidder must fill the Detailed Price Schedule given in Section VII:-Bill of Quantities) (Volume III, Price Bid)	Lot	1.0			
Total of Procument Items						
Total Item Price						
VAT						
Grand Total						